WJEC GCSE APPLICATIONS OF MATHEMATICS

MATHS



EXAM QUESTION PACK

UNIT 1 HIGHER TIER 4361 PAPERS

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Surname	Centre Number	Candidate Number
Other Names		0

GCSE LINKED PAIR PILOT

4361/02

S16-4361-02

APPLICATIONS OF MATHEMATICS

UNIT 1: Applications 1
HIGHER TIER

A.M. THURSDAY, 9 June 2016

2 hours

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**4**	
2.	**6**	
3.	**3**	
4.	**9**	
5.*(a)(b)(c)(d)*	**11**	
5.*(e)(f)*	**6**	
6.	**4**	
7.*(a)*	**7**	
7.*(b)*	**5**	
8.	**7**	
9.	**11**	
10.	**4**	
11.	**5**	
12.	**4**	
13.	**14**	
Total	**100**	

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ADDITIONAL MATERIALS

A calculator will be required for this paper.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** the questions in the spaces provided.

Take π as 3·14 or use the π button on your calculator.

INFORMATION FOR CANDIDATES

You should give details of your method of solution when appropriate.

Unless stated, diagrams are not drawn to scale.

Scale drawing solutions will not be acceptable where you are asked to calculate.

The number of marks is given in brackets at the end of each question or part-question.

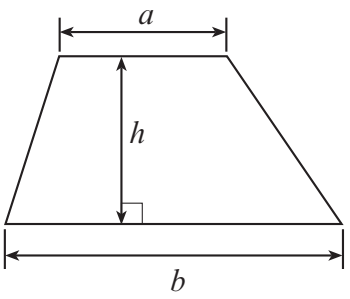
You are reminded that assessment will take into account the quality of written communication (including mathematical communication) used in your answer to question **4***(b)*.

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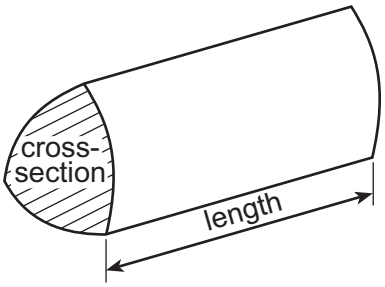
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Formula List

Area of trapezium = $\frac{1}{2}(a + b)h$

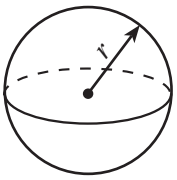


Volume of prism = area of cross-section × length



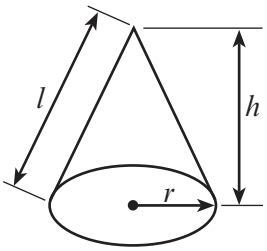
Volume of sphere = $\frac{4}{3}\pi r^3$

Surface area of sphere = $4\pi r^2$



Volume of cone = $\frac{1}{3}\pi r^2 h$

Curved surface area of cone = $\pi r l$

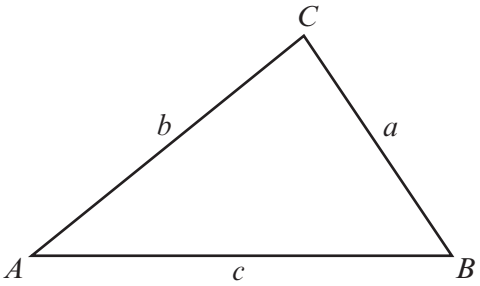


In any triangle ABC

Sine rule $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Cosine rule $a^2 = b^2 + c^2 - 2bc\cos A$

Area of triangle = $\frac{1}{2}ab\sin C$



The Quadratic Equation

The solutions of $ax^2 + bx + c = 0$

where $a \neq 0$ are given by

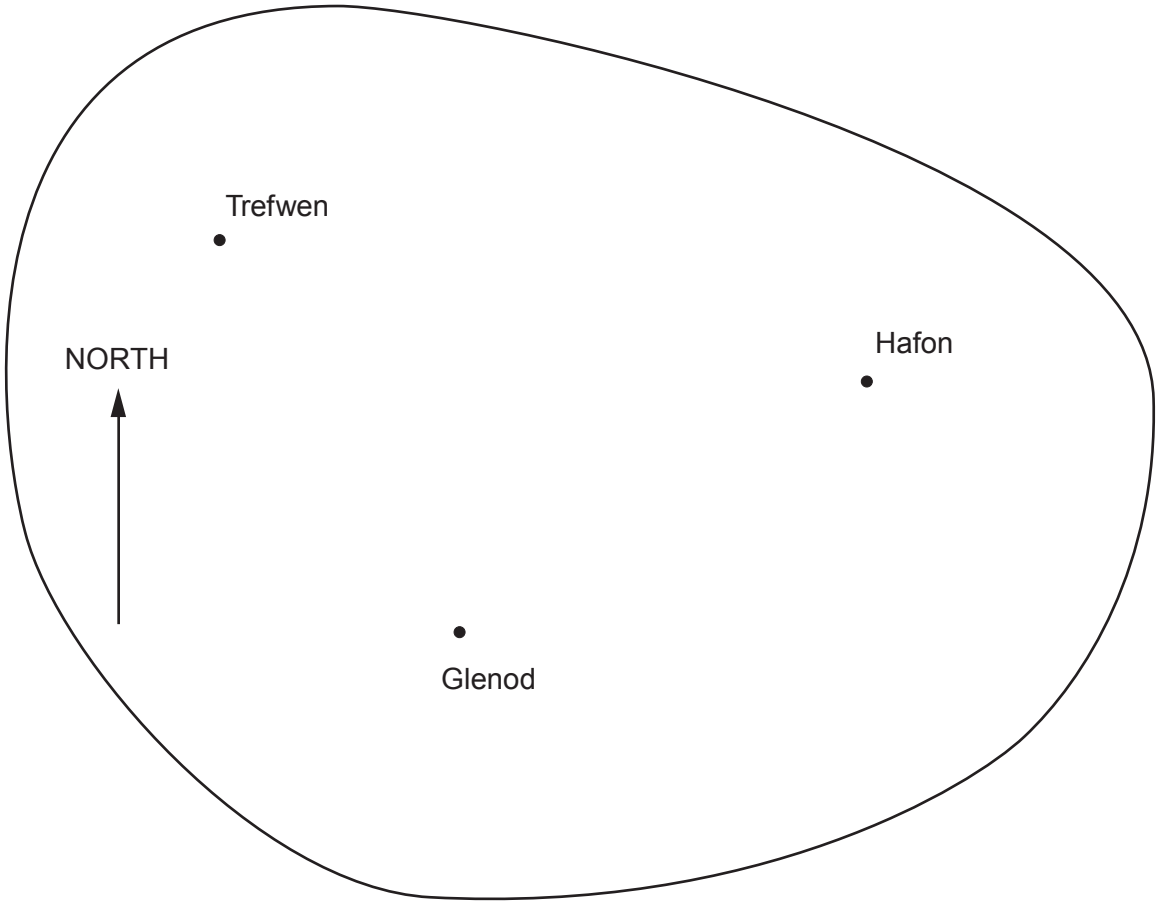
$$x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$$

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1. Trefwen, Hafon and Glenod are three castles.
The simplified map below shows the positions of the three castles.



A visitor centre is being built.

The visitor centre is on a bearing 035° from Glenod and on a bearing of 125° from Trefwen.
What is the bearing of the visitor centre from Hafon? [4]

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Bearing of the visitor centre from Hafon is ..... °

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2. Katie uses two mirror tiles in her bathroom.
She has one tile in the shape of an equilateral triangle, *T*, and one tile in the shape of a rhombus, *R*.
All the edges of the tiles are equal in length.

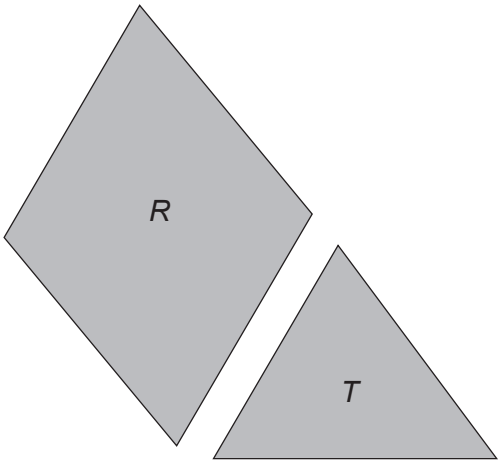


Diagram not drawn to scale

When the two tiles, *R* and *T*, are joined to form one large mirror, the shape formed is a quadrilateral.

(a) Calculate the size of each of the angles in tile *R*.
You may indicate any angles you calculate on the diagram above.
You must show your working. [4]

Angles are ..... , ... , ... , and .....

(b) Give the name of the quadrilateral that Katie forms with her two tiles. [1]

(c) How many lines of symmetry does this quadrilateral have? [1]

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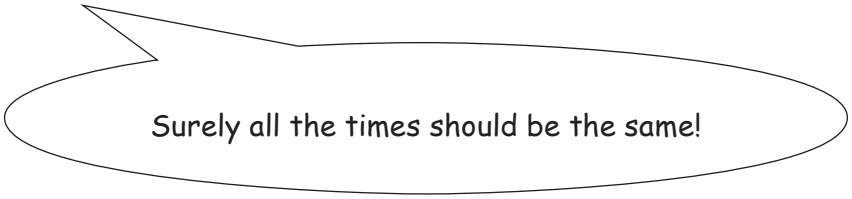
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3. Judy, Trefor and Wyn each time how long it takes for a coin to fall from their classroom window to the ground outside.

Judy's coin takes 1·8 seconds.
Trefor's coin takes 2·4 seconds.
Wyn's coin takes 2·2 seconds.

Their friend Abbie says:



List **3** factors that could play a part in the times not being the same. [3]

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2. .....

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3. .....

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4. Alfie sells 480 raffle tickets, at 50p each, to raise money for charity.

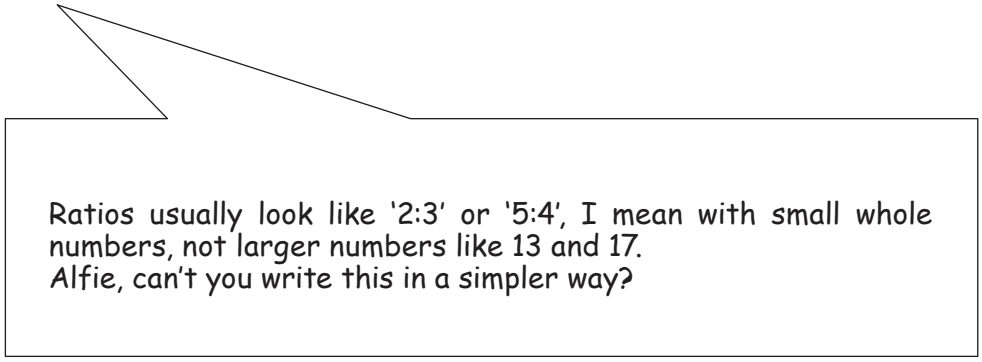
There are 3 different raffle prizes: a bike, roller skates and a teddy bear.

The bike and the roller skates were prizes donated by a local sports shop.
Alfie paid

- £12 for the teddy bear prize,
- £14 to have the raffle tickets printed, and
- £32 to print advertising posters.

After paying the costs, Alfie donates any money raised from the raffle to charity.
He intends to give the money to a children's charity and to the local hospice in the ratio 13:17.

(a) Gary says to Alfie:



How can Alfie explain to Gary that he cannot write the ratio 13:17 in a simpler way? [1]

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(b) *You will be assessed on the quality of your written communication in this part of the question.*

Calculate how much money Alfie donates to the local hospice.
Give your answer correct to the nearest £. [6]

(c) Gary has bought 3 of the 480 raffle tickets sold.

The first ticket drawn wins the bike.
The second ticket drawn wins the roller skates.
Gary does not win either of the first two prizes.

What is the probability that Gary wins the teddy bear? [2]

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5. *GoPrint* and *MyPrint* are two companies specialising in printing business cards.



The charges for the cards are shown in the table below.

<table>
<tr><th>*GoPrint* charges</th><th>*MyPrint* charges</th></tr>
<tr><td>The first 500 business cards are free.

Example prices:
<table><tr><td>1500 cards</td><td>500 free cards +
£10 for the other 1000 cards
Total cost £10</td></tr><tr><td>2500 cards</td><td>500 free cards +
£20 for the other 2000 cards
Total cost £20</td></tr><tr><td>4000 cards</td><td>500 free cards +
£35 for the other 3500 cards
Total cost £35</td></tr></table>
Ask for a price for any other number of cards required!</td><td>The first 1000 cards cost £20.

Buy more than 1000 cards for a small additional cost.

For example:
<table><tr><td>2000 cards</td><td>£20 for the first 1000 cards
+
£5 for the other 1000 cards
Total cost £25</td></tr><tr><td>3200 cards</td><td>£20 for the first 1000 cards
+
£11 for the other 2200 cards
Total cost £31</td></tr><tr><td>4400 cards</td><td>£20 for the first 1000 cards
+
£17 for the other 3400 cards
Total cost £37</td></tr></table>
Ask for a price!
No orders for fewer than 1000 cards are taken.</td></tr>
</table>

(a) After paying £20 for the first 1000 cards, how much **extra** does *MyPrint* seem to charge for each additional 100 cards? [2]

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(b) How much do you think *GoPrint* would charge for 1800 cards? [2]

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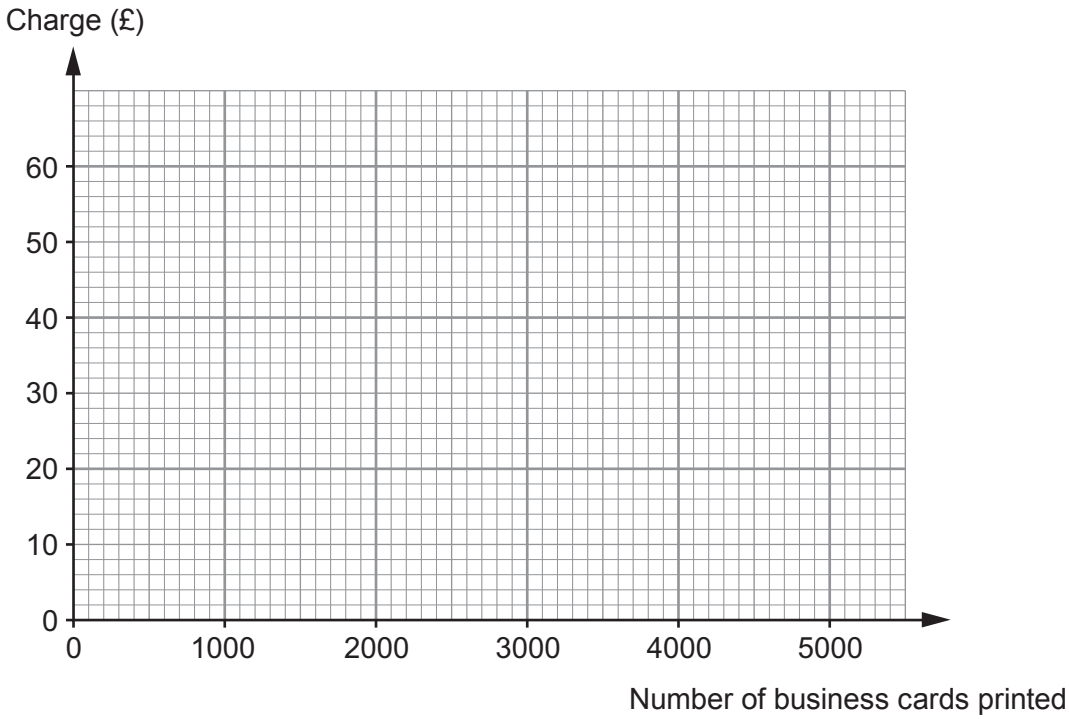
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(c) Use the information given in the tables to draw graphs to represent the *GoPrint* and *MyPrint* charges for printing up to 5000 business cards.
Label your graphs clearly. [5]



(d) Rhian decides to order a number of business cards.
She finds that both of the companies, *GoPrint* and *MyPrint*, would charge the same for her order.
How many cards is Rhian intending to order? [2]

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(e) *MyPrint* uses the following formula for working out the charges for business cards,

$$C = 20 + \frac{5(n - 1000)}{1000}$$

where

- C is the charge in £, and
- n is the number of business cards printed.

(i) Use this formula to calculate the charge for 56 500 business cards. [2]

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(ii) A trainee in the offices of *MyPrint* takes a telephone call from a customer requesting 800 business cards.
Explain why the formula cannot be used. [1]

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(f) Use your graph or the *GoPrint* charges shown below, to derive a formula that *GoPrint* could use to calculate charges for numbers of business cards.
You must define any variables you use. [3]

GoPrint charges	
The first 500 business cards are **free**.	
Example prices:	
1500 cards	500 **free** cards + £10 for the other 1000 cards *Total cost £10*
2500 cards	500 **free** cards + £20 for the other 2000 cards *Total cost £20*
4000 cards	500 **free** cards + £35 for the other 3500 cards *Total cost £35*

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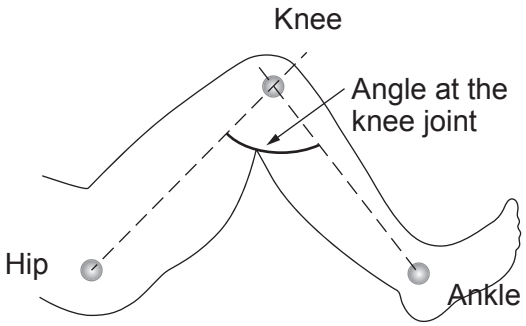
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6. A sports therapist measures the angle at a knee joint using a goniometer.



Measurements of the distance from the hip to the knee and the distance from the knee to the ankle are also recorded.





(a) Ewan has a knee injury.
The measurement between Ewan's hip and his knee is 45 cm.
The measurement between Ewan's knee and his ankle is 40 cm.
A sports therapist records the angle at Ewan's knee joint as 105°.

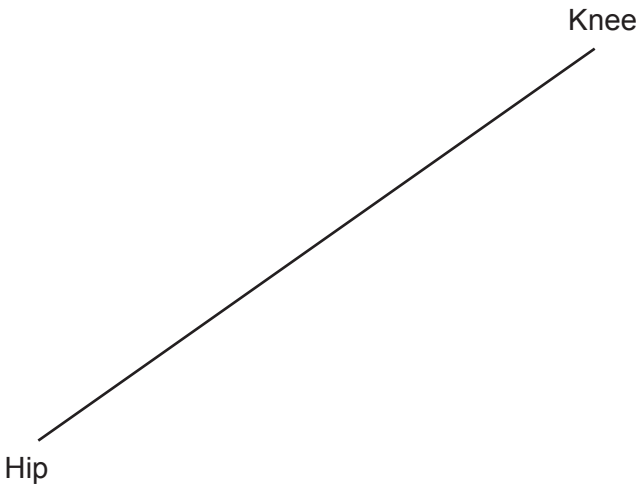
Complete the scale diagram opposite to show the position of Ewan's ankle.
Use a scale of 1 cm to represent 5 cm.

The line representing the distance from the hip to the knee has been drawn for you. [2]

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(b) Write down the actual distance between Ewan's hip and ankle when his leg is in this position. [2]

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7. *(a)* A gardener plants water lilies in a circular pond.



When looking at the surface of the pond, the ratio of the surface covered by water lilies to clear water is 2:3.

The area of the surface covered by water lilies is $3{\cdot}8\,m^2$.

Calculate

- the surface area of the pond, and
- the diameter of the pond.

Give your answers correct to 2 significant figures.
You must show all your working. [7]

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The surface area of the pond is ..... m^2

The diameter of the pond is ..... m

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QUESTION 7 continues on page 16

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(b) The diameters of water lilies in the pond were measured by the gardener. The results are summarised in the grouped frequency distribution below.

Diameter, d (cm)	$0 < d \leqslant 2$	$2 < d \leqslant 4$	$4 < d \leqslant 6$	$6 < d \leqslant 8$	$8 < d \leqslant 10$	$10 < d \leqslant 12$	$12 < d \leqslant 14$	$14 < d \leqslant 16$	$16 < d \leqslant 18$
Frequency	1	0	4	10	16	14	4	1	1

When reviewing the results, the gardener decides that the groups $0 < d \leqslant 2$ and $2 < d \leqslant 4$ should be combined, and so should the groups $14 < d \leqslant 16$ and $16 < d \leqslant 18$.

(i) Do you think this decision is sensible?
Give a reason for your answer. [1]

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(ii) Complete the table below and draw a histogram to display the results for the water lilies measured. [4]

Diameter, d (cm)	$0 < d \leqslant 4$	$4 < d \leqslant 6$	$6 < d \leqslant 8$	$8 < d \leqslant 10$	$10 < d \leqslant 12$	$12 < d \leqslant 14$	$14 < d \leqslant 18$
Frequency Density							

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8. Luca bought a sandwich van to start selling sandwiches from 1st April.



He records his weekly sales to the nearest pound during his first six weeks.

Week	1	2	3	4	5	6
Sales (£)	70	95	111	100	41	84

The time series graph for the sales of sandwiches for each week has been plotted on the graph paper opposite.

(a) Calculate the 3-point moving averages correct to the nearest £ and complete the table below. [4]

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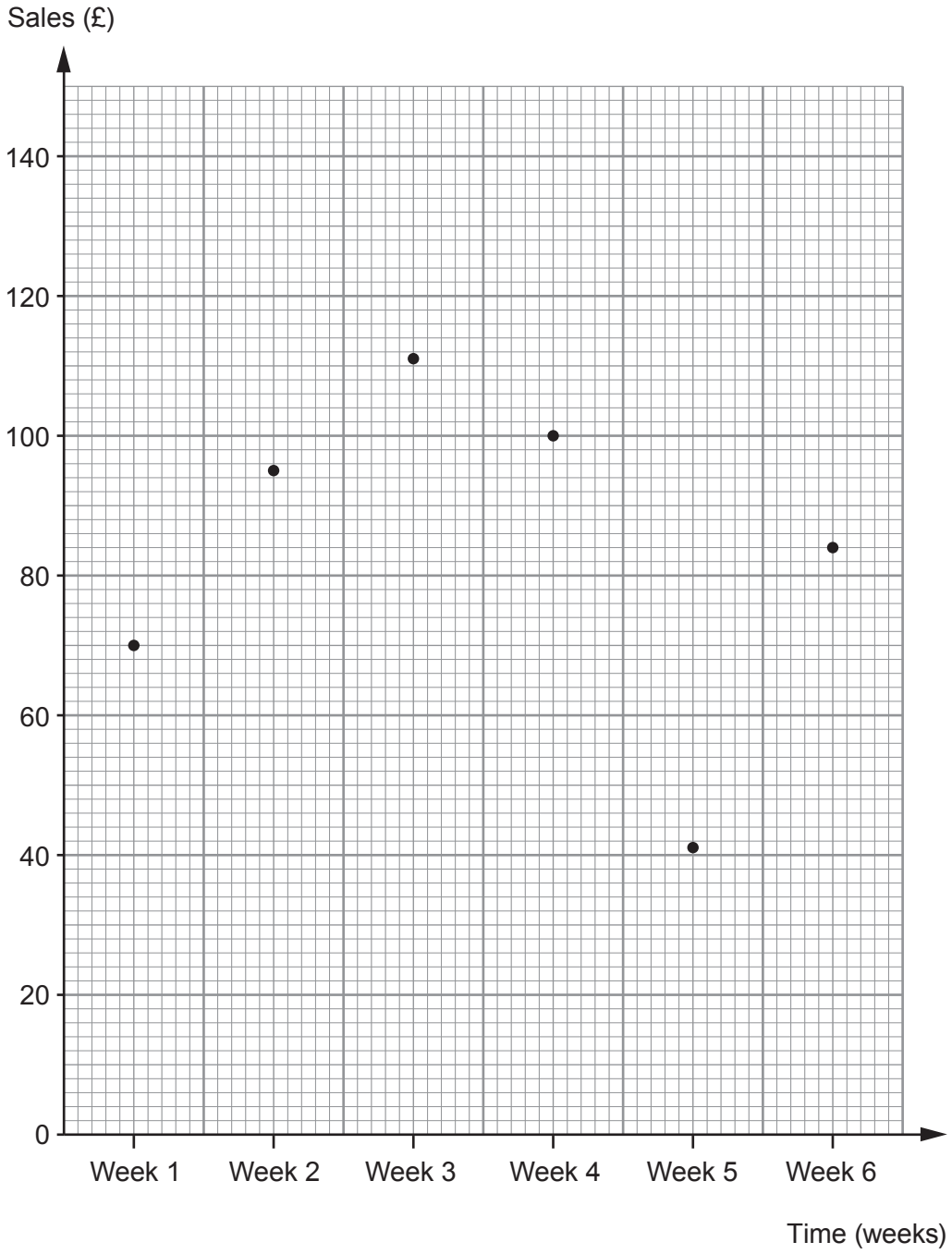
3-point period	Week 1 to week 3	Week 2 to week 4	..... to	..... to .....
3-point moving average (£)				

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(b) On the graph below, plot the 3-point moving averages and draw a trend line. [2]



(c) Luca looks at the trend line and says his sales are falling.

What can you say to reassure Luca that his business is not on the decline? [1]

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9. Freya visits the gym on 60 occasions.
She records the length of time she spends on the treadmill on each of these 60 occasions.



Freya has grouped her data in 5 minute intervals.
Her first interval is $0 < \text{time} \leqslant 5$ minutes.
Her final interval is $35 < \text{time} \leqslant 40$ minutes.
Freya drew a cumulative frequency diagram.

From her results she gives you the following information:

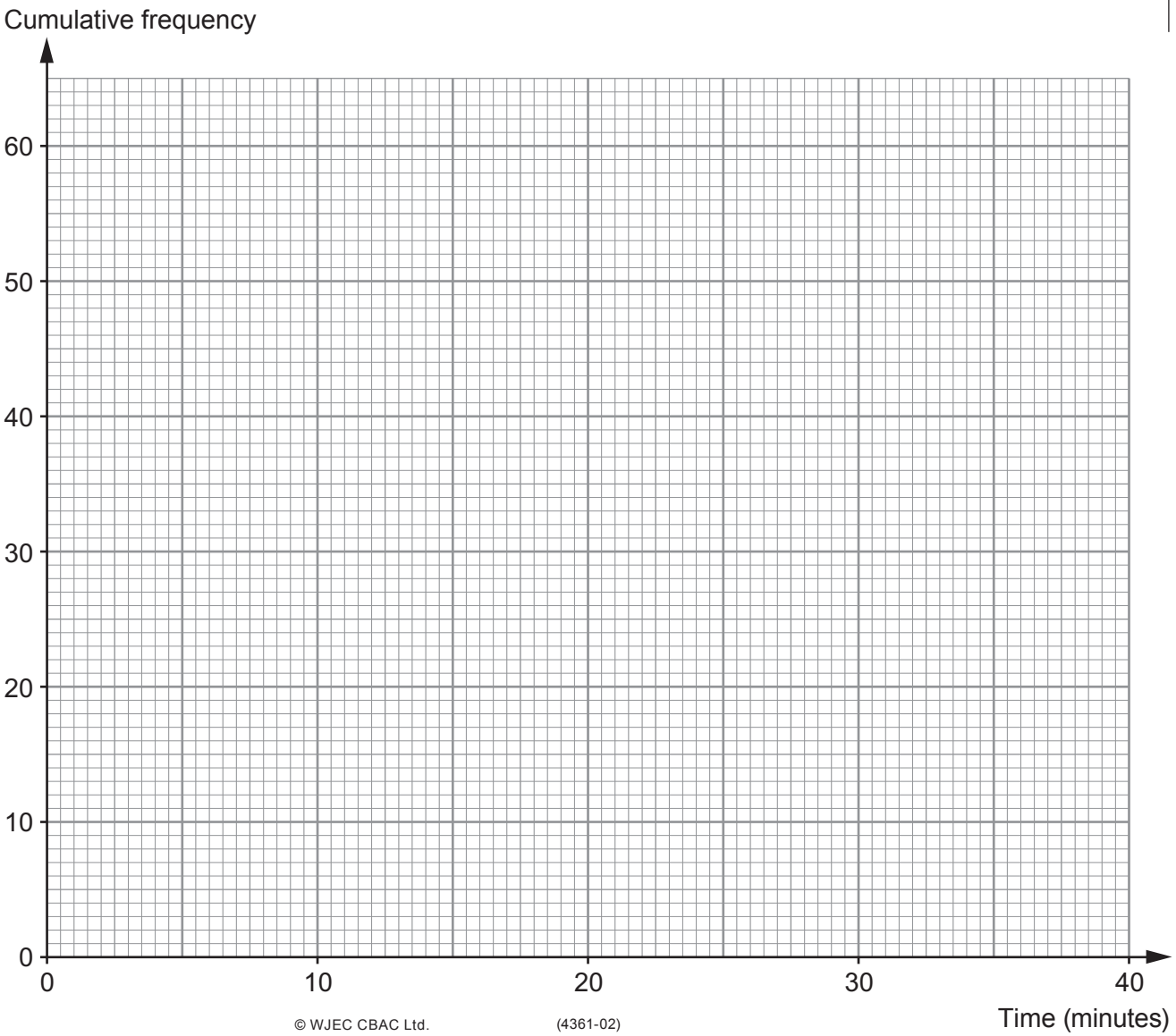
- The shortest time she spent on the treadmill was 5 minutes and this happened only once.
- The range of her times is 35 minutes.
- Her median time is 18 minutes.
- Her lower quartile is 10 minutes.
- Her interquartile range is 14 minutes.
- There were only 5 occasions when Freya spent more than 30 minutes on the treadmill.

(a) Use this information to complete a possible cumulative frequency diagram on the axes given below. [7]

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(b) The cumulative frequency diagram you have drawn is not exactly the same as the one Freya had drawn.
Explain why your cumulative frequency diagram is different from Freya's cumulative frequency diagram. [1]

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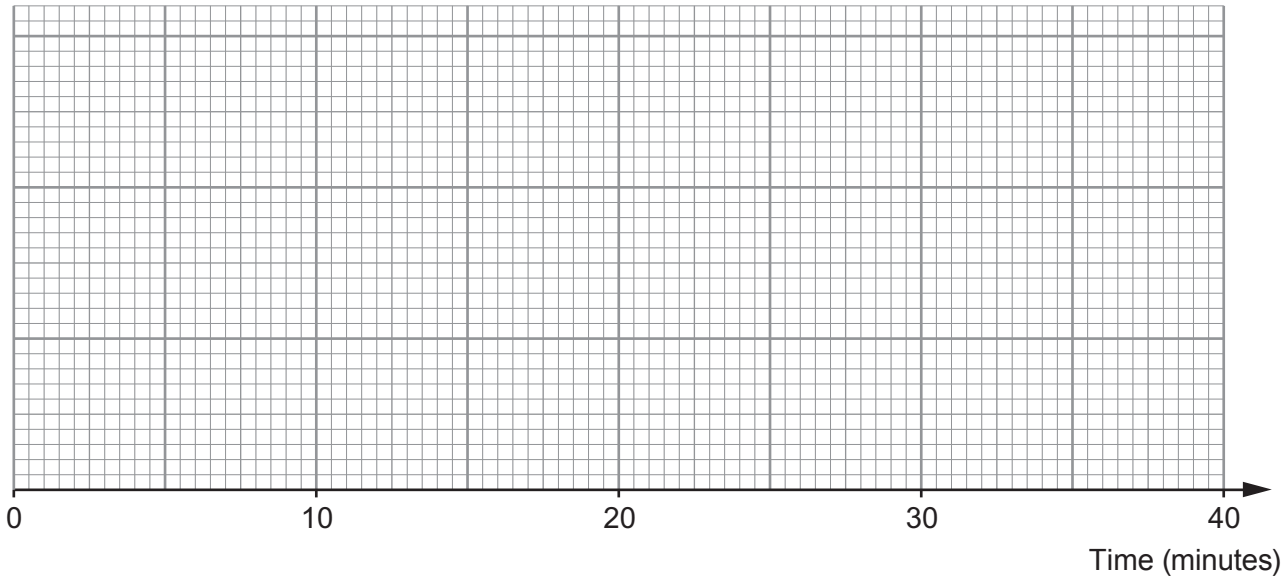
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(c) Use the information given and your cumulative frequency diagram to draw a box-and-whisker diagram on the graph paper below. [3]

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10. Over a period of 30 days it snowed every day.
In her notepad, Rita recorded the snowfall, correct to the nearest centimetre, in a grouped frequency table.
She then calculated an **estimate of the mean** snowfall for these 30 days as 27 cm.
Unfortunately Rita has torn the page containing the table from her notepad and lost some of the original data.

Snowfall, s (cm)	Number of days
$1 \leqslant s \leqslant 9$	2
$10 \leqslant s \leqslant 18$	8
$19 \leqslant s \leqslant 27$	4
$28 \leqslant s \leqslant 36$	
$37 \leqslant s \leqslant 41$	

Find the values of the frequencies missing in Rita's table. [4]

$28 \leqslant s \leqslant 36$	.....
$37 \leqslant s \leqslant 41$	.....

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11. *(a)* There are typically 3×10^4 grains of rice in 600 g.
Calculate how many grains of rice there would typically be in 5 g.
Give your answer in standard form. [2]

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(b) A grain of sugar weighs 2×10^{-5} g.
Calculate how many grains of this sugar would be in a 1 kg bag of sugar.
Give your answer in standard form. [3]

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12. Daniel has found a relationship between two variables, x and y.
Daniel states that

$$y = \frac{8}{x^2}$$

Daniel is trying to find the value of x that meets the above relationship and the following rule:

> This value of x has a y-value that is half the value of y when $x = \frac{1}{2}$.

Find the positive value of x that meets this rule. [4]

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TURN OVER FOR QUESTION 13

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13. In an experiment, it was found that the velocity, v in m/s, of a particle at time t seconds after the start of the experiment, was given by the equation $v = 7t - t^2$.

(a) Draw the curved graph of $v = 7t - t^2$ for values of t from 0 to 7. [5]

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(b) The acceleration of the particle is the rate of change of the velocity.

(i) Find the value of t when the acceleration of the particle is zero. [1]

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(ii) Find an approximation for the acceleration when $t = 5{\cdot}2$.
State the units of your answer. [4]

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(c) Use the graph to find an approximation for the distance travelled by the particle between the times $t = 1$ and $t = 5$. [4]

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END OF PAPER

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GCSE MARKING SCHEME

SUMMER 2016

GCSE MATHEMATICS LINKED PAIR APPLICATIONS UNIT 1 HIGHER
4361-02

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INTRODUCTION

This marking scheme was used by WJEC for the 2016 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conference, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

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APPLICATIONS OF MATHEMATICS
UNIT 1 (HIGHER TIER) SUMMER 2016

Applications of Mathematics Unit 1 Higher Tier	Mark	Comments
1. 035° ±2° from Glenod 125° ±2° from Trefwen Correct position of the visitor centre 250(°) ±2° from Hafon	B1 B1 B1 B1 4	Use 'their N' provided only ±2° from the given N Accept intersection shown FT provided at least B1 previously awarded Use 'their N' provided only ±2° from the given N Strict FT from their position of the visitor centre
2(a) 60°, 120°, 60° and 120° in any order (b) (Isosceles) trapezium (c) 1	B4 B1 B1 6	Any angles indicated should be appropriate B3 for 60° and 120° included in their answer B2 for the angle in the equilateral triangle as 60° and realising that the angle formed in connecting is 180°, e.g. sight of 180° - 60° B1 for indication of the angle in the equilateral triangle as 60° **or** realising that the angle formed in connecting is 180°, e.g. sight of 180° - 'their 60°', provided their 60 is from 180°÷3 Ignore spelling if intention clear CAO
3. In any order, any 3 factors: • Not from exactly same height, not from the same window • Timing may be inaccurate / different stopwatches • Ground may not be level, may not land in the same place • Someone may throw the coin up first, someone could throw with force • Gust of wind might take one of the coins • (Allow) not the same coin used	B3 3	B1 for each correct factor Accept any other valid factor Allow - height of window from the ground - 'weight' of coin different 'Coins are different sizes' and 'coins have different masses' is counted as 1 factor

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Applications of Mathematics Unit 1 Higher Tier	Mark	Comments
4(a) Explanation that mentions no common factor (other than 1), or 13 & 17 as prime numbers, or that it is not possible to divide (to simplify) 13 & 17 by any number except 1 (to result in whole number values)	E1	Allow 'neither of these numbers are divisible by the same number', or '13 & 17 can't be divided by a smaller whole number' Do not accept 'both numbers are odd and can not be simplified further', '13 & 17 don't go into the same number', '13 does not go into 17'
(b) (Money from sales of raffle ticket – costs) 480×50p – £12 – £14 – £32 or equivalent (£182)	M1	Intention to calculate 'total raised – costs' (= 240 – 58)
÷30 ×17	M1	FT 'their derived 182'
(£)103	A2	CAO. A1 for 102 or 103.(...) Allow A1 only as a FT, provided 'their error' is not with place value, depends on previous M1 *Treat ÷30×13 as a misread (leading to 78.866… or 79)*
QWC2: Candidates will be expected to • present work clearly, with words explaining process or steps **AND** • make few if any mistakes in mathematical form, spelling, punctuation and grammar and include units in their final answer QWC1: Candidates will be expected to • present work clearly, with words explaining process or steps **OR** • make few if any mistakes in mathematical form, spelling, punctuation and grammar and include units in their final answer	QWC 2	QWC2 Presents relevant material in a coherent and logical manner, using acceptable mathematical form, and with few if any errors in spelling, punctuation and grammar. QWC1 Presents relevant material in a coherent and logical manner but with some errors in use of mathematical form, spelling, punctuation or grammar OR evident weaknesses in organisation of material but using acceptable mathematical form, with few if any errors in spelling, punctuation and grammar. QWC0 Evident weaknesses in organisation of material, and errors in use of mathematical form, spelling, punctuation or grammar.
(c) 3/478	B2 9	Ignore incorrect cancelling B1 for an answers …/478 or 3/480 or 3/477 Allow B1 for '3 in 478' or '3 out of 478'

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Applications of Mathematics Unit 1 Higher Tier	Mark	Comments
5(a) Use of £5 per 1000 cards	M1	For example 1000 ÷ 5 (= 200 cards for £1), or sight of 200 (cards) with £1, or 5 ÷ 1000 (= £0.005 per card)
£0.5(0) or 50p (per 100 cards)	A1	If units are given they must be correct, allow £0.50p *SC1 for misread as GoPrint with answer £1*
(b) Use of £10 per 1000 cards for 1300 cards	M1	Or sight of 1800÷100 – 5, or equivalent
£13 (for 1800 cards)	A1	*If no marks, award SC1 for an answer of £18*
(c) GoPrint: Any 2 points correctly plotted	M1	
(Dotted) straight line correctly drawn from (500, 0) to beyond 4000 cards	A1	
MyPrint: Any 2 points correctly plotted	M1	
(Dotted) straight line correctly drawn starting from (1000, 20) to beyond 4400 cards	A2	A1 for correct (dotted) straight line but drawn for values less than (1000, 20) to beyond 4400 cards, OR for line correctly drawn starting from (1000, 20) to 4400 cards (not beyond)
(d) Intention to interpret the intersection of the two graphs OR correct interpretation from the table	M1	FT their graphs provided at least one of the lines is straight
Correct reading for the number of cards or 4000 cards	A1	Answer of the cost implies M1 only, however accept an answer including the cost e.g. '4000 cards is £35'
	11	
5(e)(i) 20 + 5(56500 – 1000)/1000	M1	
(£)297.5(0)	A1	
(ii) Reason, e.g. 'formula only for number of cards greater than 1000', 'n – 1000 is negative', 'don't know charges for less than 1000 cards', 'don't take orders for less than 1000 cards', 'because 800 – 1000 is negative', or 'as 800 – 1000 = -200'	E1	Ignore any additional incorrect statement included Do not accept 'they can use it, the cost would be £19'
(f) Variable for charge and number of cards defined, e.g. 'C is charge (in £) & n is (number of) cards' stated	B1	FT their graph if equivalent level of difficulty Allow 'C is the charge and n is the number'
C = 0.01(n – 500) or equivalent	B2	B1 for equivalent of 0.01 × …. or for … × (n-500), or n – 500 ÷ 100 (missing brackets)
	6	
6(a) Angle at knee 105°±2°	B1	
Knee to ankle line 8cm ±2mm	B1	
(b) Hip to ankle measured on the diagram	M1	FT for their diagram measurement ±2mm
Measurement (13.5±2mm × 5 =) 67.5 (cm ±1cm)	A1	FT 5×'their appropriate measurement' accurately calculated ±2mm
	4	
7(a) (Total surface area of the pond is) 3.8×5÷2	M2	M1 for calculation of surface area of clear water 3.8×3÷2 (= 5.7m^2) or sight of 5.7(m^2)
9.5(m^2)	A1	Allow an answer of 9.50(m^2)
(Pond surface area) 9.5 = πr^2	M1	FT 'their derived surface area of the pond' = πr^2
(Radius) r = √(9.5/π)	m1	Isolation of r
= 1.738...(m)	A1	Depends on M1, m1. Accept rounded or truncated
(Diameter of the pond is) 3.5 (m)	B1	Must be correct to 2 significant figures. FT 'their *r*' × 2 evaluated provided 'their *r*' has been given (and used) to at least 2d.p. and rounded to 2 sig figs provided M1, m1 previously awarded
	7	

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Applications of Mathematics Unit 1 Higher Tier	Mark	Comments
7(b)(i) Reason 'No, data is destroyed' or 'Yes, not many very small or very large diameters of water lilies'	E1	Needs to give a decision with logic/reasoning explained
(ii) Any 3 correct frequency densities 0.25, 2, 5, 8, 7, 2, 0.5	M1 A1	
Axes correct and labelled, no gaps between bars	B1	'Histogram' needs to be attempted. Do not accept labels as blocks or groups, e.g. 0 – 4, etc.
Correct histogram	B1 5	FT if correctly drawn without axes labelled for 'their non linear' groups shown FT candidates frequency density if table completed incorrectly but the idea of frequency density must be used
8(a) 'week 3 to week 5' and 'week 4 to week 6' 92, 102, 84, 75	B1 B3	OR B2 for any two correct entries, OR B1 for a correct method seen, or one correct entry
(b)Plots correct for their data at the mid interval with a line of best fit drawn	B2	B1 for correct plots at mid interval (ignore if joined dot to dot), or consistent translated plots with a line of best fit drawn
(c) Explanation, e.g. ' Week 5 has impacted on the trend line', 'there was just the one poor week', 'only a 6 week period considered, this is only a short period'	E1 7	Accept 'by week 6 sales increase again' Allow 'sales increase again in week 6' Do not accept 'line increases again in week 6', 'business may increase over the summer period'
9(a)Points ((0,0),) (5, 1), (10, 15), (18, 30), (24, 45), (30,55), (40, 60) plotted	B6	B1 for each correct point plotted Ignore additional points for intervals
Points joined with a curve or straight line	B1	Only FT if at least B3 previously awarded and all plots are cumulative
(b) Reason, e.g. 'do not know all the results for each of the intervals'	E1	Ignore additional incorrect details
(c) Correct box-and-whisker diagram 11	B3	Candidates may use original information Only FT their appropriate cumulative frequency graph (if possible) (not from bars) FT must be the best of consistency for either original or 'their graph' Ends of whiskers must be shown B2 for attempt box-and-whisker with • both ends correct and any 2 of LQ, median, UQ correct, or • one end correct and LQ, median & UQ all correct B1 for attempt box-and-whisker with • both ends correct with any 1 one of LQ, median, UQ correct, or • one end correct with any 2 of LQ, median, UQ correct, or • LQ, median, UQ all correct

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Applications of Mathematics Unit 1 Higher Tier	Mark	Comments
10. $5\times2 + 14\times8 + 23\times4 + 32\times\ldots + 39\times\ldots = 30\times27$ or equivalent	S1	Allow with incorrect midpoints provided each one is within the correct interval Maybe written as ÷30 with '=27', or sight of (27 × 30 =) 810 with (810 – 214 =) 596
Missing frequencies sum is 16, e.g. sight of 16 (more days)	S1	
Trial of any two values, e.g. (10+112+92 + 32×? + 39×??)÷30, with '?' the same value or different, not necessarily with sum 16	M1	e.g. 214 + 32×? + 39×?? = 810 where ? and ?? are any values FT for their mid points for M1 only
4 and 12 respectively	A1 4	CAO Do not accept in reverse order Do not accept from obvious incorrect working (10+ 112 + 92 + 32×4 + 39×12 = 30×27) (128 468) *Alternative (although not in specification)* *32x + 39y = 596 and x + y = 16 S1, M1* *(32x + 39y = 596 alone S1, M0)* *Method to solve m1* *4 and 12 A1*
11(a) $3 \times 10^4 \times 5 \div 600$ or equivalent 2.5×10^2 (grains of rice)	M1 A1	An answer of 250 implies M1
(b) $1000 \div (2\times10^{-5})$ or equivalent 5×10^7 (grains of sugar)	M1 A2 5	A1 for 50 000 000 or 50 million
12. $y = 8 / ½^2$ y = 32 hence looking for y = 16 $16 = 8/x^2$ or $x^2 = 8/16$ x = 0.707… or equivalent	M1 m1 m1 A1 4	FT for their value of y then halved FT using their halved value of y used Allow ±0.707 or 0.7 from correct working

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Applications of Mathematics Unit 1 Higher Tier	Mark	Comments
13(a) Correct evaluation of at least 3 coordinates	B1	
Suitable axes with appropriate scale and labels	B1	
Plotting at least 6 correct points	M2	FT for their axes if reasonable. M1 for plotting between 3 and 5 correct points
Joining all 8 points with a curve	A1	
(b)(i) (At t =) 3.5	B1	FT from 'their graph'. If FT from straight lines used then '3 to 4 seconds' is the required answer as a range
(ii) Strategy, e.g. Draw a tangent at t = 5.2	S1	
Use of difference v / difference t	M1	Must be differences, not readings from axes
= - ……	A1	Must be from a tangent, negative and reasonable from their graph
m/s^2	U1	Independent mark
(c) Identifying the required area	S1	Maybe shown on their graph Working with additional area is S0, however FT for possible M marks, but A0
Splitting area into areas that can be approximated	M1	
Complete calculation for the area required	M1	e.g ½ (6+10) + ½ (10+12) + 1×12 + ½ (10+12) = 8+11+12+ 11, or ½ (6 + 10 + 2×(10 + 12 + 12))
Accurately calculated (42m)	A1	Their answer may differ slightly from 42m, this is only a guide
	14	

t	0	1	2	3	4	5	6	7
v	0	6	10	12	12	10	6	0

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Surname	Centre Number	Candidate Number
Other Names		0

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4361/02

W16-4361-02

APPLICATIONS OF MATHEMATICS

UNIT 1: Applications 1
HIGHER TIER

A.M. WEDNESDAY, 13 January 2016

2 hours

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**4**	
2.	**6**	
3.	**7**	
4.	**8**	
5.*(a)(b)*	**7**	
5.*(c)(d)*	**9**	
6.	**9**	
7.	**9**	
8.*(a)(b)*	**9**	
8.*(c)*	**6**	
9.	**11**	
10.	**15**	
Total	**100**	

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ADDITIONAL MATERIALS

A calculator will be required for this paper.

A ruler, a protractor and a pair of compasses may be required.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** the questions in the spaces provided.

Take π as 3·14 or use the π button on your calculator.

INFORMATION FOR CANDIDATES

You should give details of your method of solution when appropriate.

Unless stated, diagrams are not drawn to scale.

Scale drawing solutions will not be acceptable where you are asked to calculate.

The number of marks is given in brackets at the end of each question or part-question.

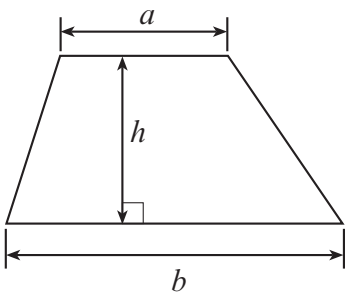
You are reminded that assessment will take into account the quality of written communication (including mathematical communication) used in your answer to question **5***(d)*.

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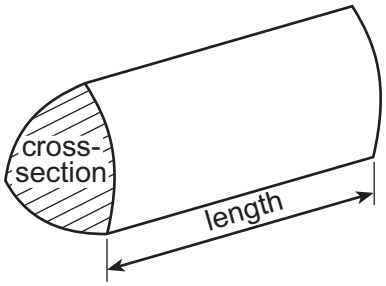
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Formula List

Area of trapezium = $\frac{1}{2}(a + b)h$

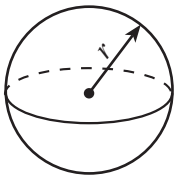


Volume of prism = area of cross-section × length



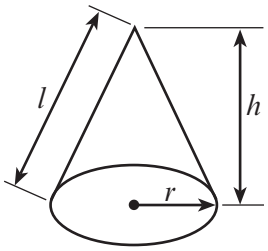
Volume of sphere = $\frac{4}{3}\pi r^3$

Surface area of sphere = $4\pi r^2$



Volume of cone = $\frac{1}{3}\pi r^2 h$

Curved surface area of cone = $\pi r l$

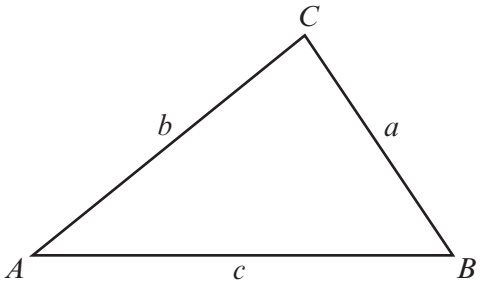


In any triangle ABC

Sine rule $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Cosine rule $a^2 = b^2 + c^2 - 2bc\cos A$

Area of triangle = $\frac{1}{2}ab\sin C$



The Quadratic Equation

The solutions of $ax^2 + bx + c = 0$

where $a \neq 0$ are given by

$$x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$$

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1. The diagram below shows a plan of paths within a park.
Write down the sizes of the missing angles. [4]

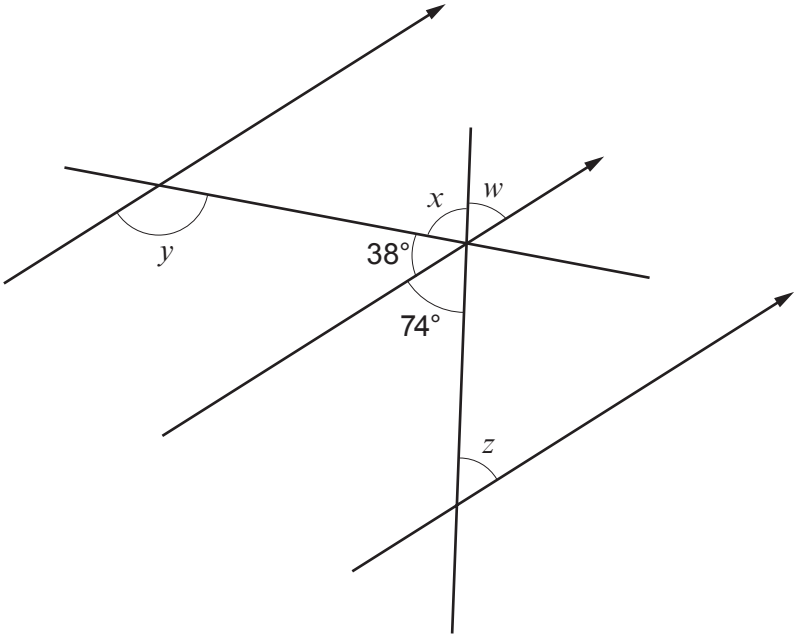


Diagram not drawn to scale

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w = ... ° x = ... ° y = ... ° z = ... °

4

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2. A company makes stainless steel cutlery.



Each production run takes 35 minutes.

There are 6 forks, 7 knives, 4 soup spoons and 21 teaspoons made in each production run.

There is a 5 minute break between each production run.

The first production run starts at 9 a.m.

(a) How many soup spoons have been produced by 11 a.m.?
You must show all your working. [2]

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(b) 252 teaspoons are produced by the end of the working day.
How many knives have been produced? [2]

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(c) After how many production runs will there be 52 more forks than soup spoons? [2]

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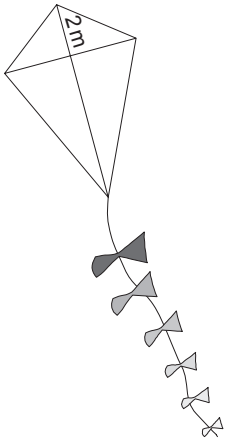
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3. Rowena decides to make a scale drawing of a kite without its tail.



The lengths of the diagonals of this kite are 3 m and 5 m.
The two diagonals meet at a point.
The length of the longer diagonal above this point is 2 m.

(a) Rowena decides to use a scale of 2 cm to represent 1 m.

Draw the scale drawing of the kite for Rowena. [5]

Scale:
2 cm to represent 1 m

(b) To cut the fabric to make the kite, Rowena needs to measure the size of the angle at each of the vertices.
Write down the size of these angles. [2]

..... ° ..... ° ..... ° and ..... °

7

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Turn over.

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4. Luke plans to make a bird feeder box with a completely open front.



Luke has made a sketch of the **back** of the bird feeder box, as shown.

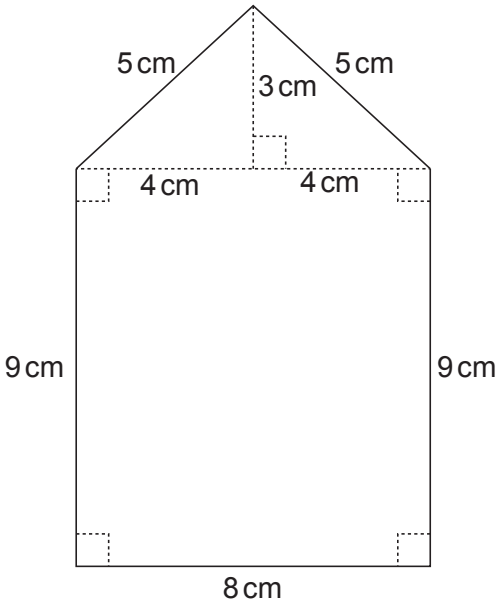


Diagram not drawn to scale

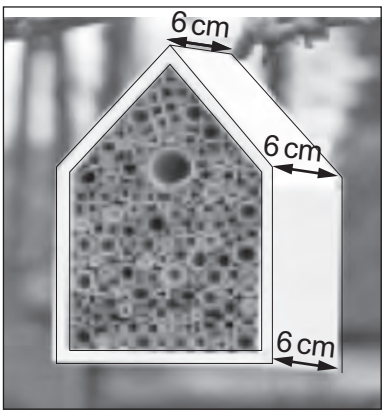


Diagram not drawn to scale

The **depth** of the bird feeder box is 6 cm.

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(a) Calculate the **area** of the back of the bird feeder box. [3]

(b) Calculate the **perimeter** of the floor of the bird feeder box. [2]

(c) Calculate the **area** of each of the following. [3]

- One of the vertical sides.

- One of the roof pieces.

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5. *(a)* An air parcel company, *FlyPack*, wants to build a helicopter base.

The helicopter base is to be
- equidistant from Shrewsbury and Hereford, **and**
- equidistant from Aberystwyth and Newtown.

The map below is drawn to scale, but the scale has been left out.
Using a pair of compasses and a ruler, indicate the position of the helicopter base on the map.
You must show any lines that you use. [3]



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(b) The distance from Haverfordwest to Carmarthen is approximately 33 miles.
Complete each of the following sentences. [4]

Rhyl is approximately ..... miles from Shrewsbury.

The bearing of Rhyl from Shrewbury is ..... °.

Carmarthen is approximately ..... miles from Newtown.

The bearing of Carmarthen from Newtown is ..... °.

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(c) The costs of running a helicopter are given below.

- Fuel costs £f for every mile.
- The daily rate to pay the helicopter crew is £c.
- Landing charges are £b per day.
- Insurance costs £n per day.

(i) A helicopter flies x miles in one day.
Write down the formula for working out the cost of fuel, £F, for one day. [2]

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(ii) Hence, write down the formula for working out the total cost, £T, for running a helicopter for a day. [1]

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(d) *You will be assessed on the quality of your written communication in this part of the question.*
Helicopter fuel costs £8.25 per gallon.
Helicopters consume 30 gallons of fuel for every 25 miles.

A helicopter in Haverfordwest has £600 worth of fuel on board.
Will the helicopter have enough fuel to fly to Hereford?
You must show all your working. [6]

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6. Charlotte runs a snack bar.
She makes and packs 3 varieties of sandwiches to sell.

All her sandwiches sell for £1.50 per pack.

She keeps a list of sandwiches sold during the first hour one Monday morning.

Time sold	Number of sandwiches sold			Total number of sandwiches sold
	Salmon	Cheese	Chicken	
09:00 up to 09:15	4	2	4	10
09:15 up to 09:30	2	8	0	10
09:30 up to 09:45	3	3	4	10
09:45 up to 10:00	5	3	2	10

(a) What is the best estimate of the probability that the next sandwich Charlotte sells will be a cheese sandwich? [2]

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(b) Charlotte is thinking she might reduce the price of the least favourite sandwich in order to sell more of them to her customers.
Which sandwich would this be?
Do you think by doing this Charlotte will take more money?
You must explain your answer. [1]

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Charlotte decides not to introduce a special offer.



All sandwiches £1.50 per pack

(c) Express the ratio of the total number of salmon to cheese to chicken sandwiches sold during the first hour on Monday morning in its simplest form. [2]

(d) Early on Tuesday morning Charlotte prepares the sandwiches for the day.
She uses the same ratio as the sales for the first hour of Monday morning.

She makes a total of 220 sandwiches.
How many of these sandwiches should be salmon? [2]

(e) The following day Charlotte finds she sells the same number of salmon sandwiches as she does chicken sandwiches.
She also notices that she sells twice as many cheese sandwiches as either salmon or chicken sandwiches.

- Why might making sandwiches ready for sale in the same ratio as those sold during the first hour on Monday morning be a problem?
- How could Charlotte improve her strategy for making sandwiches in advance?

You must clearly explain your answers. [2]

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7. *(a)* A Ferris wheel is a popular tourist attraction and a way of getting views of a city. People pay to travel in pods positioned on the circumference of the Ferris wheel.

The table below gives some information comparing two Ferris wheels.

		Wheel diameter	Number of pods
	Wiener Riesenrad Ferris wheel	64 metres	15
	Dubai Eye Ferris wheel	210 metres	36

On which of the two Ferris wheels are two adjacent pods positioned closer together? Approximately how much closer together are these pods around the circumference of the wheel?
You must show all your calculations. [7]

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(b)

		Cost to build in euros, €
	London Eye	$8{\cdot}4 \times 10^7$
	Singapore Flyer	$1{\cdot}08 \times 10^8$

Complete the following statement. [2]

The Singapore Flyer cost ..... million euros **more** to build than the London Eye.

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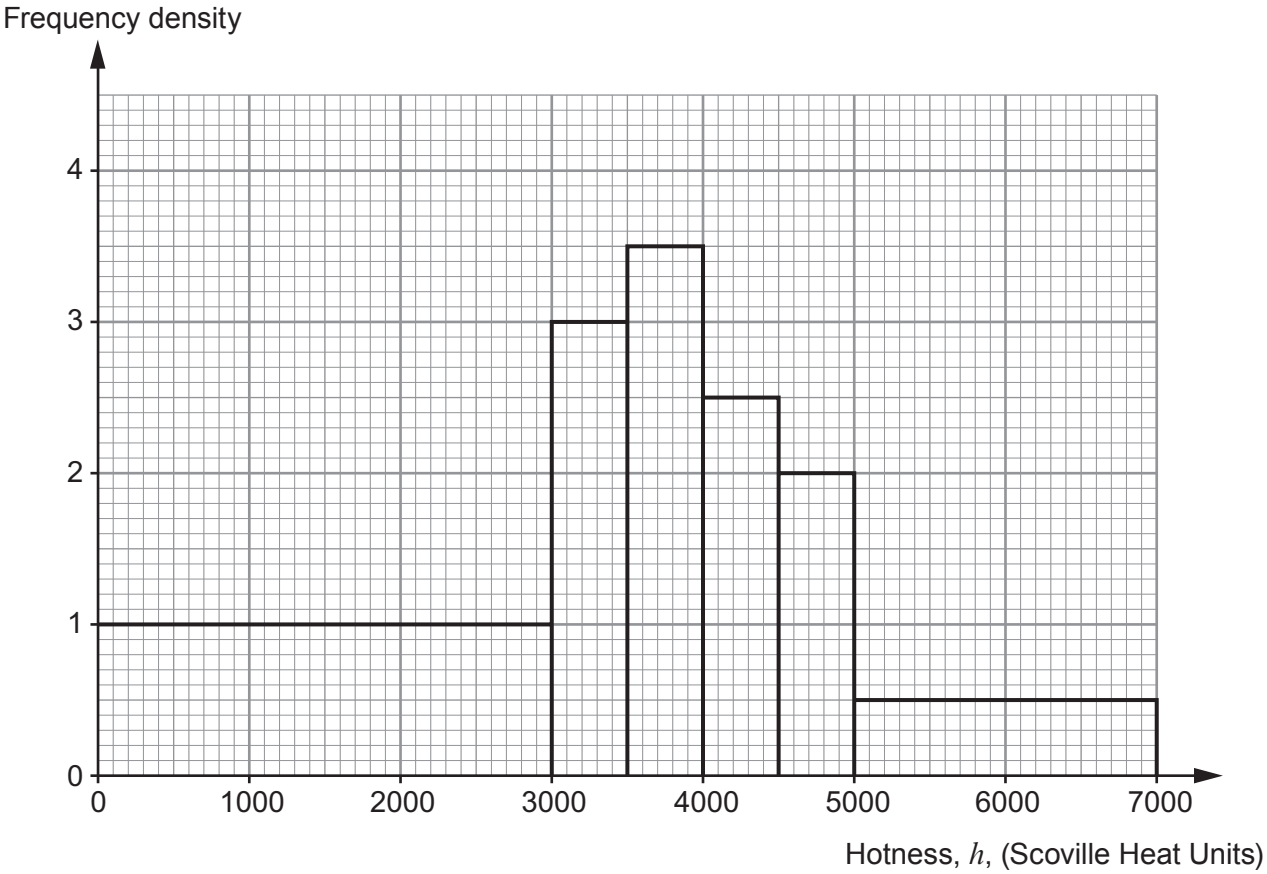
8. The Scoville Heat Unit is used to measure the hotness of a chilli pepper.



For example,
a poblano pepper has a hotness of anywhere between 1000 and 1500 Scoville Heat Units.

A supermarket records the hotness of the varieties of chilli peppers sold each month.

(a) A report on the sales of chilli peppers in November contains the histogram shown below.



Calculate the total number of chilli peppers sold by the supermarket in November. [3]

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(b) The table below shows the hotness of chilli peppers sold by the supermarket in December.

Hotness of chilli peppers in Scoville Heat Units, h	December sales: number of chilli peppers
$1000 < h \leqslant 3000$	1500
$3000 < h \leqslant 3500$	3000
$3500 < h \leqslant 4000$	5500
$4000 < h \leqslant 4500$	7000
$4500 < h \leqslant 5000$	2500
$5000 < h \leqslant 7000$	500

Calculate estimates of the mean and the median hotness of chilli peppers sold during December.
You must show all your working. [6]

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Estimated mean = ... Scoville Heat Units

Estimated median = ... Scoville Heat Units

9

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(c) In the following year, the manager was given the list shown below.
She uses 3-month moving averages to write a report.

Number of chilli peppers sold

January	23000
February	31000
March	9000
April	8000
May	4300
June	9000

(i) Calculate the first four 3-month moving averages for the number of chilli peppers sold. [3]

(ii) The 3-month moving average for the number of chilli peppers sold, for the period from May to July, is 8000.
How many chilli peppers were sold in July? [3]

6

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9. In an experiment, a ball is dropped from a height of 20 metres on to level ground.



It bounces back up to half the original height.
The next bounce is to a height of half the previous height and so on.

(a) What height does the ball reach after the 4th bounce? [2]

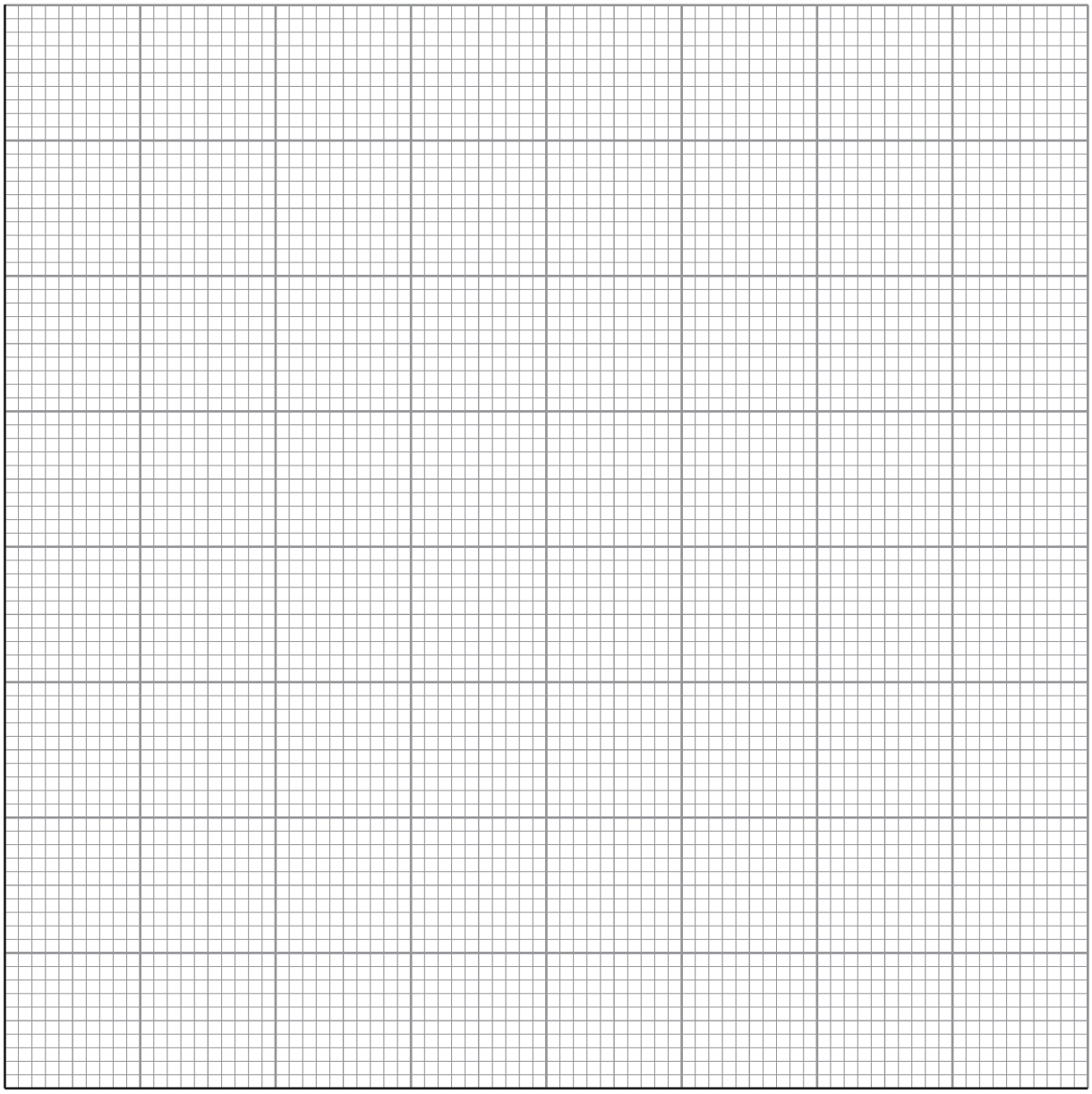
(b) The ball falls vertically and bounces back up vertically.
What is the total distance travelled by the ball as it hits the ground for the 5th time? [3]

(c) Use the graph paper opposite to draw a graph to show the maximum height that the ball reached after each of the first 8 bounces. [3]

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(d) The ball is dropped from a height of h metres.
Derive a formula to calculate the maximum height, M metres, that the ball reaches after the nth bounce. [3]

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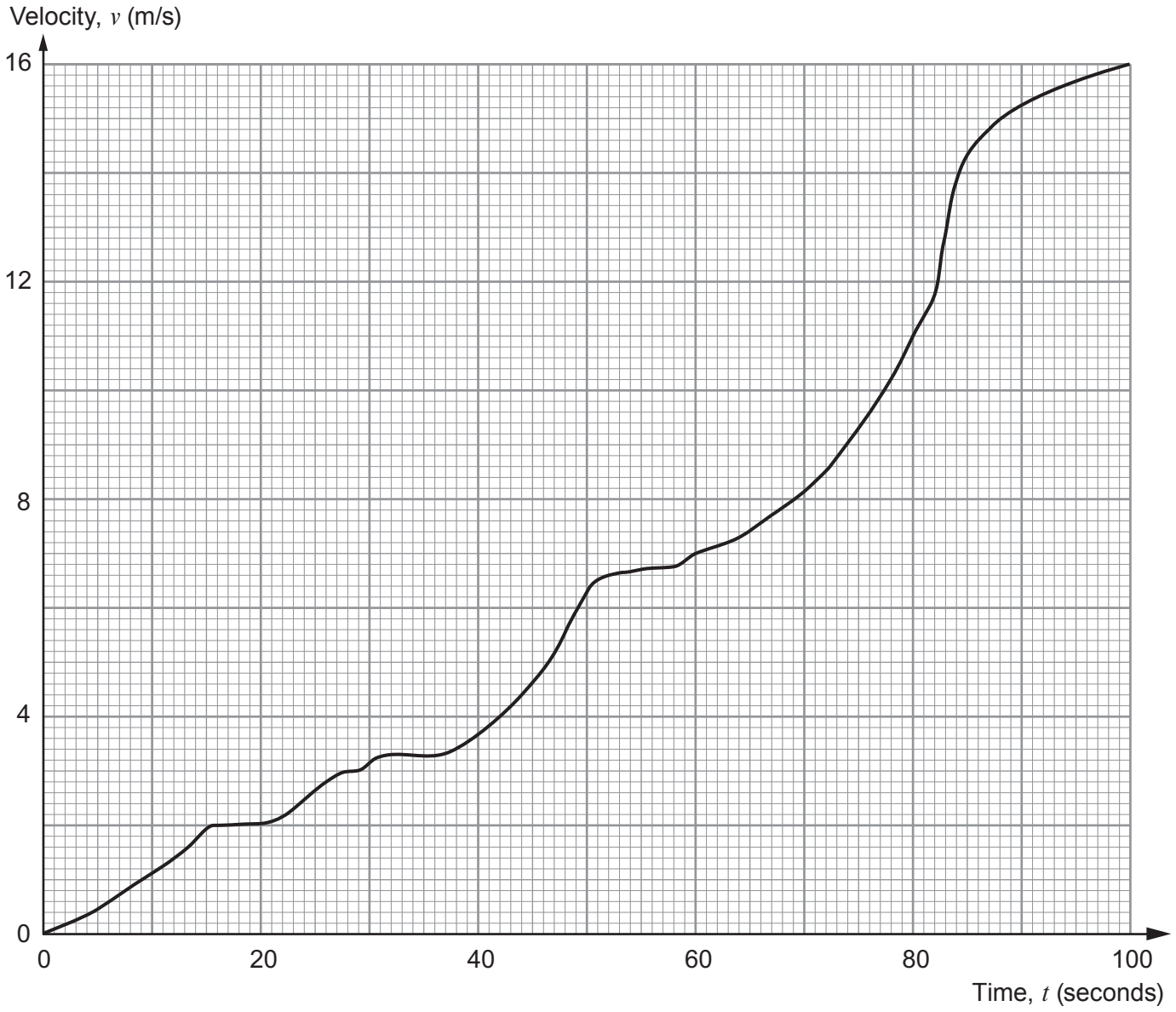
11

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10. A velocity-time graph, representing a 100-second journey of a truck accelerating from 0 m/s, is shown below.



(a) After how many seconds is the velocity of the truck 25 **km/h**? [4]

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After ..... seconds

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(b) Calculate an estimate for the acceleration at t = 70 seconds.
You must give the units for your answer. [4]

Acceleration is .....

(c) Calculate an estimate for the distance travelled by the truck in the first 80 seconds. [3]

Distance travelled is ..... metres

(d) Over the same period, the velocity of another truck is given by the equation

$$v = 4 + 0{\cdot}0012t^2.$$

The velocities of the two trucks are the same at 100 seconds.
There is another time for which the velocities of the trucks are the same.
Give this time correct to the nearest second. [4]

Time is ..... seconds

END OF PAPER

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GCSE MARKING SCHEME

JANUARY 2016

APPLICATIONS OF MATHEMATICS
UNIT 1 - HIGHER TIER
4361/02

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INTRODUCTION

This marking scheme was used by WJEC for the 2016 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conference, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

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GCSE APPLICATIONS OF MATHEMATICS
UNIT 1 - HIGHER TIER

MARK SCHEME – JANUARY 2016

Applications Unit 1 Higher Tier January 2016		Final
1. w = 74° x = 68° y = 142° z = 74°	B1 B1 B1 B1 4	 FT 142 – their w FT their w + their x FT their w
2.(a) 09:00 to 09:35 or 09:40, 09:40 to 10:15 or 10:20, 10:20 to 10:55 or 10:20 to 11:00 OR, Attempt 120 minutes ÷ 35 minutes or ÷40 minutes, OR equivalent towards finding 3 production runs (3×4 =) **12** (soup spoons)	B1 B1	Working may be shown in stages
(b) 7 × 252 ÷ 21 OR ⅓ × 252 **84** (knives)	M1 A1	OR sight of '12 production runs'
(c) Forks 6, 12, 18, 24, AND Soup spoons 4, 8, 12, 16 WITH sight of comparison of difference in numbers for each run, OR Trial & improvement, e.g. 20×6 compared with 20×4 and consider the difference **26** (production runs)	M1 A1 6	OR sight of 156 and 104, OR sight of 52 ÷ 2 (as 2 more soup spoons in each run)
3(a) Correct scale used with diagonals 6 cm and 10 cm Longer diagonal split 4 cm and 6 cm at intersection Shorter diagonal split 3 cm and 3 cm Diagonal intersection 90° (±2°) Outline of the kite correct	B1 B1 B1 B1 B1	 FT their consistent scale if possible FT their kite for an equal split of the shorter diagonal, a kite must be seen May not be shown, implied provided kite outline seen CAO, not FT *Diagonals given treated as sides, award:* *B1 if scale of sides is correct,* *B0* *B1 if their kite has an equal split of the shorter diagonal,* *B0,* *B0*
(b) Both obtuse angles AND Head and tail angles correctly measured, ±2°	B2 7	FT their quadrilateral B1 for any 2 or 3 angles correctly measured, ±2° (Approximately 74°, 53°, 117°, 117°, but measure their angles) There is no requirement for their angle sum to be 360°
4(a) Area triangle = ½ × 8 × 3 or 2 × ½ × 4 × 3 Total area = 9×8 + ½×8×3 (= 72 + 12) or equivalent 84 (cm^2)	B1 M1 A1	OR an appropriate non rectangular area FT their 'area triangle' CAO
(b) Perimeter floor = 8 + 6 + 8 + 6 or equivalent 28 (cm)	M1 A1	
(c) Vertical side area = 9 × 6 OR Roof piece area = 5 × 6 54 (cm^2) 30 (cm^2)	M1 A1 A1 8	

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Applications Unit 1 Higher Tier January 2016		Final
5(a) Perpendicular bisector (±2°) between Shrewsbury and Hereford Aberystwyth and Newtown Helicopter base indicated	 B1 B1 B1	 *Arcs must be shown* *Arcs must be shown* Accept sight of the intersections of the perpendicular bisectors FT provided B1 previously awarded and the other perpendicular bisector is within ±4° tolerance *If B0, B0 due to no arcs, allow FT for possible final B1 provided perpendicular bisectors used* Accept the intersection of the two perpendicular bisectors as their indication. FT provided at least one line accurate but the other slightly outside the tolerance, ±4°
(b) 62 miles (±5 miles) AND 325 ° (±2°) 70 miles (±5 miles) AND 225 ° (±2°)	B2 B2 7	B1 for each answer B1 for each answer *If neither B1 given for bearings then allow SC1 for bearings meeting ±4° tolerance*
5(c)(i) F = fx (ii) (T =) fx + c + b + n or (T =) F + c + b + n	B2 B1	Accept F = f×x. B1 for sight of fx FT their 'fx'
(d) Use of Haverfordwest to Hereford ≥120 but <125 miles	S1	
Method to calculate cost of flying ≥100 miles, OR calculate number of miles possible with £600 fuel	M1	e.g. 100 miles costs: 4×30×8.25 (=£990) e.g. Number of gallons is 600÷8.25 (=72.72… gallons) AND comparison with 30 gallons for flying 25 miles
All necessary calculations or approximations reasonable, e.g. **'£990** of fuel for 100 miles calculated correctly', '£1089 fuel for 110 miles', or '72.72.. gallons (rounded or truncated) ÷ 30 is 2.42.. multiples of 25 miles, **60.6 miles** worth of fuel'	A1	
Conclusion: 'Insufficient fuel'	E1	Depends on M1 and appropriate interpretation of their working provided their distance ≥100 miles
QWC2: Candidates will be expected to • present work clearly, with words explaining process or steps. **AND** • make few if any mistakes in mathematical form, spelling, punctuation and grammar and include units in their final answer QWC1: Candidates will be expected to • present work clearly, with words explaining process or steps. **OR** • make few if any mistakes in mathematical form, spelling, punctuation and grammar and include units in their final answer	QWC 2 9	QWC2 Presents relevant material in a coherent and logical manner, using acceptable mathematical form, and with few if any errors in spelling, punctuation and grammar. QWC1 Presents relevant material in a coherent and logical manner but with some errors in use of mathematical form, spelling, punctuation or grammar OR evident weaknesses in organisation of material but using acceptable mathematical form, with few if any errors in spelling, punctuation and grammar. QWC0 Evident weaknesses in organisation of material, and errors in use of mathematical form, spelling, punctuation or grammar.

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Applications Unit 1 Higher Tier January 2016		Final
6(a) 16/40 or equivalent ISW	B2	B1 for either 16/ … or …/40
(b) Chicken AND conclusion, e.g. 'Reduce Chicken, yes more money because people will buy more', or 'Chicken, she will not take more as same number of sandwiches might be sold, less takings'	E1	
(c) 7 : 8 : 5	B2	B1 for sight of 14:16:10, sight of 7, 8 and 5 in order
(d) 7 × 220 ÷ (7+8+5) or 220 × 14/40 or equivalent 77 (salmon sandwiches)	M1 A1	FT from their ratio for M1 only
(e) Implies first hour and /or Monday morning may not be typical	E1	Must be the flaw in the current strategy
Strategy to improve, e.g. 'need to collect more data', 'need to make the list for more than the first hour'	E1	Must be a way to improve the strategy
	9	
7(a) Use of πd or equivalent for <u>either</u> wheel, sight of π×64 or π×210	M1	
Circumference of <u>both</u> wheels 200.96 to 201.14… (m) <u>and</u> 659 to 660 (m)	A1	
Circumference of either wheel with division by 15 <u>or</u> 36 appropriately	m1	FT their circumference provided M1 awarded
Gaps on circumference 13.39 to 13.41 (m) **and** 18.3 to 18⅓ (m)	A2	A1 for either answer. FT from M1, m1 previously awarded
Conclusion: • Implies Wiener pods closer together • By approximately 5 metres	A1 A1	FT from M1, m1 previously awarded FT from M1, m1 previously awarded Accept equivalent comparison, e.g. as a percentage *Allow alternative using trigonometry (not content):* *Use of 360°÷number of pods for <u>either</u> wheel, sight of 360÷15 or 360÷36* *B1* *(Use of right-angled triangle with angle 12° <u>or</u> 5°, OR cosine rule with angle 24° <u>or</u> 10°, e.g.) sin12°=½gapW/32 <u>or</u> sin5°=½gapD/105 <u>or</u> equivalent correct substitution into cosine rule* *M1* *½gapW =32×sin12° <u>and</u> ½gapD=105×sin5°, or* *equivalent (gap)^2 from cosine rule* *m1(also implies previous M1)* *½gapW =6.653..(m) <u>and</u> ½gapD=9.1513 (m)* *A1* *then as main mark scheme:* *Gaps on circumference* *13.3(m) <u>and</u> 18.3(m)* *A1* *Conclusion:* *Implies Wiener pods closer together* *A1* *By approximately 5 metres* *A1* *If no marks, then SC2 for 'Dubai wheel has circumference (210/64 =) 3.28 times as big as the Wiener wheel, therefore would expect over 3 times as many pods, therefore Wiener pods closer together'*
(b) 24 (million)	B2	B1 for sight of 108 million or 84 million, or evidence of method $1.08\times10^8 - 8.4\times10^7$, or 24000000, 2.4×10^7 or equivalent
	9	

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Applications Unit 1 Higher Tier January 2016		Final
8(a) Method to find area 3000×1+500×3+500×3.5+500×2.5+500×2+2000×0.5 9500 (chilli peppers) (b) Mean: mid points 2000, 3250, 3750, 4250, 4750, 6000 2000×1500+3250×3000+3750×5500+ 4250×7000+4750×2500+6000×500 (78 000 000) ÷20000 3900 (Scoville Heat Units) Median: 20000(chilli peppers) with idea to find mid value hotness 4000 (Scoville Heat Units)	M1 m1 A1 B1 M1 m1 A1 M1 A1 9	Any one area correct (3000 + 1500 + 1750 + 1250 + 1000 + 1000) Allow for sight of any 4 correct products in a sum of 6 CAO FT their mid points provided at least 5 are within appropriate intervals, including bounds FT their sum of products divided by 20000 CAO Allow for sight of 20000÷2 or 10000 (including as a final answer) FT 'their 20000' provided ≠ 6
8(c)(i) (23000+31000+9000)÷3 21000, 16000, 7100, 7100 (ii) 8000×3 -4300 – 9000 10700 (chilli peppers)	M1 A2 M1 m1 A1 6	Or any other sum of 3 consecutive values with intention to divide by 3 A1 for any one correct answer *Alternative(x + 4300 + 9000)÷3 = 8000 M1* *Trial value for x OR 8000×3 -4300-9000 m1* *10700 (chilli peppers) A1*
9(a) (20,) after 1st bounce 10m, after 2nd bounce 5m, after 3rd bounce 2.5m, after 4th bounce 1.25m (b) 20 + 10 + 10 + 5 + 5 + 2.5 + 2.5 + 1.25 + 1.25 57.5 (metres) (c) Axes with uniform scale, 0 to at least 10m and hits 1 to 8 Axes labelled appropriately Points plotted 10, 5, 2.5, 1.25, 0.625, 0.3125, 0.15625, 0.078125 (metres) (d) After 1st hit h/2, after 2nd hit h/2² or h/4, … After *n* hits M= h/2ⁿ	M1 A1 M2 A1 B1 B1 B1 M1 A2 11	Evidence of repeat halving, at least twice M1 for the sum of halved distances showing 20 once plus at least one other distance twice, CAO *SC1 for answers of 77.5(m) or 38.75(m) from working with all distances twice or once respectively* Intention, as appropriate for graph paper *Ignore joining points* A1 for sight of h/2ⁿ. also implies M mark *If no marks, award SC1 for sight of M = (h/2)ⁿ*

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Applications Unit 1 Higher Tier January 2016		Final
10(a) (25) ÷ 60 ÷ 60	M1	
× 1000	M1	
6.9(44… m/s)	A1	
Reading from graph 59 to 60 (seconds)	B1	FT from their 6.9 provided at least 1 M mark previously awarded
(b) Tangent at t = 70	M1	
Use of difference in v / difference in t	M1	Accept with or without sight of a tangent
Acceleration …… (reasonable for their tangent)	A1	Must be evaluated from their tangent
m/s^2 or ms^{-2}	U1	Independent mark
(c) Use of area under the curve from 0 to 80 seconds	S1	*Treat area 0 to 100 seconds as MR-1 then FT*
Correct method, including ½×11×80, or 20 + 56 + 106 + 180	M1	Accept any suitable calculation for 1 or more blocks of area
Correct answer to calculation, e.g. 440(m) or 362(m)	A1	Allow suitable estimates for the vertical scale values
(d) Attempt to find at least one point, i.e. value of v for a value of $0 < t \leq 100$	S1	
At least 2 correct plots or 2 appropriate values of v	P1	
Suitable curve between 80 and 100 or 3 values of v evaluated in the interval $80 \leq t \leq 100$	C1	
(t) 82 or 83 seconds (to the nearest second)	B1	*Allow B4 for a correct answer resulting from a substitution or trial method*
	15	

t	20	40	60	80	100
v	4.48	5.92	8.32	11.68	16

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Surname	Centre Number	Candidate Number
Other Names		0

GCSE LINKED PAIR PILOT

4361/02

S15-4361-02

APPLICATIONS OF MATHEMATICS

UNIT 1: Applications 1
HIGHER TIER

A.M. THURSDAY, 4 June 2015

2 hours

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**5**	
2.	**10**	
3.	**5**	
4.	**10**	
5.	**9**	
6.	**13**	
7.	**11**	
8.	**8**	
9.	**9**	
10.	**6**	
11.	**14**	
Total	**100**	

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ADDITIONAL MATERIALS

A calculator will be required for this paper.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** the questions in the spaces provided.

Take π as 3·14 or use the π button on your calculator.

INFORMATION FOR CANDIDATES

You should give details of your method of solution when appropriate.

Unless stated, diagrams are not drawn to scale.

Scale drawing solutions will not be acceptable where you are asked to calculate.

The number of marks is given in brackets at the end of each question or part-question.

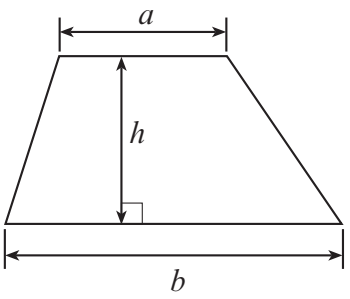
You are reminded that assessment will take into account the quality of written communication (including mathematical communication) used in your answer to question **6***(a)*.

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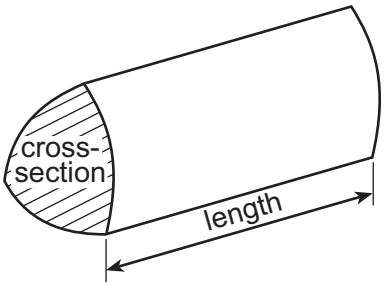
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Formula List

Area of trapezium = $\frac{1}{2}(a + b)h$

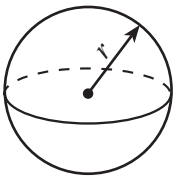


Volume of prism = area of cross-section × length



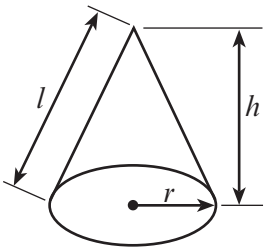
Volume of sphere = $\frac{4}{3}\pi r^3$

Surface area of sphere = $4\pi r^2$



Volume of cone = $\frac{1}{3}\pi r^2 h$

Curved surface area of cone = $\pi r l$

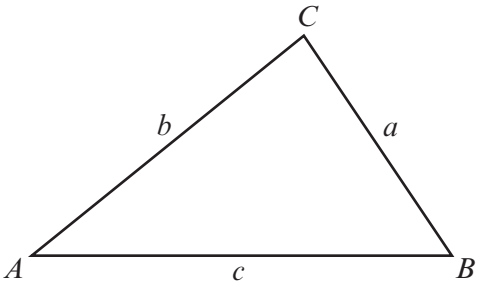


In any triangle ABC

Sine rule $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Cosine rule $a^2 = b^2 + c^2 - 2bc\cos A$

Area of triangle = $\frac{1}{2}ab\sin C$



The Quadratic Equation

The solutions of $ax^2 + bx + c = 0$

where $a \neq 0$ are given by

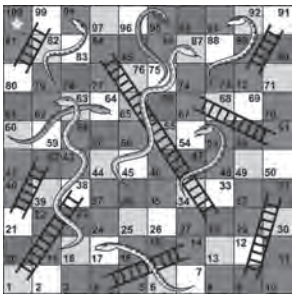
$$x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$$

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1. *Vintage Games* makes board games such as snakes and ladders.



Vintage Games decides to make a biased spinner to include with their board games.
The spinner is numbered 1 to 4.
The probability of scoring each of the numbers has been decided.

Number	1	2	3	4
Probability	0·1	0·3	0·4	.....

(a) Complete the table. [1]

.....

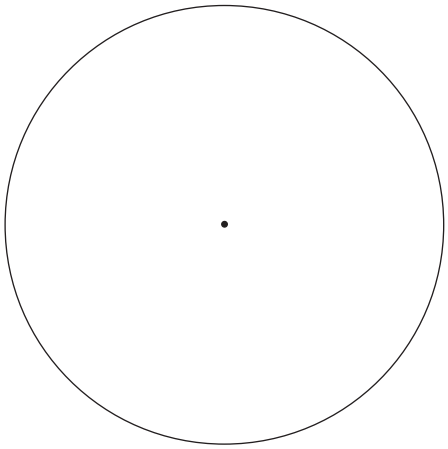
(b) An outline of the biased spinner to be made by *Vintage Games* is shown below.
The centre of the spinner has been marked.
Using the information in the table, complete an accurate drawing of the biased spinner.
You must show your working. [4]

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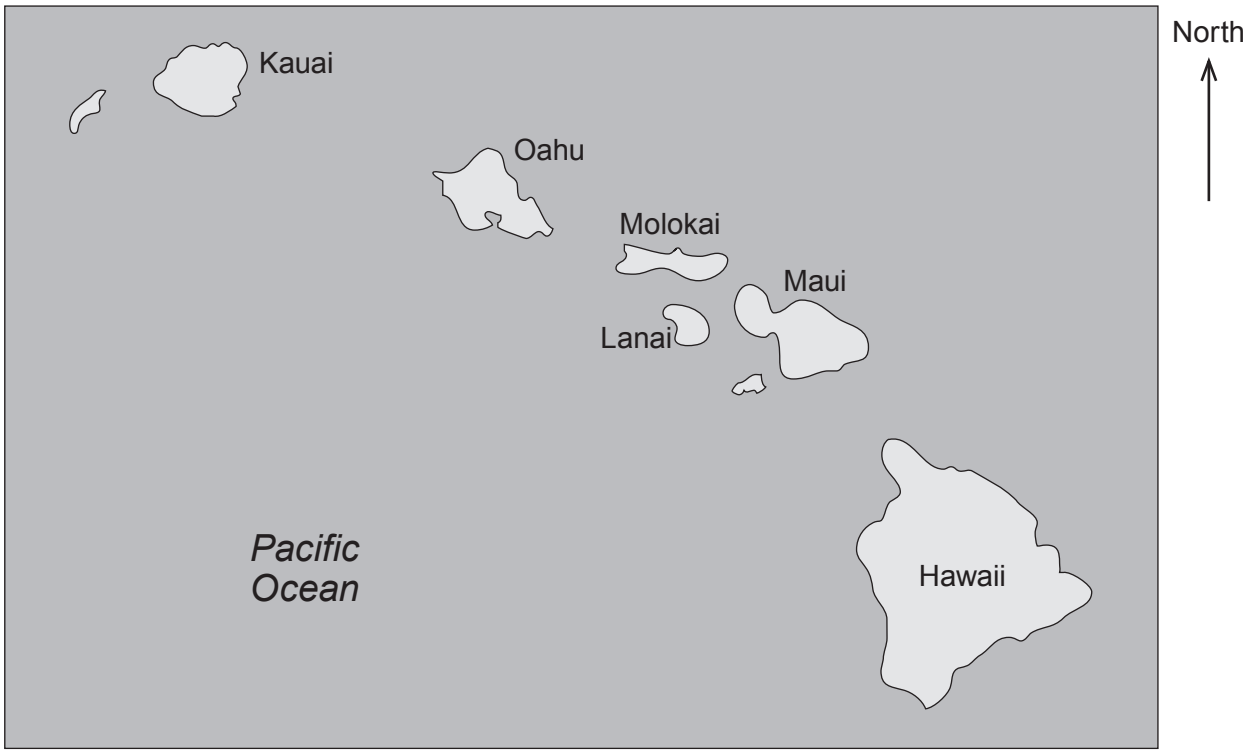
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2. The state of Hawaii in the USA consists of 8 main islands.
The six largest of these islands are Hawaii, Maui, Oahu, Kauai, Molokai and Lanai.



(a) The land area of Oahu is 596·7 square miles.
1 square mile is approximately 2·59 km^2.
Calculate the land area of Oahu in km^2.
Give your answer correct to 3 significant figures. [3]

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(b) Place points on the diagram to mark the approximate centres of the islands of Kauai and Maui.

(i) Use these two central points to complete the sentence below. [3]

The island of Kauai is on a bearing of ..... from the island of Maui.

.....

.....

(ii) Why is there a risk that your answer for the bearing may not be completely accurate? [1]

.....

.....

.....

(c)

1 foot = 12 inches
1 yard = 36 inches

The highest point on the island of Lanai is 3366 feet.
Express the measurement of the highest point on Lanai in inches.
Give your answer in standard form.
You must show all your working. [3]

.....

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3. Shireen is working for *EcoEstates* to prepare plans for a new sports centre.
She is working on the ground plan of the entrance hall and the paths to the sports centre.
The entrance hall is to be in the shape of a rhombus.
A sketch of the plan is shown below.

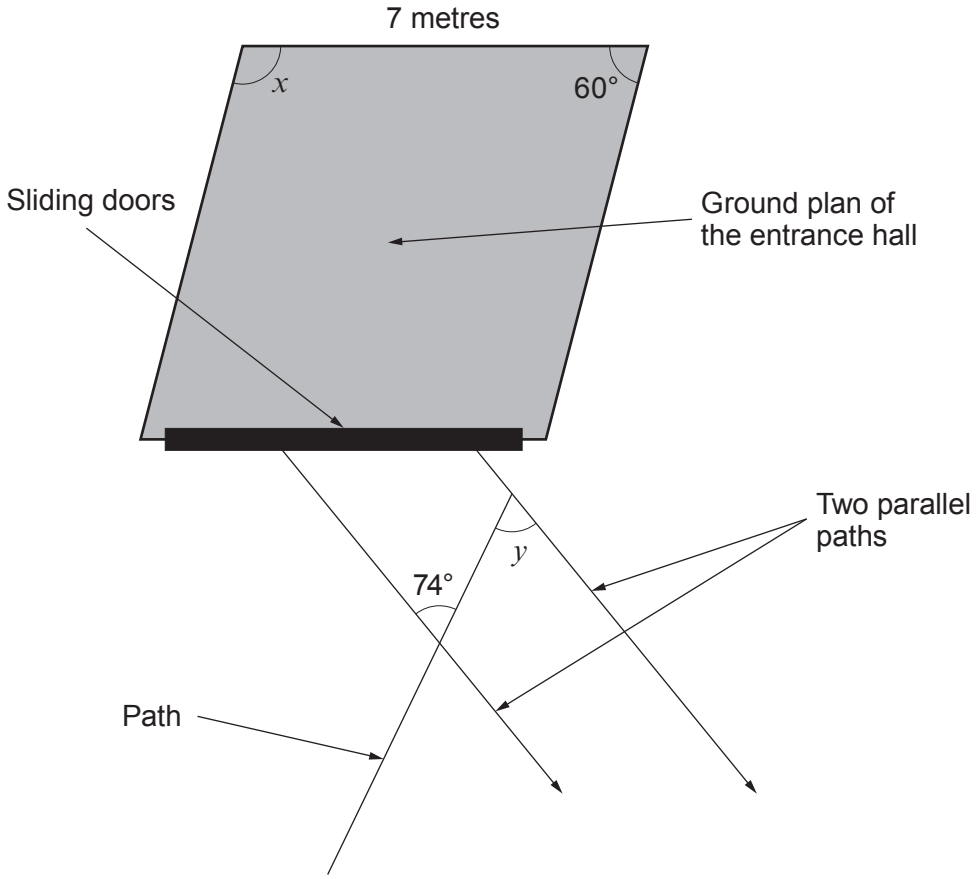


Diagram not drawn to scale

(a) Calculate the size of each of the angles x and y. [2]

.....

.....

$x =$ ..... ° $y =$ ..... °

(b) Use the page opposite to construct an accurate scale drawing of the **rhombus** shown as the **ground plan of the entrance hall**.
You must use a pair of compasses and a ruler and show all your construction arcs.
Use a scale of 1 cm to represent 1 metre. [3]

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Ground plan of the entrance hall drawn to a scale of 1cm to represent 1m.

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4. *EcoEstates* has considered the dimensions of rectangular sports halls.
The dimensions have been expressed algebraically, as shown on the plan.

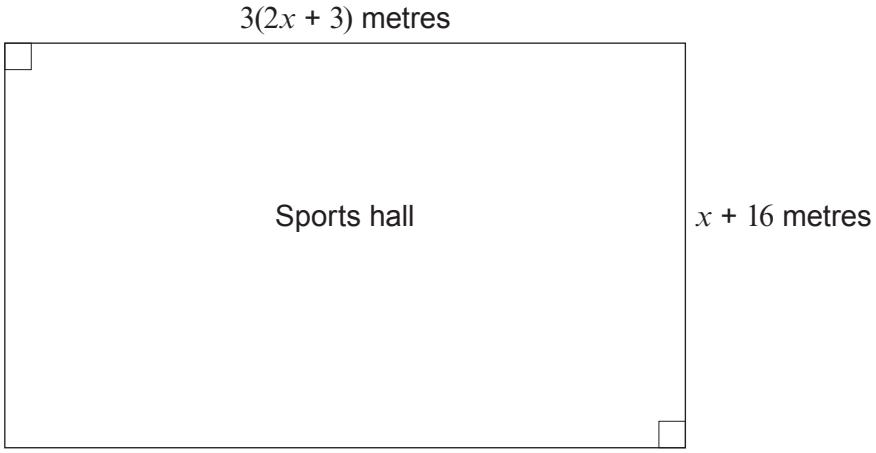


Diagram not drawn to scale

(a) Find the perimeter of a sports hall in terms of x.
Express your answer in its simplest form. [4]

(b) Find the dimensions of the sports hall when $x = 4{\cdot}5$. [2]

Length = ... metres Width = ... metres

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(c) The area of the floor of a sports hall, in m^2, is given by the formula shown below.

$$\text{Area} = 6x^2 + 105x + 144$$

Calculate the area of the floor of the sports hall when $x = 4$. [2]

(d) Angus suggests that it is possible to use negative values for x in the expressions for the dimensions of the rectangular sports halls.
Is he correct?
Show all your working.
Give a reason for your answer. [2]

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5. *Fisher Tours* has a new coach.



(a) On Sunday, the coach took 45 passengers on a trip to the zoo.
The ratio of men to women to children was 2 : 3 : 4.
How many children were on the coach? [2]

.....

.....

.....

(b) The coach has 47 seats for passengers.
Fisher Tours recorded the number of passengers on the coach every day during one week in the summer.
Fisher Tours says that this is typical data for any week in the summer.

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Number of seats occupied	45	30	40	38	34	38	41

(i) For a trip on a **Thursday** in the summer, calculate the best estimate of the probability that a seat on the coach, selected at random, would be empty. [2]

.....

.....

.....

.....

.....

(ii) One summer's day, Gareth says,

'If this is typical data then there should be 7 empty seats on the coach next Tuesday.'

Explain why this is not true and how *Fisher Tours* could improve the way they estimate the number of seats that might be empty each day. [2]

.....

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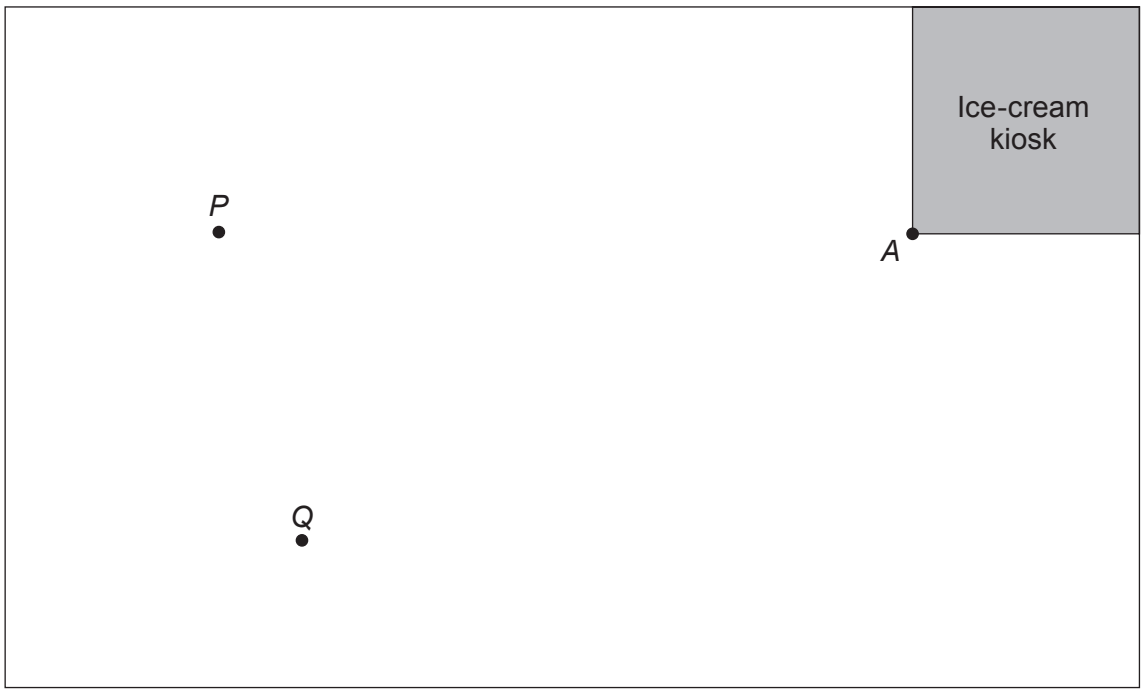
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(c) When *Fisher Tours* takes a coach trip to the zoo they must follow instructions for parking. An accurate scale drawing of the entire coach-parking zone at the zoo is shown below. *Fisher Tours* has been allocated a parking area within this parking zone.



Scale: 1 cm represents 4 metres

The instructions for parking are as follows:

- Must be further than 12 metres away from point *A* at the ice-cream kiosk.
- Must be closer to the lamp post *Q* than to lamp post *P*.

Indicate, on the scale drawing above, the region in which *Fisher Tours* can park their coach. [3]

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6. *GyroVac* makes and sells industrial vacuum cleaners.



(a) *You will be assessed on the quality of your written communication in this part of the question.*

Each wheel on the vacuum cleaners has a radius of 2·8 cm.

In cleaning a carpet in an office, the vacuum cleaner is pushed a total distance of 30 metres.
Calculate how many **complete** times each wheel on the vacuum cleaner rotated during the cleaning of the office carpet. [7]

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(b) In the year 2000, *GyroVac* employed 10 people and sold 40 000 spare parts for its vacuum cleaners.

After the year 2000, the number of people employed by *GyroVac* increased by 15 each year.
Also after the year 2000, sales of spare parts reduced by 700 every year.

(i) Calculate how many spare parts *GyroVac* sold in 2006. [2]

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(ii) Write down the most efficient calculation that could be used to calculate the number of spare parts sold in 2013. [1]

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(iii) Derive a formula to calculate how many people *GyroVac* employed in any year from 2000.
You must use
- n to represent the number of years since 2000
- P to represent the number of people employed by *GyroVac*. [3]

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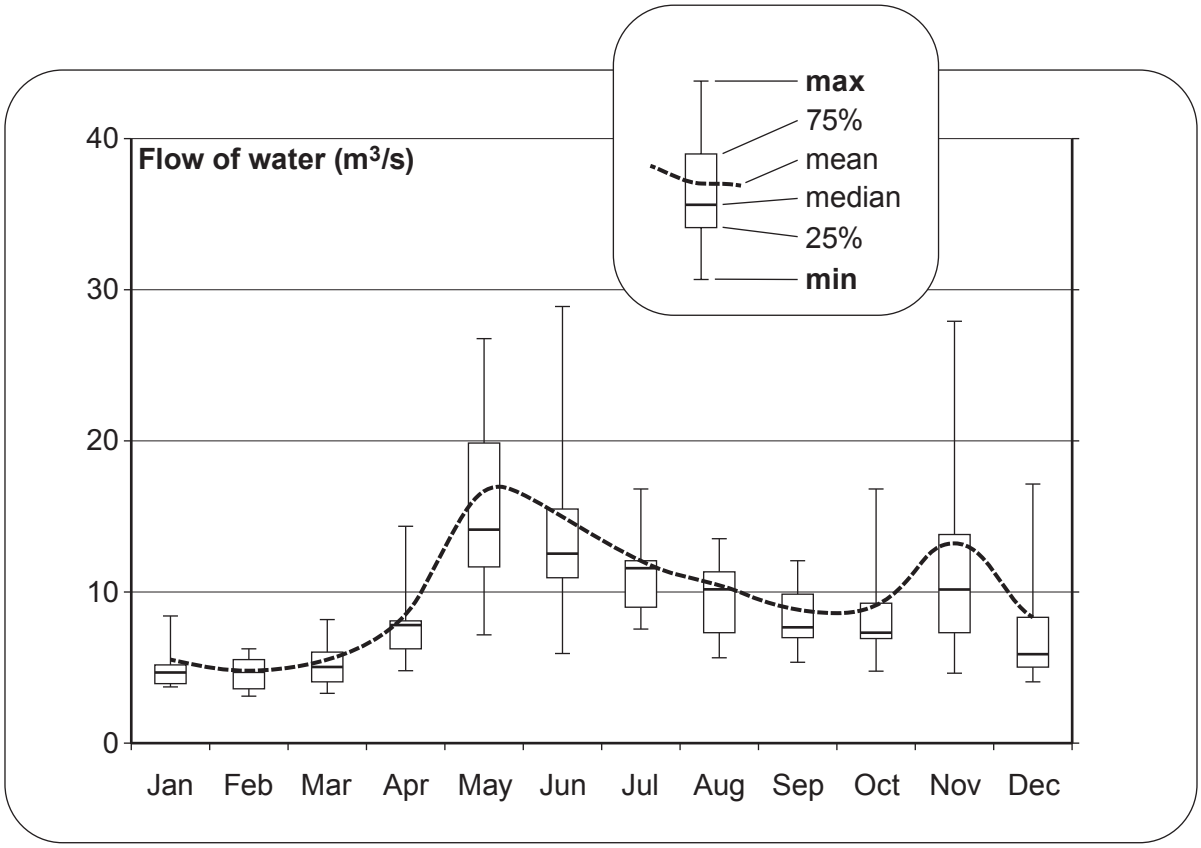
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7. The information board shown below was seen by a river in the Italian mountains.



The information board gives monthly data about the volume of water flowing past a cross-section of the river every second.

(a) Write down the month with the greatest **mean** flow of water.
Estimate this greatest **mean** flow of water, giving the units of your answer. [3]

Month .....

Greatest mean flow .....

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(b) Which month had the smallest range of water flow?
Estimate this range.
Your **must** show all your working. [2]

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Month .....

Range .....

(c) Which month had the greatest interquartile range of water flow?
Estimate this interquartile range.
You **must** show all your working. [3]

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Month .....

Interquartile range .....

(d) The local newspaper publishes a picture of the river with a caption.



The mean flow of the river for the year was .....

Complete this caption.
You **must** show all your working. [3]

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8. Kenny has an internet business selling USB drives.



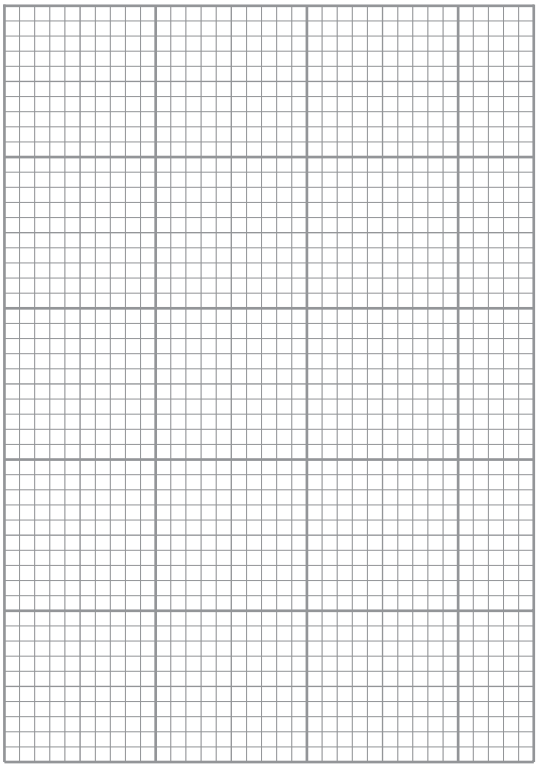
He posts orders out to customers every Monday, Wednesday and Friday.
Kenny sells both 8GB and 16GB USB drives.

The table below shows the number of USB drives he has posted.

Day	Week 1		Week 2		Week 3	
	8GB	16GB	8GB	16GB	8GB	16GB
Monday	8	10	12	6	8	6
Wednesday	6	16	14	14	10	8
Friday	14	12	2	2	20	2

(a) (i) Use the graph paper to illustrate, on the same axes

- the trend in total weekly sales of 8GB USBs, and
- the trend in total weekly sales of 16GB USBs. [3]

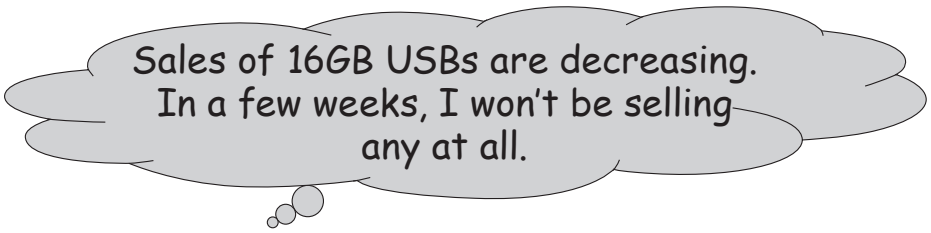


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(ii) Kenny thinks,



Explain to Kenny why he is wrong to draw this conclusion. [1]

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(b) (i) Kenny decides to calculate the 3-point moving averages for sales of **8GB** USBs.
Calculate the first three 3-point moving averages for the **8GB** USBs.
Complete the table below.
Give your answers correct to 1 decimal place. [3]

3-point period	Monday week 1 to Friday week 1	Wednesday week 1 to Monday week 2	..... to .....
3-point moving average	.....	.....	.....

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(ii) Why is it more sensible for Kenny to use 3-point moving averages rather than 5-point moving averages? [1]

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9. The lengths of the worms collected in a one square metre area of woodland were measured. The results are summarised in the grouped frequency distribution below.

Length, l (mm)	Frequency
$0 < l \leqslant 10$	4
$10 < l \leqslant 20$	2
$20 < l \leqslant 30$	10
$30 < l \leqslant 40$	20
$40 < l \leqslant 50$	24
$50 < l \leqslant 60$	24
$60 < l \leqslant 70$	0
$70 < l \leqslant 80$	2

It is decided by the team recording the lengths of the worms that:

- groups $0 < l \leqslant 10$ and $10 < l \leqslant 20$ should be combined
- groups $60 < l \leqslant 70$ and $70 < l \leqslant 80$ should be combined.

(a) Explain why you think this decision was made and whether you think it is a sensible idea. [1]

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(b) Complete the table below and draw a histogram to display the results for the lengths of the worms, keeping to the decision made for combining the results. [4]

Length, l (mm)	Frequency	Frequency density
$0 < l \leqslant 20$		
$20 < l \leqslant 30$		
$30 < l \leqslant 40$		
$40 < l \leqslant 50$		
$50 < l \leqslant 60$		
$60 < l \leqslant 80$		

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(c) Write down an estimate for the median length of the worms.
You **must** show your working. [4]

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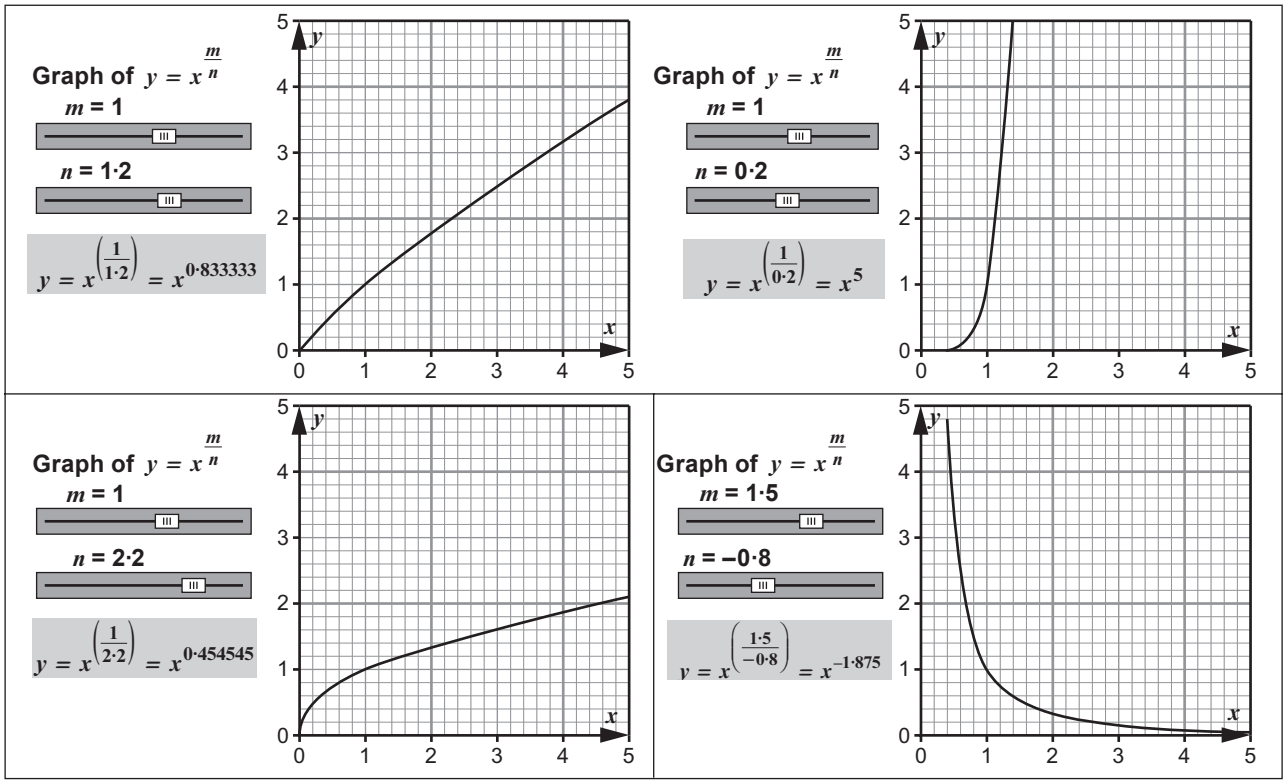
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10. Dilys works as a financial researcher for a bank.

She looks at some graphs of $y = x^{\frac{m}{n}}$ on the internet.

Some of her results, using various values of m and n, are shown below.



(a) Write down possible values for m and n that Dilys could use to produce a straight line graph. [1]

$m =$ ..... $n =$ .....

(b) Dilys looks at the graph $y = x^{-1{\cdot}875}$.
She states,

'I think that when $x = 500$ the value of y would be exactly zero.'

Dilys is not correct.

To help Dilys understand why she is not correct:

(i) write down the value of y when $x = 500$ expressed in standard form [2]

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(ii) explain what happens to the value of y as the value of x increases. [1]

(c) Dilys has the following data:

$y = 24{\cdot}5$ $m = 3$ $n = 8$ $y = x^{\frac{m}{n}}$

Find the value of x. [2]

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11. In an experiment it was found that the velocity, v in m/s, of a particle at time t seconds after the start of the experiment was given by the equation $v = 3t - t^2$.

(a) Draw the **curved** graph of $v = 3t - t^2$ for values of t from 0 to 3, for increasing values of t in steps of 0·5. [5]

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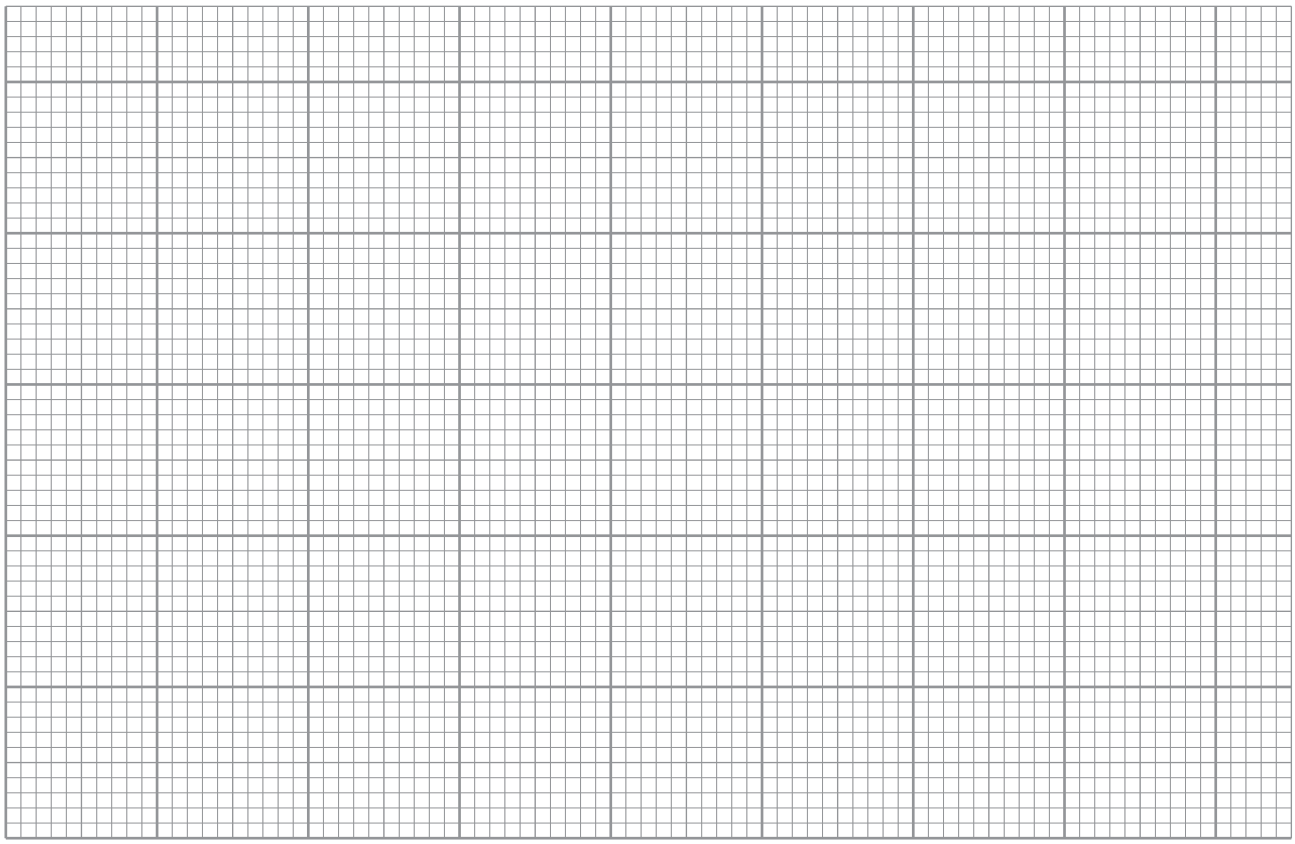
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(b) The acceleration of the particle is the rate of change of the velocity.

(i) Find the time at which the acceleration of the particle is zero. [1]

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(ii) Find an approximation for the acceleration when $t = 2{\cdot}2$. [4]

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(c) The distance travelled by the particle can be found using the graph of $v = 3t - t^2$.
Use the trapezium rule to find an approximation for the distance travelled by the particle for values of t from 0 to 3. [4]

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Surname	Centre Number	Candidate Number
Other Names		0

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4361/02

W15-4361-02

APPLICATIONS OF MATHEMATICS

UNIT 1: Applications 1

HIGHER TIER

A.M. WEDNESDAY, 14 January 2015

2 hours

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**6**	
2.*(a)(b)*	**9**	
2.*(c)(d)*	**5**	
3.*(a)(b)*	**10**	
3.*(c)(d)*	**12**	
3.*(e)*	**5**	
4.*(a)*	**11**	
4.*(b)(c)*	**12**	
4.*(d)(e)*	**11**	
5.	**8**	
6.	**11**	
Total	**100**	

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ADDITIONAL MATERIALS

A calculator will be required for this paper.

A ruler, a protractor and a pair of compasses may be required.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** the questions in the spaces provided.

Take π as 3·14 or use the π button on your calculator.

INFORMATION FOR CANDIDATES

You should give details of your method of solution when appropriate.

Unless stated, diagrams are not drawn to scale.

Scale drawing solutions will not be acceptable where you are asked to calculate.

The number of marks is given in brackets at the end of each question or part-question.

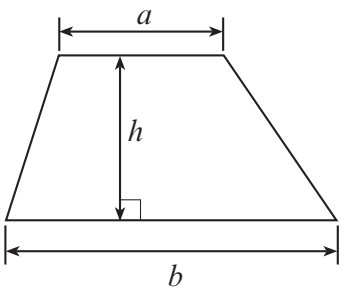
You are reminded that assessment will take into account the quality of written communication (including mathematical communication) used in your answer to question **3***(a)*.

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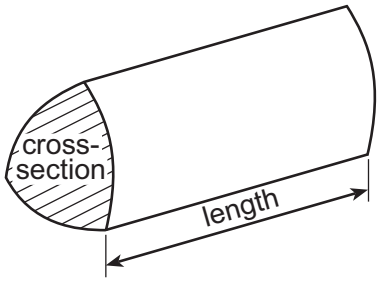
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Formula List

Area of trapezium $= \frac{1}{2}(a + b)h$

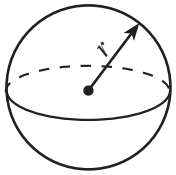


Volume of prism = area of cross-section × length



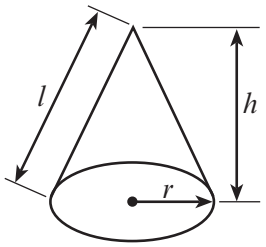
Volume of sphere $= \frac{4}{3}\pi r^3$

Surface area of sphere $= 4\pi r^2$



Volume of cone $= \frac{1}{3}\pi r^2 h$

Curved surface area of cone $= \pi r l$

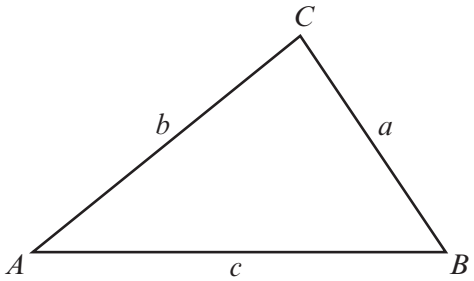


In any triangle ABC

Sine rule $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Cosine rule $a^2 = b^2 + c^2 - 2bc\cos A$

Area of triangle $= \frac{1}{2}ab\sin C$



The Quadratic Equation

The solutions of $ax^2 + bx + c = 0$

where $a \neq 0$ are given by

$$x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$$

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1. *(a)*



Berlin's main railway station is known as the Hauptbahnhof.
Bellevue and Wildau are two railway stations in opposite directions from the Hauptbahnhof.

On a particular day,

- trains leave the Hauptbahnhof to Bellevue every 14 minutes
- trains leave the Hauptbahnhof to Wildau every 12 minutes.

A train to Bellevue and a train to Wildau both leave the Hauptbahnhof at 10:00.

When will a train to Bellevue and a train to Wildau next leave the Hauptbahnhof at the same time? [4]

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(b) Raimund records the arrival time of the first 10 trains each hour.
A summary of his results is shown in the table below.

Time, after	Number of trains late	Number of trains on time or early
1 p.m.	2	8
2 p.m.	1	9
3 p.m.	5	5
4 p.m.	1	9
5 p.m.	3	7

Calculate the best estimate of the relative frequency of a train arriving late. [2]

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2. *(a)* Jack is planning to build a fence across his field.
He has placed a note on the sketch of his field to show where he intends to place the fence.

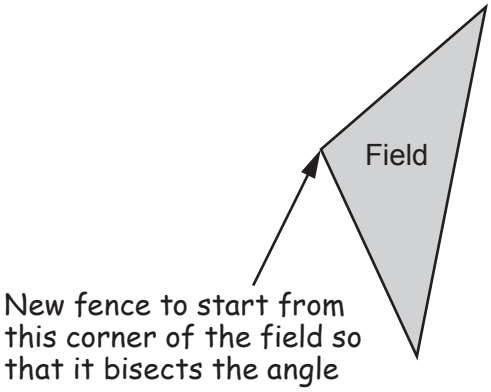
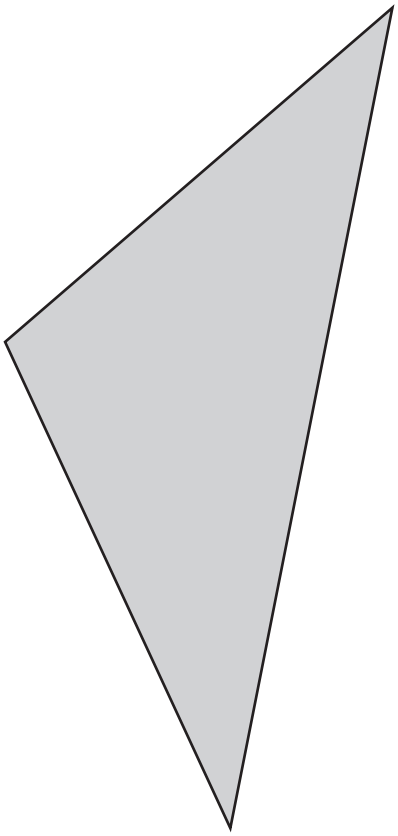


Diagram not drawn to scale

Complete the scale drawing below to show where the new fence is to be placed.
You must use a pair of compasses and a ruler to bisect the obtuse angle.
You must show all of your construction marks on the diagram. [2]



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(b) Jack employs two workers, Siân and Dan.
He pays each of them as follows:

- £3.75 each day they work, for checking the hedges and fences on the way to work
- £16.25 per hour when working with the animals
- £18.50 per hour when working with equipment, such as fork lift trucks and tractors.

(i) Siân works 3 days a week.
Last week she spent 4 hours each day working with animals and 2 hours each day using the fork lift truck.
How much was Siân paid last week? [3]

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(ii) Dan works 4 days a week.
He always spends y hours per day feeding the animals.
He always spends $2y$ hours per day driving the tractor.
Dan gets paid £P per week.
Write down a formula for P in terms of y.
Give your answer in its simplest form. [4]

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(c)



There is a duck pond on Jack's farm.

The duck pond is circular, with a diameter of 12 metres.
Calculate the surface area of the duck pond. [2]

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(d) Jack uses a trundle wheel to measure the lengths of his fields and buildings.



He counts how many times the wheel on his trundle wheel rotates so that he can calculate lengths.
The radius of Jack's trundle wheel is 0·24 m.

Complete the table below. [3]

Measured	Number of turns of the trundle wheel	Actual length in metres
Length of west field	32	
Length of the building for equipment storage	14	

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3. Seven friends hire a boat, **The Wave**, to explore where dolphins swim.



The Wave

(a) You will be assessed on the quality of your written communication in this part of the question.

The cost of hiring **The Wave** for a week is £2380.
Two sponsors, *Connelly Boats* and *Water Watch*, pay part of the hire cost.

The cost of hiring **The Wave** is shared in the ratio 2 : 3 : 5 with

- *Connelly Boats* paying the **smallest** share
- *Water Watch* paying the **largest** share
- The seven friends sharing the remaining cost equally.

How much does *Connelly Boats* pay?
How much does *Water Watch* pay?
How much does each of the seven friends pay?
You must show all your working. [8]

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(b) The charges for mooring boats are displayed in the harbour.

Mooring charges for boats for 24 hours

Mooring charges depend on the length of your boat.

Boats up to 6 m in length:	charge is £4.80 per metre
Boats 7 m in length:	charge is £4.40 per metre
Boats 8 m in length:	charge is £3.90 per metre
Boats longer than 8 m:	charge is £3.55 per metre

Charge includes fresh water, electricity and use of the showers

The friends notice that the charges were not very clear for boats between 6 m and 8 m in length.

The Wave is 7·1 m in length.
The friends were charged £30.80 for mooring **The Wave**.

Explain how the charge was calculated and suggest how the charges could be displayed more clearly. [2]

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(c) On Monday, the friends recorded the bearings and distances sailed.

The Wave's sailing log for Monday	
Harbour to buoy 1	600 metres on a bearing of 110°
From buoy 1 to buoy 2	360 metres on a bearing of 320°
From buoy 2 to buoy 3	150 metres on a bearing of 055°



Buoys

(i) Using a scale of 1 cm to represent 60 metres, complete an accurate scale drawing of **The Wave's** route on Monday. [5]



(ii) Write down the bearing of the harbour from the position of buoy 1. [1]

..... °

(iii) Find the distance and the bearing of the harbour from the position of buoy 3. [2]

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Distance: ..... m

Bearing: ..... °

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(d) The friends want to moor **The Wave** off the coast of an island in order to watch dolphins.



Dolphins have been spotted within a 20 km radius of Funchal.
No dolphins have been spotted closer than 5 km to the coast of this island.
No dolphins have been spotted closer to Ribeira Brava than to Santa Cruz.

Indicate the approximate region on the map where dolphins have been spotted. [4]

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(e) The height of **The Wave**'s mast is 33 feet 4 inches.

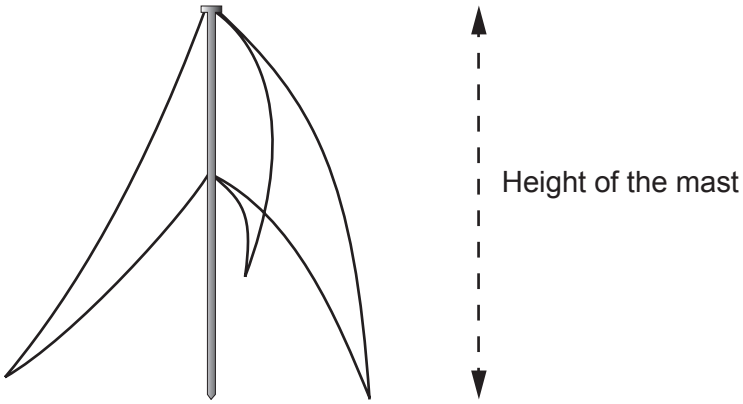


Diagram not drawn to scale

There are 12 inches in 1 foot and 1 cm is approximately 0·3937 inches.

(i) Calculate the approximate height of **The Wave**'s mast in centimetres. [3]

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(ii) Complete the following table. [2]

The Wave		
Measure	Height **in mm**	Height **in mm** written in standard form
Height of the mast (33 feet 4 inches)	.....	.....

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4. *(a)* A broadcasting company, *Stateside3*, investigated television-viewing habits.

The table below shows the number of minutes 80 people spent watching television last Wednesday.

Time (t minutes)	Frequency
$0 \leqslant t < 90$	10
$90 \leqslant t < 180$	38
$180 \leqslant t < 270$	20
$270 \leqslant t < 450$	8
$450 \leqslant t < 810$	4

(i) Did any of these people spend longer than 15 hours watching television last Wednesday?
Give a reason for your answer. [1]

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(ii) Calculate an estimate for the mean time these people spent watching television last Wednesday. [4]

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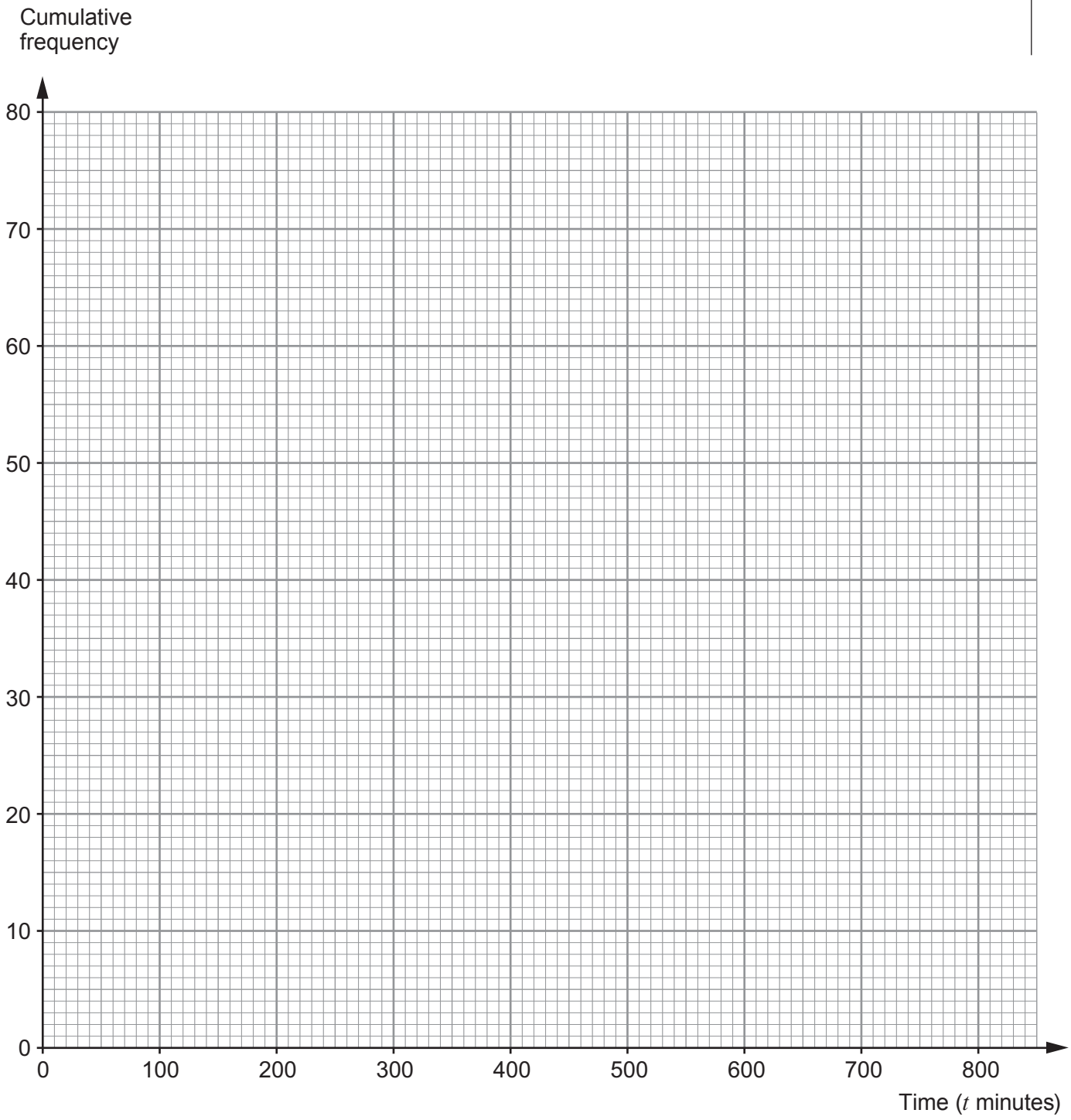
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(iii) Complete the following cumulative frequency table. [1]

Time (t minutes)	$t \leqslant 0$	$t < 90$	$t < 180$	$t < 270$	$t < 450$	$t < 810$
Cumulative frequency	0					

(iv) On the graph paper below, draw a cumulative frequency diagram to show this information. [2]



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(v) Use your cumulative frequency diagram to find an estimate for the median and the interquartile range of the times spent watching television last Wednesday.
You **must** show your working. [3]

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Median = ... minutes

Interquartile range = ... minutes

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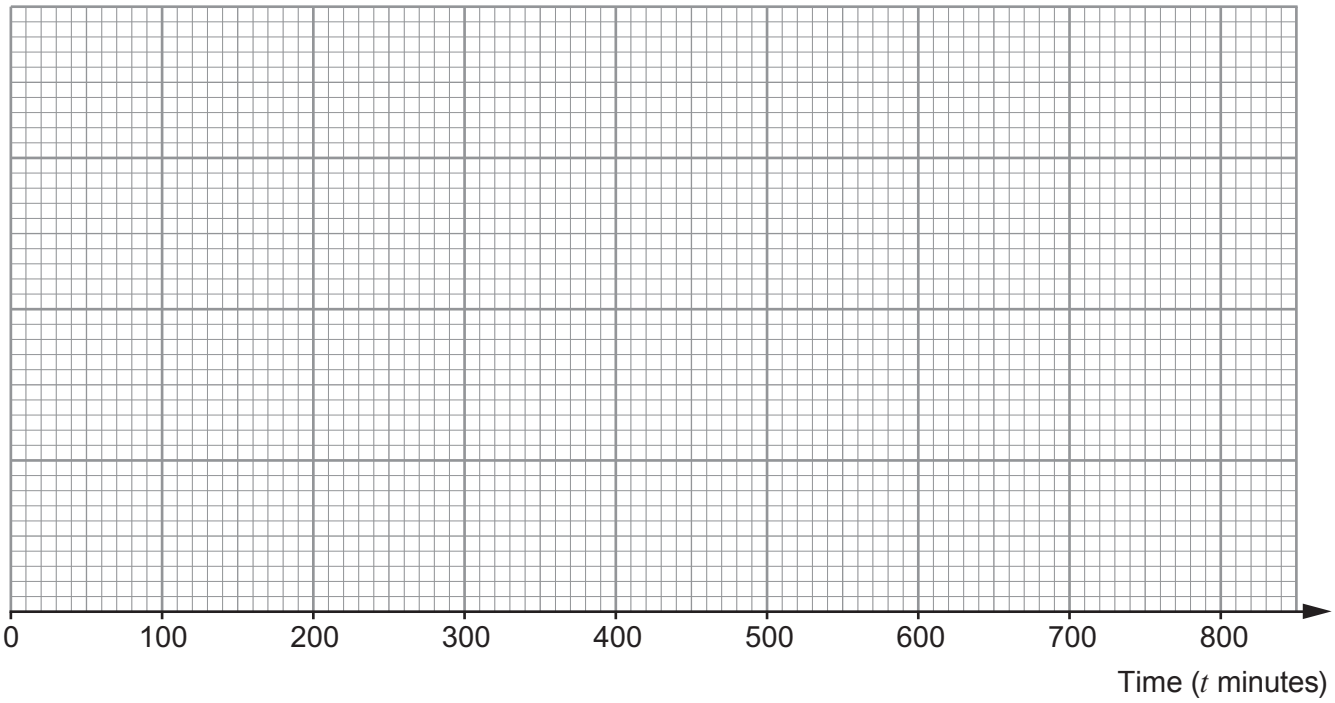
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(b) (i) *Stateside3* also investigated how long this group of 80 people spent watching television last Thursday.
They published the following statement.

> Last Thursday, 80 people answered our survey on how many minutes they spent watching television.
> We now know:
> - The median time was 310 minutes.
> - The lower quartile was 200 minutes.
> - The upper quartile was 560 minutes.
> - The person who watched the least television spent 50 minutes.
> - The person who watched the most television spent 800 minutes.

Draw a box and whisker diagram to illustrate this information. [4]



(ii) *Stateside3* considers the results of the two surveys of the same 80 people.
The manager of *Stateside3* states,

> 'I think people are watching more TV on a Wednesday night than on a Thursday night.'

Do you agree with the manager of *Stateside3*?
You must explain your answer with reference to the median and the interquartile range for both days. [3]

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(c) A different broadcasting company, *Metro Vision*, also analyses information about the number of people watching the programmes broadcast on their channel.
They refer to this as their 'viewing figures'.
The table below shows the viewing figures for each day of the week.

Day	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu
Week number	1	1	1	1	1	1	1	2	2	2	2
Viewing figures, to the nearest million	1·2	2·3	3·4	2·0	4·3	7·8	8·9	1·4	2·6	3·8	1·5

(i) *Metro Vision* decides to track 7-point moving averages.
Explain fully why using a 7-point moving average, as there are 7 days in the week, would be more useful than using a 5-point moving average. [1]

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(ii) Calculate the five possible 7-point moving averages for the *Metro Vision* viewing figures. Give each of your answers correct to 3 significant figures. [4]

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12

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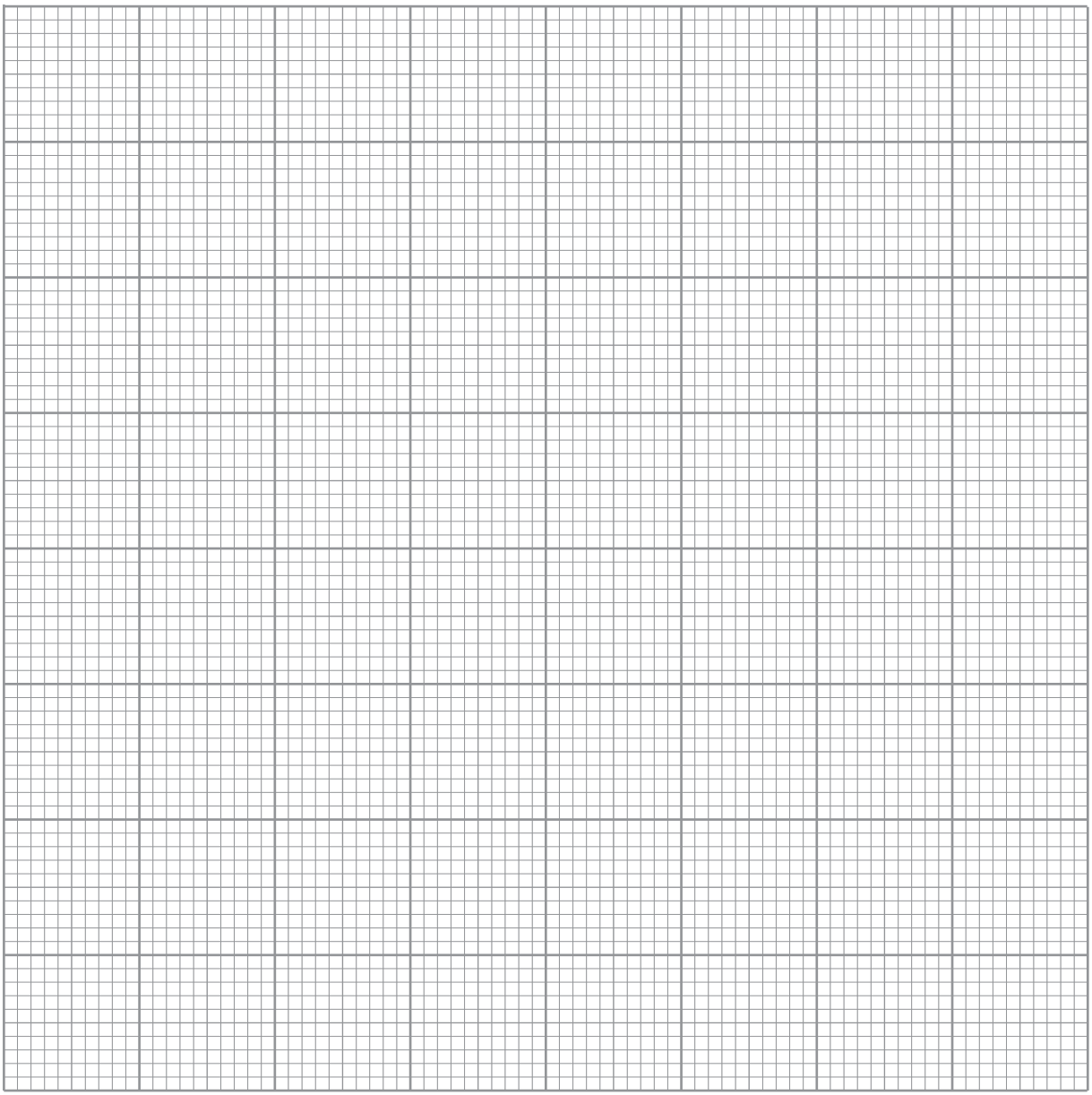
(d) The table below shows the number of minutes a different group of people spent watching programmes broadcast by *Hafod West TV* last Friday.

Time (t minutes)	Frequency
$0 \leqslant t < 100$	6
$100 \leqslant t < 200$	36
$200 \leqslant t < 300$	24
$300 \leqslant t < 500$	4
$500 \leqslant t < 800$	6

(i) Draw a histogram, on the graph paper opposite, to represent this data. [3]

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(ii) Indicate the median on your histogram.
Show how you decided where the median should be placed on the histogram. [3]

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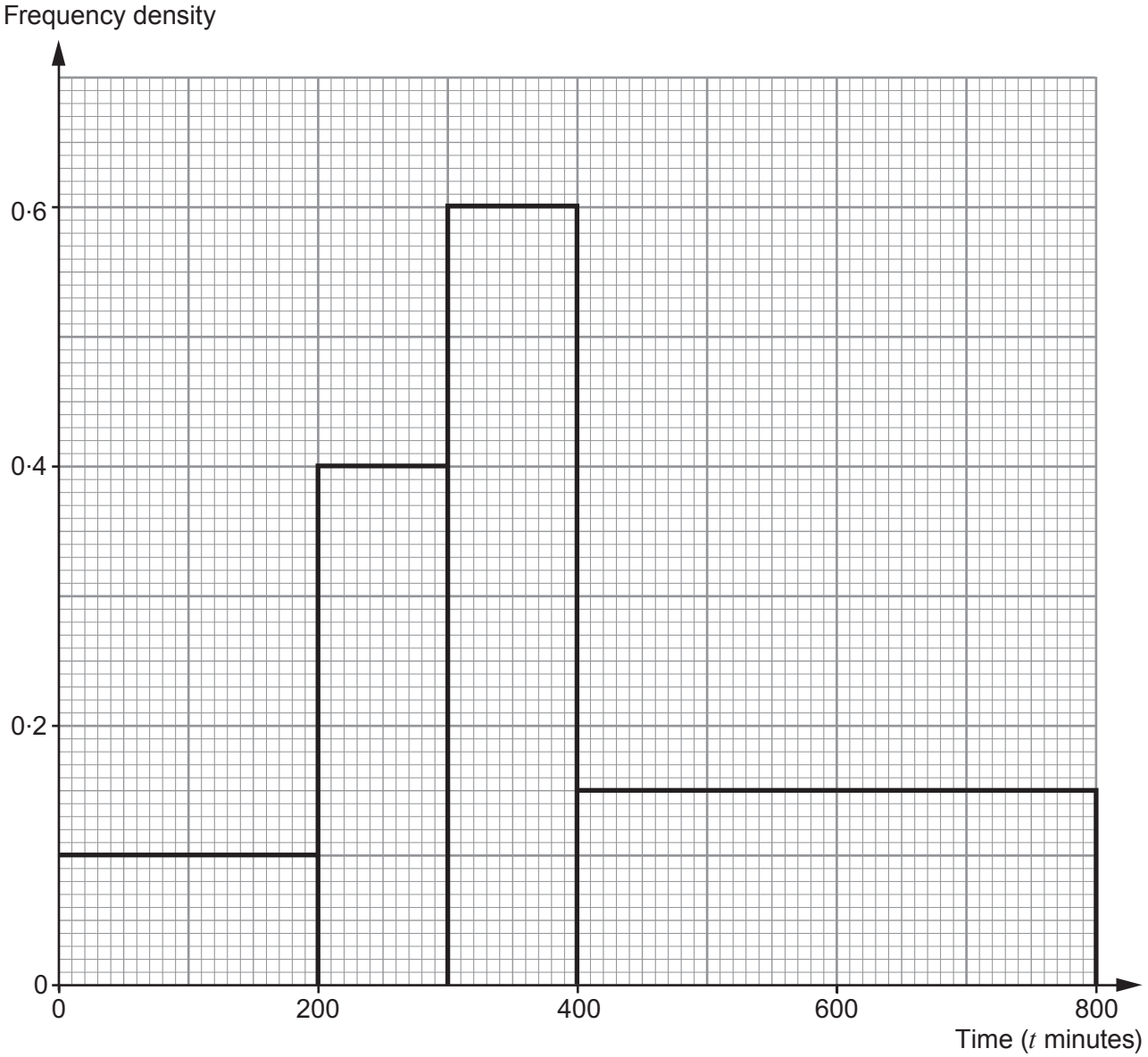
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(e) After asking a number of people to complete a questionnaire, *Hafod West TV* published the histogram shown below.
It illustrates the number of minutes a group of people spent watching programmes broadcast on other television channels last Friday.



(i) How many people answered the questionnaire? [3]

.....

.....

.....

(ii) How many people spent less than 250 minutes watching these other channels last Friday? [2]

.....

.....

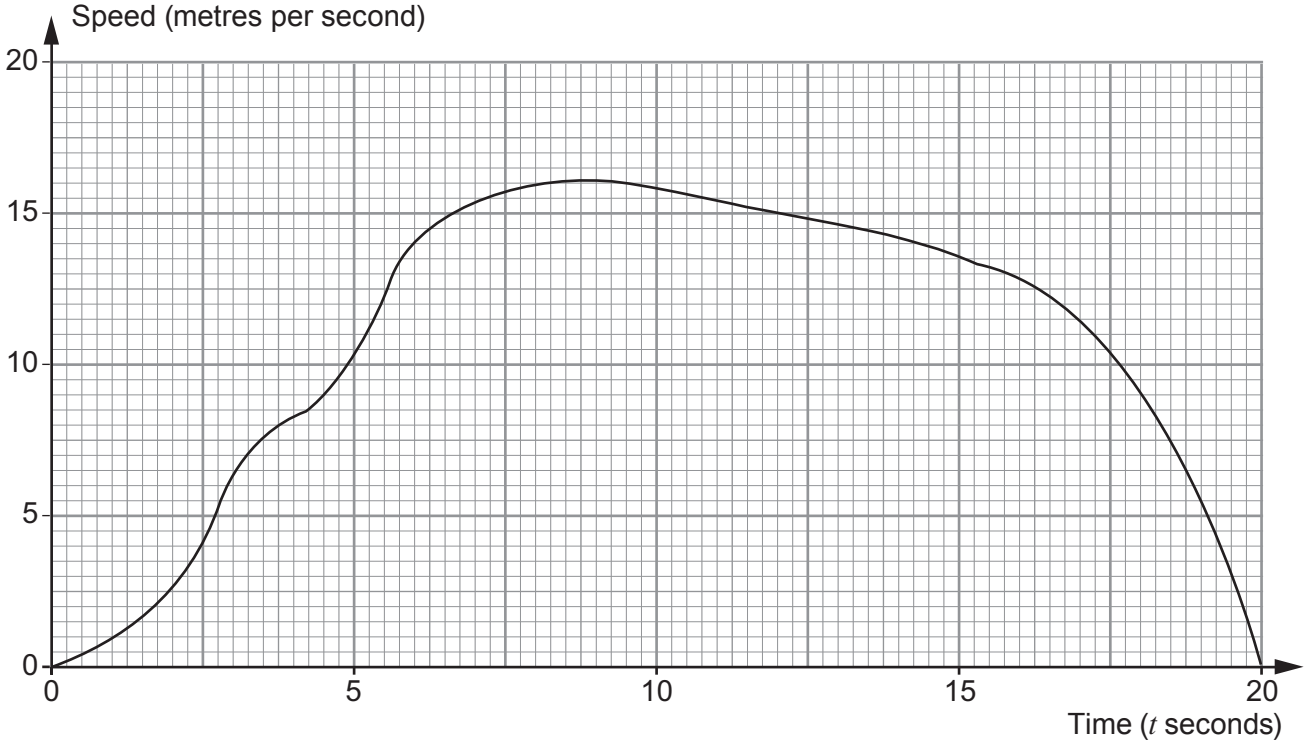
.....

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5. The graph below shows the speed of a cyclist, between two sets of traffic lights.



(a) Calculate the acceleration of the cyclist at t = 7·5 seconds.
Give the units of your answer. [4]

.....

.....

.....

(b) Calculate an estimate for the distance between the two sets of traffic lights. [4]

.....

.....

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8

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6.



When a stone is dropped from a bridge into the river below, the equation for calculating the height of the bridge is given as

$$H = \frac{1}{2} gt^2.$$

In this equation:

- H is the height of the bridge in metres
- g is the acceleration of the stone due to gravity, which is measured in m/s^2
- g = 9·8
- t is the time taken in seconds for the stone to hit the surface of the water.

Glynis carries out experiments on different bridges.
The highest bridge she uses in her experiment is 200 m above the river level.



Glynis drops a stone from each bridge and times how long it takes to hit the water.
These times allow Glynis to find the heights of the bridges.

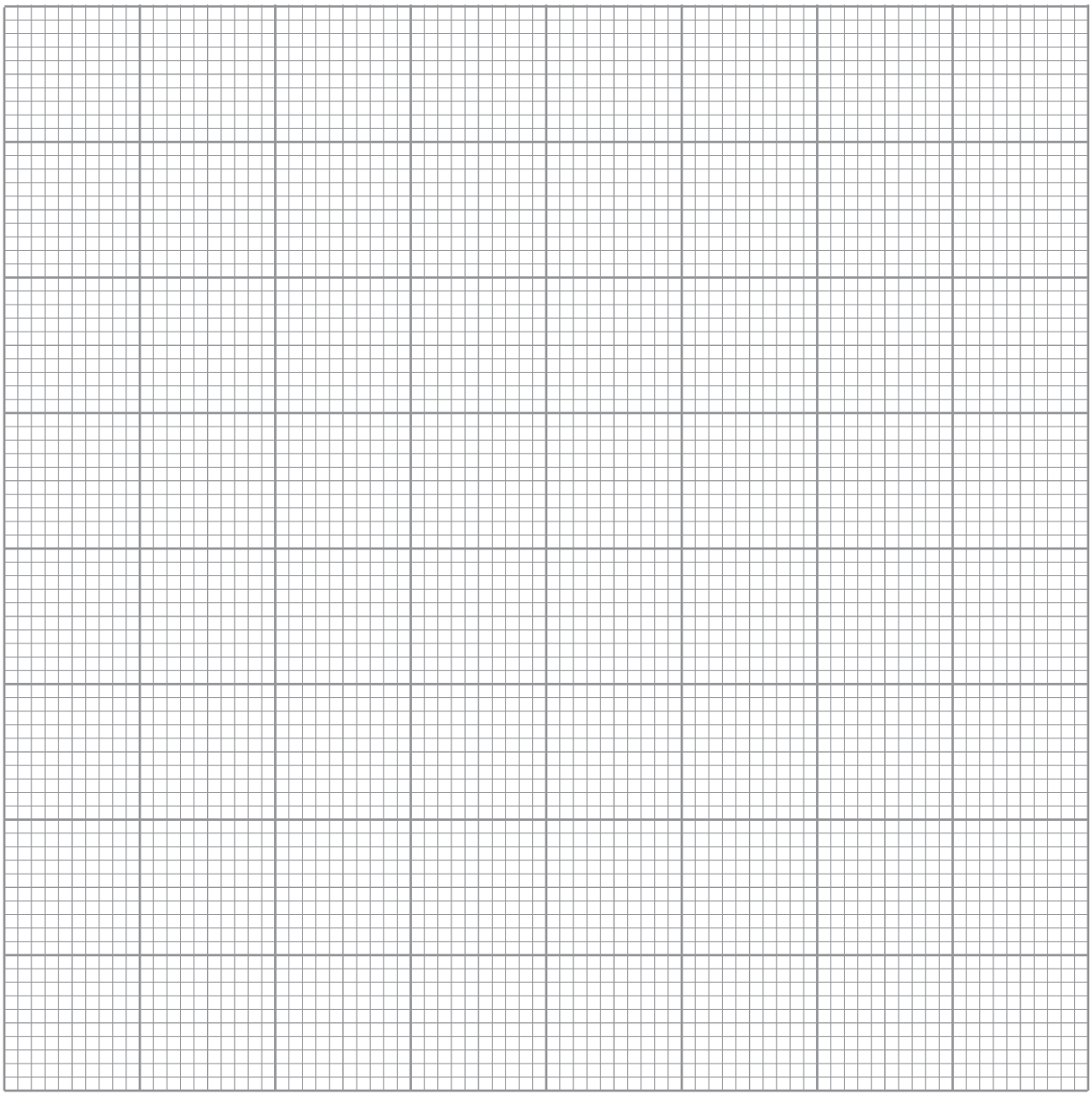
She decides that a graph would be a helpful way of finding the heights of the bridges.

(a) Use the graph paper opposite to draw a graph for Glynis to be able to read off the heights of various bridges. [5]

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(b) **Use your graph** to complete the table. [2]

Time taken for stone to drop, in seconds	Height of bridge, in metres	Height of bridge, in kilometres written in standard form
2·5	.....	.....
5·2	.....	.....

.....

.....

.....

.....

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(c) Glynis thinks there is a risk that there are some errors in her data.
State a possible error. [1]

.....

.....

.....

.....

.....

(d) In 2009 the Sidu River Bridge in China became the world's highest river bridge.
Its height is 496 metres.



Calculate, using the formula $H = \frac{1}{2}gt^2$, how long it would take a stone dropped from the bridge to hit the surface of the Sidu River below.
You must show all your working. [3]

.....

.....

.....

.....

.....

.....

11

END OF PAPER

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GCSE MARKING SCHEME

APPLICATIONS OF MATHEMATICS (LINKED PAIR PILOT)

JANUARY 2015

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INTRODUCTION

The marking schemes which follow were those used by WJEC for the January 2015 examination in GCSE APPLICATIONS OF MATHEMATICS (LINKED PAIR PILOT). They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

	Page
Unit 1 Foundation Tier	1
Unit 1 Higher Tier	4
Unit 2 Foundation Tier	8
Unit 2 Higher Tier	11

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APPLICATIONS UNIT 1
FOUNDATION TIER

<table>
<tr><th>Applications Unit 1 Foundation Tier
January 2015</th><th>Mark</th><th>Comment</th></tr>
<tr><td>1.(a) 6000
(b) 1600
(c) 4/9 × 4500
2000
(d) (i) Correct reason given why statement is incorrect.

(ii) 3200/5738</td><td>B1
B1
M1
A1
E1

B1

6</td><td>

A correct statement that indicates more home supporters. Eg. “Because more tickets were sold to home supporters than away supporters.” “Only 2538 tickets were sold to away supporters.” “Not the same amount of tickets sold to home supporters and away supporters.” “3200 home and 2538 away.” “More home than away.”

</td></tr>
<tr><td>2. (a) (Spends) (£)26 + 2 × (£)15.99
(£)57.98
(Extra needed) (£)57.98 – (£)20 - (£)25
(£)12.98

Look for
• spelling
• clarity of labels
• the use of notation (watch for the use ‘=’ “£” being appropriate)

QWC2: Candidates will be expected to
• present work clearly, with words explaining process or steps
AND
• make few if any mistakes in mathematical form, spelling, punctuation and grammar in their answer

QWC1: Candidates will be expected to
• present work clearly, with words explaining process or steps
OR
• make few if any mistakes in mathematical form, spelling, punctuation and grammar in their final answer

(b) (i) Right angle
(ii) 360 – (90 + 90 + 107) or 180 – 107 or equivalent

73(˚)</td><td>M1
A1
M1
A1

Q
W
C
2

B1
M1

A1
9</td><td>

FT ‘their 57.98’

Alternative method
Uses one voucher to pay for the jeans so pays either £1 or £6 B1
Method for using other voucher for paying for the 2 tops
2 × (£)15.99 - 20 (or 25) OR 20 (or 25) - 2 × (£)15.99 M1
(pays) (£)11.98 or (£)6.98 A1
(spends) (£)12.98 B1

QWC2 Presents relevant material in a coherent and logical manner, using acceptable mathematical form, and with few if any errors in spelling, punctuation and grammar.

QWC1 Presents relevant material in a coherent and logical manner but with some errors in use of mathematical form, spelling, punctuation or grammar
OR
evident weaknesses in organisation of material but using acceptable mathematical form, with few if any errors in spelling, punctuation and grammar.

QWC0 Evident weaknesses in organisation of material, and errors in use of mathematical form, spelling, punctuation or grammar.

Do not accept 90 ˚
For the intention of subtracting 3 given angles from 360 or for subtracting 107 from 180</td></tr>
<tr><td>3.

(a) Two numbers less than or equal to 4 AND two numbers greater than 4.
(b) Four numbers less than 3</td><td>

B1

B1

2</td><td>For both parts accept use of appropriate decimal or fractional values.
Eg 1, 2, 5, 6 OR 3, 4, 5, 6 OR 4, 4, 7, 7 etc

Eg 0, 0, 0, 0 OR 2, 1, 0, -1 etc</td></tr>
<tr><td>4.
<table><tr><th>Given Information</th><th>Quadrilateral</th></tr><tr><td>This quadrilateral has all 4 sides equal in length</td><td>Square</td></tr><tr><td>This quadrilateral has opposite sides equal in length</td><td>Parallelogram</td></tr><tr><td>This quadrilateral only has one pair of parallel sides</td><td>Trapezium</td></tr><tr><td>This quadrilateral does not have any parallel sides</td><td>Kite</td></tr></table></td><td>

B3

3</td><td>

Award B2 for 2 or 3 correct.
Award B1 for 1 correct.</td></tr>
</table>

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Applications Unit 1 Foundation Tier January 2015	Mark	Comment
5. (a)(i) Evidence of counting squares on at least 2 shapes Shapes B AND D (ii) Evidence of calculating perimeter of at least 2 shapes or the correct perimeter of one shape evaluated Shape A (b) Evidence of counting squares Answer in range 22 - 26 cm^2 (c) Correct triangle drawn with line of 9cm (±2mm) and 2 angles of 55°(±2°). 10	M1 A1 M1 A1 M1 A1 U1 B3	*(Area A=14, B=16, C=5, D=16)* Evidence may be seen on diagram *(Perimeter A=22, B=20, C=12, D=12)* Award SC1 for answer of A with no workings Award M1 for 6 × 4 Award A1 for 24 Independent mark Award B3 for a **complete** correct triangle Award B2 for 2 of the 3 measurements correct in a completed triangle OR all 3 correct but a **triangle** not completed Award B1 for 1 of the 3 measurements correct.
6. (a) Adding numbers (= 410) 410 ÷ 10 Mean = 41 (b) Put in order 34, 37, 38, 39, 41, 42, 42, 44, 45, 48 Median = 41.5 (c) Mode = 42 (d) Explanation given eg 'Yes because the mean is 41' or 'because all of the averages - mean, median and mode are about 41 or 42' 7	M1 m1 A1 M1 A1 B1 E1	Attempt to add numbers. Award M1 for sight of a value between 362 and 458 or sight of an answer from 35 – 48 as evidence of attempting to add FT 'their 410'÷ 10 CAO Sight of 41 and 42 only would gain M1 FT "their values". The explanation given must mention or imply the comparison of their averages or mean or median or mode.
6. (e) 40 ÷ 2.5 or equivalent 16 (inches) (f) 360 (grams) 3	M1 A1 B1	
6. (g)(i) Correctly labelled axes Uniform scales used All points plotted correctly Points joined with straight lines (ii) Explanation of graph given (iii) 18 – 3 15(°) 7	B1 B1 P1 L1 E1 M1 A1	 FT "their points". Accept solid or dotted lines. The explanation must imply that the temperature increase AND then decreases. Eg. "The temperature increases through the day and decreases through the evening." "It gets hotter during the middle of the day until the evening then goes down." Award E0 for explanations such as "The temperature at daytime rises."
7.(a)(i) Plotting at least two correct points Correct straight line through points (ii) Full explanation given using the graph Approximately 6300 (DKK) (b) 90 90 ÷ 18 5 days Total of 6 days 8	P1 L1 E1 B1 B1 M1 A1 B1	Accept (0,0) as one of the points plotted. CAO. If no clear evidence of points plotted but line is correct award P1 L1 Eg"he could find what £350 is and then double it". FT their graph Accept answers in the range 6200 – 6400 (DKK) May be seen or implied FT 'their 115 – 25' **Unsupported answer of 5 gets no marks.**
8.(a) Considering multiples of 12 and 14, e.g. sight of 12, 24, 36, .. AND 14, 28, 42, .., OR Looking at factors of 12 and 14, e.g. sight of 2×6 AND 2×7 Correct list of multiples of 12 to at least 72, or multiple 72 AND Correct list of multiples of 14 to at least 70, or multiple 70 , OR Sight of 2×6×7 Sight of 84 (as common multiple or number of minutes) Time 11:24 (b) 12/50 or equivalent (ISW) 6	S1 M1 A1 A1 B2	At least 3 correct multiples for both 12, 24, 36, 48, 60, 72, 84 14, 28, 42, 56, 70, 84 OR 1 hour 24 minutes FT time from 10:00 for their number of minutes provided S1 and M1 awarded *If no marks SC2 for an answer of 12(:)48, OR SC1 for sight of 2hours 48minutes* *No marks for sight of 168(minutes) alone.* B1 for sight of 12, or 'their attempt to sum number of trains'/50

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Applications Unit 1 Foundation Tier January 2015	Mark	Comment
9. (a) Appropriate arc(s) (dashes) shown on both lines, AND intersection arcs shown, using first set of arcs	M1	± 2 mm M0 if no arcs seen ± 2mm
Angle bisector drawn	A1	*SC1 if steps of process seen but slightly outside tolerance, OR SC1 if no arcs seen on the sides of the triangle but a correct set of arcs for the bisector shown*
(b)(i) 3×3.75 + 3 × (4 × 16.25 + 2 × 18.5(0))	M2	M1 for sight of the terms 3×3.75 and 4 × 16.25 + 2 × 18.5(0) (11.25) (65+37 = 102) OR M1 for sight of the terms 3 × 4 × 16.25 and 3× 2 × 18.5(0)) (195) (111) OR M1 for 3.75 + 4 × 16.25 + 2 × 18.5(0) (= 105.75)
(Sian's pay is 11.25 + 195 + 111 = £) 317.25	A1	FT from M1
(ii) 4 × 3.75 (= 15)	B1	May be seen in stages of working
(4 ×) 2y × 18.5(0) + (4 ×) y × 16.25	B2	Must be as an expression or formula of at least 2 terms which may have been simplified, OR B1 for either term correct in an expression of at least 2 terms
P = 15 + 213*y*	B1	CAO. Must be a formula ISW *If no marks allow SC1 for P = 12y (+15)*
	9	
9. (c) $\pi \times 6^2$ Between 113.04 to 113.1(43m^2) inclusive, or 113(m^2)	M1 A1	Ignore incorrect rounding or truncation if a correct response is seen. Accept 36π (m^2) as the final answer
	2	
10. (a) 1 share seen or implied 2380 ÷10 or 238	B1	
(Connelly Boats pay) 2380 ×2 ÷10 **OR** (Water Watch pay) 2380 ×5 ÷10	M1	B1 implied if both appropriate calculations seen
(Connelly Boats pay £) 476	A1	If these answers are unlabelled they must be in the correct order
(Water Watch pay £) 1190	A1	
(The 7 friends altogether have to pay £) 714	B1	FT 2380 minus the sum of their Connelly Boats and Water Watch payments, i.e. 2380 – 'their 476' – 'their 1190' correctly evaluated
(Each of the seven friends has to pay 714 ÷ 7) (= £) 102	B1	CAO depends on the award of all previous marks
(b) Sight of 7× 4.40 (= £ 30.80) OR clear description e.g. "They have rounded the length to 7m and charged them for that"	B1	*Allow 30.80 ÷ 7 = 4.4(0) or 30.80 ÷ 4.4(0) = 7* *Do not allow they were charged 4.4(0) per metre*
Suggestion how the charges could be displayed more clearly, e.g. 'sign should include '*to the nearest metre*' or 'boats between 6.5 and 7.5 charged …	E1	*Need to show appreciation of the rounding for E1 e.g. "Give the total costs on the display so £30.80 for a 7m boat" is insufficient* *Accept 6-5 – 7.5(m) charged £4.40 per (whole) m or equivalent.* *Accept only suggestions that keep the cost for 7.1m as £30.80 e.g. 'boats between 6 and 8 m long are charged £4.40 per m'* *Do not allow suggestions that lead to changes in the costs displayed for example: 'boats 7 to 8 (m) are charged…' is E0* *Ignore suggestions that do not relate to the costs for 7.1m*
	8	

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APPLICATIONS UNIT 1
HIGHER TIER

Applications Unit 1 Higher Tier January 2015	Mark	Comment
1(a) Considering multiples of 12 and 14, e.g. sight of 12, 24, 36, .. AND 14, 28, 42, .., OR Looking at factors of 12 and 14, e.g. sight of 2×6 AND 2×7	S1	At least 3 correct multiples for both
Correct list of multiples of 12 to at least 72, or multiple 72 AND Correct list of multiples of 14 to at least 70, or multiple 70 , OR Sight of 2×6×7	M1	12, 24, 36, 48, 60, 72, 84 14, 28, 42, 56, 70, 84
Sight of 84 (as common multiple or number of minutes) Time 11:24	A1 A1	OR 1 hour 24 minutes FT time from 10:00 for their number of minutes provided S1 and M1 awarded *If no marks SC2 for an answer of 12(:)48, OR SC1 for sight of 2hours 48minutes* *No marks for sight of 168(minutes) alone.*
(b) 12/50 or equivalent (ISW)	B2 6	B1 for sight of 12, or 'their attempt to sum number of trains'/50
2(a) Appropriate arc(s) (dashes) shown on both lines, AND intersection arcs shown, using first set of arcs	M1	± 2 mm M0 if no arcs seen ± 2mm
Angle bisector drawn	A1	*SC1 if steps of process seen but slightly outside tolerance, OR SC1 if no arcs seen on the sides of the triangle but a correct set of arcs for the bisector shown*
(b)(i) 3×3.75 + 3 × (4 × 16.25 + 2 × 18.5(0))	M2	M1 for sight of the terms 3×3.75 and 4 × 16.25 + 2 × 18.5(0) (11.25) (65+37 = 102) OR M1 for sight of the terms 3 × 4 × 16.25 and 3× 2 × 18.5(0)) (195) (111) OR M1 for 3.75 + 4 × 16.25 + 2 × 18.5(0) (= 105.75)
(Sian's pay is 11.25 + 195 + 111 = £) 317.25	A1	FT from M1
(ii) 4 × 3.75 (= 15) (4 ×) 2y × 18.5(0) + (4 ×) y × 16.25 P = 15 + 213*y*	B1 B2 B1 9	May be seen in stages of working Must be as an expression or formula of at least 2 terms which may have been simplified, OR B1 for either term correct in an expression of at least 2 terms CAO. Must be a formula ISW *If no marks allow SC1 for P = 12y (+15)*
2(c) $\pi \times 6^2$ Between 113.04 to 113.1(43m^2) inclusive, or 113(m^2)	M1 A1	Ignore incorrect rounding or truncation if a correct response is seen. Accept 36π (m^2) as the final answer
(d) (1 revolution measures) 2 × π × 0.24 × 32 or × 14 (West field) 48.2 to 48.3(2m), or 48(m) AND (Storage building) 21.(1…m)	M1 m1 A1 5	May be embedded in working (C = 1.507…m)

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Applications Unit 1 Higher Tier January 2015	Mark	Comment
3(a) 1 share seen or implied 2380 ÷10 or 238 (Connelly Boats pay) 2380 ×2 ÷10 **OR** (Water Watch pay) 2380 ×5 ÷10 (Connelly Boats pay £) 476 (Water Watch pay £) 1190 (The 7 friends altogether have to pay £) 714 (Each of the seven friends has to pay 714 ÷ 7) (= £) 102	B1 M1 A1 A1 B1 B1	B1 implied if both appropriate calculations seen If these answers are unlabelled they must be in the correct order FT 2380 minus the sum of their Connelly Boats and Water Watch payments, i.e. 2380 – 'their 476' – 'their 1190' correctly evaluated CAO depends on the award of all previous marks
QWC2: Candidates will be expected to • present work clearly, with words explaining process or steps. **AND** • make few if any mistakes in mathematical form, spelling, punctuation and grammar and include units in their final answer QWC1: Candidates will be expected to • present work clearly, with words explaining process or steps. **OR** • make few if any mistakes in mathematical form, spelling, punctuation and grammar and include units in their final answer	QWC 2	QWC2 Presents relevant material in a coherent and logical manner, using acceptable mathematical form, and with few if any errors in spelling, punctuation and grammar. QWC1 Presents relevant material in a coherent and logical manner but with some errors in use of mathematical form, spelling, punctuation or grammar OR evident weaknesses in organisation of material but using acceptable mathematical form, with few if any errors in spelling, punctuation and grammar. QWC0 Evident weaknesses in organisation of material, and errors in use of mathematical form, spelling, punctuation or grammar.
(b) Sight of 7× 4.40 (= £ 30.80) OR clear description e.g. "They have rounded the length to 7m and charged them for that" Suggestion how the charges could be displayed more clearly, e.g. 'sign should include '*to the nearest metre*' or 'boats between 6.5 and 7.5 charged …	B1 E1 10	*Allow 30.80 ÷ 7 = 4.4(0) or 30.80 ÷ 4.4(0) = 7* *Do not allow they were charged 4.4(0) per metre* *Need to show appreciation of the rounding for E1 e.g. "Give the total costs on the display so £30.80 for a 7m boat" is insufficient* *Accept 6-5 – 7.5(m) charged £4.40 per (whole) m or equivalent.* *Accept only suggestions that keep the cost for 7.1m as £30.80 e.g. 'boats between 6 and 8 m long are charged £4.40 per m'* *Do not allow suggestions that lead to changes in the costs displayed for example: 'boats 7 to 8 (m) are charged…' is E0* *Ignore suggestions that do not relate to the costs for 7.1m*
3(c) (i) 110° drawn from harbour 320° drawn from the position of buoy 1 055° drawn from the position of buoy 2 Line 10cm OR 6cm OR 2.5cm for the appropriate stage Accurate chart with lengths and angles correct (ii) 290° (iii) Distance (±2mm) from the position of buoy 3 to the harbour Bearing (±2°) from the position of buoy 3 to the harbour (d) Lines following the shape of coast line at 5km An arc of radius 20km from Funchal Perpendicular bisector (Ribeira Brava and Santa Cruz) Appropriate region indicated	 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 12	Accept 'their North' provided ±2° from the North given. Penalise 'their North' outside of this tolerance once only ±2° ±2° ±2° ±2mm Within tolerances allowed ±2°. FT from their diagram ±2° FT from their diagram (Actual is approximately 8 × 60 = 480 m) FT from their diagram (Actual is approximately 250°) 1cm ± 2 mm 4cm ± 2mm ±2° FT for region provided at least B2 previously awarded with an attempt at all three conditions
3(e)(i) 33 × 12 + 4 (=400 inches) ÷ 0.3937 (or × 2.54) 1016(.002….cm) or 1020(cm) (ii) 10160 | $1(.016\ldots) \times 10^4$	M1 m1 A1 B1 B1 5	*Allow M1 if 33 × 12 and an additional 4 seen in the working* Do not accept ×2.5 Left entry, 10160(.02) or 10200 or FT 10× 'their (e)(i)' Right entry, $1(.016\ldots) \times 10^4$. FT from use of 'their 10160'

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Applications Unit 1 Higher Tier January 2015	Mark	Comment
4(a)(i) Implies or states 'no' with a valid reason, e.g. 'No as 810 minutes is less than 15 hours'	B1	(For information 810mins = 13.5 hrs, 900mins = 15hrs) Any calculations shown must be correct
(ii) Mid-points 45, 135, 225, 360, 630 45×10 + 135×38 + 225×20 + 360×8 + 630×4 (450 + 5130 + 4500 + 2880 + 2520 = 15480) ÷80 193.5	B1 M1 m1 A1	FT their mid-points including bounds. Allow 1 slip in their mid-points outside boundaries if otherwise correct method FT their $\Sigma fx/80$ Accept 193 or 194 if correct working is seen
(iii) 10 | 48 | 68 | 76 | 80	B1	
(iv) Correct cumulative frequency diagram, points plotted at upper bounds and joined by a curve or straight line	B2	FT from cumulative (iii). Must show initial plot at the origin. B1 for points correct but not joined, OR B1 correct apart from 0.5 translation, OR B1 if one error in plotting but joined correctly
(v) Median 160 Intention to subtract readings from horizontal axis for vertical 60 & 20 Interquartile range from diagram	B1 M1 A1 11	FT from their cumulative diagram. Not cumulative no FT FT from their cumulative diagram.
4(b)(i) Range ends 50 and 800 correctly indicated with 'whiskers' Within a box: Median line correctly indicated LQ correctly indicated UQ correctly indicated	B1 B1 B1 B1	There must be a box drawn for these three marks, not vertical lines only.
(ii) Suitable comparison statement for medians Suitable comparison statement for IQR Conclusion, e.g. 'Don't agree because….'	M1 M1 A1	FT their (a)(v) median IQR Thursday is 360, and FT their (a)(v) IQR Depends on first M1 Accept 'Don't agree' OR 'No' 'because on average Thursday is higher' Ignore extra comment based on the IQR providing it does not contradict their conclusion based on the median. If no marks awarded SC1 for 'Cannot decide as we do not know if these are a typical Thursday and a typical Wednesday'.
(c)(i) Reason that implies 'like with like' comparison, i.e. always includes the full set of days or because a 7 point moving average will provide an average for the week	E1	Do not accept 'because there are 7 days in a week' or 'using the whole week's data' without further explanation *Accept statements such as "the results then show the viewing figures for a week"*
(ii) 4.27, 4.30, 4.34, 4.40, 4.33 (million)	B4 12	'0' representing hundredths must be shown as appropriate B3 for 4.27…. , 4.3, 4.34…, 4.4, 4.32857… (million) rounded or truncated, B2 for any three correct moving averages, rounded or truncated, B1 for a correct method seen, or 1 correct moving average (29.9/7, 30.1/7, 30.4/7, 30.8/7, 30.3/7)
4(d)(i) Correct histogram	B3	Accept missing labels for B2 or B1 B2 for sight of 0.06, 0.36, 0.24, 0.02 and 0.02 or histogram with at least 3 bars correct, OR B1 for histogram with any 1 bar correct, or for a suitable frequency density scale, uniform to a least 0.36
(ii) Median (76 + 1)/2 or 76/2 Attempt to identify 1/9 or 8/9 of the second bar Correct identification of the median	B1 B1 B1	FT from their histogram if possible Could also be 32.5/36 or 3.5/36 *Allow, in the answer space or indicated on the histogram the calculated value of 188.888…OR 190.2777 (people) truncated or rounded.*
(e)(i) 200×0.1 + 100×0.4 + 100×0.6 + 400 × 0.15 180 (people)	M2 A1	M1 for any 3 correct area calculations (20+40+60+60) FT for a summation of their 4 values provided M1 awarded
(ii) 200×0.1 + ½× 100×0.4 40 (people)	M1 A1 11	FT their values from (i)

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Applications Unit 1 Higher Tier January 2015	Mark	Comment
5(a) Strategy, e.g. to draw a tangent at 7.5 seconds	S1	
Use of difference v / difference t	M1	Must be differences, not readings from axes. Ignore signs
= 0.4 to 0.6	A1	Reasonable from their graph. *Allow a fraction for example 4/7*
m/s^2 or m per s^2	U1	Does not depend on previous marks Maybe shown on their graph
(b) Identifying the required area	S1	
Splitting area into areas that can be approximated	M1	Must include at least 1 calculation for an appropriate area, or correct statement of the trapezium rule
Complete calculation for the area required	M1	OR correct substitution into the trapezium rule, allow 1 slip
Accurately calculated area	A1 8	(Possible answers around 195 to 215 metres)

t	0	1	2	3	4	5	6	**6.4**	7	8	9	10
H	0	4.9	19.6	44.1	78.4	122.5	176.4	**200**	240.1	313.6	396.9	490

t	0	10	20	30	40	50	60
H	0	490	1960	4410	7840	12250	17640

6(a) Suitable uniform scales on labelled axes	B2	Scale for H does not extend beyond 400(m) B1 on labelled scale for H extends beyond 400(m) Award B1 for correct scales and one label missing.
At least 6 correct values calculated (or plotted) which could produce an appropriate curve.	B2	For example including values of H for t = 3, 4, 5, 6, (7) OR values of t for H = 175 and 200 B1 for 2, 3, 4 or 5 correct values calculated
At least 6 correct values plotted AND joined with a curve that includes H = 200	C1	No incorrect values plotted
(b) Check reading for their graph:		MUST FT their graph, **not** for calculation (Calculated values are 30.625 and 132.496) FT only from derived points or values.
from graph ≈28 to 33 — e.g 3×10^{-2} , 3.1×10^{-2}	B1	For both readings correct for their graph
from graph ≈ 130 to 135 — e.g 1.32×10^{-1}, 1.33×10^{-1}	B1	FT expressed in km in standard form *If no marks, SC1 for one correct reading from their graph, as km and correctly given in standard form*
(c) Suggests error due to river level changing or other suitable reason, or that the time taken was not accurately measured, or not drop from consistent level on the bridge, or rivers were not all horizontal, or different river levels, or windy, or air resistance neglected , or…	E1	Allow comparison that implies the stones are different
(d) $496 = ½ \times 9.8 \times t^2$	M1	
$t^2 = 101.2244898…$	A1	*Accept (t between) 10 and 10.1 from use of trial and improvement*
t = 10(.06…seconds)	A1 11	CAO

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Surname	Centre Number	Candidate Number
Other Names		0

GCSE LINKED PAIR PILOT

4361/02

APPLICATIONS OF MATHEMATICS

UNIT 1: Applications 1
HIGHER TIER

A.M. FRIDAY, 13 June 2014

2 hours

ADDITIONAL MATERIALS

A calculator will be required for this paper.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** the questions in the spaces provided.

Take π as 3·14 or use the π button on your calculator.

INFORMATION FOR CANDIDATES

You should give details of your method of solution when appropriate.

Unless stated, diagrams are not drawn to scale.

Scale drawing solutions will not be acceptable where you are asked to calculate.

The number of marks is given in brackets at the end of each question or part-question.

You are reminded that assessment will take into account the quality of written communication (including mathematical communication) used in your answer to question **4***(a)*.

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**4**	
2.	**7**	
3.	**4**	
4.	**9**	
5.	**8**	
6.	**7**	
7.	**7**	
8.	**5**	
9.	**5**	
10.	**10**	
11.	**7**	
12.	**3**	
13.	**9**	
14.	**10**	
15.	**5**	
Total	**100**	

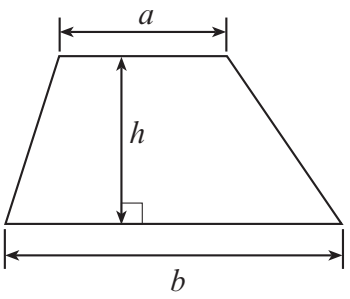
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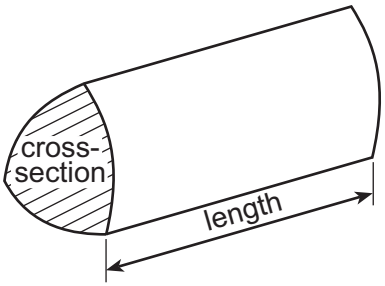
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Formula List

Area of trapezium = $\frac{1}{2}(a + b)h$

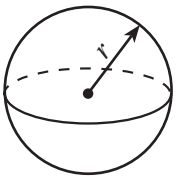


Volume of prism = area of cross-section × length



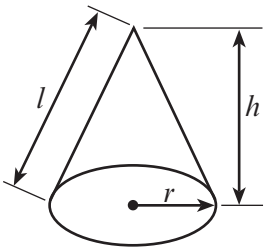
Volume of sphere = $\frac{4}{3}\pi r^3$

Surface area of sphere = $4\pi r^2$



Volume of cone = $\frac{1}{3}\pi r^2 h$

Curved surface area of cone = $\pi r l$

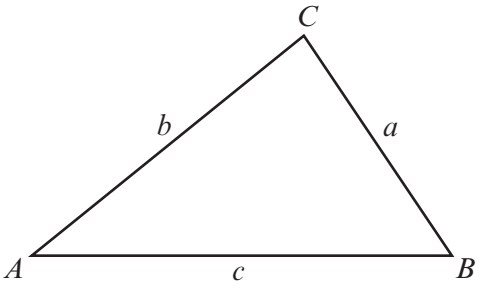


In any triangle ABC

Sine rule $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Cosine rule $a^2 = b^2 + c^2 - 2bc\cos A$

Area of triangle = $\frac{1}{2}ab\sin C$



The Quadratic Equation

The solutions of $ax^2 + bx + c = 0$

where $a \neq 0$ are given by

$$x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$$

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1. A survey is to be carried out to find the popularity of buying books with various age groups of the general population.

The survey is carried out by asking people questions as they come out of a book shop. Two questions from the survey questionnaire are shown below.

1. How old are you?
Put a tick in the box.

under 20	☐
20 to 30	☐
30 to 40	☐
older than 40	☐

2. Do you buy books?
Put a tick in the box.

Yes	☐
No	☐

(a) Explain why this may be a biased survey. [1]

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(b) State a criticism about the design of question 1 in the survey. [1]

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(c) Write a question with a selection of answer boxes, to find out how much people are prepared to pay for a paperback book. [2]

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2. A construction company is working on plans to lay a new gas pipe.
The gas pipe is to run from Abermor to Brentor to Cantefore then continues on to another town.

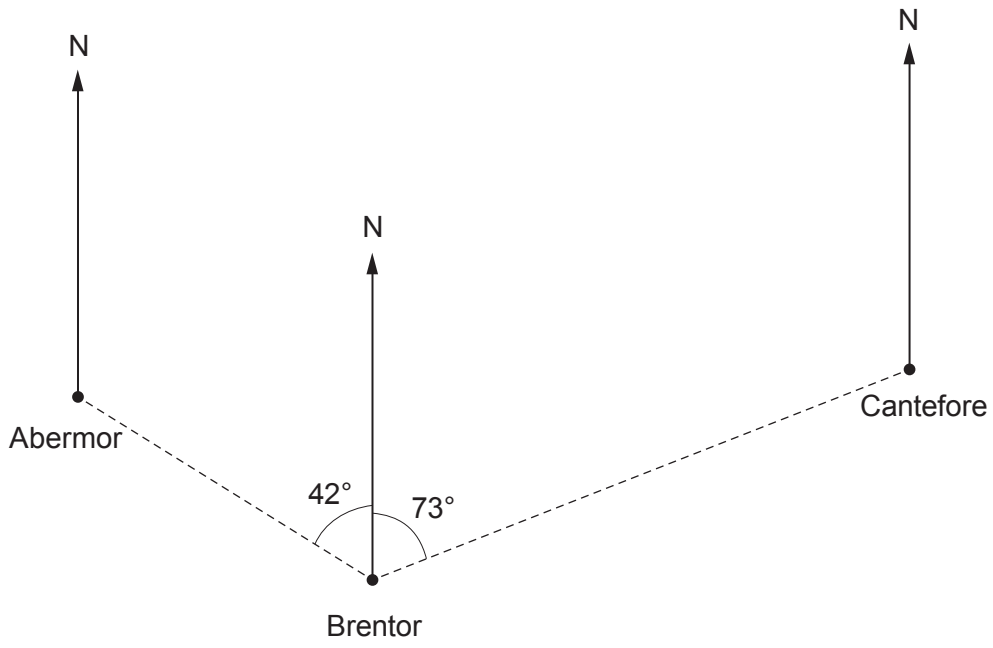


Diagram not drawn to scale

(a) The above diagram shows the section of gas pipe from Abermor to Cantefore.
Write down the bearing of

(i) Brentor from Cantefore, [2]

.....

.....

(ii) Abermor from Brentor. [2]

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(b) As the gas pipe continues towards the next town, it has to make a 30° turn so that it follows the road, as shown in the sketch.

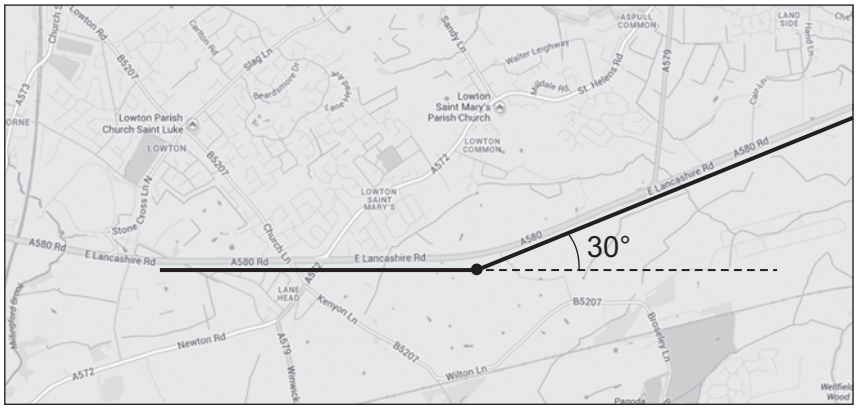


Diagram not drawn to scale

Using a pair of compasses and a ruler, construct a line that shows the direction of the gas pipe as it follows the road after the 30° turn.
You must show all of your construction lines and arcs. [3]

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3. Bikes are built around a frame.



Below is a scale drawing of a bike frame.

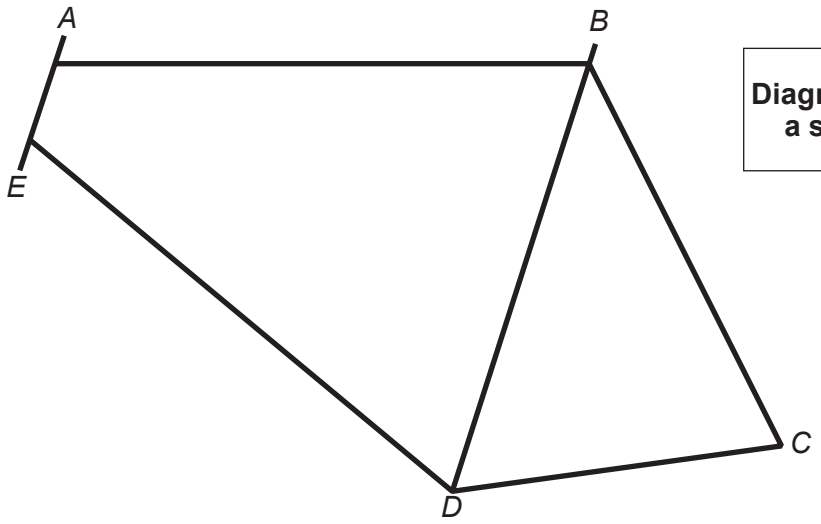


Diagram drawn to a scale of 1:8

(a) Write down an approximate length of the cross bar *AB*.
Give your answer in **metres**. [2]

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(b) Is *AE* parallel to *BD*?
Use angle facts to give a reason for your answer. [2]

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4. *(a)* *You will be assessed on the quality of your written communication in this part of the question.*

Jasmine makes necklaces.
Each necklace is made using 34 red beads, 10 yellow beads and 6 black beads.

Jasmine has 918 red beads.
She does not have any yellow or black beads.
Jasmine plans to use all her red beads to make necklaces.

How many yellow and black beads does Jasmine need to buy?
You must show all your working. [6]

(b) Jasmine also makes bracelets.
Each bracelet is made using 24 purple beads and 9 green beads.
Jasmine buys her beads in bags of 6 purple beads and bags of 6 green beads.
She wants to buy the smallest number of bags of beads and **must** use all the beads she buys.
How many bags of purple beads and green beads does Jasmine need to buy? [3]

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5. Lizzie's job is to calculate solutions for a data analysis company which involves working with algebraic equations and expressions.

Process the following for Lizzie.

(a) Factorise $35x + 15$. [1]

(b) Simplify $3a + 5b - 19a - 16b$. [1]

(c) Simplify $3(3d - 2e) - (d - e)$. [2]

(d) Lizzie knows that a solution to the equation $x^3 - 2x - 40 = 0$ lies between 3 and 4. Find this solution correct to one decimal place. [4]

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6. *(a)* A company delivers boxes of apples.

There are 20 apples in each layer of each box.

Each box has five layers of apples.



The number of rotten apples in each of the five layers of one opened box is listed below:

3 0 1 4 1

(i) Write down the best estimate of the relative frequency for randomly selecting a rotten apple in one layer of apples. [3]

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(ii) How many rotten apples might you expect to find in 8 boxes of apples? [2]

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(b) A different company delivers boxes with 24 apples in each box.

The company knows that the number of rotten apples they are likely to find in a box is a factor of 24, but is more than 1 apple.
The company makes a statement as shown below.



There are **hardly any** rotten apples in our boxes.

An apple is selected at random from one of these boxes.
Write down the **best** estimate of the probability that this apple is rotten. [2]

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Turn over.

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7. Alys bought an ice cream van at the end of December, to start selling ice cream from the 1st January.



She records her monthly sales correct to the nearest £10 during the first seven months of the year.

Month	January	February	March	April	May	June	July
Sales (£)	140	240	220	360	380	420	600

The time series graph for the sales of ice creams for each month has been plotted on the graph paper opposite.

(a) Calculate the 4-point moving averages and complete the table below. [3]

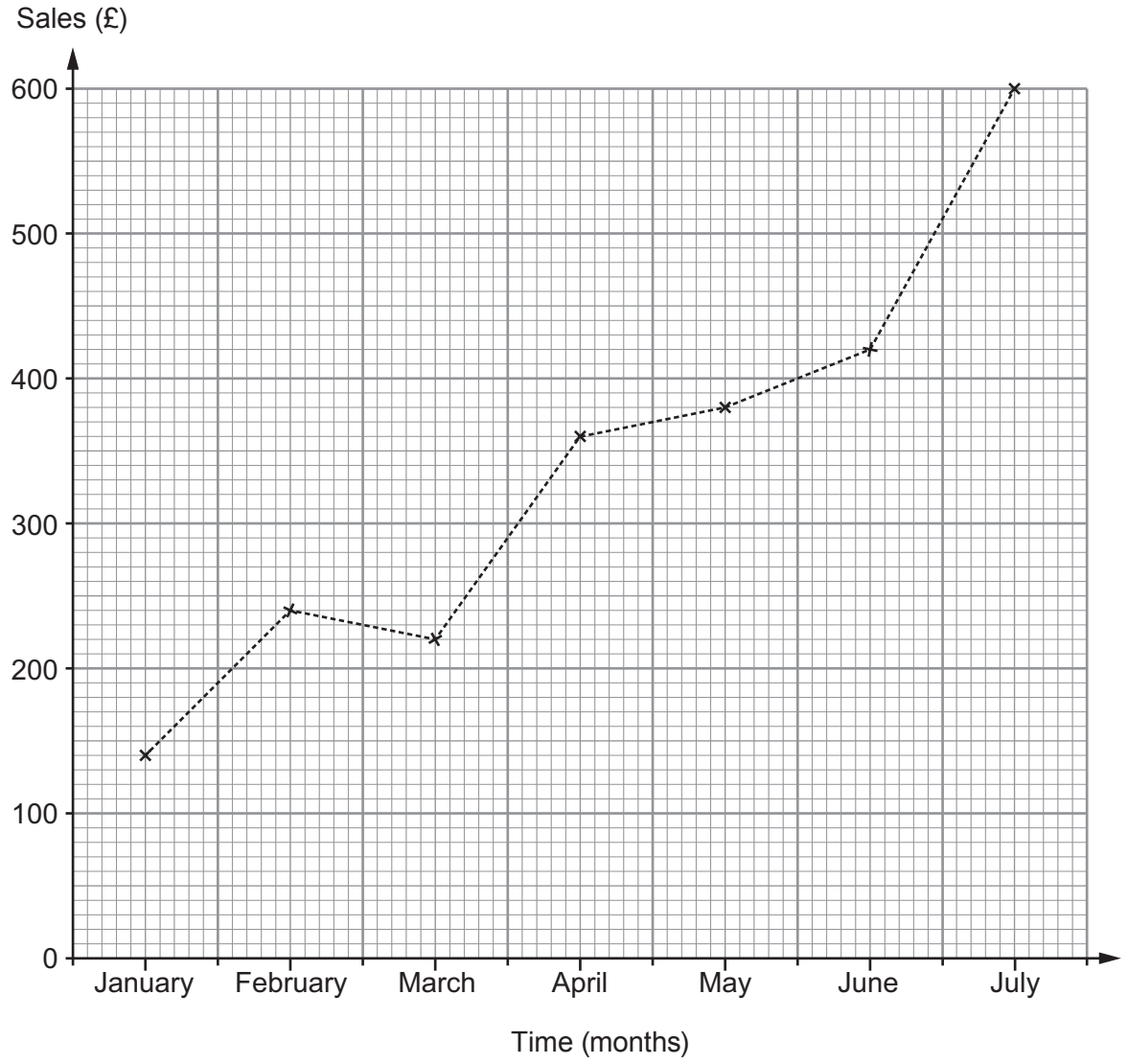
4-point period	January to April	February to May	March to June	April to July
4-point moving average (£)				

(b) On the graph opposite, plot the 4-point moving averages and draw a trend line. [2]

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(c) The scale that Alys has used for the time axis has equal spacing for each month.
She now thinks that this may not be correct.
Should Alys be worried about the equal spaces between each month on her graph?
Tick (✓) a box. You must give a reason for your answer. [1]

Yes ☐ No ☐

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(d) Alys is very pleased to see an upward trend in sales. Do you think this trend will continue?
Tick (✓) a box. You must give a reason for your answer. [1]

Yes ☐ No ☐

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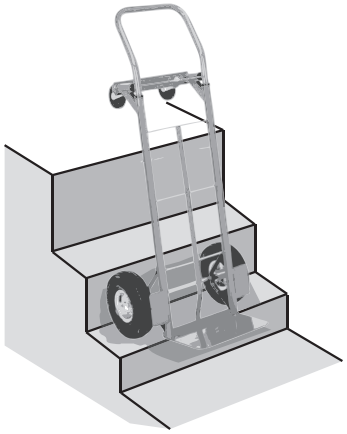
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8. A trolley is pulled up a few steps.



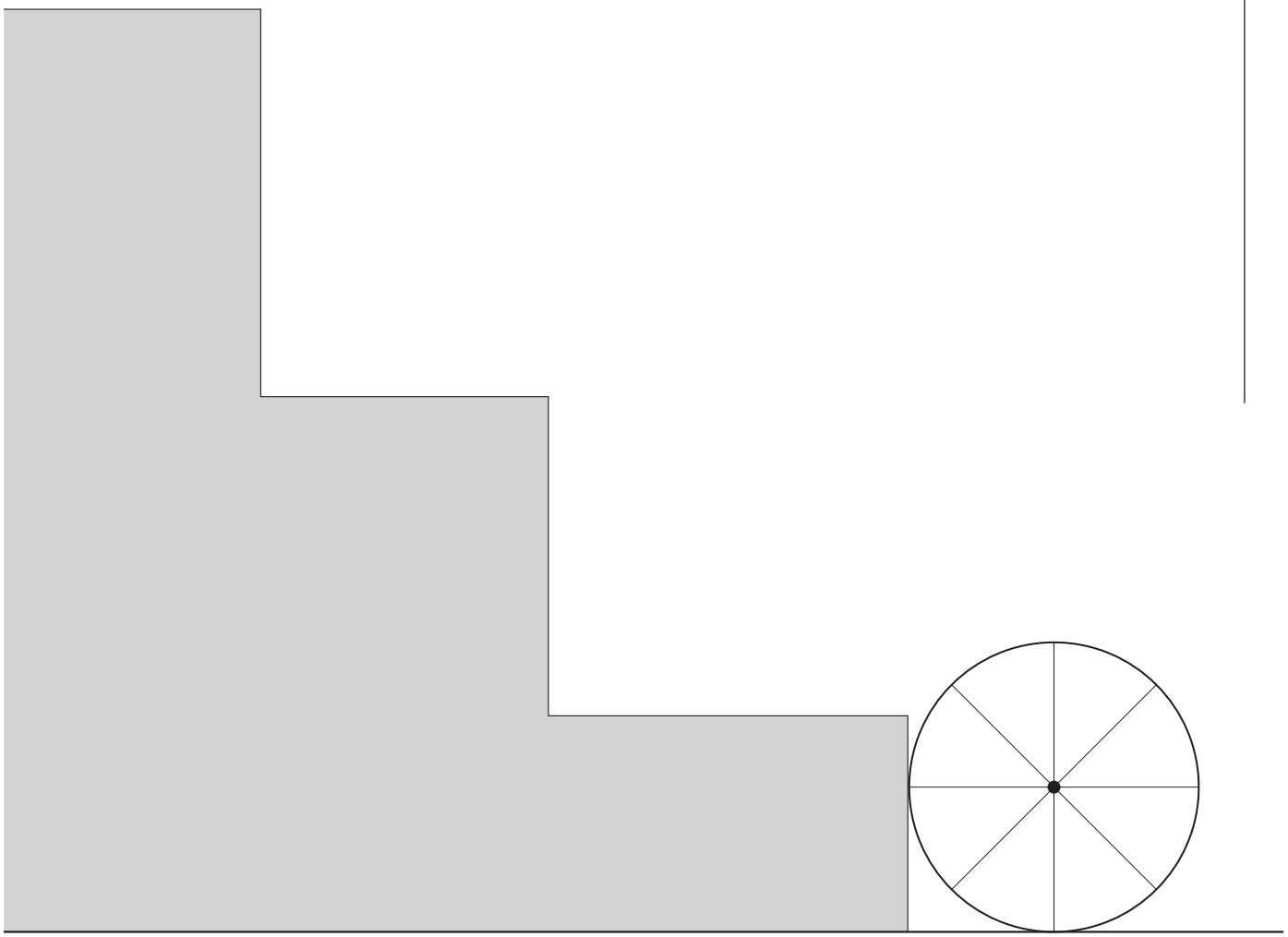
The wheels of the trolley always stay in contact with the steps on the way up.

The diagram on the opposite page shows the side view of a trolley wheel and the steps.
On the diagram, draw the locus of the **centre** of the trolley wheel as the trolley is pulled up onto the top step. [5]

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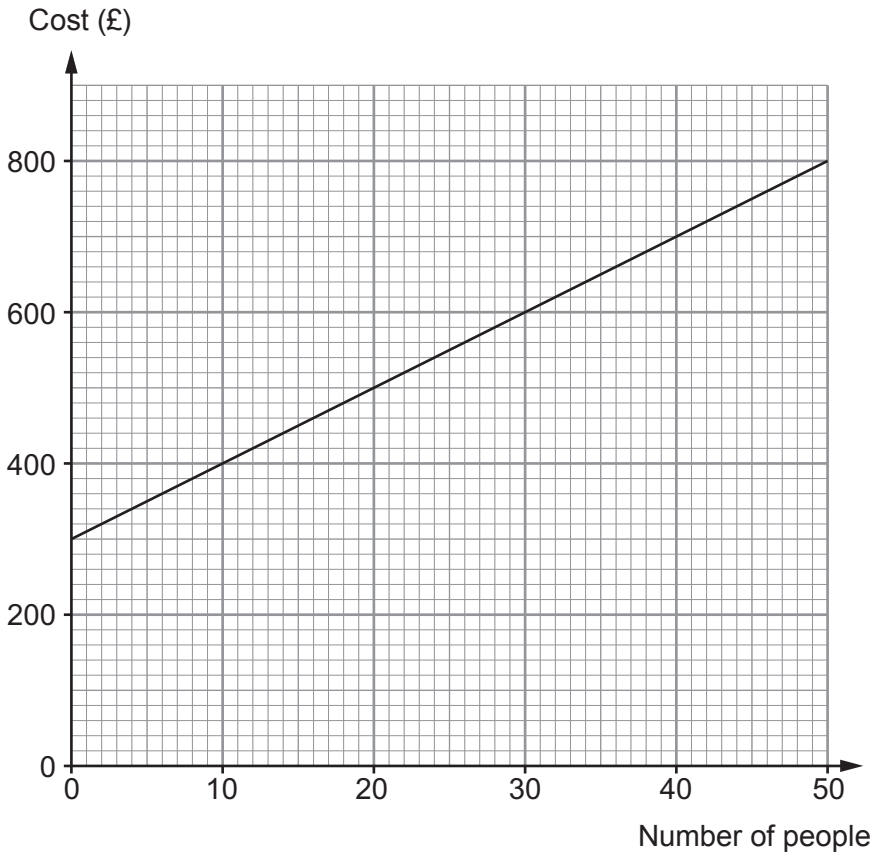


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9. Faye has organised a conference in a hotel.
The hotel has given Faye a graph to illustrate the costs for room hire with refreshments for different numbers of people.



(a) (i) Calculate the gradient of the straight line graph. [2]

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(ii) Explain what the gradient tells you about the conference costs. [1]

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(iii) The straight line graph intersects the vertical axis at £300.
Explain what this tells you about the conference costs. [1]

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(b) 20 more people arrived at the conference than Faye had expected.
The hotel prepared extra food and set out more chairs in the conference room.
Calculate how much **extra** Faye has to pay the hotel. [1]

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10.



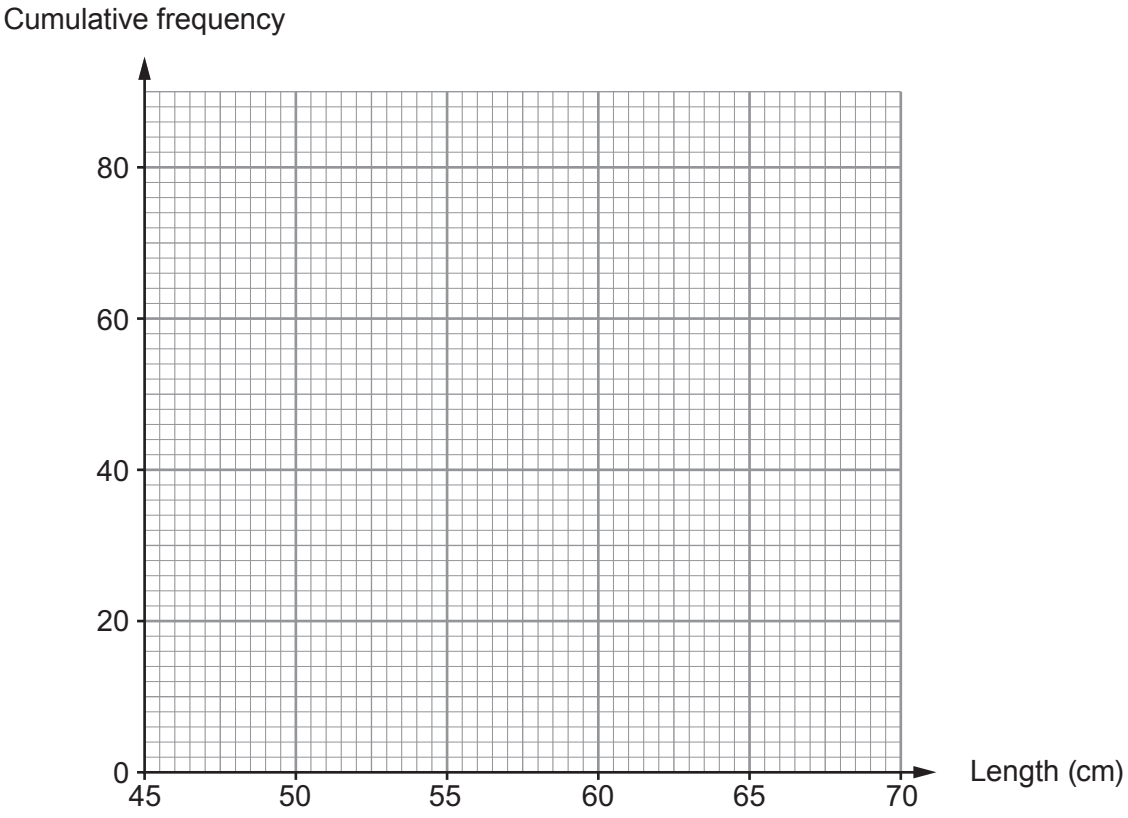
The table gives the grouped frequency distribution for the lengths of the electrical cords of 80 toasters.

Length, to the nearest cm	49-53	54-58	59-63	64-68
Number of toasters	6	38	32	4

(a) Complete the following cumulative frequency table. [1]

Length (cm)	<48·5	<53·5	<58·5	<63·5	<68·5
Cumulative frequency	0	6			

(b) On the graph paper below, draw a cumulative frequency diagram to show this information. [2]



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(c) Use your cumulative frequency diagram to find an estimate for the median, the lower quartile, the upper quartile and the interquartile range of the lengths of the electrical cords in centimetres. [4]

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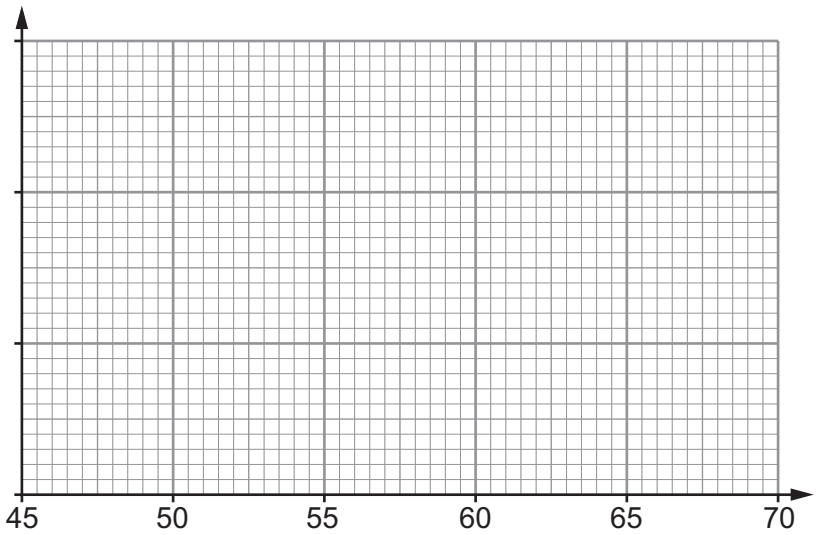
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Median	
Lower quartile	
Upper quartile	
Interquartile range	

(d) The length of the shortest electrical cord is 50 cm.
The length of the longest electrical cord is 68 cm.
Draw a box and whisker diagram to illustrate the lengths of the electrical cords. [3]



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11. Gerry has sketched the floor plan of a room.
All the corners of the room are either 90° or 270°.
Gerry has forgotten some of the measurements but she knows two of the measurements are the same, so she has labelled them x metres.

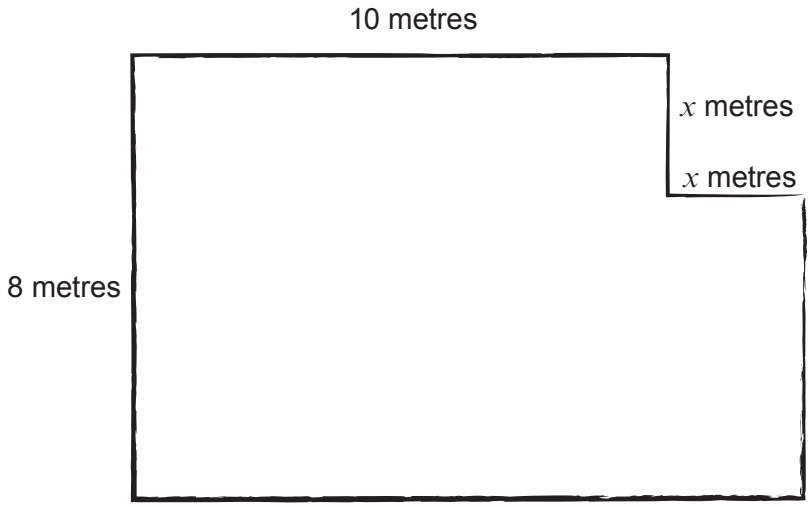


Diagram not drawn to scale

(a) Show that the area of the floor, in square metres, is $80 + 8x - x^2$. [2]

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(b) Use the graph paper opposite to draw the graph representing the area, in square metres, of the floor plan.
Use values of x from $x = 0$ to $x = 5$. [3]

The area is $80 + 8x - x^2$ square metres.

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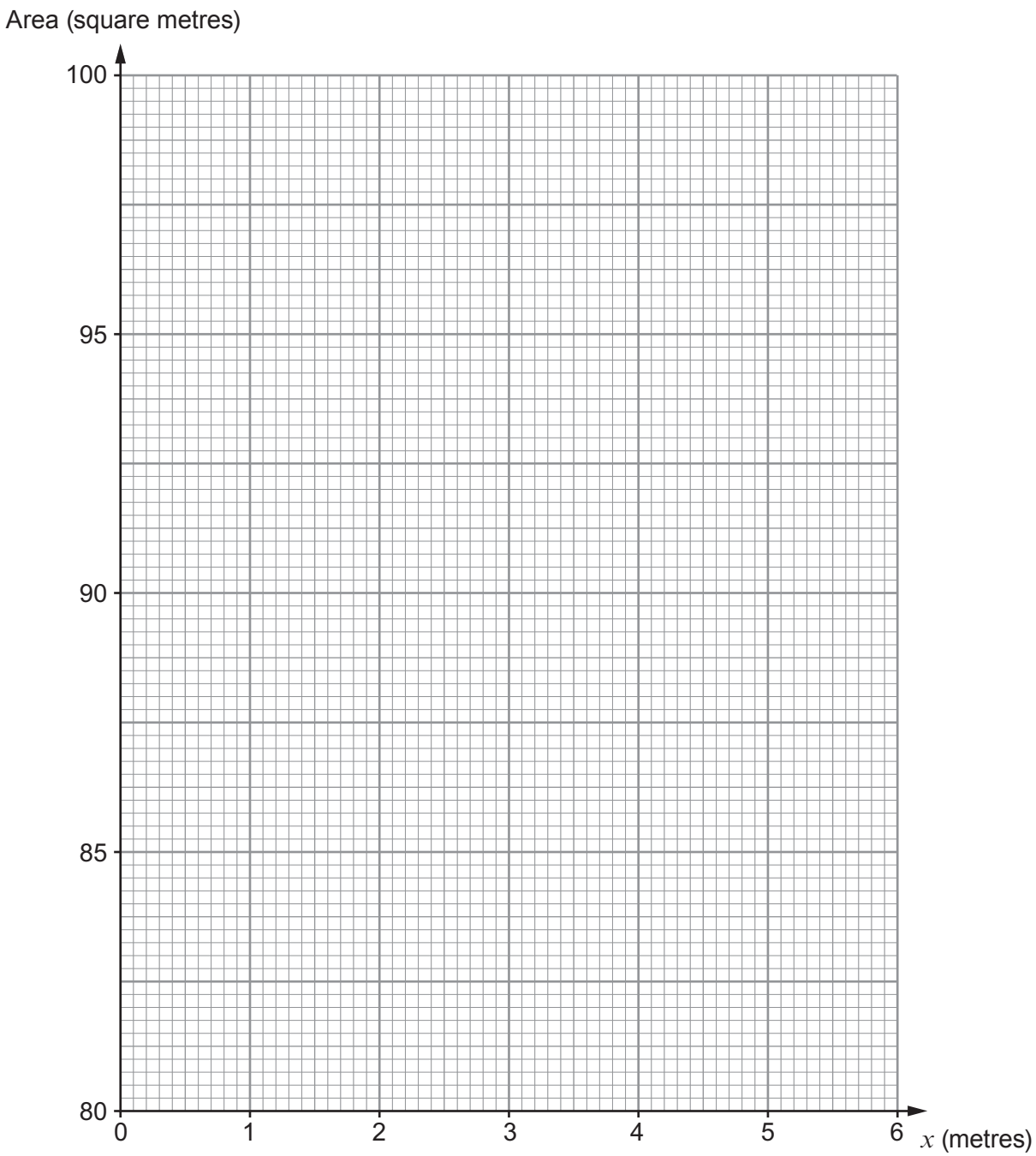
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(c) Gerry calculated the area of the floor in the room before she lost some of measurements.
The area is 83·75 square metres. Find the value of x. [2]

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Turn over.

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12. Dafydd works in a scientific research unit.
He has been asked to evaluate a number of results from experiments.

Complete the following table for Dafydd to give the values correct to 2 significant figures. [3]

Result	Value correct to 2 significant figures
$10^2 + 2^3$	110
$\left(8^{\frac{1}{3}} + 4^{-\frac{1}{2}}\right)$	
$2{\cdot}3 \times 10^{-1} + 9^0$	
$\left(\sqrt[3]{125}\right)^2 + 12 \times 160000^{-\frac{1}{4}}$	

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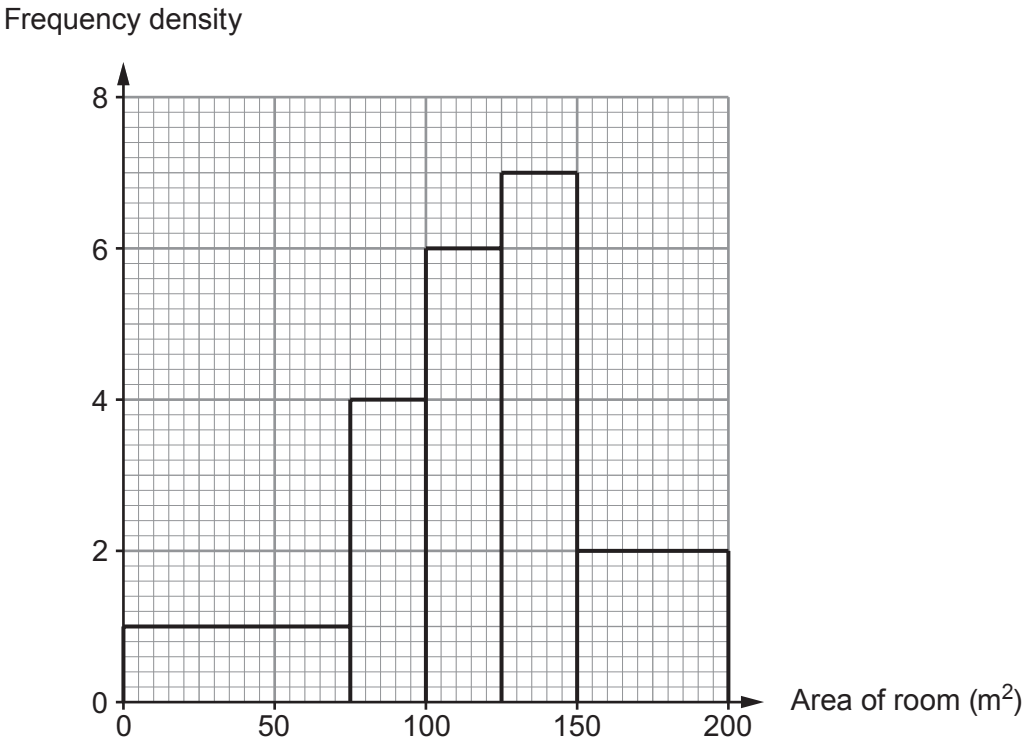
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Turn over for Question 13.

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13. The histogram illustrates the floor areas of the offices available to let by *Office Space UK* letting agency.



(a) Calculate how many of the offices available to let have a floor area greater than 75 m^2.

[3]

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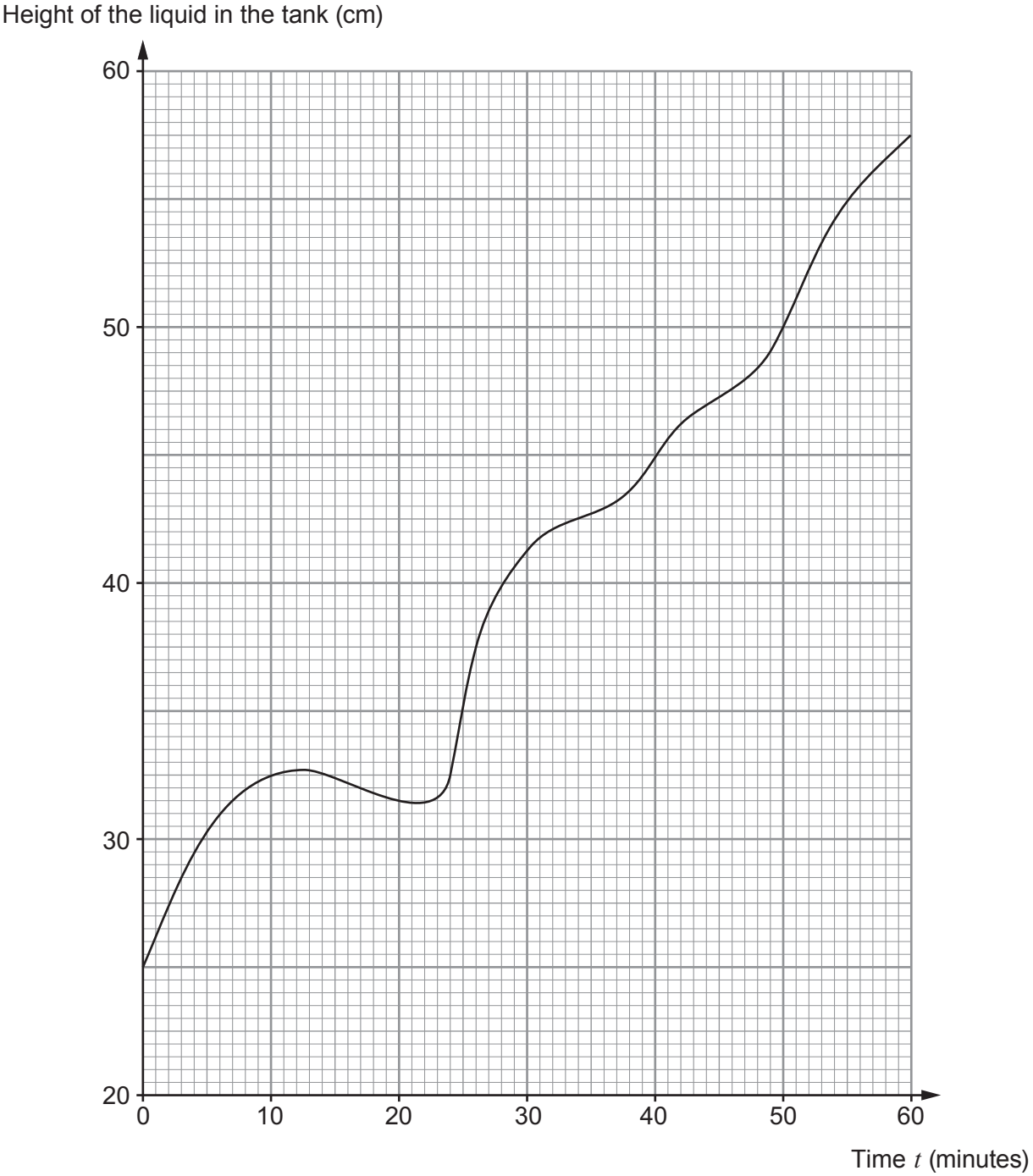
(b) *Office Space UK* charges a £200 arrangement fee when any of the offices with a floor area of up to 100 m^2 are let.
Assuming that all of the offices less than 100 m^2 are let, how much will *Office Space UK* receive in arrangement fees for these offices?
Give your answer in standard form. [4]

(c) It is reported that the median size of office space available to let is 80 m^2.
Is this true for the offices that are available to let by *Office Space UK*?
You must give a reason for your answer. [2]

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14. The graph shows the height of the liquid in a tank during a one-hour period.



(a) During which **5-minute period** was the height of the liquid increasing at the greatest rate? [1]

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(b) Calculate an estimate for the rate of increase in the height of the liquid in the tank at time $t = 35$. State the units of your answer. [4]

(c) The tank has a circular base.
The area of the base is $562\,cm^2$.
Calculate the circumference of the base of the tank.
Give your answer correct to one significant figure. [5]

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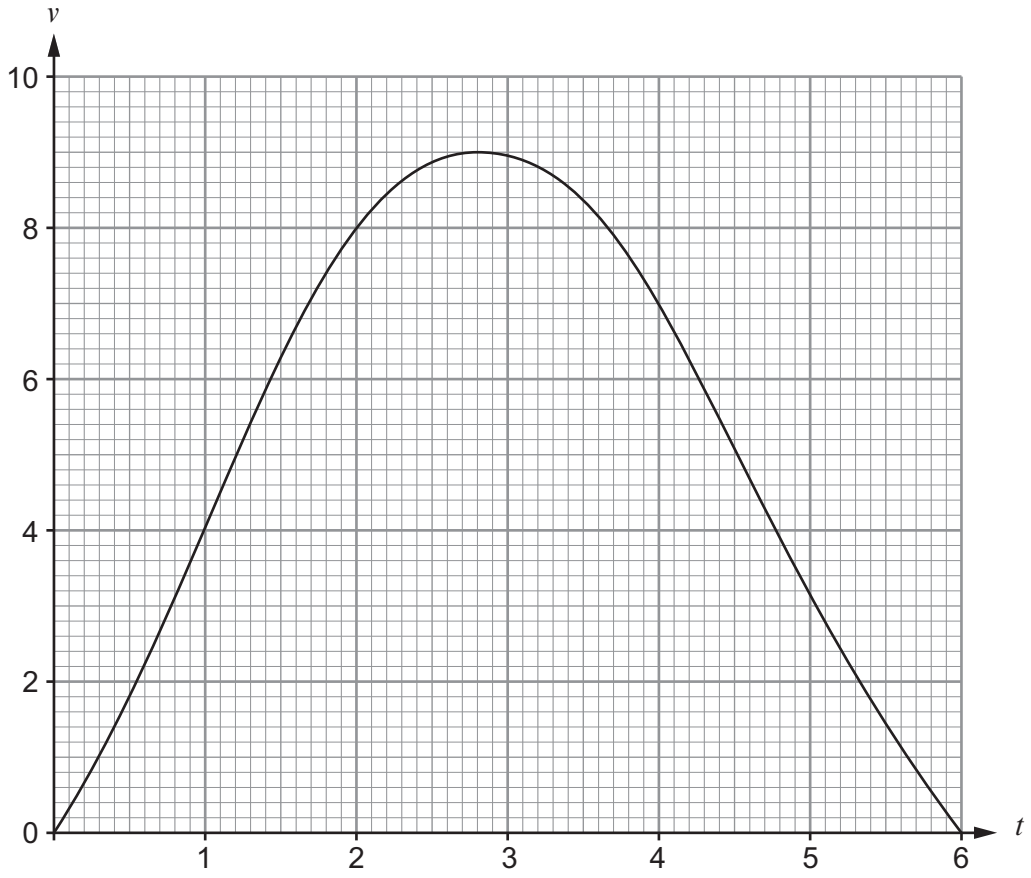
Turn over.

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15. The graph below shows the velocity, v, in m/s, of a particle at time t seconds after the start of the experiment.

(a) Find an approximation for the distance travelled by the particle during the 6 seconds of the experiment using the ordinates $t = 0$, $t = 2$, $t = 4$, $t = 6$. [4]



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(b) Is your approximation an over estimate or under estimate of the actual distance travelled?
Tick (✓) a box.
Give a reason for your answer. [1]

Over estimate ☐ Under estimate ☐

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END OF PAPER

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GCSE MARKING SCHEME

APPLICATIONS OF MATHEMATICS (LINKED PAIR PILOT)

SUMMER 2014

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INTRODUCTION

The marking schemes which follow were those used by WJEC for the Summer 2014 examination in GCSE APPLICATIONS OF MATHEMTICS (LINKED PAIR PILOT). They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

	Page
Unit 1 - Foundation Tier	1
Unit 1 - Higher Tier	5
Unit 2 - Foundation Tier	10
Unit 2 - Higher Tier	15

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UNIT 1 (FOUNDATION TIER)

Applications Unit 1 Foundation Tier June 2014	Mark	Comment
1. (a) 37	B1	
(b) 85˚ drawn	B1	±2˚
130˚ drawn	B1	±2˚
Line of 6cm AND 4.5cm drawn	B2	±2mm B1 for line of 6cm OR 4.5cm drawn or indicated. Within tolerances allowed
(c)(i) Church (2, 5)	B1	Reverse coordinates B0 throughout (c)
Castle (-4, -3)	B1	
(ii) Skating park (S) plotted at (3, 0)	B1	Accept any indication of (3, 0)
(d) (i) 45 (minutes)	B1	
(ii) ¾ (hours) + 20 (mins) + 1.5 (hours)	M1	For adding the 3 times given. FT 'their 45 minutes'
Changing all to hours OR all to mins correctly	B1	Either 45 + 20 + 90 OR ¾ + $^1/_3$ + 1.5 or equivalent
155 mins or 2 hrs 35 mins or 2.58(3....)hours ISW	A1	Do not accept 0.3 for 1/3 for A1 but allow for B1 If units used they must be correct. Do not accept 2.35 but allow 2:35
	12	
2. (a) Working towards 13 & 12 boxes or Engaging with buy 1 get 1 half price	S1	
13 × (£)27.6(0) or 12 × (£)13.8(0)	M1	
(£)358.8(0)	A1	
(£)165.6(0)	A1	
(£)524.4(0)	A1	FT 'their (£)358.8(0)' + 'their (£)165.6(0)'
		If M0 awarded allow SC1 for sight of (£)13.8(0). Possible S1 can still be awarded.
		Alternative method: *Cost of 2 boxes = 1.5 × £27.60 B1* *∴ cost of 24 boxes* *= 12 × 1.5 × £27.60 = 496.80 M1A1* *Total cost including 25th Box* *= 27.60 + 524.40 M1 A1*
(b) A, B & D circled	B2	Award B1 for any 2 correct nets circled and C not circled
	7	
3. (a) Mean, total of numbers = 154	M1	Attempt to add all given values
÷ 7	m1	FT 'their 154'
= 22	A1	CAO
Put in order 17, 19, 19, 20, 24, 25, 30	M1	
Median = 20	A1	
Mode = 19	B1	
Range = 13	B1	
(b)17 + 19 OR 30 - 19	M1	FT 'their 19'. Accept embedded answers.
36 OR 11	A1	
	9	

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Applications Unit 1 Foundation Tier June 2014	Mark	Comment
4. (a) (cost of room) (5 × 24 =) (£)120 (total cost of meals) 27 × 154 (£)4158 (total money spent) 120 + 4158 + 356 + 165 (£)4799 (total money collected from tickets) 154 × 35 (£)5390 (Money given to charity) (£)591	B1 M1 A1 M1 A1 M1 A1 B1	FT 'their 120' **and** 'their 4158' but not 24 and 27. FT 'their correct total collected' – 'their total money spent' Unsupported correct answer implies all previous marks. <u>*Alternative method*</u> *(cost of room) (5 × 24 =) (£)120 B1* *(Difference in meal and ticket price) 35 – 27 M1* *= (£)8 A1* *(Total money from this difference) 8 × 154 M1* *= (£)1232 A1* *(total money spent) 120 + 356 + 165 M1* *(£)641 A1* *(Money given to charity) (£)591 B1*
Look for • Spelling • Clarity of text explanation • the use of notation, watch for the use of '=', '£' being appropriate For QWC2 labels, appropriate use of '=' and units (£) must be evident. QWC2: Candidates will be expected to • present work clearly, with words explaining process or steps **AND** • make few if any mistakes in mathematical form, spelling, punctuation and grammar in their answer QWC1: Candidates will be expected to • present work clearly, with words explaining process or steps **OR** • make few if any mistakes in mathematical form, spelling, punctuation and grammar in their answer	QWC 2 10	QWC2 Presents relevant material in a coherent and logical manner, using acceptable mathematical form, and with few if any errors in spelling, punctuation and grammar. QWC1 Presents relevant material in a coherent and logical manner but with some errors in use of mathematical form, spelling, punctuation or grammar OR evident weaknesses in organisation of material but using acceptable mathematical form, with few if any errors in spelling, punctuation and grammar. QWC0 Evident weaknesses in organisation of material, and errors in use of mathematical form, spelling, punctuation or grammar.
4. (b) 6.5 × 3.5 = 22.75 Metres^2 or m^2 or square metres (c) (i) (£)295 + (£)2.8(0) × 20 (£)351 (ii) C = (£)295 + (£)2.8(0)m	M1 A1 U1 M1 A1 B2 7	Independent mark For the intention of multiplying and then adding Accept C = (£)295 + (£)2.8(0) × m Award B1 for (£)295 + (£)2.8(0) × m OR sight of (£)2.8(0) × m or equivalent

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Applications Unit 1 Foundation Tier June 2014	Mark	Comment
5. (a) Strategy knowing that **all** sides are equal in length 27×7 189 (mm) 18.9 (cm) (b) Sight of 60(˚) 360 – 90 – 90 – 60 120(˚)	S1 M1 A1 B1 B1 M1 A1 7	May see 27 or 2.7 on all sides. Sight of 27×9 (=243) implies S1 Or equivalent FT 'their 189(mm)' *Alternative method for changing to cm 1st* *Award S1 as above* *Sight of 2.7 (cm) B1* *2.7×7 M1* *18.9 (cm) A1*
6. (a) 24 (seconds) (b) (i) 3.6 (miles) (ii) 69 (mins) (iii) Before, steeper graph 	B2 B1 B1 E1 5	Award B1 for other multiples of 24 eg 48 (seconds) **OR** for listing multiples of 8 **AND** multiples of 6. Accept "Before as more vertical" or Before, because he travelled 3.6 miles in 30 mins and afterwards, 2.2 miles in 30 mins"
7. (a) Reason, e.g. outside the bookshop (b) Two boxes if you are 30 (c) Suitable question with at least 3 boxes, no overlaps or gaps and prices from a low value upwards (to maybe £20) considered or a number of boxes given but concentrated at lower prices 	E1 E1 B2 4	Accept reference to people not buying, but checking out ready for downloading, 'showcasing', or that 'older people are more likely these days to buy from shops than younger people' Do not accept reference to groups under 20 and over 40. Or refers to widths groups for younger or older people, or unequal groups. Allow 'overlap(s)'. Ignore incorrect response if correct response is given. Do not accept 'doesn't give options for under 20s or over 40s', or '2 options for 20 year olds' B1 Suitable question with at least 3 boxes, with either consistent overlaps or gaps OR a suitable range of prices is not considered, OR B1 for suitable choice of groups with no gaps or overlaps but without a suitable question being asked *Examples of consistent overlaps or gaps:* *'£0 - £5, £5 - £10, £10 - …'* *'under £5, £6 - £10, £11 - £15, £16 - …'* *'over £5, over £10, over £20'** **however possible B2 if asked to tick only one box*
8. (a) 7cm (± 0.2cm) × 8 (÷ 100) 0.56 (m) (b) Measuring 2 appropriate angles (±2°) to check allied, or appropriate corresponding or alternate angles Conclusion based on the angles measured and accurate knowledge of parallel line angle facts.	M1 A1 B1 E1 4	Award M1 only for answers 56cm or 56m or 56 or similar from ±0.2cm tolerance The size of angles may not actually be recorded, e.g. on diagram equal angles marked *x* and *y*. Accept references to the angles which are equal or sum to 180° *(Angle at D & E appropriately 110°±2° or 70°±2°, Angle at A & B appropriately 108°±2° or 72°±2°)* Do not accept 'travelling in the same direction so won't meet'

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Applications Unit 1 Foundation Tier June 2014	Mark	Comment
9. (a) (Number of necklaces is) 918 ÷ 34 = 27 (necklaces)	M1 A1	 *Note: Sight of 270 (yellow) or 162 (black) implies M1, A1*
(Number of yellow beads is 27×10 =) 270 (Number of black beads is 27×6 =) 162	B1 B1	FT their consistent 'derived 27' × 10 correctly evaluated FT their consistent 'derived 27' × 6 correctly evaluated
(b) Deciding to make two bracelets 8 bags of purple beads 3 bags of green beads	B1 B1 B1	OR sight of needing 48 purple or 18 green Reversed answer: '3 purple bags and 8 green bags' following correct working award B1, SC1. Note intention to match 72s is incorrect working. *If no marks, allow SC2 for 4 bracelets with 16 bags of purple beads and 6 bags of green beads, OR* *SC1 for other possible number of bracelets with the number of whole bags of purple and green correctly evaluated in the correct ratio*
	7	
10. (a) 5(7x + 3) (b) -16a -11b (c) 9d – 6e – d + e = 8d – 5e (d) One correct evaluation, $3 \le x \le 4$ 2 correct evaluations, $3.55 \le x \le 3.75$, one either side of 0 2 correct evaluations, $3.55 \le x \le 3.65$, one either side of 0 OR correct evaluation for x = 3.65 if previous B1 awarded 3.6 *No calculations shown: accept "too high",">", etc.*	B1 B1 B1 B1 B1 B1 M1 A1	 Allow -16a (+) -11b FT until 2nd error x $x^3 - 2x - 40$ 3 -19 3.1 -16.409 3.2 -13.632 3.3 -10.663 3.4 -7.496 3.5 -4.125 **3.55 -2.361125** 3.6 -0.544 **3.65 1.327125** 3.7 3.253 **3.75** 5.234375 3.8 7.272 3.9 11.519 4 16
	8	*Award SC1 for an unsupported answer of 3.6*

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UNIT 1 (HIGHER TIER)

Applications Unit 1 Higher Tier June 2014	Mark	Comment
1(a) Reason, e.g. outside the bookshop	E1	Accept reference to people not buying, but checking out ready for downloading, 'showcasing', or that 'older people are more likely these days to buy from shops than younger people' Do not accept reference to groups under 20 and over 40.
(b) Two boxes if you are 30	E1	Or refers to widths groups for younger or older people, or unequal groups. Allow 'overlap(s)'. Ignore incorrect response if correct response is given. Do not accept 'doesn't give options for under 20s or over 40s', or '2 options for 20 year olds'
(c) Suitable question with at least 3 boxes, no overlaps or gaps and prices from a low value upwards (to maybe £20) considered or a number of boxes given but concentrated at lower prices	B2 4	B1 Suitable question with at least 3 boxes, with either consistent overlaps or gaps OR a suitable range of prices is not considered, OR B1 for suitable choice of groups with no gaps or overlaps but without a suitable question being asked *Examples of consistent overlaps or gaps:* *'£0 - £5, £5 - £10, £10 - …'* *'under £5, £6 - £10, £11 - £15, £16 - …'* *'over £5, over £10, over £20'** **however possible B2 if asked to tick only one box*
2(a)(i) 180 + 73 or 360 - 107 $= 253^{(o)}$ (ii) 360 – 42 $= 318^{(o)}$	M1 A1 M1 A1	*SC1 for answers of 073(°) and 138(°) in (i) and (ii)*
(b) 60° with construction arcs (30° by) bisecting 'their angle', with arcs shown Correct 30° from appropriate construction with line shown at the right hand end of the line	M1 M1 A1 7	Accept anywhere on the line *Allow sight of construction arcs for 60°* Line (road) may not be shown Depends on both M marks
3(a) 7cm (± 0.2cm) × 8 (÷ 100) 0.56 (m)	M1 A1	Award M1 only for answers 56cm or 56m or 56 or similar from ±0.2cm tolerance
(b) Measuring 2 appropriate angles (±2°) to check allied, or appropriate corresponding or alternate angles Conclusion based on the angles measured and accurate knowledge of parallel line angle facts.	B1 E1 4	The size of angles may not actually be recorded, e.g. on diagram equal angles marked *x* and *y*. Accept references to the angles which are equal or sum to 180° *(Angle at D & E appropriately 110°±2° or 70°±2°, Angle at A & B appropriately 108°±2° or 72°±2°)* Do not accept 'travelling in the same direction so won't meet'

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Applications Unit 1 Higher Tier June 2014	Mark	Comment
4(a) (Number of necklaces is) 918 ÷ 34 = 27 (necklaces)	M1 A1	
		Note: Sight of 270 (yellow) or 162 (black) implies M1, A1
(Number of yellow beads is 27×10 =) 270	B1	FT their consistent 'derived 27' × 10 correctly evaluated
(Number of black beads is 27×6 =) 162	B1	FT their consistent 'derived 27' × 6 correctly evaluated
QWC2: Candidates will be expected to • present work clearly, with words explaining process or steps **AND** • make few if any mistakes in mathematical form, spelling, punctuation and grammar and include units in their final answer	QWC 2	QWC2 Presents relevant material in a coherent and logical manner, using acceptable mathematical form, and with few if any errors in spelling, punctuation and grammar.
QWC1: Candidates will be expected to • present work clearly, with words explaining process or steps **OR** • make few if any mistakes in mathematical form, spelling, punctuation and grammar and include units in their final answer		QWC1 Presents relevant material in a coherent and logical manner but with some errors in use of mathematical form, spelling, punctuation or grammar OR evident weaknesses in organisation of material but using acceptable mathematical form, with few if any errors in spelling, punctuation and grammar. QWC0 Evident weaknesses in organisation of material, and errors in use of mathematical form, spelling, punctuation or grammar.
(b) Deciding to make two bracelets 8 bags of purple beads 3 bags of green beads	B1 B1 B1	OR sight of needing 48 purple or 18 green Reversed answer: '3 purple bags and 8 green bags' following correct working award B1, SC1. Note intention to match 72s is incorrect working. *If no marks, allow SC2 for 4 bracelets with 16 bags of purple beads and 6 bags of green beads, OR* *SC1 for other possible number of bracelets with the number of whole bags of purple and green correctly evaluated in the correct ratio*
	9	
5(a) 5(7x + 3)	B1	
(b) -16a -11b	B1	Allow -16a (+) -11b
(c) 9d – 6e – d + e = 8d – 5e	B1 B1	FT until 2nd error
(d) One correct evaluation, $3 \le x \le 4$	B1	x $x^3 - 2x - 40$ 3 -19 3.1 -16.409 3.2 -13.632 3.3 -10.663 3.4 -7.496 3.5 -4.125
2 correct evaluations, $3.55 \le x \le 3.75$, one either side of 0	B1	
2 correct evaluations, $3.55 \le x \le 3.65$, one either side of 0 OR correct evaluation for x = 3.65 if previous B1 awarded	M1	**3.55 -2.361125** 3.6 -0.544 **3.65 1.327125** 3.7 3.253
3.6 *No calculations shown: accept "too high", ">", etc.*	A1	**3.75** 5.234375 3.8 7.272 3.9 11.519 4 16
	8	*Award SC1 for an unsupported answer of 3.6*

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Applications Unit 1 Higher Tier June 2014	Mark	Comment
6(a)(i) Total number of rotten apples considered 9 Total number of apples considered 100 9/100 or equivalent	B1 B1 B1	 Allow 3/20+0/20+1/20+4/20+1/20 leading to 9/100 as poor notation *Allow B2 for an answer of 1.8/20*
(ii) 8×9 or equivalent 72 (rotten apples)	M1 A1	FT their (i) × 8 *M1 only for an answer of 72/..., e.g. 72/800*
(b) 2/24 ISW (=1/12 = 0.08333…)	B2 7	B1 for appropriate sight of '2 apples' considered as a response or answers of 3/24 (= 1/8 = 0.125) or 4/24 (= 1/6 = 0.1666…)
7(a) 240, 300, 345, 440	B3	OR B2 for any two correct entries, OR B1 for a correct method seen, or one correct entry
(b)Plots correct for their data at the mid interval with trend line drawn	B2	B1 for correct plots at mid interval, or consistent translated plots with trend line drawn
(c) Explanation, e.g. 'months not equal number of days', 'months about the same number of days'	E1	Accept 'yes' or 'no' depending on a reasonable explanation Allow 'NO, it makes it easier to plot with equal spaces', or 'NO, it still displays the data correctly' Do not accept 'YES, it gives inaccurate display', without an explanation of why
(d) 'NO', stated or implied with a suitable reason, e.g. 'will go down again as it gets to winter (autumn)', 'only rising as it now includes summer months', 'No in the long term as autumn and winter approach', 'no way of knowing'	E1 7	Accept YES with an appropriate reason, e.g. 'Yes in the short term as August has yet to be included'
8. Straight lines parallel to all verticals and horizontals, with lines of radius distance away from the steps (±2mm)	B2	B1 for straight lines, or series of points (>6), parallel to 2 verticals/horizontals, radius distance away (±2mm), OR straight **lines** parallel to all 6 verticals and horizontals but not radius distance away *Do not accept curves with free hand sketches*
All inner steps, locus turn at 90° vertex	B1	
All outer steps, arcs with wheel radius (±2mm)	B2 5	B1 for arcs with wheel radius (±2mm) at 2 outer steps, OR intention of arcs at all outer steps but not necessarily at wheel radius If B5 penalise extra lines drawn -1
9.(a)(i) (800 – 300)/ 50 = 10	M1 A1	Or equivalent
(ii) Explanation, e.g. 'extra cost per person', '£10 per person', '£100 extra for every 10 people'	E1	Do not accept 'more people the more paid' FT from their gradient if reasonable
(iii) Explanation, e.g. 'fixed charge'	E1	Accept 'conference cost starts at £300', or 'hire cost'
(b) (£)200	B1 5	CAO

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Applications Unit 1 Higher Tier June 2014	Mark	Comment
10(a) 44, 76, 80	B1	
(b) Correct cumulative frequency diagram, points plotted at upper bounds and joined by a curve or straight line	B2	Accuracy: nearer the intersection of correct lines than any others FT only if cumulative in (a) B1 for points correct but not joined, OR B1 correct apart from 0.5 translation, OR B1 if one error in plotting but joined correctly
(c)		FT from their **cumulative** entries. Not cumulative means no FT. Accuracy of readings ±0.5
Median ≈ 58 reading from graph	B1	
Low quartile ≈ 55.5 reading from graph	B1	
Upper quartile ≈ 61 reading from graph	B1	
Interquartile range ≈ 5.5	B1	FT their UQ – their LQ correctly evaluated. Independent FT
(d) Range ends correctly indicated (50(cm) and 68(cm))	B1	In (d) FT consistent previous misread of scale Whiskers should be shown
Median line correctly indicated (approx. 58)	B1	If incorrect then FT their median
UQ and LQ correctly indicated (approx. 61 & 55.5)	B1 10	If incorrect then FT their UQ and LQ readings
11(a) Sight of $8(10+x) - x^2$ or $8\times10 + x(8-x)$	M1	OR sight of appropriate areas, e.g 8×10, $8\times x$ and $x\times x$
Convincing $80 + 8x - x^2$	A1	Must follow from correct working
(b) Finding at least two correct values for the area, either in working or plotted	M1	In (b) ignore any points x>5 x: 0, 1, 2, 3, 4, 5 Area: 80, 87, 92, 95, 96, 95
At least 4 correct plots	P1	
All 6 points plotted accurately and joined with a curve	C1	
(c) Either appropriate use of the graph or sight of $83.75 = 80 + 8x - x^2$	M1	
$x = 0.5$	A1	FT from their graph. Allow inclusion of 7.5 with the answer 0.5.
	7	*An answer of 7.5 only implies M1, A0*
12.		
$(8^{⅓} + 4^{-½})$ = 2.5	B1	Allow 2.50
$2.3\times10^{-1} + 9^0$ = 1.2	B1	B0 for 0.23 + 1 = 1.23, or 1.20
$\sqrt[3]{125^2 + 12\times160000^{-¼}}$ = 26	B1	B0 for 25 + 0.6 = 25.6, or 26.0 However if final 2 B marks are not awarded then SC1 for answers 1.23 **and** 25.6 respectively, or 1.20 **and 26.0**
	3	
13(a) Method of finding 1 correct area	M1	
2 correct areas AND intention to add all areas	M1	Areas are $4\times25 + 6\times25 + 7\times25 + 2\times50$ $= 100 + 150 + 175 + 100$
525	A1	CAO. Answer of 600 by considering full area, is award M1, SC1
(b) $1\times75 + 4\times25$ (=175)	M1	
$\times 200$	m1	
(£) 3.5×10^4	A2	A1 for 35000 If no marks, then SC1 for 'their 175'×200 correctly evaluated and expressed in standard form
(c) No, stated or implied with a reason, e.g. 'skew to offices greater than $80m^2$', 'the median (300^{th} value) lies within the 100–125 interval', 'No, the majority are greater than $80m^2$ (or $100m^2$)'	E2	E1 for an answer that implies no with a statement implying that the median is greater than $80m^2$ but without giving a reason why, OR E1 for NO with an incorrect median stated in the range 100<median<125 without further statement
	9	*Do not accept reference to mode*

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Applications Unit 1 Higher Tier June 2014	Mark	Comment
14(a) Approximate period: 24 to 29 (minutes) (b) Tangent drawn at t = 35 Method, difference y / difference x Evaluated answer from their reasonable tangent cm/min (c) $562 = \pi \times r^2$ $r = \sqrt{(562/\pi)}$ (r = 13.37…) C = 2 × π × their r 80 (cm)	B1 B1 M1 A1 U1 M1 m1 M1 A2 10	Accept 25 to 30 (minutes) or 23 to 28 (minutes) Not necessarily from a tangent *(May be approximately 0.2)* Accept 'cm per min(ute)' FT their derived r A1 for 84.0…
15.(a) Finding the y values: (0,) 8, 7(, 0) Use of trapezium rule or splitting into the 3 areas required and attempt to sum Complete correct calculation for the area required 30 (m) (b) 'Under estimate' with reason suggesting that trapezium is beneath the curve	B1 M1 A1 A1 E1 5	May be shown on their graph FT their values for y (8 + 15 + 7) CAO Treat splitting area into 6 parts as MR-1, then follow the stages of the mark scheme

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Surname	Centre Number	Candidate Number
Other Names		0

GCSE LINKED PAIR PILOT

4361/02

APPLICATIONS OF MATHEMATICS

UNIT 1: Applications 1
HIGHER TIER

A.M. WEDNESDAY, 15 January 2014

2 hours

ADDITIONAL MATERIALS

A calculator will be required for this paper.

A ruler, a protractor and a pair of compasses may be required.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** the questions in the spaces provided.

Take π as 3·14 or use the π button on your calculator.

INFORMATION FOR CANDIDATES

You should give details of your method of solution when appropriate.

Unless stated, diagrams are not drawn to scale.

Scale drawing solutions will not be acceptable where you are asked to calculate.

The number of marks is given in brackets at the end of each question or part-question.

You are reminded that assessment will take into account the quality of written communication (including mathematical communication) used in your answer to question **6**.

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**5**	
2.	**6**	
3.	**10**	
4.	**2**	
5.	**8**	
6.	**8**	
7.	**4**	
8.	**10**	
9.	**13**	
10.	**6**	
11.	**5**	
12.	**9**	
13.	**14**	
Total	**100**	

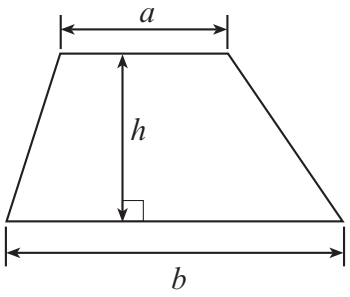
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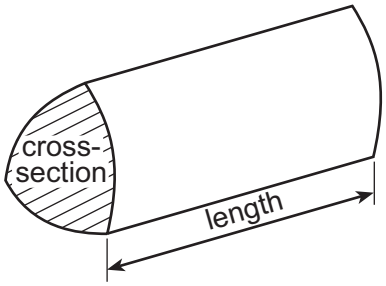
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Formula List

Area of trapezium = $\frac{1}{2}(a + b)h$

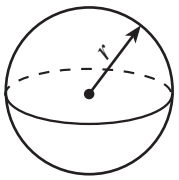


Volume of prism = area of cross-section × length



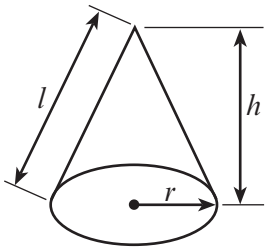
Volume of sphere = $\frac{4}{3}\pi r^3$

Surface area of sphere = $4\pi r^2$



Volume of cone = $\frac{1}{3}\pi r^2 h$

Curved surface area of cone = $\pi r l$

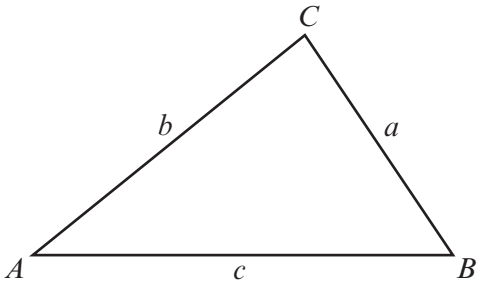


In any triangle ABC

Sine rule $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Cosine rule $a^2 = b^2 + c^2 - 2bc\cos A$

Area of triangle = $\frac{1}{2}ab\sin C$



The Quadratic Equation

The solutions of $ax^2 + bx + c = 0$

where $a \neq 0$ are given by

$$x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$$

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Examiner only

1. A survey is carried out by asking people questions as they come out of a juice bar.



A section of the questionnaire is shown below.

In questions 1 and 2 put a tick (✓) in a box

1. How old are you?

   15 to 20 ☐ 21 to 30 ☐ 30 to 40 ☐ 41+ ☐

2. Do you ever go to the juice bar to buy a fruit drink?

   Yes ☐ No ☐

3. What method of payment do you use? .....

(a) Explain why this is a biased survey. [1]

.....

.....

(b) State two criticisms of the design of question 1.
First criticism of question 1: [1]

.....

.....

Second criticism of question 1: [1]

.....

.....

(c) (i) What is wrong with the design of question 3? [1]

.....

.....

(ii) Show how question 3 could be improved. [1]

.....

.....

.....

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2. *MacReardon Construction* is contracted to work on a warehouse site where there are a number of liquid storage tanks.



A sketch of the base of one of the liquid storage tanks is shown below.

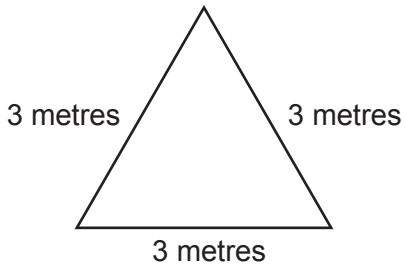


Diagram not drawn to scale

(a) Use a pair of compasses and a ruler to make an accurate scale drawing of the base shown above.
Use a scale of **2 cm to represent 1 metre**. [3]

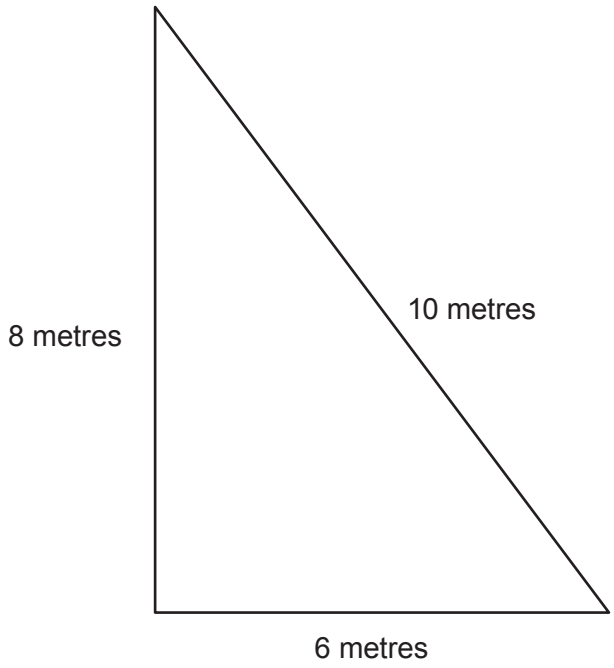
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(b) *MacReardon Construction* has been asked to lay a drain surrounding a different liquid storage tank. The drain must be exactly **2 metres** away from the perimeter of the base of the tank.

An accurate scale drawing of the base of this tank is shown below.
A scale of **1 cm to represent 1 metre** has been used.
On the scale drawing below, draw accurately the position of the drain surrounding the tank. [3]



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3. A machine is used to pack boxes of pasta shapes.



Each box of pasta shapes should weigh between 200 g and 205 g.
To check the machine, 10 boxes of pasta shapes are selected every half hour.
At each of these times, the number of boxes weighing between 200 g and 205 g is recorded.
The results are shown in the table below.

Time	00:00	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30
Number of the 10 boxes weighing between 200 g and 205 g	1	0	2	1	3	2	0	0	1	2

(a) Michelle has weighed all the boxes of pasta selected between 00:00 and 04:30.
For all these boxes, she finds that the following statement is true.

"Each box of pasta weighs at least 200g."

Explain, looking at the results in the table above, how this statement could be **true**. [1]

.....

.....

.....

(b) Michelle decides to record and plot the relative frequencies for the information shown in the previous table.

(i) Complete the table below. [4]

Time, up to	00:00	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30
Total number of the 10 boxes weighing between 200 g and 205 g	1	1	3	4						
Total number of boxes checked	10	20	30	40						
Relative frequency	0·1	0·05								

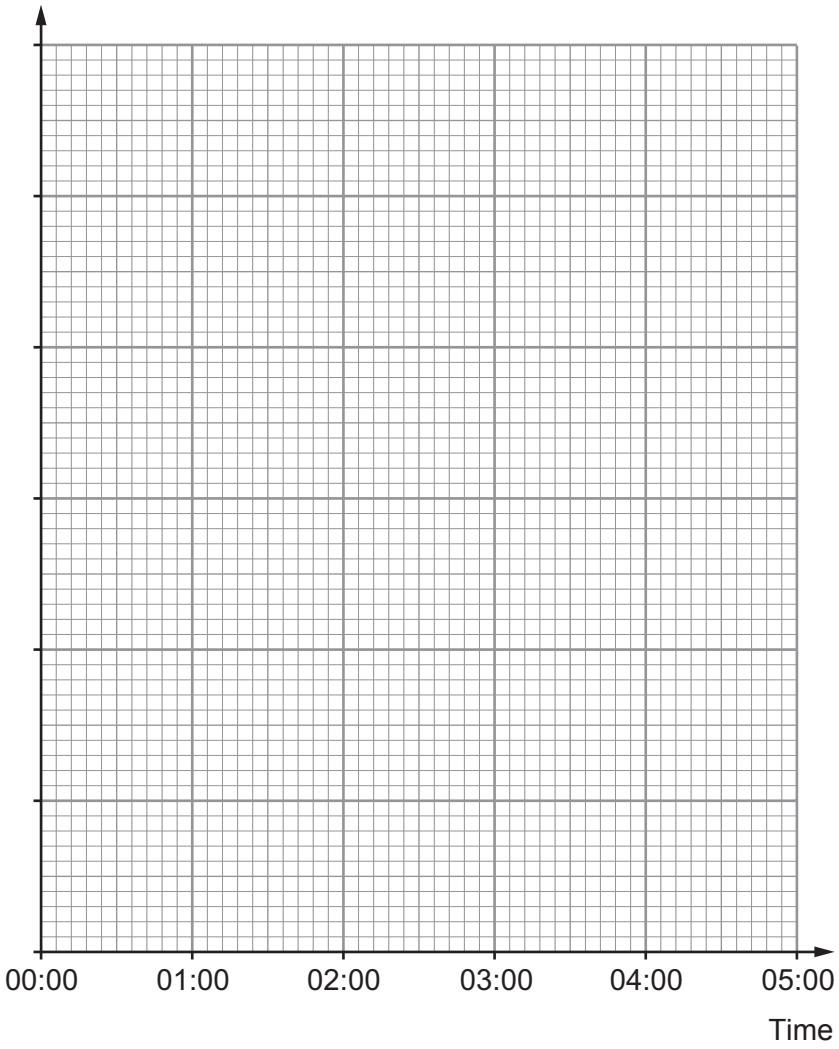
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(ii) Use the graph paper below to plot the relative frequencies. [3]

Relative frequency



(iii) Write down the best estimate for the probability that a box selected at random will weigh between 200 g and 205 g. Give a reason for your answer. [2]

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.....

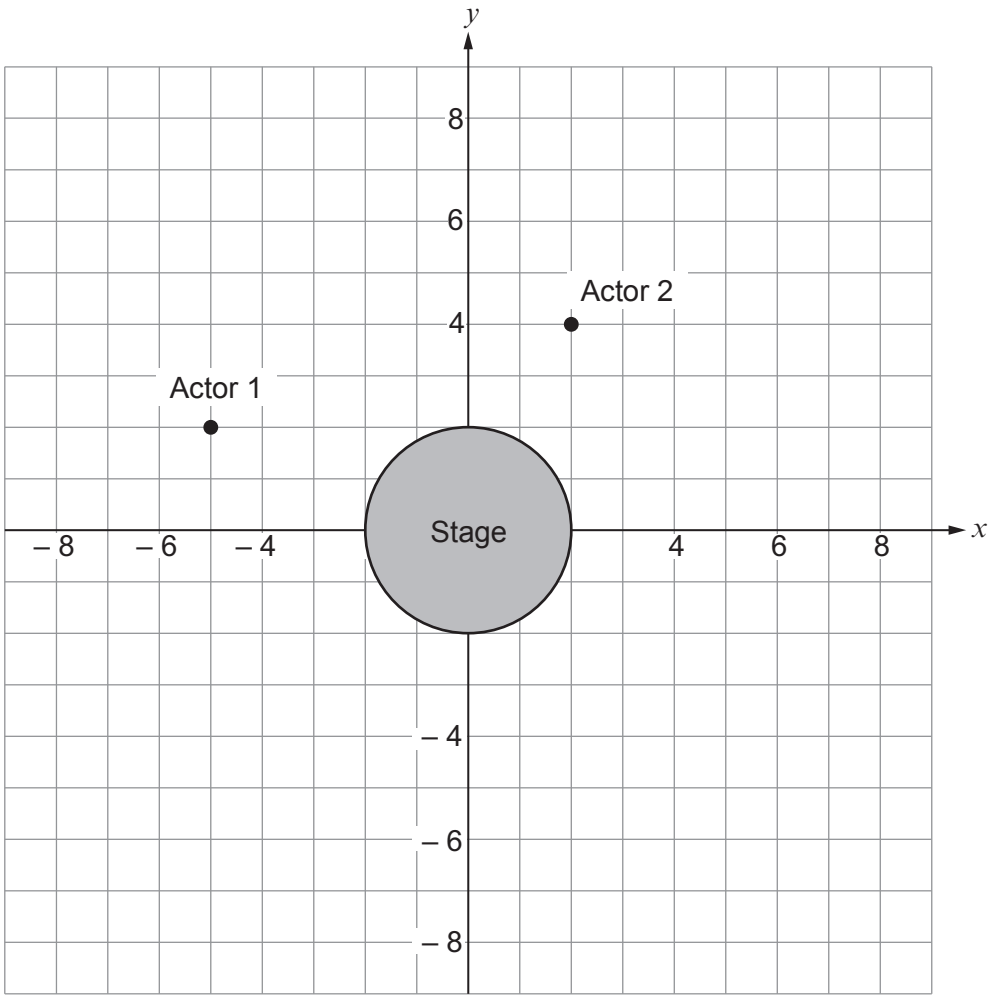
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4. The circular stage in *Theatr Seren* is in the centre of the theatre.
It is decided to seat four actors amongst the audience to hold the ends of four ribbons.
A plan of the theatre is represented by the coordinate grid shown below.
The actors are to be seated so that ribbons held by the four of them will form a square.



Mark where the other two actors should be seated, and write down the coordinates of their positions. [2]

(..... , ...) (..... , ...)

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5. One of the services offered by *Maid4U* is cleaning ovens.
Maid4U calculates the cost for this service using the following method.

- START with a standard charge of £18
- ADD a fee of £12 for every complete hour worked AND an additional fee of 25p for every additional minute worked
- MULTIPLY the total charge so far by 1·2
- This equals the final charge

(a) Calculate the cost of cleaning an oven that takes

(i) $2\frac{1}{2}$ hours [2]

.....

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.....

(ii) 45 minutes [1]

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(b) Write a formula for working out the final charge, £F for cleaning an oven taking h hours and m minutes. [4]

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.....

(c) Doris notices that there is a problem with the method for calculating the cost of cleaning an oven.
Her oven took 2 hours to clean, and her neighbour's oven took 1 hour 50 minutes.
Doris's bill for cleaning her oven was cheaper, yet took a longer time.
Explain why this happens. [1]

.....

.....

.....

4361 020009

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6. *You will be assessed on the quality of your written communication in this question.*

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Tom is making a patio using paving slabs like the one shown below.
Each paving slab is in the shape of a trapezium.

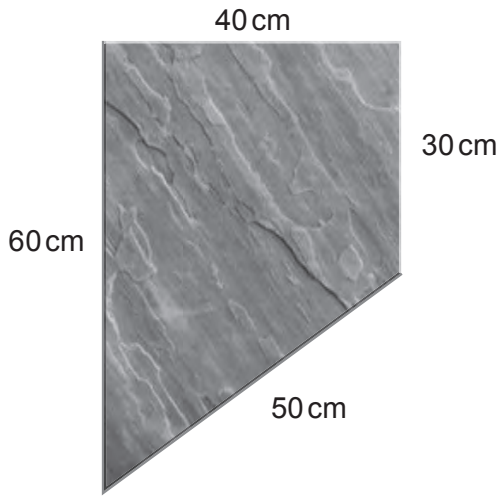


Diagram not drawn to scale

Tom used 25 of these paving slabs to make his patio.
He decides to paint the patio with a sealant to prevent staining.
Each tin of sealant that he buys covers an area of $0{\cdot}8\,m^2$.

Each tin of sealant costs £14.49.
Each paving slab costs £8.25.

Tom buys just enough tins of sealant to paint his patio.
Calculate the total cost of buying the paving slabs and sealant.
You must show all your working. [8]

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7. A replacement part for a machine is made using one spring, one washer and one rod.



Packs containing one spring, one washer and one rod are to be made for selling in a spare parts shop.

To make up these packs, boxes of springs, washers and rods are bought.
Boxes contain 40 springs or 24 washers or 16 rods.

All of the contents of the boxes bought must be used in making up the packs.
There must be no springs or washers or rods left over after making up the packs of one spring, one washer and one rod.

Complete the table below by calculating a suitable number of boxes each of springs, washers and rods that are needed to make up the packs.
You must show all your working. [4]

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	Number of boxes needed
Springs (40 in each box)	..... boxes
Washers (24 in each box)	..... boxes
Rods (16 in each box)	..... boxes

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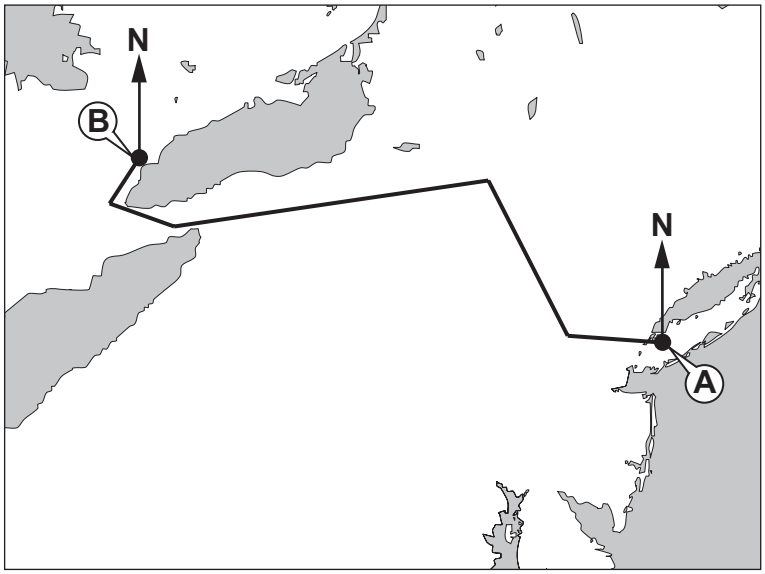
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8. The image below shows the location of New York and Toronto on a map.



Jack is setting out from New York (A) to drive to Toronto (B).
He uses the map to plan his journey in 5 stages.
These stages are shown by the straight lines he has drawn on the map below.



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(a) Jack's driving distance from New York to Toronto is approximately 500 miles. Given that 5 miles is approximately 8 km, complete the following sentence. [4]

'Looking at the map, I think that every **1 cm** represents a

journey distance of ..... kilometres.'

(b) Use the straight lines Jack has drawn on his map to complete the following statements for Jack's journey. [2]

For the first stage of his journey, Jack will leave New York travelling

on a bearing of ..... °.

For the last stage of his journey, Jack will arrive in Toronto travelling

on a bearing of ..... °.

(c) Jack finds a different map.
The new map has a scale with 1 cm representing 25 000 cm.
Express 25 000 cm in km, giving your answer in standard form. [2]

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(d) Jack wants to derive a formula he could use to calculate his total journey time.

He decides to use

- T to represent total time, in hours
- t to represent the time he spends actually driving, in hours
- b to represent the time for breaks and rests during his journey, in hours
- d to represent the total distance travelled, in miles
- s to represent the average speed in miles per hour, whilst driving, for the whole journey

He knows that t is equal to d, the total distance in miles, divided by s, the average speed whilst driving, for his journey.

Derive a formula to calculate T in terms of b, d and s. [2]

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9. *(a)* A number of adults were asked how much they would be willing to pay to visit an ancient monument.



The results are summarised in the table.

Amount of money, £x	Number of adults
$1 \leqslant x < 4$	32
$4 \leqslant x < 7$	26
$7 \leqslant x < 10$	14
$10 \leqslant x < 13$	2

(i) Calculate an estimate for the mean amount of money the adults would be willing to pay. [4]

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(ii) Find the greatest possible value of the range. [1]

.....

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Turn over.

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(b) The number of adults visiting the monument during the different seasons was recorded.

Season	Winter 2012	Spring 2012	Summer 2012	Autumn 2012	Winter 2013	Spring 2013	Summer 2013
Number of adult visitors	24	86	122	8	28	94	146

(i) Calculate 4-point moving averages and complete the table below. [3]

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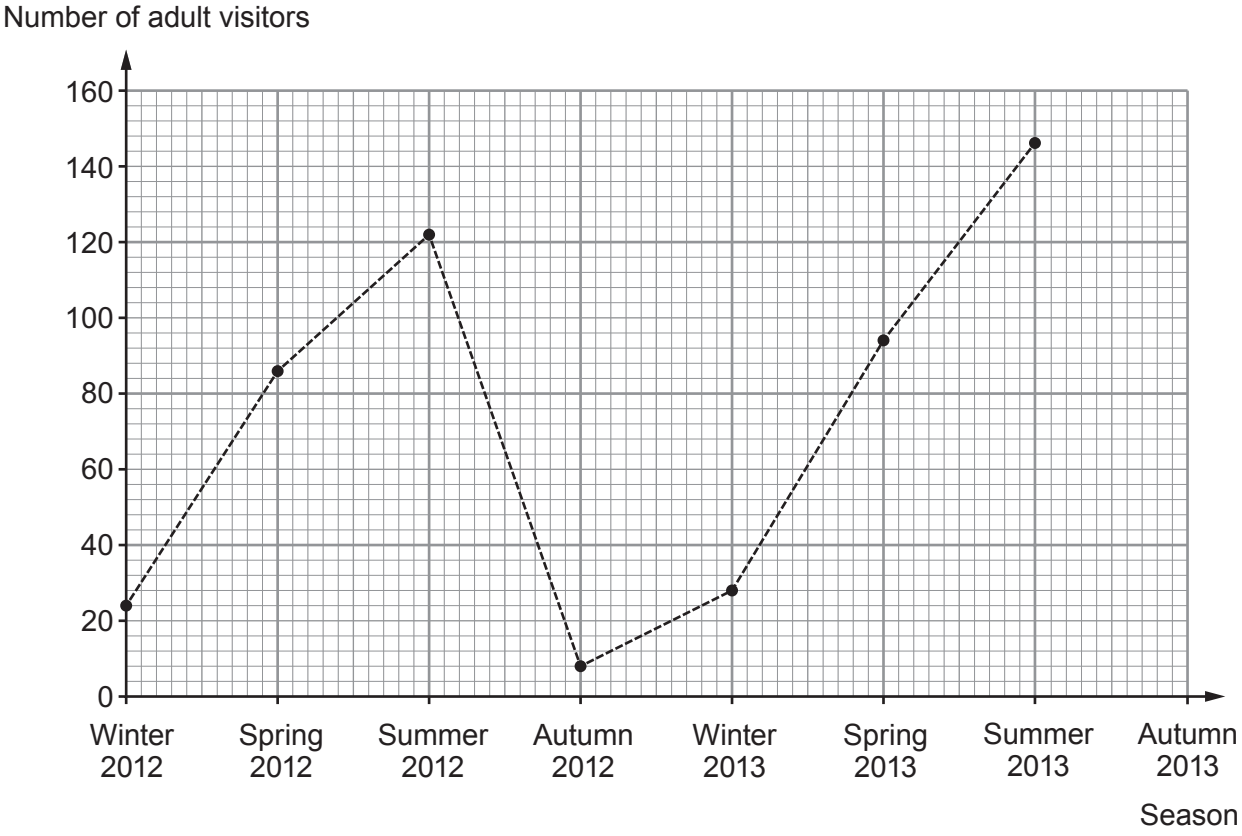
4-point period:	Winter 2012 to Autumn 2012	Spring 2012 to Winter 2013	Summer 2012 to Spring 2013	Autumn 2012 to Summer 2013
4-point moving average:				

(ii) The time series graph for the number of adults visiting the monument during the different seasons has been plotted on the graph paper opposite.
On this graph paper, plot the 4-point moving averages and draw a trend line. [3]

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(iii) Use your graph to make two different comments about the **trend** in the number of adult visitors.
One comment should refer to the time series and one comment to the trend line.
[2]

Comment 1:

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.....

.....

Comment 2:

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10. Metric prefixes are used to describe large or small numbers.
The metric prefix 'milli', in millimetres or milligrams, is used to describe small numbers.
For example, 1 millimetre is 1000^{-1} metres which can also be written as 10^{-3} metres.

Complete the table below. [6]

Metric prefix	1000^{x}	10^{y}	Standard form
hecto	$1000^{\frac{2}{3}}$	.....	.....
tera	.....	10^{12}	.....
deci	$1000^{-\frac{1}{3}}$	.....	.....
yocto	.....	10^{-24}	.....

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11. A jewellery maker is manufacturing silver charms.



A diagram of the cutting pattern he uses is shown below.
Two of these charms can be made using this cutting pattern, from regions *A* and *C*.

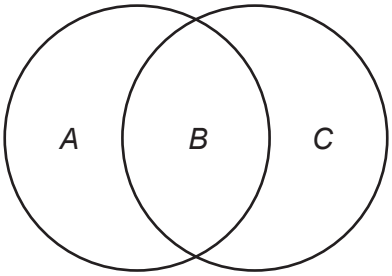


Diagram not drawn to scale

Regions *A*, *B* and *C* are indicated on the diagram, which shows two intersecting circles of equal radius.

The ratio of the areas of the regions, *A*, *B* and *C* is 2 : 3 : 2 respectively.
The radius of each circle is 1·5 cm.

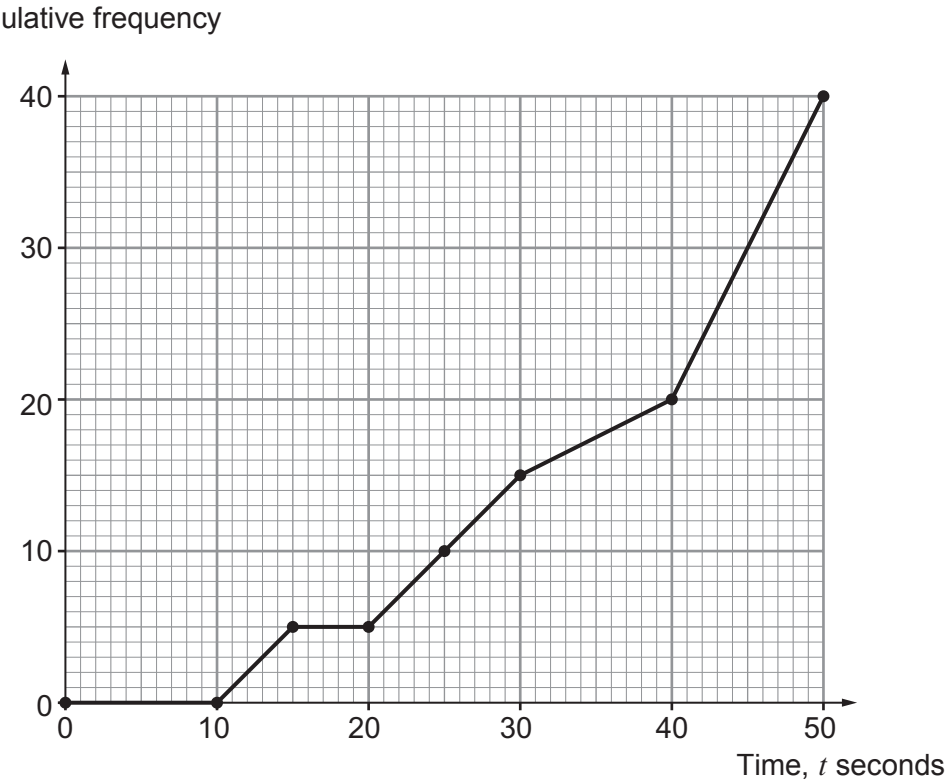
Calculate the area of the region *A*.
Give your answer in cm^2. [5]

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12. The cumulative frequency diagram shows the time taken by 40 athletes to complete a trial.



(a) Athletes completing the trial within 20 seconds are considered to be 'outstanding'.
How many athletes are 'outstanding'? [1]

.....

(b) Athletes completing the trial between 20 seconds and 40 seconds are considered to be 'excellent'.
How many athletes are 'excellent'? [1]

.....

(c) Write down an estimate for the interquartile range of the times.
You must show your working. [2]

.....

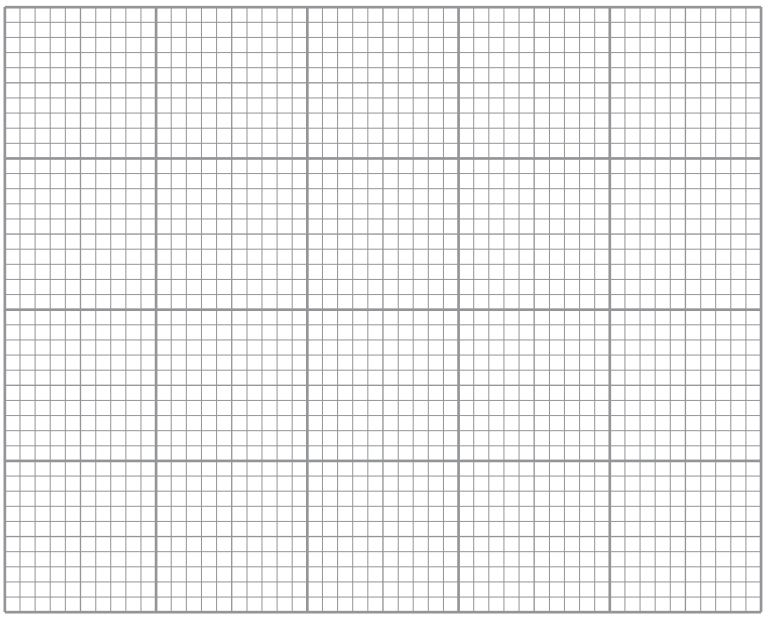
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(d) Using the same class intervals as used in the cumulative frequency diagram, draw a histogram to illustrate the time taken by the 40 athletes to complete the trial. [5]

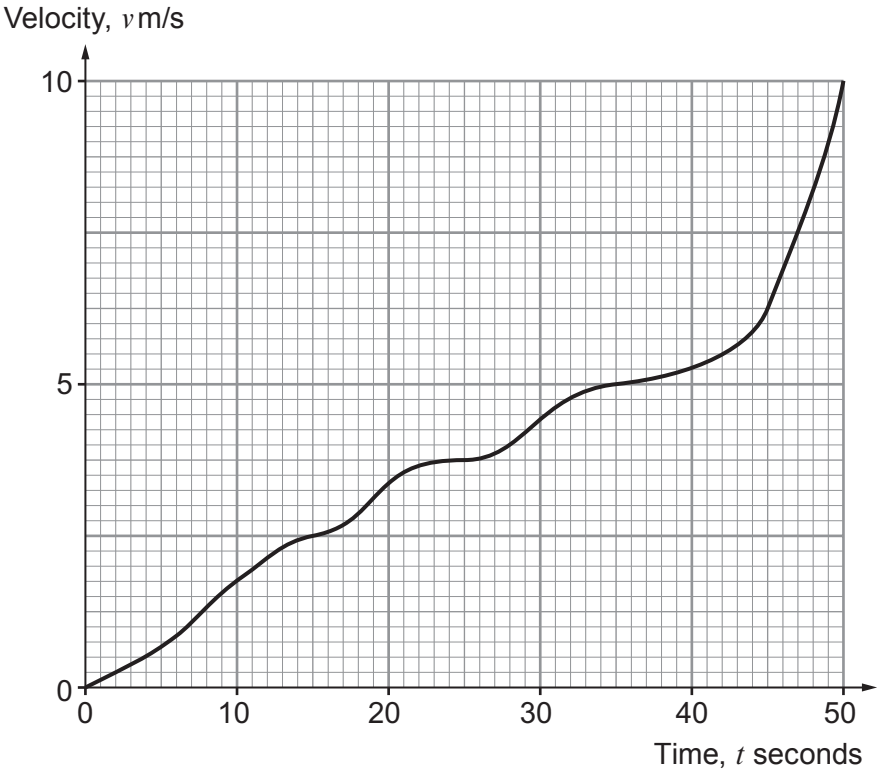


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13. A velocity-time graph, representing a 50 second journey of a car accelerating from 0 m/s, is shown below.



(a) Calculate the velocity of the car in km/h at time t = 50 seconds. [3]

.....

.....

.....

Velocity: ..... km/h

(b) Calculate an estimate for the acceleration at time t = 30 seconds.
You must give the units for your answer. [4]

.....

.....

.....

Acceleration: .....

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(c) Calculate an estimate for the distance travelled by the car in the first 30 seconds. [3]

Distance travelled .....

(d) Over the same period, the velocity of another car is given by the equation $v = 0{\cdot}004t^2$. Other than at t = 0 seconds and t = 50 seconds, find the value of t for which the velocities of the two cars are the same.
Give your answer correct to the nearest second. [4]

Time t: ..... seconds

END OF PAPER

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GCSE MARKING SCHEME

APPLICATIONS OF MATHEMATICS (LINKED PAIR PILOT)

JANUARY 2014

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INTRODUCTION

The marking schemes which follow were those used by WJEC for the January 2014 examination in GCSE APPLICATIONS OF MATHEMATICS (LINKED PAIR PILOT). They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

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Unit 1 Higher Tier	5
Unit 2 Foundation Tier	10
Unit 2 Higher Tier	14

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APPLLICATIONS UNIT 1
FOUNDATION TIER

<table>
<tr><th>Applications Unit 1 Foundation Tier January 2014</th><th>Mark</th><th>Comment</th></tr>
<tr><td>1. (a) Arrow drawn or indicated to 530 (grams)

(b) Circle drawn with radius 3.1cm</td><td>B3

B2

5</td><td>Accept indication between 520 and 540 exclusive
Award B2 for sight of 350 + 180 (=530)
OR correct evaluation indicated on diagram of 350 + “their 180”
Award B1 for sight of 180
OR for 350 + “their 180”
e.g. 350 + 190 (=540) or 350 + 140 (=490)
±2mm. Award B1 for circle with radius 6.2cm or attempt of drawing circle with radius 3.1cm</td></tr>
<tr><td>2. (a) 6 inches = 15 cm
4 inches = 10 cm

(b) 15 × 10
= 150 (cm^2)
(c) (15 + 10) × 0.55

= (£)13.75
(d) Attempt to count area
Estimate area within range 34 - 40
‘Their area’ × 3
Answer</td><td>B1
B1

M1
A1
M1

A1
M1
A1
M1
A1
10</td><td>

If 6 and 4 used in (b) and/or (c) penalise -1 once only
FT from (a) including use of 6 and 4 (inches).

M1 for substitution of values. FT from (a) including use of 6 and 4 (inches). For substitution, accept 25 × 0.55

FT “their area”
Note: for 34 – 40 area is 102 - 120</td></tr>
<tr><td>3. Rounded values
<table><tr><th>Item</th><th>Cost</th></tr><tr><td>Chicken curry</td><td>£3</td></tr><tr><td>Pizza</td><td>£3</td></tr><tr><td>Washing Powder</td><td>£6 or £6.10</td></tr><tr><td>Butter</td><td>£1 or £1.10</td></tr><tr><td>Bread</td><td>£1 or 90p</td></tr></table>
Approximate total = £14 or £13.90 or £14.10 or £14.20

Suitable explanation e.g. “ shopkeeper added £89 not 89 pence”</td><td>B3

B1

E1

5</td><td>Award B3 for all 5 values rounded
Award B2 for 3 or 4 values rounded
Award B1 for 1 or 2 values rounded

FT their approximated values if at least B2 awarded. If added up prices to give £14.12 and gives approximate value to be £14 award final B1

Accept “he forgot the decimal point for the 89 pence”</td></tr>
<tr><td>4. (a) longest jump = 4.41 (m)
Shortest jump = 4.08 (m)

(b) Adding numbers (= 34)
34 ÷ 8
Mean = 4.25(m)
In order 4.08, 4.10, 4.17, <u>4.25, 4.27</u>, 4.36, 4.36, 4.41
Median = 4.26(m)
Mode = 4.36(m)
Range = 0.33(m) or 33(cm)</td><td>B1
B1

M1
m1
A1
M1
A1
B1
B1
9</td><td>Award B1 for correct answers in incorrect place.

Attempt to add numbers
FT ‘their 34’
CAO
Accept sight of only 4.25 and 4.27

FT their values in part (a)</td></tr>
</table>

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Applications Unit 1 Foundation Tier January 2014	Mark	Comment
5. (a) (2 adults & 1 child Upper Circle row C) Sight of 30 and 30 and 15 (= 2 × (£)30 + (£)15 = 75) (2 senior citizens Mid Stalls row F) Sight of 30 and 30 (= 2 × (£)30 = 60) (4 adults & 3 children Balcony A) Sight of 4 lots of 25 and 3 lots of 12.5(0) (= 4 × (£)25 + 3 × (£)12.5(0) = 137.50) Intention of adding their appropriate costs Total cost of tickets = (£)272.5(0)	B1 B1 B1 M1 A1	CAO
<u>Notes:</u> QWC2 can only be awarded if the correct unit is shown in the final answer and the zero is included in the final answer. QWC2 requires words (labels) throughout the response not just connected to the final answer. Look for • spelling • clarity of text explanations, labels • the use of notation (watch for the use of '=', '£' and '0' appropriately used) QWC2: Candidates will be expected to • present work clearly, with words explaining process or steps. **AND** • make few if any mistakes in mathematical form, spelling, punctuation and grammar and include units in their final answer QWC1: Candidates will be expected to • present work clearly, with words explaining process or steps. **OR** • make few if any mistakes in mathematical form, spelling, punctuation and grammar and include units in their final answer	QWC 2	QWC2 Presents relevant material in a coherent and logical manner, using acceptable mathematical form, and with few if any errors in spelling, punctuation and grammar. QWC1 Presents relevant material in a coherent and logical manner but with some errors in use of mathematical form, spelling, punctuation or grammar OR evident weaknesses in organisation of material but using acceptable mathematical form, with few if any errors in spelling, punctuation and grammar. QWC0 Evident weaknesses in organisation of material, and errors in use of mathematical form, spelling, punctuation or grammar.
(b) length of each rectangular hall = 225 ÷ 3 = 75 Area of Flower Hall = 75 × 52 = 3900 (m^2) Mark final answer	M1 A1 M1 A1 11	*Alternative Method* *Total area of rectangular halls = 225 × 52* *= 11700* *Area of flower hall = 11700 ÷ 3* *= 3900 (m^2)*
6. D C A	B1 B1 B1 3	

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Applications Unit 1 Foundation Tier January 2014	Mark	Comment
7. (a) 360 – (90 + 90 + 55) = 125(˚) 125(˚) is more than 90(˚) but less than 180(˚) which is an obtuse angle (b) angle of 55˚ drawn Line of 8cm drawn Shape completed (c) Missing length of shape measured (approx 4.3cm) Length of gold border = 6.5 + 9 + 8 + (4.3) = (27.8) (cm)	M1 A1 E1 B1 B1 B1 B1 M1 A1 9	 Accept "looks more than 90(˚) but less than 180(˚). Must be a full explanation. ±2˚ ±2mm Award this B1 provided at least B1 awarded previously. ±2mm. FT their quadrilateral provided not a rectangle. FT their 4.3. Accept measurements ±2mm for 8cm
8.(a)(i) $4n$ (ii) $8n$ (b) $a + 3b$	B1 B2 B2 5	Accept $n \times 4$ or $n4$ or $n + n + n + n$ Award B1 for a correct expression not fully simplified Award B1 for a correct expression not fully simplified OR B1 for either term correct written as an expression OR both terms correct but not written as an expression.
9.(a) Reason, e.g. 'outside the juice bar', 'mostly younger people use juice bars' (b) Any 2 of: 'No under 15s', '30 appears in two boxes', 'may object to giving their age' (c) (i) Explanation, e.g. 'vague', 'no options', 'open question', 'can't display answers easily', 'can't answer if answer to Q2 is NO', 'many payment methods', 'not same pattern as Q1 & Q2', 'no boxes to tick' (ii) States 'need to give options', 'change question to allow for no drink bought' OR give some options, e.g. card, cash, vouchers from phone, etc	E1 E2 E1 B1 5	Accept reference to question 2. Accept reference to age bias E1 for each response. Do not accept: Over 40s in one group, gaps between ages different *Mark responses in the sections they appear, do not pick out responses in other sections.* *In all parts ignore additional information given by the candidate once a correct response has been given credit.*
10. (4, -3) (-3, -5)	B2 2	B1 for either or for marking both correct points on the grid. SC1 for (-2.5, 6.5) or (-7, 9)
11.(a) At least 2 sides of a triangle 6 cm (±2mm) Construction arcs to make at least 1 60° (±2°) angle Accurate triangle (see overlay) (b) Lines parallel to each side a distance of 2cm (±2mm) away Arc 2cm (±2mm) centred on at least one vertex Correct drain placement (as overlay)	 M1 M1 A1 M1 M1 A1 6	*Penalise -1 for incorrect scale in (a), then FT* Depends on M2 *Penalise -1 for incorrect scale in (b), then FT*

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Applications Unit 1 Foundation Tier January 2014	Mark	Comment
12.(a) Explanation, e.g. 'no box had less than 200g', or 'no underweight boxes of pasta', '**all other** boxes must weigh more (than 205g)', or similar	E1	Do not accept '**some** of the **other** boxes weigh more', or 'all boxes weigh more'. Do not accept a repeat of the question
(b)(i)		
(3) (4) 7 9 9 9 10 12 (30) (40) 50 60 70 80 90 100 0.1 0.1 0.14 0.15 0.128.. 0.1125 0.111.. 0.12	B1 B1 B2	FT from their cumulative totals to last row Accept truncation to 2d.p. Accept percentages B1 for any 6 correct, or all truncated to 1d.p.
(ii) Uniform scale on vertical axis	B1	
Correct plots (allow joined or not joined)	B2	FT from (b)(i) only for r.f.<1, %<100% Need not start at 0. FT to plots if possible B1 for at least 6 correct plots
(iii) (0.12)	B1	No FT to (iii) for either mark for r.f.>1 Correct response or strict FT from their last relative frequency, but must be ≤ 1
Explanation: e.g. "last point plotted", "all data used"	E1	Do not accept references to most common, all round to 0.12, etc
	10	

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APPLICATIONS UNIT 1
HIGHER TIER

Applications Unit 1 Higher Tier January 2014	Mark	Comment
1.(a) Reason, e.g. 'outside the juice bar', 'mostly younger people use juice bars'	E1	Accept reference to question 2. Accept reference to age bias
(b) Any 2 of: 'No under 15s', '30 appears in two boxes', 'may object to giving their age'	E2	E1 for each response. Do not accept: Over 40s in one group, gaps between ages different
(c) (i) Explanation, e.g. 'vague', 'no options', 'open question', 'can't display answers easily', 'can't answer if answer to Q2 is NO', 'many payment methods', 'not same pattern as Q1 & Q2', 'no boxes to tick'	E1	*Mark responses in the sections they appear, do not pick out responses in other sections. In all parts ignore additional information given by the candidate once a correct response has been given credit.*
(ii) States 'need to give options', 'change question to allow for no drink bought' OR give some options, e.g. card, cash, vouchers from phone, etc	B1 5	
2.(a) At least 2 sides of a triangle 6 cm (±2mm) Construction arcs to make at least 1 60° (±2°) angle Accurate triangle (see overlay) (b) Lines parallel to each side a distance of 2cm (±2mm) away Arc 2cm (±2mm) centred on at least one vertex Correct drain placement (as overlay)	 M1 M1 A1 M1 M1 A1 6	*Penalise -1 for incorrect scale in (a), then FT* Depends on M2 *Penalise -1 for incorrect scale in (b), then FT*
3.(a) Explanation, e.g. 'no box had less than 200g', or 'no underweight boxes of pasta', '**all other** boxes must weigh more (than 205g)', or similar (b)(i)	E1	Do not accept '**some** of the **other** boxes weigh more', or 'all boxes weigh more'. Do not accept a repeat of the question
(3) (4) 7 9 9 9 10 12 (30) (40) 50 60 70 80 90 100 0.1 0.1 0.14 0.15 0.128.. 0.1125 0.111.. 0.12	B1 B1 B2	FT from their cumulative totals to last row Accept truncation to 2d.p. Accept percentages B1 for any 6 correct, or all rounded or truncated to 1d.p.
(ii) Uniform scale on vertical axis Correct plots (allow joined or not joined)	B1 B2	FT from (b)(i) only for r.f.<1, %<100% Need not start at 0. FT to plots if possible B1 for at least 6 correct plots
(iii) (0.12)	B1	No FT to (iii) for either mark for r.f.>1 Correct response or strict FT from their last relative frequency, but must be ≤ 1
Explanation: e.g. "last point plotted", "all data used"	E1 10	Do not accept references to most common, all round to 0.12, etc
4. (4, -3) (-3, -5)	B2 2	B1 for either or for marking both correct points on the grid. SC1 for (-2.5, 6.5) or (-7, 9)

(3)	(4)	7	9	9	9	10	12
(30)	(40)	50	60	70	80	90	100
0.1	0.1	0.14	0.15	0.128..	0.1125	0.111..	0.12

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Applications Unit 1 Higher Tier January 2014	Mark	Comment
5.(a)(i) [18 + 12 × 2 + 30 × 0.25] ×1.2 (=49.5(0)×1.2)	M1	Intention ×1.2 however brackets may be missing
(£)59.4(0)	A1	
(ii)(£)35.1(0)	B1	
(b) Sight of 12 × h OR (0).25 × m, m/4	B1	Or equivalent in pence throughout
18 + 12 × h + (0).25 × m OR the product of 1.2 by the sum of at least 2 correct terms	B1	
F = 1.2(18 + 12 h + 0.25m) or equivalent	B2	Accept F= (18 + 12 × h + (0).25 × m) × 1.2 B1 for (F =) 18 + 12 × h + (0).25 × m ×1.2, i.e. missing brackets or partially in brackets OR (18 + 12 × h + (0).25 × m) × 1.2 with any 2 of the 3 terms within the brackets correct *Ignore if F is written as T*
(c) Explanation, e.g. '60×25p is more than the cost per hour', or '£15 paying for an hour charged by the minute, but £12 for the hour', '50×25p (=£12.50) is more than the cost per hour', or 'between 48 and 60 minutes cost more than an hour', or similar	E1	
	8	
6.(Area 1 slab =) 30×40 + ½×30×40 (cm^2) (=1800cm^2)	M1	OR ½ × 40× (60 + 30) (cm^2)
(Area 25 slabs =1800) × 25 (=45000cm^2)	m1	OR 25×0.18, intention their area× 25
(45000÷10000 =) 4.5 (m^2)	B1	Conversion to m^2 or correct use of measures in m with area calculation. 'Their 45000'÷10000 correctly evaluated. This may be done early as each length ÷100, or area single slab ÷10000
(Number of tins of sealant =) 6	B1	FT 'their area'/0.8 evaluated and rounded up Allow for 'their area' of 1 slab, mark is for the intention to divide by 0.8 and round up the answer. Only award for calculations involving rounding up
(Paving slabs) 25 × £8.25 (£206.25) + (+) (6 tins of sealant) 6 × £14.49 (£86.94)	M1	Their full calculation, FT their **whole** number of tins of sealant. Must be whole number of tins
((Total cost = £)293.19	A1	CAO
Look for • use of units, e.g. £, cm^2, m^2 • notation, e.g. '=' • labels for calculations QWC2: Candidates will be expected to • present work clearly, with words explaining process or steps. **AND** • make few if any mistakes in mathematical form, spelling, punctuation and grammar and include units in their final answer QWC1: Candidates will be expected to • present work clearly, with words explaining process or steps. **OR** • make few if any mistakes in mathematical form, spelling, punctuation and grammar and include units in their final answer	QWC 2 8	QWC2 Presents relevant material in a coherent and logical manner, using acceptable mathematical form, and with few if any errors in spelling, punctuation and grammar. QWC1 Presents relevant material in a coherent and logical manner but with some errors in use of mathematical form, spelling, punctuation or grammar OR evident weaknesses in organisation of material but using acceptable mathematical form, with few if any errors in spelling, punctuation and grammar. QWC0 Evident weaknesses in organisation of material, and errors in use of mathematical form, spelling, punctuation or grammar.

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Applications Unit 1 Higher Tier January 2014	Mark	Comment
7. Any common multiple of any 2 of 40, 24 and 16 OR 40 = 2 × 2 × 2 × 5 OR 24 = 2 × 2 × 2 × 3 Working towards a common multiple of 40, 24 and 16, looking at multiples, allowing 1 error in 1 sequence of multiples OR 40 = 2 × 2 × 2 × 5 and 24 = 2 × 2 × 2 × 3 and 16 = 2 × 2 × 2 × 2 2 × 2 × 2 × 2 × 3 × 5 (= 240) or any multiple of 240 Table completed correctly, or sight of correct number of boxes in working, e.g. Springs 6 boxes Washers 10 boxes Rods 15 boxes Or answers 6n, 10n, 15n when n is an integer and n>0	M1 M1 A1 A1 4	Numbers do not need to be prime, accept e.g. 40 = 8×5 OR 24 = 8×3 Accept 40 = 8×5 and 24 = 8×3 and 16 = 8×2
8.(a) Journey 800 km seen or implied Length on map measured, answers in the range 9cm to 10.5cm inclusive 800 ÷ … Sentence completed or implied by correct evaluation (b) Both bearings correct 273°±2° and 030°±2° (c) 2.5×10^{-1} (d) (T =) d/s + b or (T=) $\frac{d + bs}{s}$ or equivalent	B1 B1 M1 A1 B2 B2 B2 10	FT 800 ÷ 'their measurement in cm' B1 for either bearing correct ±2°, or both correct ±3°, or for 270±3° with 30±2° B1 for 0.25(km), or for 'their answer' in km correctly expressed in standard form, provided 'their answer'<1 or 'their answer' >10 SC1 for 2.5×10^4 (25000 in standard form) B1 for (T=) t + b with sight of d/s elsewhere

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Applications Unit 1 Higher Tier January 2014	Mark	Comment
9.(a)(i) Mid points 2.5, 5.5, 8.5, 11.5 2.5×32 + 5.5×26 + 8.5×14+ 11.5×2 (=365) ÷ 74 (£)4.93(2…) (ii) (£)11.99 (b)(i) 60, 61, 63, 69 (ii) Correct plots at mid interval points Solid trend line shown (iii) Any 2 suitable comments about number of visitors (not the lines) one comment on time series and one comment on the trend line	B1 M1 m1 A1 B1 B3 P2 L1 E1 E1 13	 FT their mid-points (within & including bounds) Their Σfx ÷ 74. Accept reasonable rounding from correct working Allow (£)12 B2 for any two correct entries, B1 for correct method seen, or 1 correct entry FT for their values from (b)(i) P1 for any 2 correct plots or a consistent translation for all correct values to labelled season (bounds) FT from P1. Allow a dotted line FT from (b)(i) and their trend line Do not accept descriptions of the lines Accept 'summer more popular' Do not accept 'steeper' (refers to the line not visitors)
10. $1000^{2/3}$ | $\mathbf{10^2}$ | $\mathbf{1 \times 10^2}$ $\mathbf{1000^4}$ | 10^{12} | $\mathbf{1 \times 10^{12}}$ $1000^{-1/3}$ | $\mathbf{10^{-1}}$ | $\mathbf{1 \times 10^{-1}}$ $\mathbf{1000^{-8}}$ | 10^{-24} | $\mathbf{1 \times 10^{-24}}$	B4 B2 6	B1 for each of 10^2, 1000^4, 10^{-1} and 1000^{-8} in the correct cell For standard form entries, FT from their penultimate column written in standard form, OR B1 for at least one standard form correct or FT
11. Strategy: use of ratio and πr^2 Use of A : B is 2 : 3 or sight of 2/5 Area circle = $\pi \times 1.5^2$ Area A = $(2/5) \times \pi \times 1.5^2$ = 2.8(27.. cm^2)	S1 B1 B1 M1 A1 5	May included use of a three stage ratio, e.g. 2 parts of 7 Mark final answer
12.(a) 5 (athletes) (b) 15 (athletes) (c) 45 – 25 = 20 (seconds) (d) t | 0 to 10 | 10 to 15 | 15 to 20 | 20 to 25 | 25 to 30 | 30 to 40 | 40 to 50 f | 0 | 5 | 0 | 5 | 5 | 5 | 20 f.d. | 0 | 1 | 0 | 1 | 1 | 0.5 | 2 Axes labelled 'frequency density' and 'time' with appropriate scales, with at least 1 correct bar Correct histogram (as acetate)	B1 B1 M1 A1 B1 B1 B1 M1 A1 9	 Indication of groups Allow 20 to 30 taken as one group Correct frequency. FT for their groups, provided there are at least 4 groups Frequency density, FT from a total of 1 or 2 errors in groups and/or frequencies FT from their frequency densities, but not from raw data (frequency) and not cumulative data (cumulative frequency) *If M0, A0, allow SC1 for correct histogram with correct groups, but axes not labelled*

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Applications Unit 1 Higher Tier January 2014	Mark	Comment
13.(a) (10) × 60 × 60	M1	
÷ 1000	M1	
36 (km/h)	A1	
(b) Tangent at t = 30	M1	
Use of difference in v / difference in t	M1	Accept with or without sight of a tangent
Acceleration …… (reasonable for their tangent)	A1	Must be evaluated from their tangent
m/s^2 or ms^{-2}	U1	Independent
(c) Use of area under the curve from 0 to 30 seconds	S1	*Treat area 0 to 50 seconds as MR-1 then FT*
Correct method, including ½×4×30 or ½×5×30	M1	Accept any suitable calculation for 1 or more blocks of area
Correct answer to calculation, e.g. 60(m) to 75(m)	A1	If units are given they must be correct *Trapezium rule (approximate values)* *10×[0+4.4+2(1.75+3.4)]/2 =73.5(m)*
(d) Attempt to find at least one point, i.e. value of v for a value of t between 10 and 50	S1	t: 10, 20, 30, 40, 50 v: 0.4, 1.6, 3.6, 6.4, 10
At least 2 correct plots or 2 appropriate values of v	P1	
Suitable curve between 30 and 40 or 3 values of v evaluated in the interval $30 \leq t \leq 40$	C1	
(t is) 35 or 36 seconds (to the nearest second)	B1	CAO *Allow B4 for a correct answer resulting from a substitution or trial method*
	14	

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Surname	Centre Number	Candidate Number
Other Names		0

GCSE LINKED PAIR PILOT

4361/02

APPLICATIONS OF MATHEMATICS

UNIT 1: Applications 1
HIGHER TIER

A.M. FRIDAY, 14 June 2013

2 hours

ADDITIONAL MATERIALS

A calculator will be required for this paper.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** the questions in the spaces provided.

Take π as 3·14 or use the π button on your calculator.

INFORMATION FOR CANDIDATES

You should give details of your method of solution when appropriate.

Unless stated, diagrams are not drawn to scale.

Scale drawing solutions will not be acceptable where you are asked to calculate.

The number of marks is given in brackets at the end of each question or part-question.

You are reminded that assessment will take into account the quality of written communication (including mathematical communication) used in your answer to question 7*(c)*(ii).

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1	**5**	
2	**11**	
3	**3**	
4	**10**	
5	**8**	
6	**4**	
7	**12**	
8	**11**	
9	**10**	
10	**4**	
11	**5**	
12	**8**	
13	**9**	
TOTAL MARK		

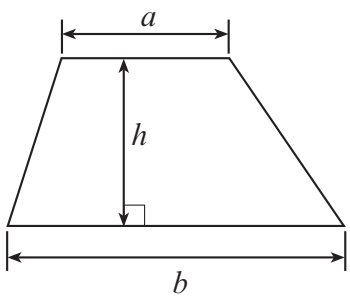
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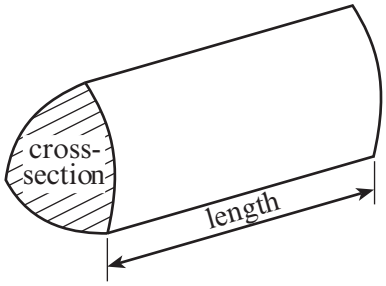
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Formula List

Area of trapezium = $\frac{1}{2}(a + b)h$

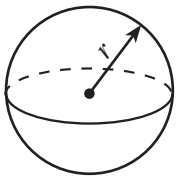


Volume of prism = area of cross-section × length



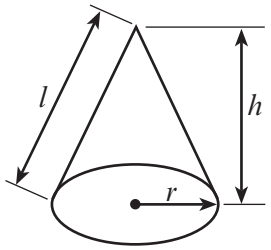
Volume of sphere = $\frac{4}{3}\pi r^3$

Surface area of sphere = $4\pi r^2$



Volume of cone = $\frac{1}{3}\pi r^2 h$

Curved surface area of cone = $\pi r l$

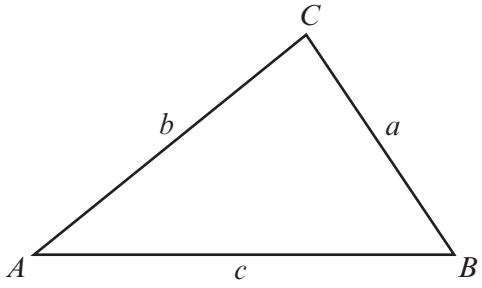


In any triangle ABC

Sine rule $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Cosine rule $a^2 = b^2 + c^2 - 2bc\cos A$

Area of triangle = $\frac{1}{2}ab\sin C$



The Quadratic Equation

The solutions of $ax^2 + bx + c = 0$

where $a \neq 0$ are given by

$$x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$$

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1. Huw has designed a new clothes hook.

He has made a rough sketch as shown below.

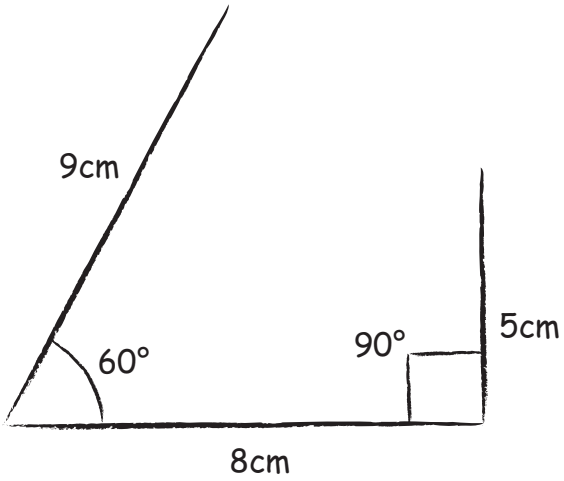


Diagram not drawn to scale

Use a pair of compasses and a ruler only to construct an accurate drawing of Huw's design.
You **must** show all your construction lines.

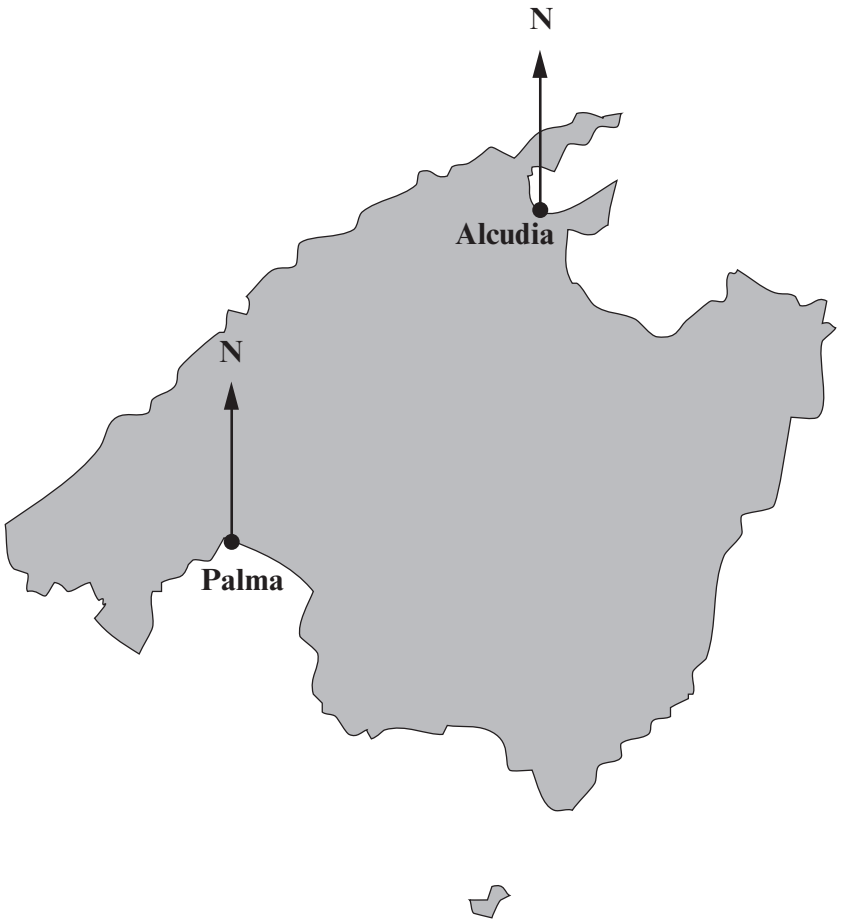
[5]

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2. The map below shows the island of Majorca.



(a) Find the bearing of Palma from Alcudia. ..... ° [1]

(b) Arta is another place on the island of Majorca.
Arta is on a bearing of 073° from Palma and on a bearing of 130° from Alcudia.
Indicate where Arta is on the above map of Majorca. [3]

(c) The distance between Alcudia and Palma is 54 km.

Write down the scale of the map in the form 1 cm: ..... m

.....

.....

.....

.....

1 cm: ..... m

[3]

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(d) A new runway site is being planned for a different island.
A diagram of the plan for the runway site is shown below.

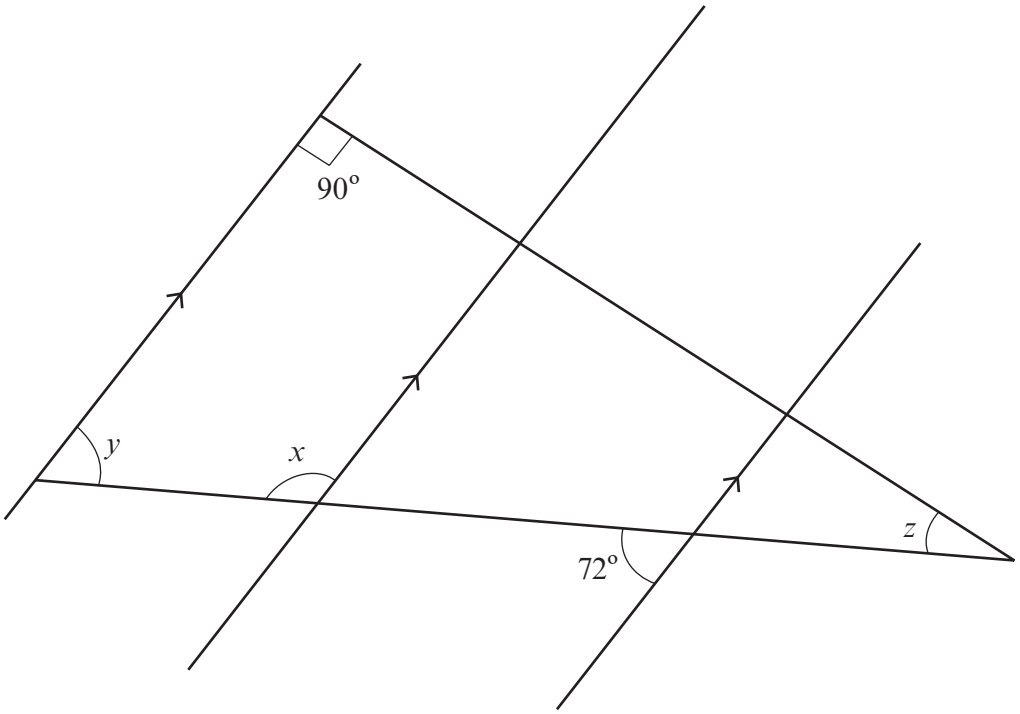


Diagram not drawn to scale

Find the size of the angles x, y and z.

.....

.....

.....

.....

x = ... ° y = ... ° z = ... °

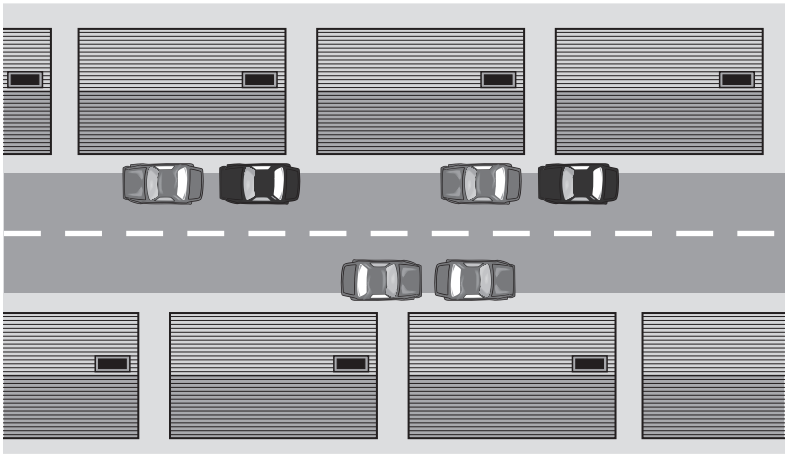
[4]

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3. *(a)* The diagram shows an aerial view of some cars parked in a street in Spain. The scale of the map is not shown.



Using the cars as a guide, complete the following statement.

1 cm represents approximately ..... **metres**

[1]

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(b) A different aerial view shows a tree with its branches spreading 2 metres in all directions from the tree trunk.
The tree has many branches and many, many leaves.
Using a scale of 1 cm to represent 0·5 metres, show how this tree would look from an aerial view. [2]

•
Tree trunk

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4. In an experiment, the weight added to the end of a vertical spring is gradually increased.

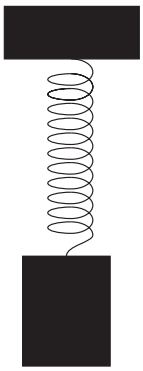
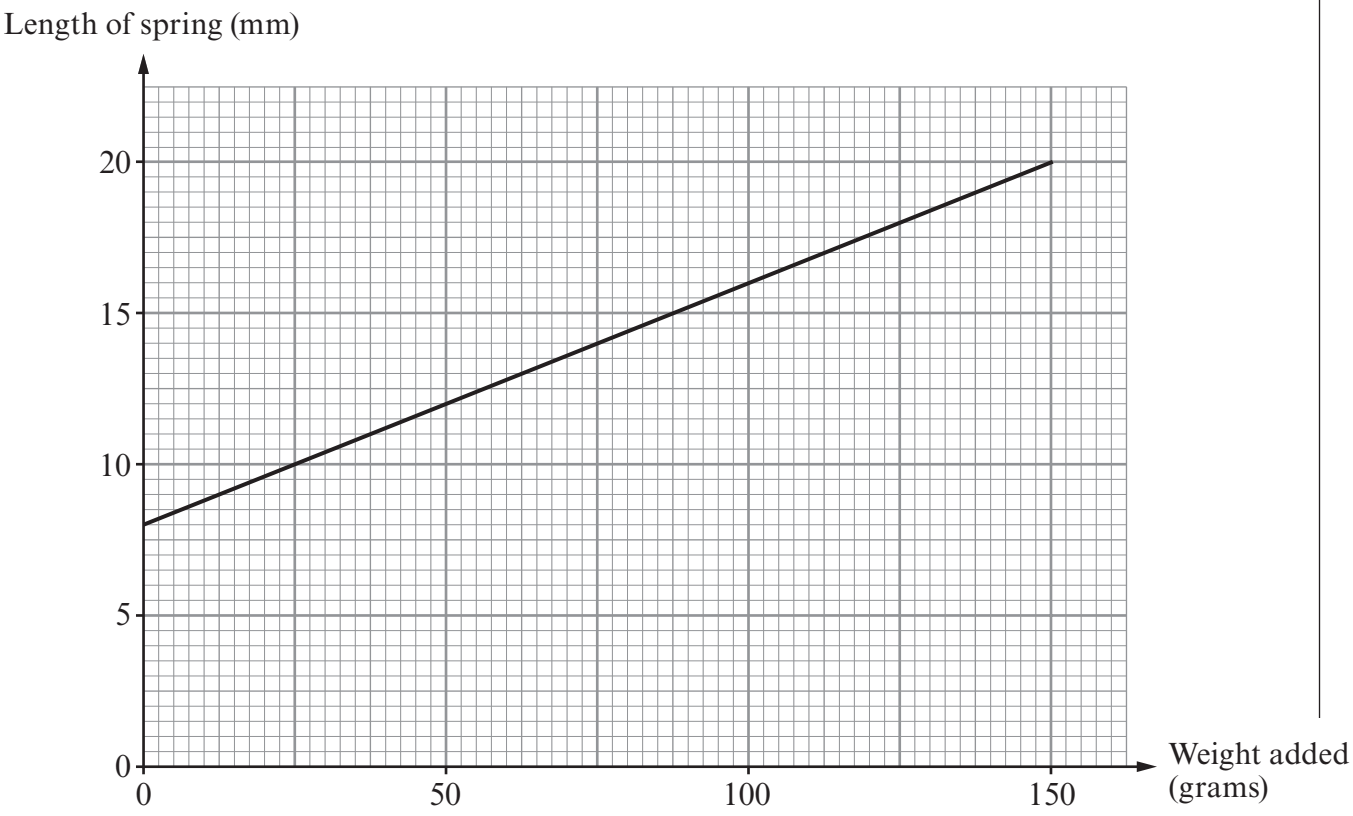


Diagram not drawn to scale

At the end of the experiment, a computer produced the graph shown below.



(a) Write down the length of the spring without any weight added.

.....

[2]

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(b) (i) Calculate the gradient of the straight line drawn on the graph.

.....

.....

.....

.....

[2]

(ii) Explain what the gradient of this graph tells you in relation to the experiment.

.....

.....

.....

[2]

(c) The straight line stops before the right-hand edge of the graph paper.
Why do you think this might be?

.....

.....

[1]

(d) In a similar experiment, weights of up to 100 g are added to the end of a different spring. The following data is recorded.

Weight added, W (grams)	0	100
Length of spring, L (mm)	35	235

Using the data given above, complete the formula to give the length of the spring, L mm, for different weights added, W g.

.....

.....

.....

.....

.....

.....

$L =$ ..... $W +$ .....

[3]

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5. *Dees Print*, a graphic design company, finds that they use 2 yellow, 8 red and 20 black cartridges each week. So, *Dees Print* always orders yellow, red and black cartridges in the ratio 2 : 8 : 20 respectively.



(a) *Dees Print* orders 210 cartridges in total.
How many cartridges of each of the colours yellow, red and black are there in this order?

.....

.....

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.....

Number of yellow cartridges .....

Number of red cartridges .....

Number of black cartridges .....

[3]

(b) In another order, x yellow cartridges are ordered, along with the corresponding number of red and black cartridges.
T is the total number of cartridges in the order.
Write down a formula for T in terms of x.
Give your answer in its simplest form.

.....

.....

.....

.....

.....

[3]

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(c) A new cupboard is bought to store cartridges.
It can hold a total of P cartridges.
When the cupboard is full, the number of yellow, red and black cartridges stored will always be in the ratio 2 : 8 : 20 respectively.

Write down an expression, in terms of P, for the number of **red** cartridges this cupboard can hold.

.....

.....

.....

.....

.....

[2]

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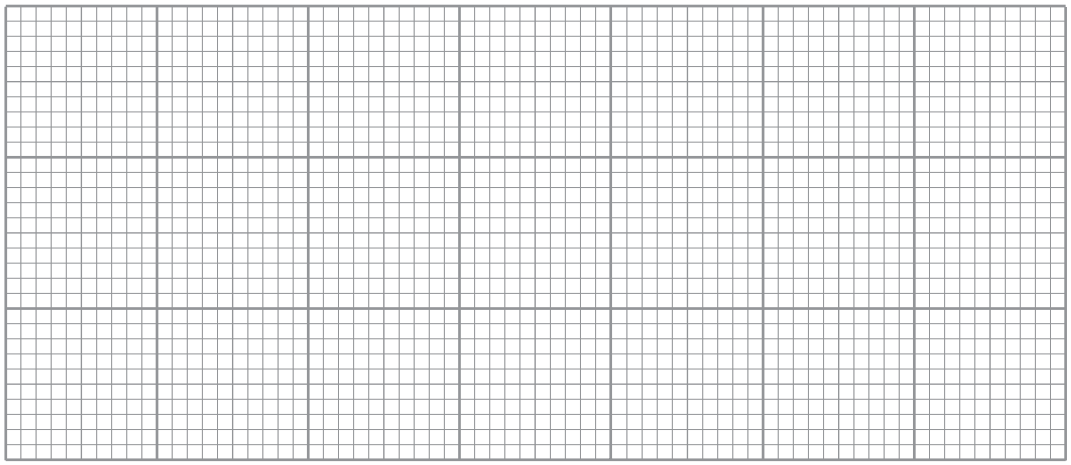
6. Iona needs to give a presentation to her work team.
Her boss has asked her to include a box-and-whisker plot in her presentation.
Iona works in a sales team, selling new telephone systems to large companies.
She had been given some sales data by her boss, as shown below.

Cheapest system sold	£30
Most expensive system sold	£140
Median price of systems sold	£60
Lower quartile price of a system	£50
Upper quartile price of a system	£100

On the graph paper below, draw a box-and-whisker plot using the data that Iona has been given.

.....

.....



[4]

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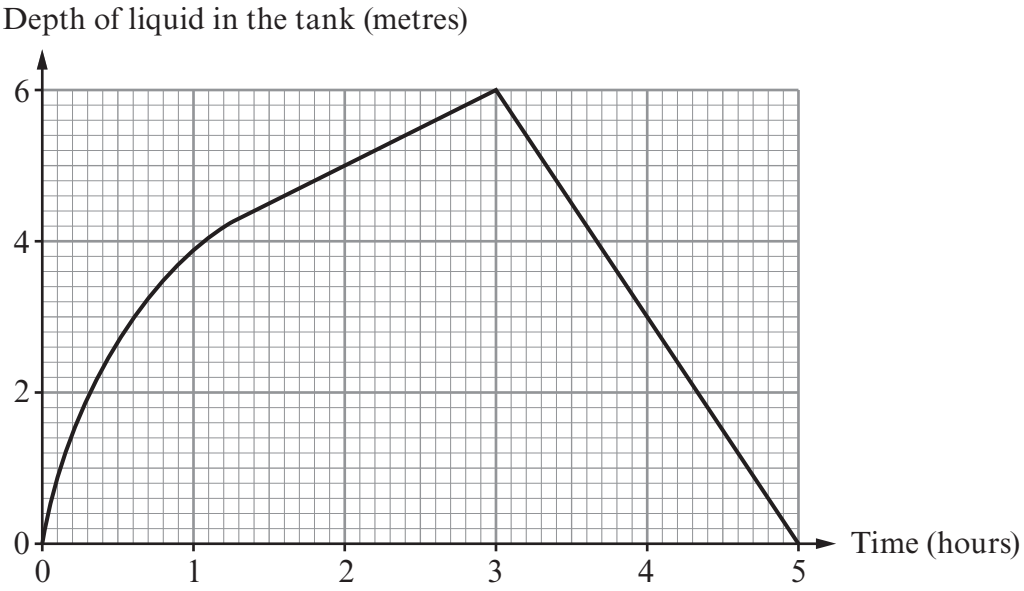
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7. A chemical factory makes a liquid that is used in the production of a waterproof fabric. A cylindrical tank is used to collect the liquid made in the factory.

The moment the tank is full, it starts to empty the liquid into a tanker in readiness for delivery to a company which makes the waterproof fabric.

This process is continuous during the week, but the production stops at weekends for maintenance.

The graph shows the process of the tank being filled and emptied into the tanker.



(a) What is the depth of the liquid in the tank $2\frac{1}{2}$ hours into the process?

..... metres

[1]

(b) How long, in minutes, does it take to half fill the cylindrical tank?

.....

.....

.....

.....

[2]

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(c) The tank is left empty over the weekend.
The continuous process starts each Monday at 07:00 by filling the tank.
This process of filling and emptying the tank continues until shutdown on Friday.

(i) Explain what is happening at 20:00 on Monday, giving the depth of the liquid in the tank.

.....

.....

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.....

.....

[3]

(ii) *You will be assessed on the quality of your written communication in this part of the question.*

The process has to shut down with the tank empty as soon after, but not before, 19:00 on a Friday. At what time should the process shut down on a Friday?
You must show all your working.

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[6]

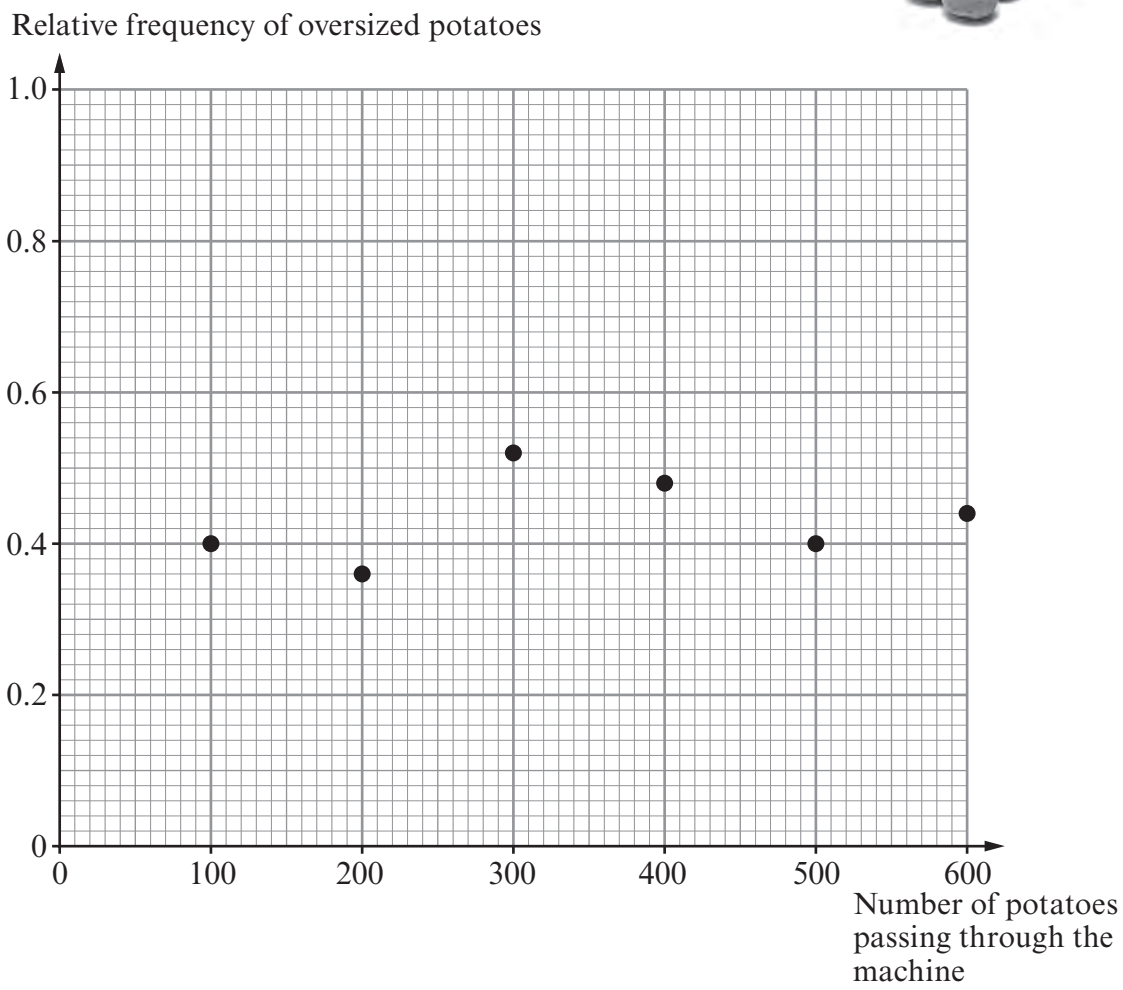
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8. A potato producer uses a machine to sort his potatoes.
The potato producer carried out a survey to investigate the probability of oversized potatoes passing through his sorting machine.
The relative frequency of oversized potatoes passing through the machine was calculated after a total of 100, 200, 300, 400, 500 and 600 potatoes.
The results are plotted on the graph below.





(a) Write down the best estimate for the probability that one of these potatoes, selected at random, will be oversized.
You must give a reason for your answer.

.....

.....

.....

.....

.....

.....

[2]

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(b) A trader offers to buy oversized potatoes at 15p each.
How much would the potato producer receive if he decided to sell, to the trader, all the oversized potatoes in the first 100 potatoes sorted by the machine?

.....

.....

.....

.....

[3]

(c) The potato producer decides not to sell his potatoes to the trader.
He sells 900 potatoes to a market stall holder.
The potato producer sells these potatoes for £4.50 per 100 potatoes.
He has agreed with the market stall holder that he will give a 2p refund per oversized potato discovered.
What would your best estimate be for the amount you would expect the potato producer to make from this transaction?

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[6]

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9.



Some data is found on two different websites, **www.sciencenow.com** and **www.planetalong.uk** about some of the planets.
The data found varies slightly between the two websites.

www.sciencenow.com		
Planet	**Radius, km**	**Mass, kg**
Mercury	2439	$3{\cdot}30 \times 10^{23}$
Venus	6052	$4{\cdot}87 \times 10^{24}$
Earth	6378	$5{\cdot}98 \times 10^{24}$
Mars	3397	$6{\cdot}42 \times 10^{23}$
Jupiter	71 492	$1{\cdot}90 \times 10^{27}$

www.planetalong.uk		
Planet	**Radius, km**	**Mass, kg**
Mercury	2439	$3{\cdot}3 \times 10^{23}$
Venus	6052	$4{\cdot}9 \times 10^{24}$
Earth	6378	$6{\cdot}0 \times 10^{24}$
Mars	3394	$6{\cdot}4 \times 10^{23}$
Jupiter	71 398	$1{\cdot}9 \times 10^{27}$

(a) Write down the radius of Mars, in km, correct to three significant figures in standard form for both of the websites.

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www.sciencenow.com ..... km

www.planetalong.uk ..... km

[3]

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(b) Use the data found at **www.sciencenow.com** to complete the statement below.
Give your answer correct to two significant figures.

Mass of Venus = ... × Mass of Mercury

.....

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[3]

(c) (i) The masses of the planets are recorded differently on the two websites.
Explain fully this difference.

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[2]

(ii) Calculate the difference between the values stated on the two websites for the mass of Mars.
Give your answer, in kg, in standard form.

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[2]

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10. Raul has been asked to look at some data.
He is asked to write the data in the form 2^n, where n is a whole number or a decimal.
Write the following numbers in the form 2^n.

(a) $\dfrac{1}{2^3}$

.....

.....

[1]

(b) $(2^{0\cdot3})^{0\cdot4}$

.....

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[1]

(c) $\left(\sqrt[4]{8}\right)^{12}$

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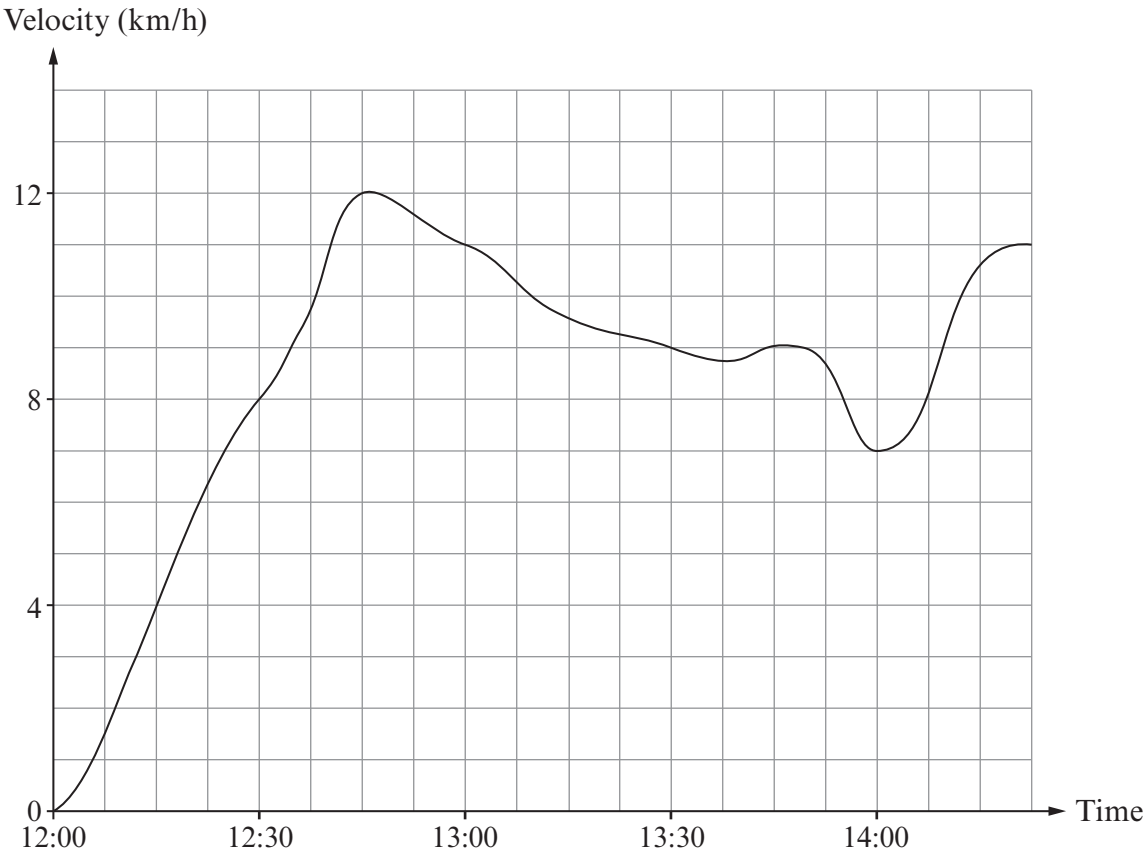
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11. Sue rode her bike along a cycle path.
She started her ride at 12:00.
The graph shows information about her cycle ride.



By considering every $\frac{1}{2}$ hour of Sue's cycle ride, use the trapezium rule to calculate an estimate for the total distance travelled in the first 2 hours.
Give the units of your answer.

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[5]

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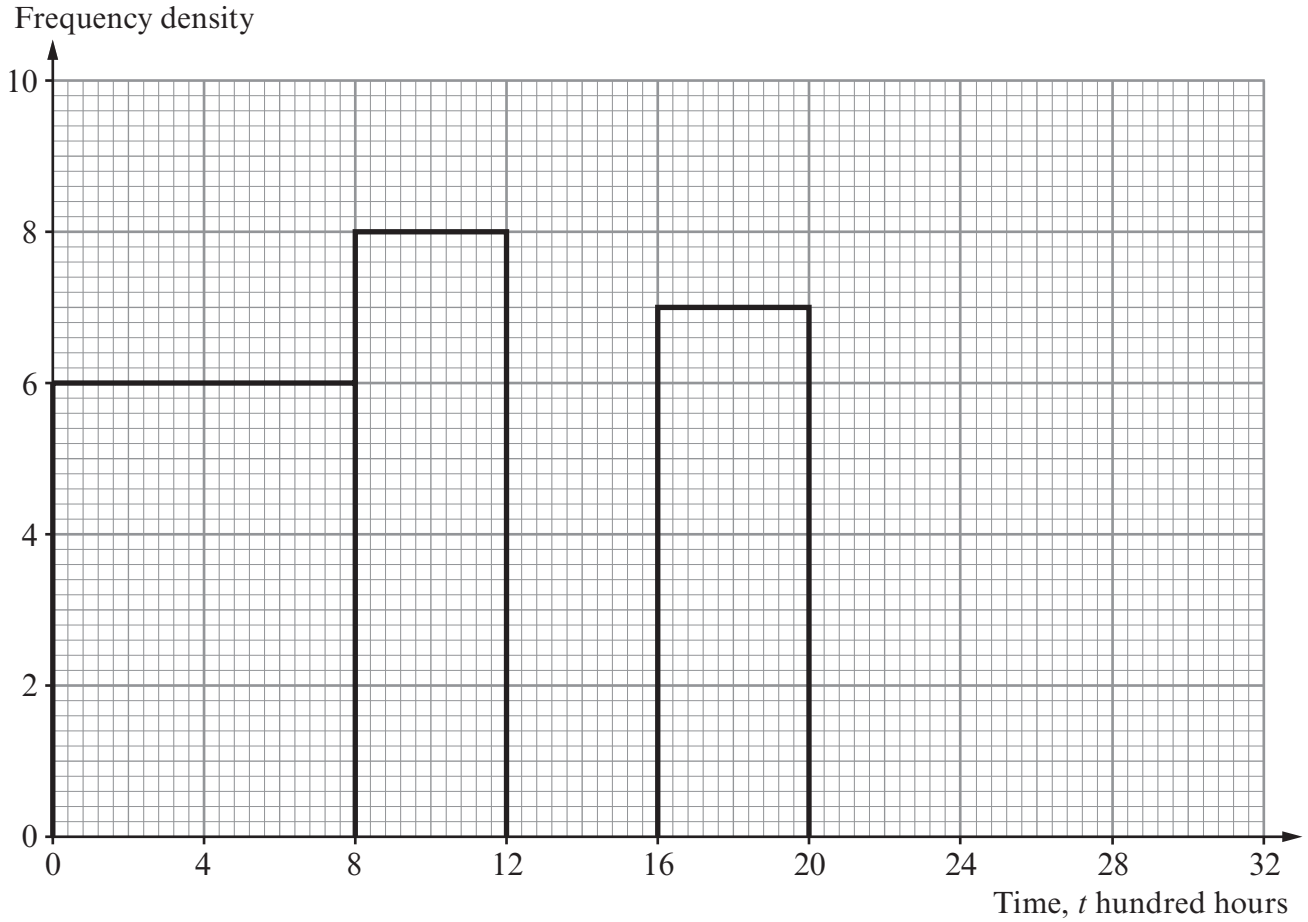
Turn over.

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12. The histogram and frequency table show some information about the time, in hundreds of hours, that a number of similar light bulbs lasted.

Time, t hundred hours	Number of light bulbs
$0 < t \leqslant 8$	48
$8 < t \leqslant 12$	.....
$12 < t \leqslant 16$	40
$16 < t \leqslant 20$	.....
$20 < t \leqslant 30$	20



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(a) Complete the frequency table and the histogram shown opposite.

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[4]

(b) Find the estimate for the number of light bulbs that lasted between 2000 hours and 2400 hours.

.....

[1]

(c) There are 56 bulbs that lasted less than y hundred hours.
Calculate an estimate for y.

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[3]

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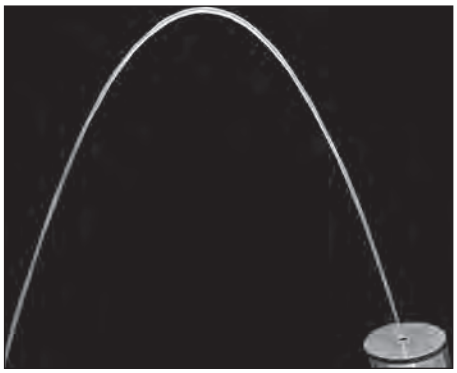
13. A fountain has jets of water that start from water level and reach different heights.



Rosie has taken a photograph of the fountain.
She has also recorded some information about one of the jets of water.

She finds

- the maximum height of the jet of water is 6·25 metres
- at its maximum height it is at a horizontal distance of 2·5 metres from the start of the jet of water
- the shape of the path of the water is a symmetrical curve



Rosie finds that the path of this jet of water is represented by $y = -x^2 + bx$, where y is the vertical height, x is the horizontal distance and b is a constant.

(a) Find the equation that represents the path of this jet of water.

.....

.....

.....

.....

.....

.....

Equation is .....

[4]

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(b) The path of a different jet of water is represented by $y = -x^2 + cx$, where y is the vertical height, x is the horizontal distance and c is a constant.
This jet of water hits the surface of the water in the fountain 6 metres away.
The path of the jet of water is symmetrical.

Draw a sketch of the path of this jet of water.

You must indicate on your sketch
- the horizontal distance measured as the jet of water reaches its maximum height
- the maximum height of the jet of water

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[5]

END OF PAPER

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GCSE MARKING SCHEME

APPLICATIONS OF MATHEMATICS (LINKED PAIR PILOT)

SUMMER 2013

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INTRODUCTION

The marking schemes which follow were those used by WJEC for the Summer 2013 examination in GCSE APPLICATIONS OF MATHEMATICS (LINKED PAIR PILOT). They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

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UNIT 1 (FOUNDATION TIER)

Applications Unit 1 Foundation June 2013		Final
1. (a) (£)5.20 + (£)3.60 (£)8.8(0) (b) (Circuits 5 × (£)4.40 =) (£)22.(00) (Zumba 4 × (£)4.50=) (£)18(.00) (Aqua 3 × (£)4.60=) (£)13.8(0) (Swim) 6 × (£)3.60=) (£)21.6(0) (Total =) (£)75.4(0) (Saves) (£)75.4(0) – (£)33 =(£)42.4(0) Look for • spelling • clarity of labels • the use of notation (watch for the use '=' "£" being appropriate) • 0 consistently missing QWC2: Candidates will be expected to • present work clearly, with words explaining process or steps AND • make few if any mistakes in mathematical form, spelling, punctuation and grammar in their answer QWC1: Candidates will be expected to • present work clearly, with words explaining process or steps OR • make few if any mistakes in mathematical form, spelling, punctuation and grammar in their final answer	M1 A1 B2 B1 M1 A1 Q W C 2 <

4. (a) 2/3 × 8652 = 5768 (b) 4120/8 (=515) 2575 (c) Correct explanation	M1 A1 M1 A1 E1 5	 Eg. "because 8652 rounded to the nearest 1000 is 9000" or "because this is a good estimate" or " it's about 9000"
5. **Event** / **Probability** A. Getting a head on a single throw of a coin. — ½ B. Rolling a 4 on a single roll of an ordinary dice. — 1/6 C. Choosing Friday when selecting a day at random from the days of the week. — 1/7 D. Choosing a letter *t* when selecting a letter at random from the word *stamp*. — 1/5 C B D A	 B2 B1 3	 Accept equivalent percentages or decimals *(Do not accept words used to describe probabilities)* Award B1 if 2 or 3 are correct Penalise -1 once only for consistent use of incorrect notation Accept probabilities to represent the events (1/7, 1/6, 1/5, ½) FT their probabilities
6. (a) (i) Correctly labelled axes and uniform scales used Points plotted **Correct** graph drawn with points joined with straight lines (ii) Explanation of graph given (b) Adding numbers (= 92) 92 ÷ 8 Mean = 11.5 (mph) Put in order 3, 5, 10, 11, 14, 15, 15, 19 Median = 12.5 (mph) Mode = 15 (mph) Range = 16 (mph)	B2 P1 L1 E1 M1 m1 A1 M1 A1 B1 B1 12	Award B1 for either both axes labelled correctly or uniform scales on both axes or one axis labelled correctly with a uniform scale. Penalise -1 if axes are reversed. Allow 1 error CAO. Accept solid or dotted lines Eg. The wind speed increases through the morning (and dies down slightly after 1500.) Accept partial explanations. Attempt to add numbers. Accept sight of values from 73 – 111 as evidence of attempting to add FT 'their 92' CAO Sight of 11 and 14 only would gain M1
7. **Person** / **Could donate blood today? Yes or No** / **Reason** Charlotte — Yes — (Meets all requirements) Aaron — No — Is over age limit Sian — No — Is under weight Alun — No — Gave blood less than 16 wks ago	B4 4	Award B1 for each correct response AND valid reason. If Charlotte 'Yes' accept blank space for reason Aaron is 66. Accept 'age'. Sian weighs 48kg. Accept 'weight'. 14 weeks since last gave blood or too soon to give blood. Accept 'time' (since last donation)
8. (a) Derek (b) Petra **and** reason (c) (i)Uniform scale on kilometre axis Plotting at least two correct points **Correct** straight line through points (ii) Full explanation given Approximately 112 (km)	B1 E1 B1 P1 L1 E1 B1 7	 Accept reason implying Petra, e.g. Petra because graph goes flat Eg use of graph or arithmetic method, eg "he could find what 35 miles is in km and then double it". FT their graph Accept answers in the range 110 – 113(km)

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9.(a) 223(°) $\pm$2° (b) Indication of bearing from Palma 073° $\pm$2° Indication of bearing from Alcudia 130° $\pm$2° Arta indicated (by a cross or name) on the map (c) 108 72 180 = 90 + z + 72, or z = x – 90, or z = 90 – y, or equivalent 18	B1 B1 B1 B1 B1 B1 M1 A1 11	 FT provided at least one correct bearing and Arta is on land FT y = 180 - x Provided x is obtuse and y is acute, and neither is 90° CAO
10.(a) Value between 3 (metres) and 5 (metres) inclusive (b) Circle (intention) with radius 4 cm $\pm$ 2mm drawn	B1 B2 3	 Accept a suitable sketch where clearly the branches are drawn to scale of 4cm $\pm$ 2mm Many branches (covering much of the region) shown within tolerance is sufficient – circumference may not be shown B1 for circle with radius other than 4cm $\pm$ 2mm, or suitable sketch with overall idea of 4cm $\pm$ 2mm radius, or a few branches shown within the tolerance
11. (a) 5.5 (metres) (b) Intention to read horizontal scale for depth of 3m filling 36 (minutes) (c)(i) Use of the 5 hour period Looking 3 hours into the period or equivalent Depth is 6(m), or statement that the tank is full (ii) Strategy to work out how many hours between 0700 Monday and a time on Friday 96 hours to 0700 Friday or 108 hours to 1900 Friday or another correct number of hours from 0700 Monday to a time on Friday Interpretation of a stop time, e.g. ‘3 hours into the process’, or ‘2 more hours’ (Finish time for process is) 21(:)00 or 9pm	B1 M1 A1 S1 B1 E1 S1 B1 B1 B1 10	Accept answers in the range 5.4 to 5.6 inclusive e.g. ‘2 cycles and 3 hours’ Accept e.g. ‘ready for emptying into tanker’, etc e.g. 0700 Mon to 0700 Friday, 4 lots of 24 hours OR working with multiples of 5 hours, or other suitable multiples of hours Allow from 1 slip in adding on time. Or other appropriate correct statement CAO. Or other appropriate correct statement Final B1 implies previous B1 Award all 4 marks for a response of 2100 only if no incorrect working seen, i.e. not a lucky correct answer *If no marks, award SC1 for an answer of 2200 (10pm) by starting at 0700 each day*

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UNIT 1 (HIGHER TIER)

Applications Unit 1 June 2013 Higher Tier		Final
1.(a) 9cm, 8cm and 5cm lines in correct orientation	B1	±2mm on all lengths *No arcs no marks!*
60°±2° constructed using the appropriate arcs	B2	B1 for appropriate arcs but angle slightly outside the tolerance, or for at least one arc correct with the other slightly outside of tolerance together with angle attempted, or for full method clearly attempted
90°±2° by appropriate compasses construction	B2	B1 for appropriate arcs but angle slightly outside the tolerance, or for full method clearly attempted If no construction arcs shown, then B0 apart from first B1 for the lengths
	5	
2.(a) 223(°) ±2°	B1	
(b) Indication of bearing from Palma 073° ±2°	B1	
Indication of bearing from Alcudia 130° ±2°	B1	
Arta indicated (by a cross or name) on the map	B1	FT provided at least one correct bearing and Arta is on land
(c) 6 cm ±2 mm measured	B1	
54÷6 or 9 (km) or 1cm: 9(km)	M1	FT 54÷ 'their 6'. Accept method with incorrect place value
(1cm :) 9000 (m)	A1	
(d) 108	B1	
72	B1	FT y = 180 - x
180 = 90 + z + 72, or z = x – 90, or z = 90 – y, or equivalent	M1	Provided x is obtuse and y is acute, and neither is 90°
18	A1	CAO
	11	
3(a) Value between 3 (metres) and 5 (metres) inclusive	B1	
(b) Circle (intention) with radius 4 cm ± 2mm drawn	B2	Accept a suitable sketch where clearly the branches are drawn to scale of 4cm ± 2mm Many branches (covering much of the region) shown within tolerance is sufficient – circumference may not be shown B1 for circle with radius other than 4cm ± 2mm, or suitable sketch with overall idea of 4cm ± 2mm radius, or a few branches shown within the tolerance
	3	
4(a) 8 mm	B2	B1 for an answer of 8, or for an answer between 6 and 9 inclusive (excluding 8) with mm given
(b) (i)Method, e.g. increase in L / increase in W	M1	Or idea of alternative complete method
e.g. 12/150 (= 0.08)	A1	Accept sight of quotient based on misread of the scale for M1 only. Or alternative complete method with accurate values Mark final answer.
(ii) Full explanation, e.g. 'rate of change length with weight', 'for every 1g increase 0.08mm increase'	E2	E1 for mention of 'rate of change' without being specific, e.g. '1g gives 0.08mm'. Allow 'length increases as weight increases' for E1only
(c) Explanation, e.g. 'no more data recorded', 'spring snaps', 'broken spring', 'spring now completely straight', etc	E1	
(d) $L = 2W + 35$	B3	B2 for either of 2 or 35 correctly placed, or B1 for a correct interpretation of data given, e.g. sketch shows start (0,35) and end (100, 235)
	10	
5(a) 210÷30 (=7)	M1	OR using 1:4:10 to find 210÷15 (=14)
14, 56, 140 in this order	A2	A1 for any one answer correct, or for 14, 56 and 140 in an incorrect order
(b) $T = 15x$	B3	B2 for (T=) $x + 4x + 10x$, or B1 for sight of $4x$ or $10x$ OR 4 and 10
(c) $8P/30$ ($= 4P/15$)	B2	Mark final answer. B1 for 8/30 or P÷30 or P/30 or from simplified ratio P÷15 or P/15 *If no marks, SC1 for sight of 'P = 3.75×variable' or equivalent*
	8	
6.A uniform scale used (shown) at least 30 to 140 with idea of box-and-whisker plot AND with label '£'	B1	
Range of whiskers correct	B1	
Lower and upper quartiles used as ends of the box	B1	
Median shown correctly within the box	B1	
	4	Award B4 for a correct response

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7(a) 5.5 (metres) (b) Intention to read horizontal scale for depth of 3m filling 36 (minutes) (c)(i) Use of the 5 hour period Looking 3 hours into the period or equivalent Depth is 6(m), or statement that the tank is full (ii) Strategy to work out how many hours between 0700 Monday and a time on Friday 96 hours to 0700 Friday or 108 hours to 1900 Friday or another correct number of hours from 0700 Monday to a time on Friday Interpretation of a stop time, e.g. '3 hours into the process', or '2 more hours' (Finish time for process is) 21(:)00 or 9pm Look for • relevance • spelling • clarity/flow of text explanations QWC2: Candidates will be expected to • present work clearly, with words explaining choices AND • make few if any mistakes in mathematical form, spelling, punctuation and grammar in their answer QWC1: Candidates will be expected to • present work clearly, with words explaining choices OR • make few if any mistakes in mathematical form, spelling, punctuation and grammar in their answer	B1 M1 A1 S1 B1 E1 S1 B1 B1 B1 QWC 2 <

10(a) 2^{-3} (b) $2^{0.12}$ (c) 2^{9}	B1 B1 B2 4	 Accept $2^{12/100}$ or equivalent B1 for sight of $8^{12/4}$ or $8^{1/4 \times 12}$ or 8^{3} or $(2^{3})^{3}$ or $(2^{3})^{1/4\times12}$ or equivalent *If a candidate writes only the index, penalise -1 once only on the first occasion*
11. Idea to find 4 areas of strip width ½ hour 2 + 4.75 + 5 + 4 15.75 km	B1 M2 A1 U1 5	 M1 for any 2 of the 4 areas correct, or '2 of their areas' correctly evaluated from an incorrect interpretation of the scale or of the ½ strip requirement, e.g. use of 4 or 30 for the horizontal Other A marks are included by sight of 15.75 Only award A1 for correct calculation based on 4 strips to 14:00 Independent mark. Accept other units from appropriate calculations
12(a) Entries in frequency table: 32 and 28 Histogram: 12 to 16 f.d. **10**, 20 to 30 f.d. **2** (b) 8 (light bulbs) (c) Identifying that the answer is in the range >8 and ≤12 Realise need 8 of the 32 ($8<t\leq12$) or 1/4 of the entry for $8< t \leq 12$ (y =) 9 or 9 hundred hours or equivalent	B2 B2 B1 M1 M1 A1 8	B1 for each correct entry B1 for each correct bar Maybe shown on the histogram. FT from their 32 entry, provided it is >8 Maybe shown on the histogram. FT from their 32 entry, provided it is >8 CAO
13(a) Suitable strategy to find b, e.g. attempt to sketch or by some substitution Either $0 = -5^2 + b\times 5$ or $6.25 = -2.5^2 + b\times 2.5$ $b = 5$ $y = -x^2 + 5x$ (b) Method to find c, e.g $0 = -6^2 + c \times 6$ $c= 6$ Use $y = -x^2 + 6x$ when $x = 3$ (Max height found) y = 9 (metres) Correct sketch with the 3(m across to max ht.) and 9(m height)	S1 M1 A1 A1 M1 A1 M1 A1 B1 9	Accept substitution with use of at least one of the values given but with incorrect interpretation Accept interpretation of $-x^2$ as $(-x)^2$ for M1 only FT their b provided M1 awarded Do not award previous 4 marks for a correct sketch based on spurious or incorrect working.

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Surname	Centre Number	Candidate Number
Other Names		0

GCSE LINKED PAIR PILOT

4361/02

APPLICATIONS OF MATHEMATICS

UNIT 1: Applications 1
HIGHER TIER

P.M. TUESDAY, 15 January 2013

2 hours

ADDITIONAL MATERIALS

A calculator will be required for this paper.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** the questions in the spaces provided.

Take π as 3·14 or use the π button on your calculator.

INFORMATION FOR CANDIDATES

You should give details of your method of solution when appropriate.

Unless stated, diagrams are not drawn to scale.

Scale drawing solutions will not be acceptable where you are asked to calculate.

The number of marks is given in brackets at the end of each question or part-question.

You are reminded that assessment will take into account the quality of written communication (including mathematical communication) used in your answer to question **8***(b)*.

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1	**7**	
2	**4**	
3	**6**	
4	**8**	
5	**8**	
6	**3**	
7	**10**	
8	**8**	
9	**6**	
10	**13**	
11	**13**	
12	**14**	
TOTAL MARK		

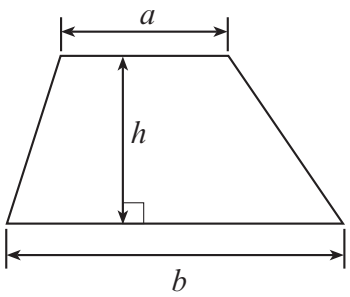
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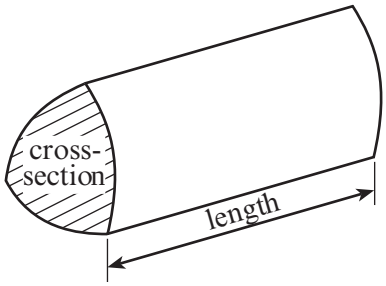
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Formula List

Area of trapezium = $\frac{1}{2}(a + b)h$

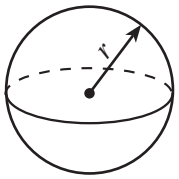


Volume of prism = area of cross-section × length



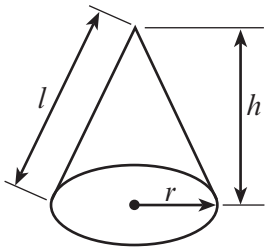
Volume of sphere = $\frac{4}{3}\pi r^3$

Surface area of sphere = $4\pi r^2$



Volume of cone = $\frac{1}{3}\pi r^2 h$

Curved surface area of cone = $\pi r l$

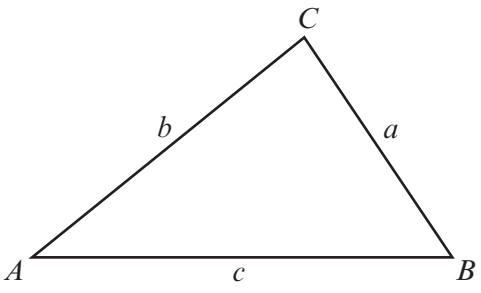


In any triangle ABC

Sine rule $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Cosine rule $a^2 = b^2 + c^2 - 2bc\cos A$

Area of triangle = $\frac{1}{2}ab\sin C$



The Quadratic Equation

The solutions of $ax^2 + bx + c = 0$

where $a \neq 0$ are given by

$$x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$$

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Examiner only

1. *(a)* Write down expressions for each of the following.

(i) The total cost, in pence, of 3 buttons at e pence each and 2 sewing needles at f pence each.

.....

.....

.....

[2]

(ii) The total cost of these buttons and needles in pounds.

.....

.....

[1]

(b) Write down an expression for the number of metres in t kilometres.

.....

.....

[1]

(c) Write down an expression for the following.
The total amount of money donated to a charity by 5 people, given that the mean amount of money each gave was x pounds.

.....

.....

[1]

(d) Write down an expression for the area of the right-angled triangle shown below written in its simplest form.

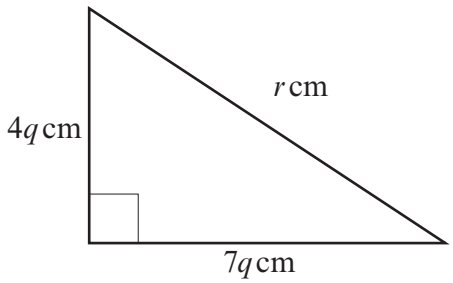


Diagram not drawn to scale

.....

.....

[2]

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Turn over.

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4361 020003

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2. Owen works in a DIY warehouse.
He is asked to sort some tiles.
He has the following shapes of tiles to sort.

Square Kite Rhombus Parallelogram

(a) He is asked to sort the tiles using the table shown below.
Complete the table.

Tiles with equal diagonals	All other tiles

[2]

(b) Owen is then asked to sort the tiles differently using the table shown below.
Complete the table.

Tiles with opposite sides parallel	All other tiles

[2]

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3. *(a)* Abby is having difficulty deciding on a four-digit code for her debit card.



To generate a code, she decides to write down an expression in which she would substitute her age.
When an expression produces a four-digit number, she could then use it as her code.
Abby is 17 years old.
In each of the following expressions, y is Abby's age.

Evaluate the expressions to find which of them Abby could use to produce a four-digit code for her debit card.
You must show all your working and answers.

$y^2 - 2y$

.....

.....

$3y(2y^2 + 5)$

.....

.....

.....

$\frac{289y + 502}{5}$

.....

.....

Abby's four-digit code .....

[4]

(b) Charlie is also having difficulty deciding on a four-digit code.
He decides to use the smallest four-digit number he gets by squaring a prime number.
Find Charlie's four-digit code.

.....

.....

.....

.....

[2]

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4361 020005

Examiner only

4. A survey is to be carried out to find out how popular MP3 players are across the various age groups of the general population.
The survey is carried out by asking people questions as they come out of a cinema.
Two questions from the survey questionnaire are shown below.

1. How old are you?

Put a tick in the box

under 10	☐
10 to 20	☐
20 to 30	☐
older than 30	☐

2. Do you own an MP3 player?

Put a tick in the box

Yes	☐
No	☐

(a) Is this a biased survey? Give a reason for your answer.

.....

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[1]

(b) State a criticism about the design of question 1 in the survey.

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[1]

(c) Write a question, with a selection of answer boxes, to find out how much people are prepared to pay for MP3 players.

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[2]

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(d) If you were to use your question to carry out a survey by asking 100 people today and again tomorrow, would you expect to get exactly the same results? Give a reason for your answer.

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[1]

(e) A different survey was carried out to find the favourite colour of MP3 players. The results are shown in the table below.

	Number of people		
Favourite colour of MP3 player	The first 20 people asked	The second 20 people asked	The third 20 people asked
Red	2	5	8
Black	5	4	3
Silver	13	11	9

(i) Did any person answering the survey have a favourite colour of MP3 player other than red, black or silver? Give a reason for your answer.

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[1]

(ii) Calculate the best estimate for the probability that one of the people answering the survey, selected at random, says that their favourite colour of MP3 player is black.

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[2]

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5. Danny is setting out a treasure hunt.
The first clue is found 300 m from the start on a bearing of 120°.
The second clue is found 360 m from the position of the first clue on a bearing of 040°.
The third clue is found 100 m from the position of the second clue on a bearing of 280°.

(a) Using a scale of 1 cm to represent 40 m, complete an accurate scale drawing of the treasure hunt route, showing the positions of the three clues.

[5]



(b) Write down the bearing of the start from the position of the first clue.

.....

[1]

(c) Write down the distance and the bearing of the start from the position of the third clue.

.....

.....

Distance ..... m

Bearing ..... °

[2]

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6. Natasha, Aled and Sara buy a computer between them.
They share the cost of the computer in the ratio 2 : 3 : 5.
Natasha pays the smallest share and Sara pays the largest share.
Aled pays £195 towards buying the computer.
Calculate how much the computer costs to buy.

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[3]

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7. *(a)* (i) When visiting a hat shop, customers had the circumference of their head measured. The table shows the results for the customers who bought a hat during December.

Head circumference, c cm	Number of customers
$50 \leqslant c < 54$	12
$54 \leqslant c < 58$	32
$58 \leqslant c < 62$	14
$62 \leqslant c < 66$	2

Calculate an estimate for the mean head circumference.

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[4]

(ii) The hat shop sells 4 different sizes of hats.
The conversion table from head circumference to hat size is shown below.

Head circumference, c cm	Hat size
$50 \leqslant c < 54$	1
$54 \leqslant c < 58$	2
$58 \leqslant c < 62$	3
$62 \leqslant c < 66$	4

A salesman places an order for new stock for the hat shop.
The salesman's order form shows that about half of the hats ordered are size 2.
The owner of the shop says the order should show that about a quarter of the hats ordered are size 2.
Who is more likely to be correct, the salesman or the owner of the shop?
You must give a reason for your answer.

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[2]

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(b) Sales of hats were recorded each season.

Season	Summer 2011	Autumn 2011	Winter 2012	Spring 2012	Summer 2012	Autumn 2012
Number of hats sold	348	184	266	170	320	160

(i) Calculate the 4-season moving averages and complete the table below.

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4-season time period ending:	Spring 2012	Summer 2012	Autumn 2012
4-season moving average:			

[3]

(ii) Explain why using the 4-season moving average is useful.

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[1]

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8. Eliza makes this sketch of a pond.

Examiner only

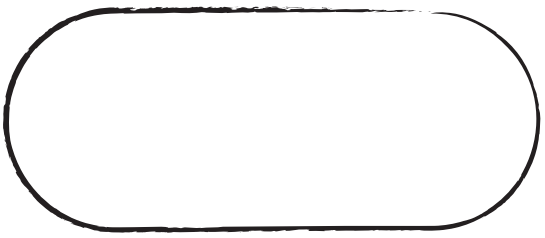


Diagram not drawn to scale

The shortest distance across the pond is 6 m.
The longest distance across the pond is 20 m.

Eliza estimates that the surface area of the pond is 120 m^2.

(a) Explain why the surface area of the pond is less than Eliza's estimate.

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[2]

(b) *You will be assessed on the quality of your written communication in this part of the question.*

Calculate an estimate for the surface area of the pond that would be more accurate than Eliza's estimate.
Show all of your working and explain how you have decided to calculate your estimate.

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[6]

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Examiner only

9. *(a)* In 2010 there were approximately 34 204 000 metres of railway track in the UK.
Each section of railway track has **two rails**.
The diagram shows a length of railway track.



Calculate an estimate for the total length, in metres, of **rails** in the UK in 2010.
Give your answer in standard form.

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[2]

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(b) In some countries there are small gaps in the rails to allow them to expand in hot weather.



There is a 3 cm gap in every 19 metres of rail.
In one of these countries there is $5{\cdot}43 \times 10^6$ metres of rail.
Calculate an estimate for the total length of the **gaps in the rail**, in metres.
Give your answer in standard form.

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[4]

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Examiner only

10. A company is considering changes to its price list for delivering parcels in a local area.
The company is considering a charge based on the distance between the warehouse and the destination of the parcel.
The table gives the grouped frequency distribution for the distances, measured to the nearest km, for 60 parcels.

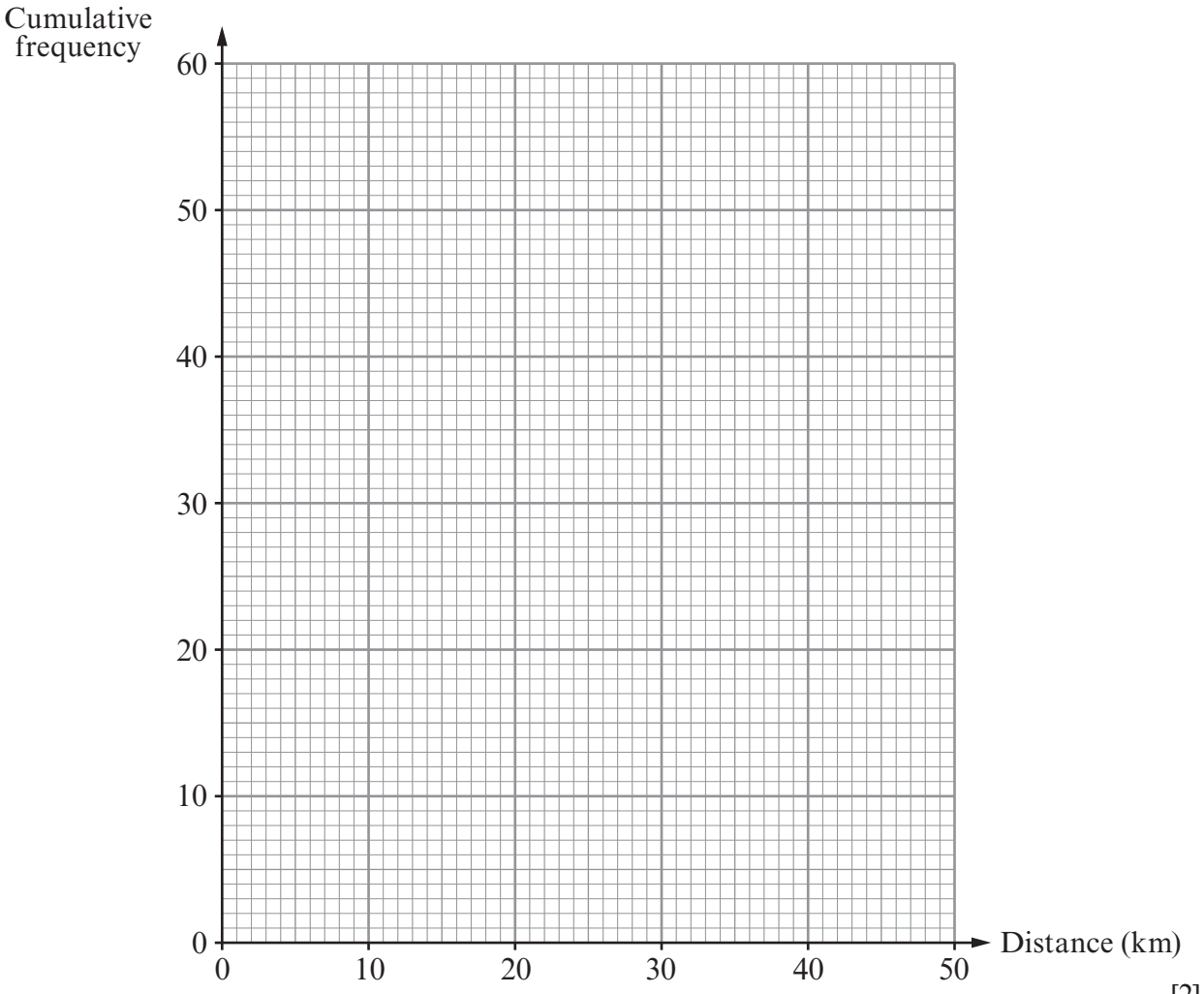
Distance, to the nearest km	1 - 10	11 - 20	21 - 30	31 - 40
Number of parcels	10	30	15	5

(a) Complete the following cumulative frequency table.

Distance (km)	$<0{\cdot}5$	$<10{\cdot}5$	$<20{\cdot}5$	$<30{\cdot}5$	$<40{\cdot}5$
Cumulative frequency	0	10			

[1]

(b) On the graph paper below, draw a cumulative frequency diagram to show this information.



[2]

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(c) Use your cumulative frequency diagram to find an estimate for the median and the interquartile range of the delivery distances.
You **must** show your working.

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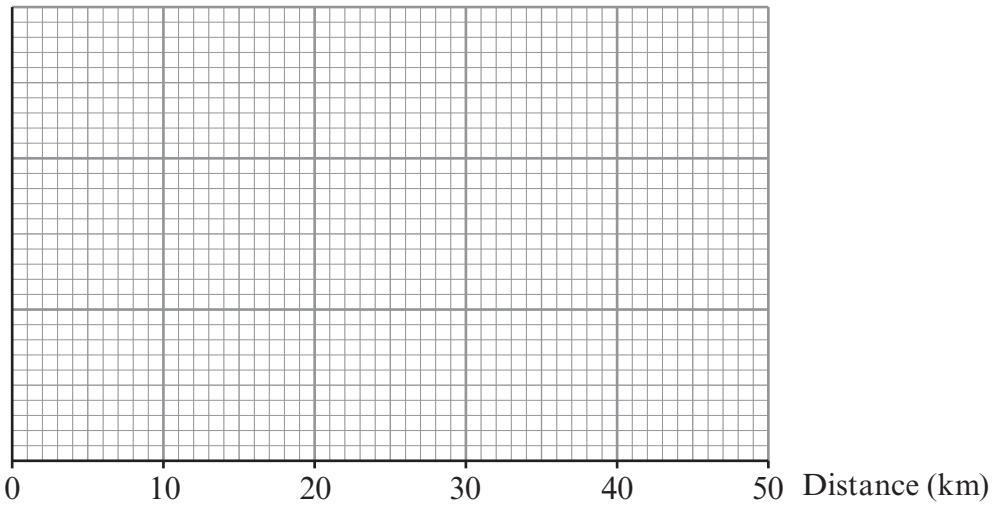
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Median ..... Interquartile range .....

[3]

(d) For these 60 parcels, the shortest delivery distance is 2 km and the longest delivery distance is 37 km.
Draw a box and whisker diagram to illustrate this information.



[4]

(e) Previously, the delivery charge was £2 for each parcel.

The new pricing plan being considered is:

- free delivery for all parcels up to the median delivery distance;
- £4 per parcel for all other deliveries.

Would you expect the company to profit from the new pricing for parcel delivery?
Explain your answer.

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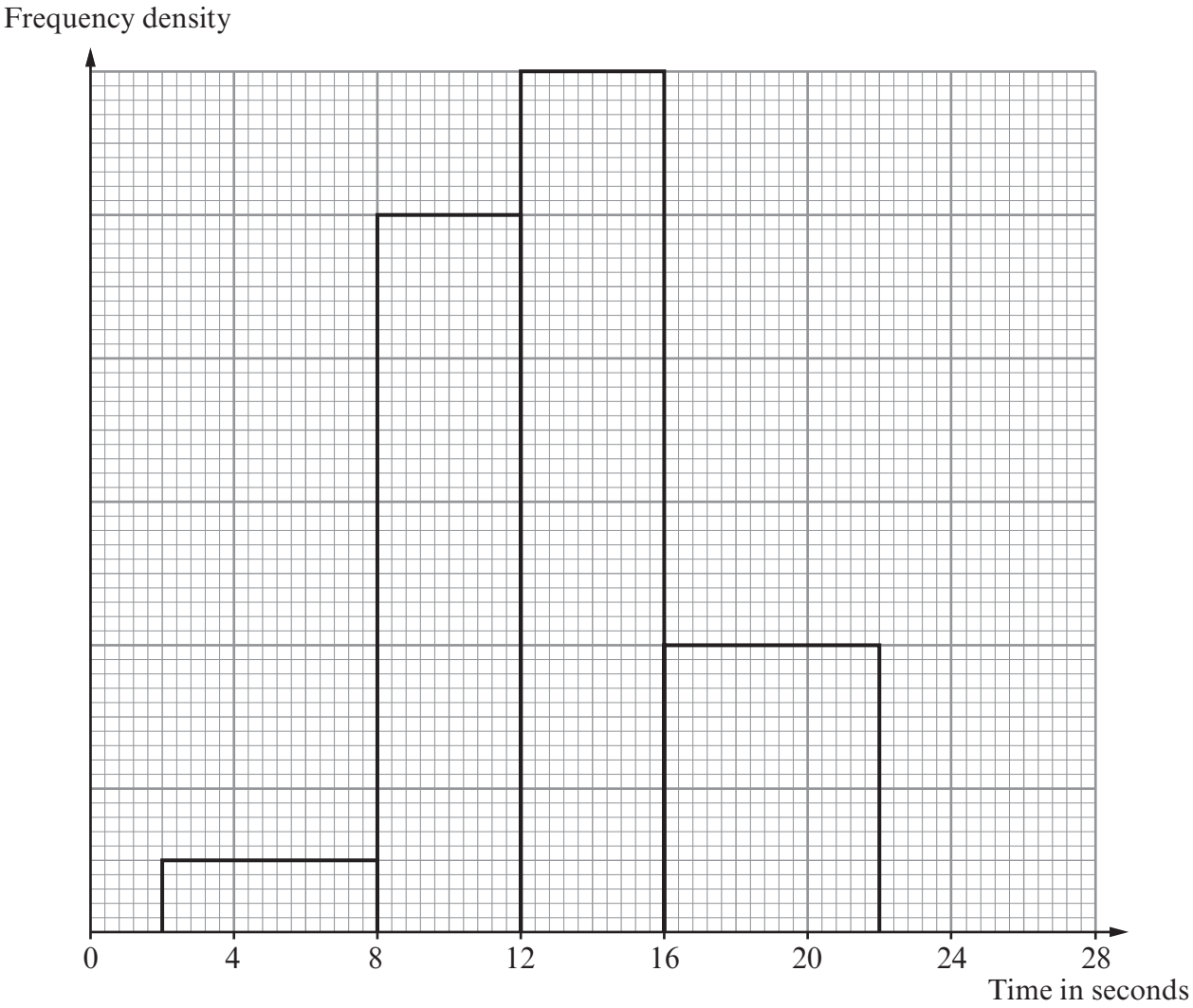
[3]

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11. *(a)* As part of a quality control exercise in a supermarket, the time taken to scan 20 items was measured for each worker under the age of 40.
A printout of the histogram that illustrates the results obtained is shown below.



Unfortunately, the labelling of the frequency density axis was missing from the printout. It is known that there were 12 workers under the age of 40 that took more than 16 seconds to scan the 20 items.

(i) Complete the labelling of the scale on the frequency density axis.

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[3]

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(ii) Calculate how many workers under the age of 40 took part in this quality control exercise.

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[2]

(iii) Calculate an estimate of the median time taken by a worker under the age 40 to scan 20 items.

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[4]

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(b) As part of the quality control exercise in a supermarket, the time taken to scan 20 items was measured for each worker aged 40 or over.
The table below shows the results.

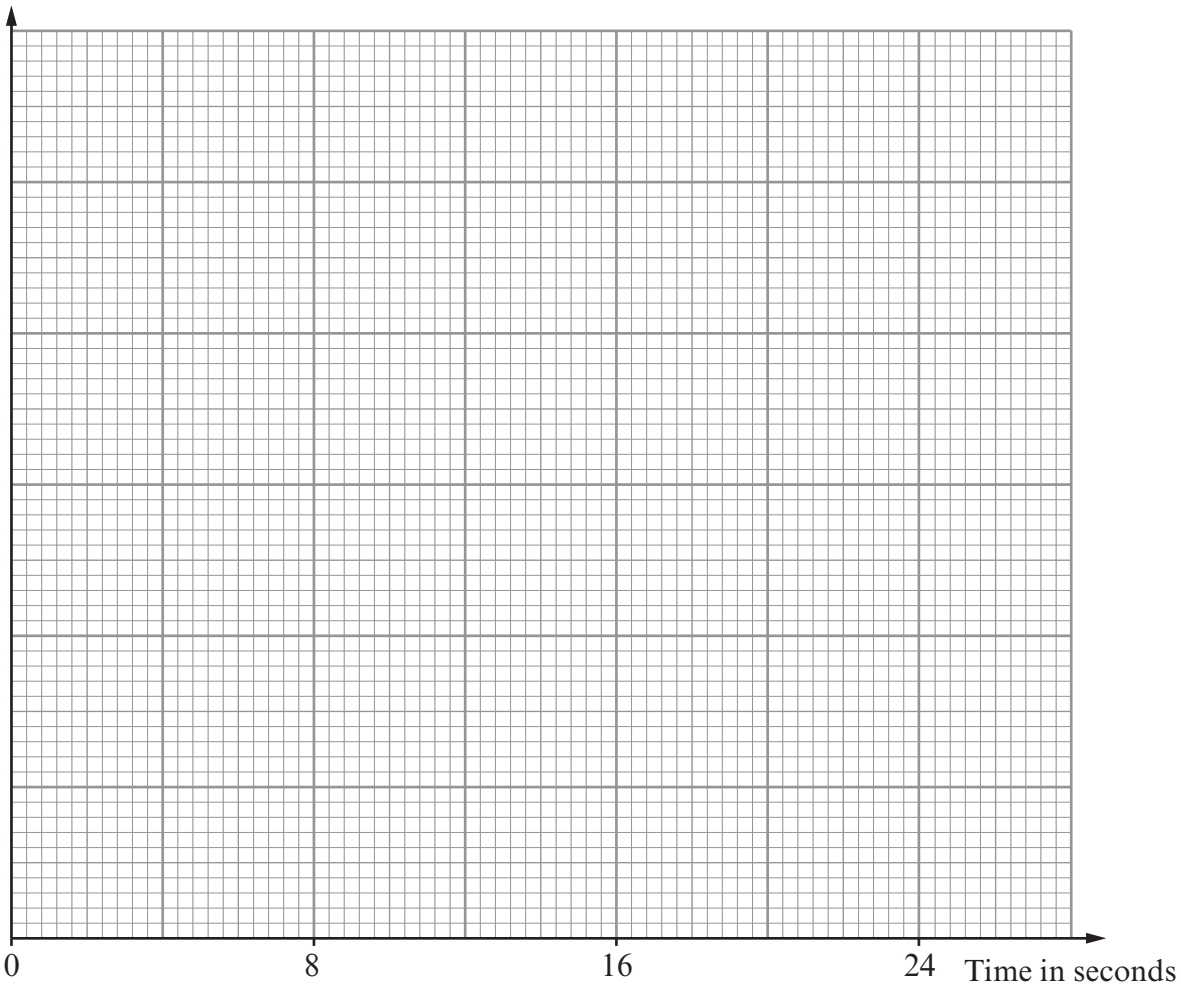
Time in seconds, t	$0 < t \leqslant 4$	$4 < t \leqslant 8$	$8 < t \leqslant 12$	$12 < t \leqslant 16$	$16 < t \leqslant 24$
Number of workers	0	2	36	24	8

Complete the scale on the frequency density axis and draw a histogram to illustrate the distribution on the graph paper below.

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Frequency density



[3]

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(c) Which of the two groups of workers is, on average, quicker at scanning 20 items in the supermarket? You must give a reason for your answer.

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[1]

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Examiner only

12. The formula $v = 8t - t^2$ is used to calculate the velocity v m/s of a particle at a time t seconds after the start of an experiment.

(a) Draw the graph of $v = 8t - t^2$ for values of t from 0 to 8.

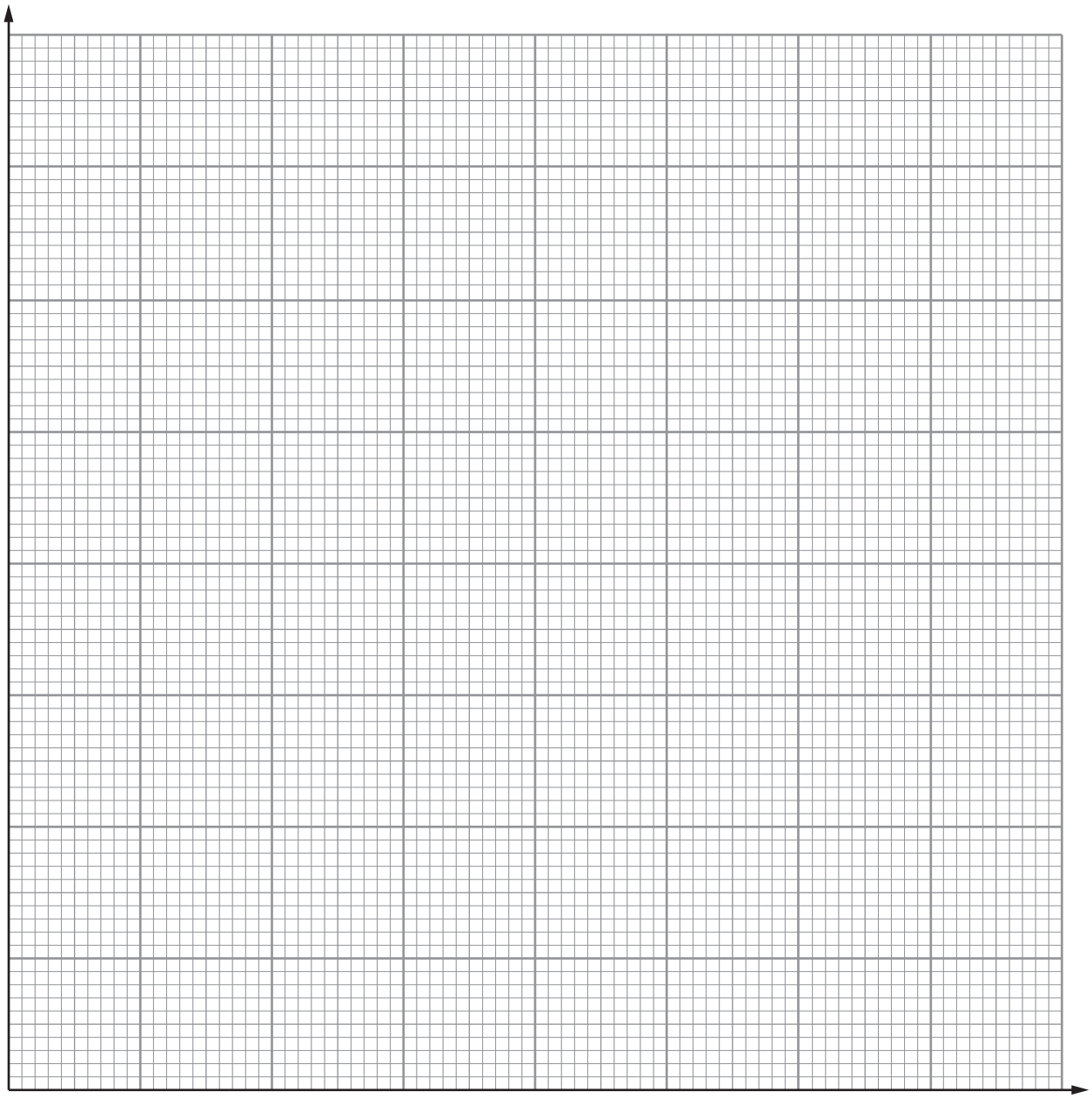
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[5]

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(b) Find the time at which the acceleration of the particle is zero.

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[1]

(c) Find an approximation for the acceleration when $t = 7$.
State the units of your answer.

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[4]

(d) Find an approximation for the distance travelled by the particle by the time $t = 8$.

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[4]

END OF PAPER

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GCSE MARKING SCHEME

APPLICATIONS OF MATHEMATICS (LINKED PAIR PILOT)

JANUARY 2013

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INTRODUCTION

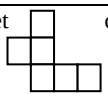
The marking schemes which follow were those used by WJEC for the January 2013 examination in GCSE APPLICATIONS OF MATHEMATICS (LINKED PAIR PILOT). They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

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UNIT 1 - FOUNDATION TIER

Applications Unit 1 Foundation Tier January 2013		Final
1. (a) Moscow at -8°C Los Angeles at 13°C (b) 21(°C)	B1 B1 B1 3	 Accept between 12 and 14 exclusive Accept -21(°C)
2.(a) Sian AND valid explanation eg "5 divides (exactly) into 10" David AND valid explanation eg "5 isn't in the 10 times table" or "10 is a multiple of 5" or "5 is a factor of 10" (b)(i) No AND valid explanation eg "No because 3^2 is 9" or "when you square an odd number you get an odd answer" (ii) No AND valid explanation eg "No because 3 × 5 = 15" or " 3(or 5) goes into 15" or " 3(or 5) is a factor of 15" (c) Valid explanation eg. (2^3 =) 8 or " it's 2 × 2 × 2 not 2 × 3	E1 E1 E1 E1 E1 5	Sian may be implied from valid explanation. Do not accept "Sian is correct because 5 is a factor of 10." David may be implied from valid explanation No may be implied No may be implied
3. total ticket sales = 108770 Cost of tickets = 108770 × 24 (£) 2610480 2610500	B1 M1 A1 B1 4	 FT their 108770 FT 'their 2610480' rounded to the nearest 100 *Alternative method* *18535 × 24 + 26750 × 24 + 19125 × 24 + 15400 × 24 + 28960 × 24 M2* *(444840 + 642000 + 459000 + 369600 + 695040)* *Award M1 for multiplying at least 3 of the number of tickets at each venue by 24 with an intention to add OR for multiplying all 5 of the number of tickets at each venue by 24 with no intention to add* *(£)2610480 A1* *2610500 B1* *FT 'their 2610480' rounded to the nearest 100 for last B1*
4. (a) For attempting to count squares Accept in range 24 to 32 (centimetre squares) (b) Area of lawn in range 78 to 86 Their area × 5 Area in range 390 to 430 (m^2)	M1 A1 B1 M1 A1 5	Accept use of πr^2 M1 for correct method, $\pi \times 3^2$ A1 for correct answer. 28 – 28.3 ISW if their pond area × 5 FT 110 (area of rectangle) – their (pond)(a) FT their area *If no marks awarded in (b) award SC1 for sight of 550 (implies × 5)*
5. (a) Correct net  circled or clearly indicated (b) Area of one face = 49 (cm^2) Total surface area = 49 × 6 = 294 cm^2	B1 B1 M1 A1 U1 5	 FT their 49 but not 7
6. (a) Mean for Andy = 336 ÷ 6 = 56 (b) Put in order 39, 40, 42, 62, 70 71 Median of Jim = 52	M1 m1 A1 M1 A1 5	Attempt to add all given values for Andy FT 'their 336' CAO Sight of 42 and 62 only would gain M1

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Applications Unit 1 Foundation Tier January 2013		Final
7. (a) S = 0.6 × 3.8 × 32.5 = 74.1 (b) Marks = 100.8 ÷ (4.2 × 0.6) = 40	M1 A1 M1 A1 4	
8. (a) Angle LQN = 180 – 118 = 62(°) Angle LQP (= 62 + 90) = 152(°) (b) circle drawn with radius 4cm (c) 125° or 80° drawn Accurate completed shape	 M1 A1 B2 B1 M1 A1 7	Look at diagram, may be seen or implied Or 360 – (118 + 90 + 90) FT their 62. Award B1 for angle PQN = 90(°) (may be on diagram) *Alternative method* *Sum of interior angles of pentagon = 540 (°) B1* *Angle PON or QPO = 90(°) B1* *540 – (118 + 90 + 90+ 90) M1* *152(°) A1* ±2mm ±2°
9. (Andrea) (£)10.75 (Ravinder) (£)7.85 (Erika) (£)10.65 (Total Bill) (£)29.25 (Each pays) 29.25 ÷ 3 (£)9.75 Andrea(benefits the most) by (£)1(.00) Look for • Spelling • Clarity of text explanation • the use of notation, watch for the use of '=', '£', ÷ being appropriate For QWC2 labels, appropriate use of '=' and units(£) must be evident. QWC2: Candidates will be expected to • present work clearly, with words explaining process or steps AND • make few if any mistakes in mathematical form, spelling, punctuation and grammar in their answer QWC1: Candidates will be expected to • present work clearly, with words explaining process or steps OR • make few if any mistakes in mathematical form, spelling, punctuation and grammar in their answer	B2 B1 M1 A1 A1 QWC 2 8	Award B1 for any 2 of Andrea, Ravinder & Erika correct. FT their '10.75 + 7.85 + 10.65' (£)29.25 implies B2 B1 FT their total bill (£)9.75 implies all previous marks FT their values. Unsupported correct answer implies all previous marks. QWC2 Presents relevant material in a coherent and logical manner, using acceptable mathematical form, and with few if any errors in spelling, punctuation and grammar. QWC1 Presents relevant material in a coherent and logical manner but with some errors in use of mathematical form, spelling, punctuation or grammar OR evident weaknesses in organisation of material but using acceptable mathematical form, with few if any errors in spelling, punctuation and grammar. QWC0 Evident weaknesses in organisation of material, and errors in use of mathematical form, spelling, punctuation or grammar.
10. (a) Plotting at least two correct points Correct straight line through points (b) Approximately 110 (lbs) (c) Clear method shown Approximately 91 (kg). Accept answers in range 85 - 95	P1 L1 B1 M1 A1 5	 FT their graph, within 1 small square Accept use of graph or 200 ÷ 2.2 or other valid method. FT their line Award SC1 for unsupported answers in the ranges 80 – 84.9 or 95.1- 100 Incorrect answers from a correct method but still in range award M1 A0

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Applications Unit 1 Foundation Tier January 2013		Final
11. (a) (y = 1 is line) q (x = -3 is line) s (b) (i) x | -2 | -1 | 0 | 1 | 2 | 3 y=2x - 1 | -5 | **-3** | -1 | 1 | **3** | 5 (ii) Plotting points correctly Correct line drawn	B1 B1 B2 P1 L1 6	Award B1 for each FT their points for P1 CAO Award P1, L1 for line drawn passing through the correct points
12(a) Square | Kite, Rhombus, Parallelogram (b) Square, Rhombus, Parallelogram | Kite	B2 B2 4	B1 for any 3 unambiguous correct entries B1 for any 3 unambiguous correct entries
13.(a) 3e + 2f (p) (b) $\frac{3e + 2f}{100}$ or 0.03e + 0.02f (p) or equivalent	B2 B1 3	Allow 3×e + 2×f B1 for either 3e (or 3×e or e×3) or 2f (or 2×f or f×2) If B2, penalise further incorrect work -1 Must clearly show ALL divided by 100. FT their (a) if a sum of 2 terms, equivalent difficulty
14(a) 120° drawn from Start 040° drawn from the position of the first clue 280° drawn from the position of the second clue Line 7.5cm OR 9cm OR 2.5cm for the appropriate stage Accurate chart with lengths and angles correct (b) 300° (c) Distance (±2mm) from the position of the third clue to the start Bearing (±2°) from the position of the third clue to the start	 B1 B1 B1 B1 B1 B1 B1 B1 8	Accept 'their North' provided ±2° from the North given. Penalise 'their North' outside of this tolerance once only ±2° ±2° ±2° ±2mm Within tolerances allowed ±2°. FT from their diagram FT from their diagram (Actual is approximately 10.5×40 = 420m) FT from their diagram (Actual is approximately 250°)
15(a) Reason, e.g. all different age groups (b) Two boxes if you are 20 or refers to 'wide' group of older people (c) Suitable question with at least 3 boxes, no overlap or gaps (in pence) and prices from a low value upwards considered (d) Reason implying 'no' showing understand that repeating an experiment can lead to different results (e)(i) Reason implying no, such as: 'all columns total 20', 'all 60 answered', 'all people selected red, black or silver' (ii) Strategy to use all data (for 60 people) 12/60 (= 1/5 = 0.2)	E1 E1 E2 E1 E1 S1 B1 8	Not marking choice 'yes' or 'no', marking understanding of cross-section of people asked. So could be, e.g. 'yes, as older people don't go to the cinema', or 'no, as all sorts of people go to the cinema'. Look for focus on age in response. Do not accept contradiction of choice yes or no with reason. Do not accept reference to age related ownership of MP3 Do not accept 'people not liking to give age', or 'lie about age', or 'not enough boxes' (as ambiguous) E1 for suitable question with at least 3 boxes, max of 1 overlap or 1 gap, must be suitable for amounts such as £19.99, i.e. pence considered as well as £s, OR E1 for prices from a low value upwards considered, minimum acceptable range ≈£30 to ≈£50 Accept 'no, as different people have different thoughts/amount to spend' Accept more complex answers. Do not accept reference to just 20 people Ignore incorrect cancelling of 12/60. B0 for 12 out of 60, or 12 in 60, but either of these responses gets S1

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UNIT 1 - HIGHER TIER

Applications Unit 1 Higher Tier January 2013		Final
1.(a)(i) $3e + 2f$ (p)	B2	Allow $3\times e + 2\times f$ B1 for either $3e$ (or $3\times e$ or $e\times 3$) or $2f$ (or $2\times f$ or $f\times 2$) If B2, penalise further incorrect work -1
(ii) $\frac{3e + 2f}{100}$ or $0.03e + 0.02f$ (p) or equivalent	B1	Must clearly show ALL divided by 100. FT their (i) if a sum of 2 terms, equivalent difficulty
(b) 1000t	B1	Allow $1000\times t$ or $t\times 1000$
(c) $5x$	B1	Allow $5\times x$ or $x\times 5$
(d) $14q^2$ (cm^2) or equivalent	B2 7	B1 for $\frac{1}{2} \times 4q \times 7q$ If B2, penalise further incorrect work -1
2(a) Square | Kite, Rhombus, Parallelogram	B2	B1 for any 3 unambiguous correct entries
(b) Square, Rhombus, Parallelogram | Kite	B2 4	B1 for any 3 unambiguous correct entries
3(a) 255 $51(578 + 5)$ OR $6y^3 + 15y$ = 29733 Abby's code AND 1083	B1 M1 A1 B1	CAO CAO CAO. Answer space not a contradiction. FT 1083 AND all their 4 digit codes selected If correct evaluation accept blank 'Abby's code ....' space
(b) 1369	B2 6	B1 for sight of 37
4(a) Reason, e.g. all different age groups	E1	Not marking choice 'yes' or 'no', marking understanding of cross-section of people asked. So could be, e.g. 'yes, as older people don't go to the cinema', or 'no, as all sorts of people go to the cinema'. Look for focus on age in response. Do not accept contradiction of choice yes or no with reason.
(b) Two boxes if you are 20 or refers to 'wide' group of older people	E1	Do not accept reference to age related ownership of MP3 Do not accept 'people not liking to give age', or 'lie about age', or 'not enough boxes' (as ambiguous)
(c) Suitable question with at least 3 boxes, no overlap or gaps (in pence) and prices from a low value upwards considered	E2	E1 for suitable question with at least 3 boxes, max of 1 overlap or 1 gap, must be suitable for amounts such as £19.99, i.e. pence considered as well as £s, OR E1 for prices from a low value upwards considered, minimum acceptable range ≈£30 to ≈£50
(d) Reason implying 'no' showing understand that repeating an experiment can lead to different results	E1	Accept 'no, as different people have different thoughts/amount to spend'
(e)(i) Reason implying no, such as: 'all columns total 20', 'all 60 answered', 'all people selected red, black or silver'	E1	Accept more complex answers. Do not accept reference to just 20 people
(ii) Strategy to use all data (for 60 people)	S1	
12/60 (= 1/5 = 0.2)	B1 8	Ignore incorrect cancelling of 12/60. B0 for 12 out of 60, or 12 in 60, but either of these responses gets S1
5(a)		Accept 'their North' provided ±2° from the North given. Penalise 'their North' outside of this tolerance once only
120° drawn from Start	B1	±2°
040° drawn from the position of the first clue	B1	±2°
280° drawn from the position of the second clue	B1	±2°
Line 7.5cm OR 9cm OR 2.5cm for the appropriate stage	B1	±2mm
Accurate chart with lengths and angles correct	B1	Within tolerances allowed
(b) 300°	B1	±2°. FT from their diagram
(c) Distance (±2mm) from the position of the third clue to the start	B1	FT from their diagram (Actual is approximately $10.5\times 40 = 420$m)
Bearing (±2°) from the position of the third clue to the start	B1 8	FT from their diagram (Actual is approximately 250°)
6. 195/3 (=65) × 10 (£)650	M1 m1 A1 3	OR sight of 130, (195,) and 325 OR sight of 130+195+325 CAO

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Applications Unit 1 Higher Tier January 2013		Final
7.(a)(i) Mid-points 52, 56, 60 and 64 52×12 + 56×32 + 60×14 + 64×2 (= 3384) /60 56.4 (ii) Strategy to look back that 32 out of 60 are size 2, e.g. '(table shows) about half customers are size 2 Conclusion to give Salesman is correct (b)(i) 242 235 229 (ii) Refers to 'smoothing out data', or 'giving a picture of a complete year's sales', or similar	B1 M1 M1 A1 M1 A1 B3 E1 10	 FT their mid-points including bounds FT their $\Sigma fx/60$ Accept 56 from correct working seen Accept reference back to (a)(i) table without specific numeral details provided 'salesman correct' stated. B2 for any two correct entries, B1 for a correct method seen, or 1 correct entry Do not accept 'makes it clearer' Accept 'averages data out'
8(a) Valid reason or explanation, e.g. 'pond fits inside a rectangle' or 'pond fits inside a rectangle' or 'approximates to a rectangle' Sight of 6×20 (b) E.g. Considers 2 semi-circles and a rectangle Method of calculating area Accuracy in establishing missing lengths / dimensions Improved estimate QWC1 for a clear explanation of 'their idea' with generally accurate spelling Look for • relevance • spelling • clarity of text explanations, • the use of notation (watch for the use '=' being appropriate) • units • labelling QWC2: Candidates will be expected to • present work clearly, with words explaining process or steps AND • make few if any mistakes in mathematical form, spelling, punctuation and grammar in their answer QWC1: Candidates will be expected to • present work clearly, with words explaining process or steps OR • make few if any mistakes in mathematical form, spelling, punctuation and grammar in their final answer	S1 B1 S1 M1 M1 A1 QWC 2 <

Applications Unit 1 Higher Tier January 2013		Final
10(a) 40, 55, 60	B1	
(b) Correct cumulative frequency diagram, points plotted at bounds and joined by a curve or straight line	B2	FT from cumulative (i) . Allow initial plot at the origin. B1 for points correct but not joined, OR B1 correct apart from 0.5 translation, OR B1 if one error in plotting but joined correctly
(c) Median 17 (±0.5)	B1	FT from their cumulative diagram. Not cumulative no FT
Intention to subtract readings from horizontal axis for vertical 45 & 15	M1	FT from their cumulative diagram. *Watch for an answer of 12 from LQ rather than interquartile range, must be IQR is (24-12 =) 12 if working shown*
Interquartile range (12±1)	A1	
(d) General idea of what box – whisker should be	S1	
Range ends 37 and 2 correctly indicated	B1	
Median line correctly indicated	B1	FT their median
UQ and LQ correctly indicated	B1	FT their UQ and LQ readings
(e) Strategy: use of median as same number above and below	S1	
Interpretation: half free + half at £4	M1	
Conclusion based on appropriate working that no difference expected, i.e. compares with all at £2	A1	
	13	
11(a)(i) Idea: 6 × … = 12	S1	
Height of 16 to 22 group indicated as 2	B1	
Correct uniform scale shown	B1	3 correct values, no incorrect values is sufficient
(ii) Method of summing width × height	M1	Must include at least 3 correct products. FT from their histogram with a uniform scale (6×0.5 + 4×5 + 4×6 + 6×2)
59	A1	CAO
(iii) Finding middle worker, i.e. 30th value (or 29 ½ th)	S1	FT from their histogram with a uniform scale
Realising within 12 to 16 interval	M1	
7 (or 6.5) out of the 24 in the group	M1	
13(.17seconds) or 13(.08 seconds)	A1	Must FT from histogram or either no working or correct working Do not accept an answer of 13 without working
(b) Correct histogram on the graph paper provided	B3	B2 for suitable uniform scale to at least 9, having worked with frequency density with at least 3 bars of the histogram correct B1 for working with frequency density, at least 3 calculations correct, OR sight of a uniform scale to 9 (not a scale to 36)
(c) '40 and over' with a reason based on the shape of the histogram or the skew of the data	E1	Accept 'over 40s' with a suitable reason Accept 'over 40s, other median is 13 seconds where as median for these lies in 8 to 12 second group'
	13	
12(a) Correct evaluation of at least 3 coordinates	M1	t: 0 1 2 3 4 5 6 7 8 v: 0 7 12 15 16 15 12 7 0
Suitable axes with appropriate scale and labels	A1	t= 0 to 8 and v = 0 to 16 (or 20). Must FT at least 3 correct points
Plotting at least 7 correct points (allow 2 slips)	M2	FT for their axes if reasonable. M1 for plotting between 3 and 6 correct points
Joining all 9 points with a curve	A1	
(b) (t =) 4 (seconds)	B1	FT from their graph
(c) Strategy, e.g. to draw a tangent at t = 7	S1	Accept appropriate other methods, e.g. close calculations to 7
Use of difference v / difference t	M1	Must be differences, not readings from axes. Ignore signs
= …… m/s^2 or ms^{-2}	A1	Reasonable from their graph. Must be negative (e.g. -6)
	U1	Does not depend on previous marks
(d) Identifying the required area	S1	Maybe shown on their graph
Splitting area into areas that can be approximated	M1	
Complete calculation for the area required	M1	
Accurately calculated	A1	(Possible answers include 80 (metres) using 2 triangles and 2 trapezia, or 84 (metres) using 2 triangles and 6 trapezia, 85.33... (metres)
	14	

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Surname	Centre Number	Candidate Number
Other Names		0

GCSE LINKED PAIR PILOT

4361/02

APPLICATIONS OF MATHEMATICS
UNIT 1: APPLICATIONS 1
HIGHER TIER

A.M. WEDNESDAY, 13 June 2012

2 hours

ADDITIONAL MATERIALS

A calculator will be required for this paper.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** the questions in the spaces provided.

Take π as 3·14 or use the π button on your calculator.

INFORMATION FOR CANDIDATES

You should give details of your method of solution when appropriate.

Unless stated, diagrams are not drawn to scale.

Scale drawing solutions will not be acceptable where you are asked to calculate.

The number of marks is given in brackets at the end of each question or part-question.

You are reminded that assessment will take into account the quality of written communication (including mathematical communication) used in your answer to question **8**.

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1	**6**	
2	**4**	
3	**3**	
4	**5**	
5	**5**	
6	**9**	
7	**12**	
8	**7**	
9	**15**	
10	**4**	
11	**6**	
12	**5**	
13	**8**	
14	**5**	
15	**6**	
TOTAL MARK		

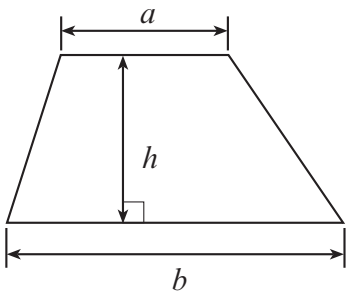
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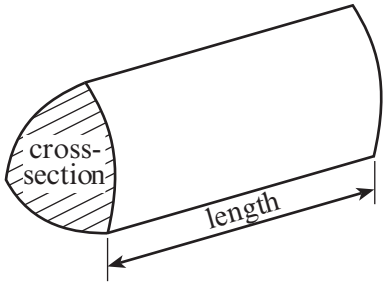
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Formula List

Area of trapezium = $\frac{1}{2}(a + b)h$

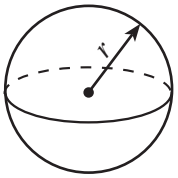


Volume of prism = area of cross-section × length



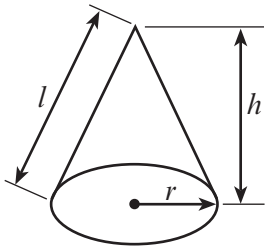
Volume of sphere = $\frac{4}{3}\pi r^3$

Surface area of sphere = $4\pi r^2$



Volume of cone = $\frac{1}{3}\pi r^2 h$

Curved surface area of cone = $\pi r l$

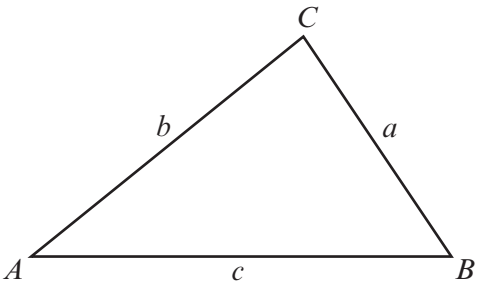


In any triangle ABC

Sine rule $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Cosine rule $a^2 = b^2 + c^2 - 2bc\cos A$

Area of triangle = $\frac{1}{2}ab\sin C$



The Quadratic Equation

The solutions of $ax^2 + bx + c = 0$

where $a \neq 0$ are given by

$$x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$$

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1. *(a)* A plan of the layout of a number of cycle tracks to be made around a park is shown below.
In order to mark out the cycle tracks the size of the angles *a*, *b*, *c* and *d* need to be found.

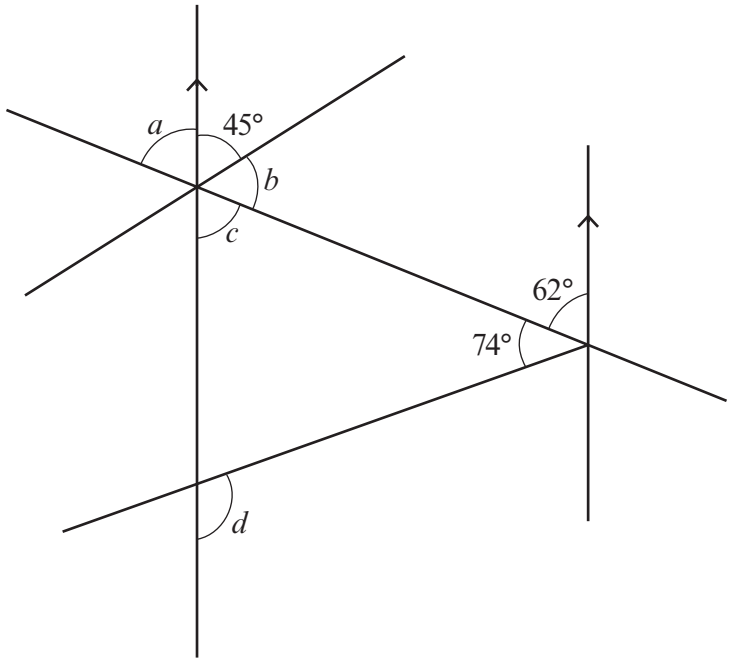


Diagram not drawn to scale

Calculate the angles marked *a*, *b*, *c*, and *d*.

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a = ...°

b = ...°

c = ...°

d = ...°

[4]

(b) In another section of the park there is a flowerbed in the shape of a rhombus.
One of the angles of the rhombus is 46°.
Calculate the size of the other three angles of the rhombus.

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[2]

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2. *(a)* Two boxes are stacked on top of each other.
The height of each box is 6 cm, measured to the nearest centimetre.

Explain why these two boxes may not fit in a space that is 12 cm high.

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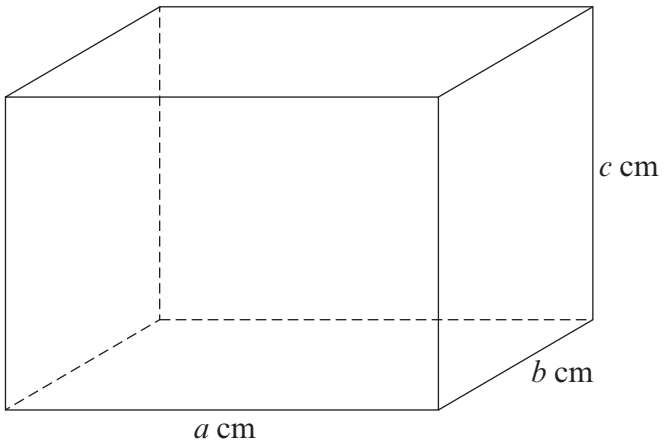
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[2]

(b) Joseph works in a factory that makes boxes.
The boxes are all cuboids.
Each cuboid has dimensions a cm, b cm and c cm.



Joseph has been asked to write a simplified expression for the total length of all the edges of the cuboid.
Joseph writes down the expression $2a + 3b + 4c$.
Joseph's expression is incorrect.

What should the correct simplified expression be for the total length of all the edges?

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[2]

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3. A pattern using dots is to be created on a background for a large window display.
The instructions say that the background should be a grid 9 squares across by 16 squares up and the coordinate system for plotting should be used.
Dots are then placed at points where the x-coordinate is a factor of 9 and the y-coordinate is a factor of 16, for example (3, 4).
Use the grid below to plot all the dots for the window display.

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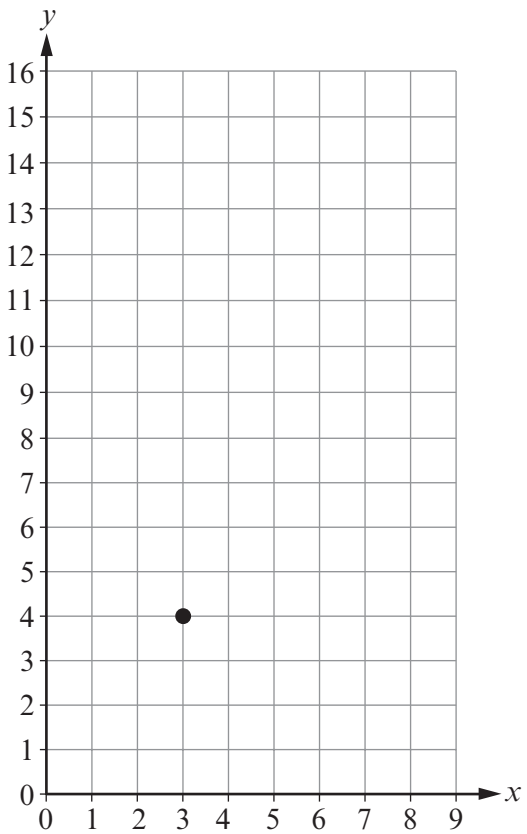
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[3]

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4. You are asked to check Damian's homework.
He has answered 7 questions.
The homework questions and Damian's answers are given in the table below.

Question number	Question	Damian's answer
1	Calculate $48 + 62$	100
2	Simplify $3a - 5b + 26a - 26b$	$29a + 31b$
3	Expand $6(x + 2)$	$6x + 12$
4	Simplify $3(2x + 5) - (x - 3)$	$5x + 12$
5	Factorise $24x + 8$	$8(3x + 0)$
6	Factorise $3x + 15$	$3(x + 5)$
7	Find the value of $2a - 3b$ when $a = 6$ and $b = -4$	0

Complete the table below to indicate if Damian's answers are correct or not.
If any of his answers are incorrect, you must give the correct answer.

Question number	Correct? Yes or No	If no, give the correct answer
1	No	110
2		
3		
4		
5		
6		
7		

Extra working space

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[5]

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5. A chart is kept to show the position of a yacht at three times during the day.
These are the notes that have been kept in order to plot the positions of the yacht on the chart.

Notes:

- Start time was 12 noon
- At 13:00 its position was 6 nautical miles on a bearing of 134° from the start
- At 14:00 its position was 4 nautical miles on a bearing of 200° from its position at 13:00

(a) Use a scale of **1 cm to represent 1 nautical mile** to complete the chart.

[3]



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(b) Write down the bearing of the yacht and its distance from the start position at 14:00.

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Bearing .....°

Distance ..... nautical miles

[2]

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6. The manager of an electrical store had a plan to gradually decrease the number of ordinary light bulbs, on the shelves, between 2005 and 2011.

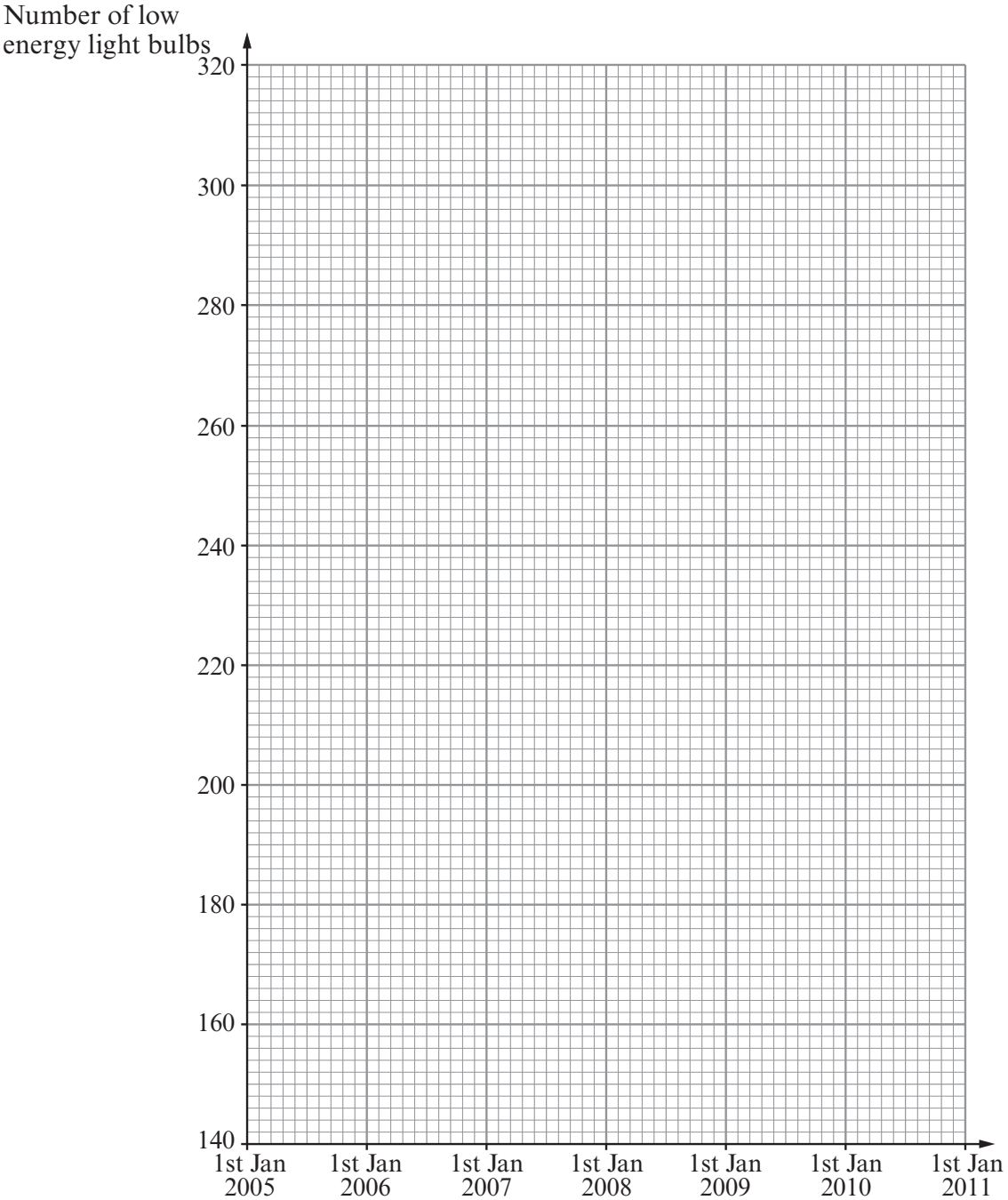
At the same time, the plan was to increase the number of low energy light bulbs on the shelves.

The number of both types of light bulbs, on the shelves, has followed the general trends as planned.
There were no variations to the trend.

(a) The number of low energy light bulbs was recorded each year on the 1st January. The table gives this information from 2005 to 2011.

1st January, Year	2005	2006	2007	2008	2009	2010	2011
Number of low energy light bulbs	150	172	198	248	300	310	320

(i) Use the graph paper below to display this information. [3]



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(ii) Use the information given to write down a reasonable estimate for the number of low energy light bulbs, on the shelves, on 1st July 2008.
You can assume that, within each year, the number of low energy light bulbs on the shelves increases at a steady rate.

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[2]

(b) The number of ordinary light bulbs, on the shelves, halved every year between 1st January 2005 and 1st January 2011.
On 1st January 2005 there were 640 ordinary light bulbs on the shelves.
Find in which year and in which quarter of the year (1st, 2nd, 3rd or 4th) there were approximately an equal number of ordinary and low energy light bulbs on the shelves.
You must show all your working.
You can assume that, within each year, the numbers of low energy light bulbs and ordinary light bulbs on the shelves both change at a steady rate.

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[4]

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7. Cheryl and Ben planned a cycle ride using a 1 : 25 000 scale map.
The route they planned measured approximately 80 cm on the map.

(a) Calculate approximately how far they planned to cycle.
You must give your answer in km.

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[5]

(b) After the ride Cheryl's cycle-computer showed that she travelled 24 km.
What was this measurement on the map in centimetres?

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[3]

(c) Ben and Cheryl's cycle-computers showed 24 km after the ride.
The ratio of the distance Ben cycled to the distance he pushed his bike uphill was 5:1.
The ratio of the distance Cheryl cycled to the distance she pushed her bike uphill was 11:1.

Calculate how far Ben cycled and how far he pushed his bike uphill.

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Cycled ..... km Pushed bike uphill ..... km

Calculate how far Cheryl cycled and how far she pushed her bike uphill.

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Cycled ..... km Pushed bike uphill ..... km

[4]

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8. *You will be assessed on the quality of your written communication in this question.*

A fishing competition is to be held out at sea in a rectangular area that is 5 km by 4 km and marked out by buoys. Safety boats are positioned at two different corners of the rectangular area marked out by the buoys.
Each safety boat patrols an area not exceeding 3 km from its initial position.

Consider the options for positioning the two safety boats.
Decide which of your options is best for positioning the two safety boats.
You must clearly show and explain why your solution is the best option.

Explanation:

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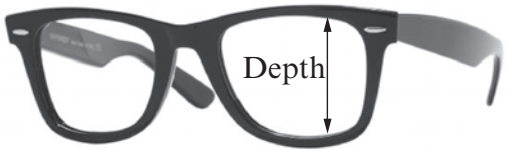
[7]

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9. *(a)* The depth of a lens in a pair of glasses is measured as shown below.



A number of people wearing glasses were surveyed.
The depth of the lens in their glasses was measured and recorded correct to the nearest mm.
The results are summarised in the table.

Depth of lens, x mm, to the nearest mm	Number of people
$10 \leqslant x \leqslant 19$	6
$20 \leqslant x \leqslant 29$	28
$30 \leqslant x \leqslant 39$	48
$40 \leqslant x \leqslant 49$	18

(i) Calculate an estimate for the mean depth of a lens.

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[4]

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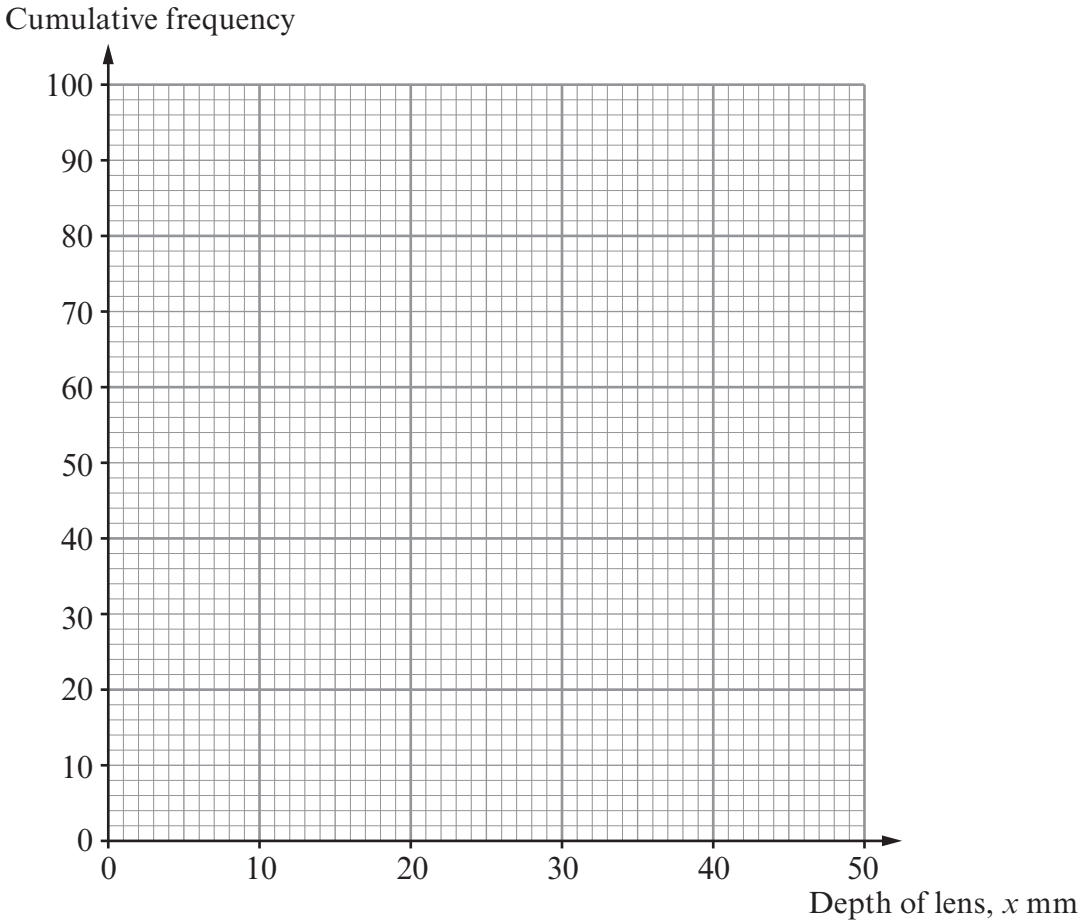
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(ii) Complete the following cumulative frequency table.

Depth of lens, x mm	$x < 9{\cdot}5$	$x < 19{\cdot}5$	$x < 29{\cdot}5$	$x < 39{\cdot}5$	$x < 49{\cdot}5$
Cumulative frequency	0	6	34		

[1]

(iii) On the graph paper below, draw a cumulative frequency diagram to show this information. [2]



(iv) Use your graph to estimate each of the following.

The median depth of a lens.

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The interquartile range for the depth of a lens.

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[3]

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(b) An optician records the number of pairs of glasses she sells in each season.

Year	2011				2012	
Season	Winter	Spring	Summer	Autumn	Winter	Spring
Number of pairs of glasses	1084	2124	4326	1242	1348	2456

(i) Calculate the 4-point moving averages and complete the table below.

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4 season time period ending:	Autumn 2011	Winter 2012	Spring 2012
4-point moving average:			

[3]

(ii) In the summer of 2011 the optician had the following offer

Buy one pair and get a second pair half price.

She has decided not to repeat this offer in the summer of 2012, but instead to have a promotion in the autumn of 2012

Buy one pair get one free.

Explain fully what impact this may have on the 4-point moving average for the 4 season time period ending in the summer of 2012.

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[2]

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10. Jade entered a number into her calculator.
To this number, she added the square of the original number and the cube of the original number.
Jade got the answer 432·288.
Find the number that Jade first entered into her calculator.
Show all your working.

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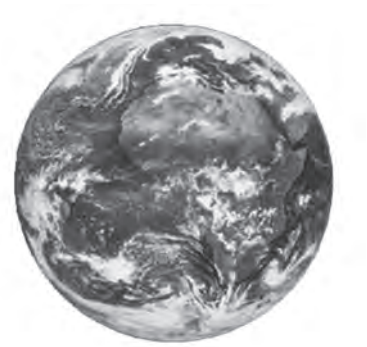
[4]

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11. The Earth is approximately spherical.



(a) The radius of the Earth is 6378·1 km.
Calculate the circumference of the Earth, giving your answer in standard form correct to 3 significant figures.

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[4]

(b) The total surface area of the Earth is approximately $5{\cdot}112 \times 10^8$ square kilometres.
Oceans cover an approximate area of $3{\cdot}618 \times 10^8$ square kilometres and the remainder of the surface is covered by land.
Calculate the area of the Earth covered by land, giving your answer in standard form.

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[2]

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12. The fee for advertising on an Internet website includes a charge for the number of words in an advertisement, as well as a standard charge.
There is a standard charge of R pounds for the placement of each advertisement.
The charge, in pounds, for the number of words in an advertisement is equal to one-tenth of the total number of words.

(a) Derive a formula for B, the total fee in pounds, for placing an advertisement which has h words.

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[3]

(b) A seller is charged a fee of £4.60 for placing an advertisement on this website.
The standard charge is £2.
Calculate how many words were placed in the advertisement.

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[2]

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13. A production line making chocolates sometimes develops a fault and shuts down.

The distance the chocolates travel towards the next process before shut down is d metres. The speed of the production line is v m/s.

When the fault occurs, it is noticed that the distance the chocolates travel towards the next process, is inversely proportional to the square of the speed of the production line.

The fault last occurred when the distance the chocolates moved on towards the next process was 8 m and the speed of the production line was 4 m/s.

(a) Find an expression for d in terms of v.

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[3]

(b) Calculate d when $v = 6$ m/s.

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[2]

(c) Calculate v when d is 25 cm.

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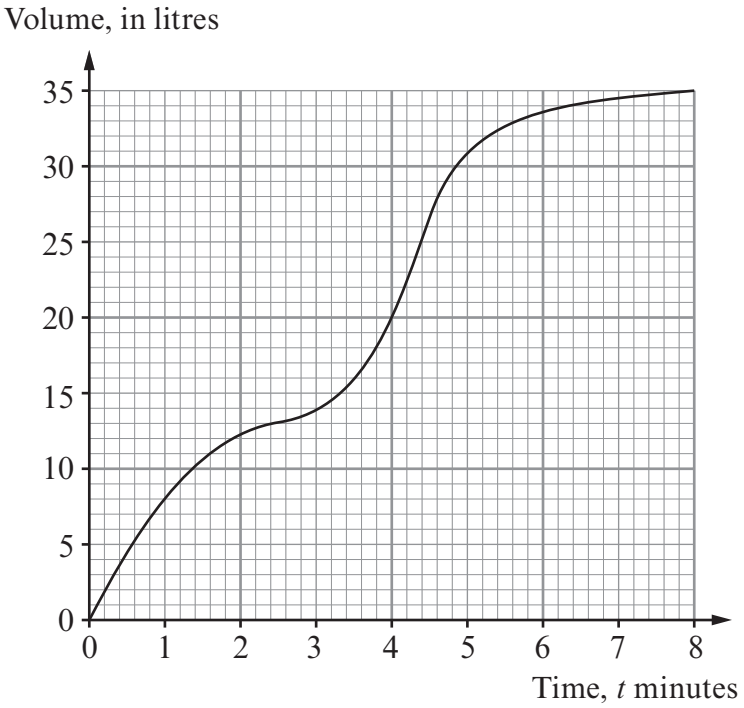
[3]

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14. A tank has been filled with water.
The graph below shows the volume of water in the tank over a time period of 8 minutes.



(a) Calculate the gradient of the graph at time $t = 3$.
You must state the units of your answer.

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[4]

(b) Explain what the gradient of the graph is measuring.

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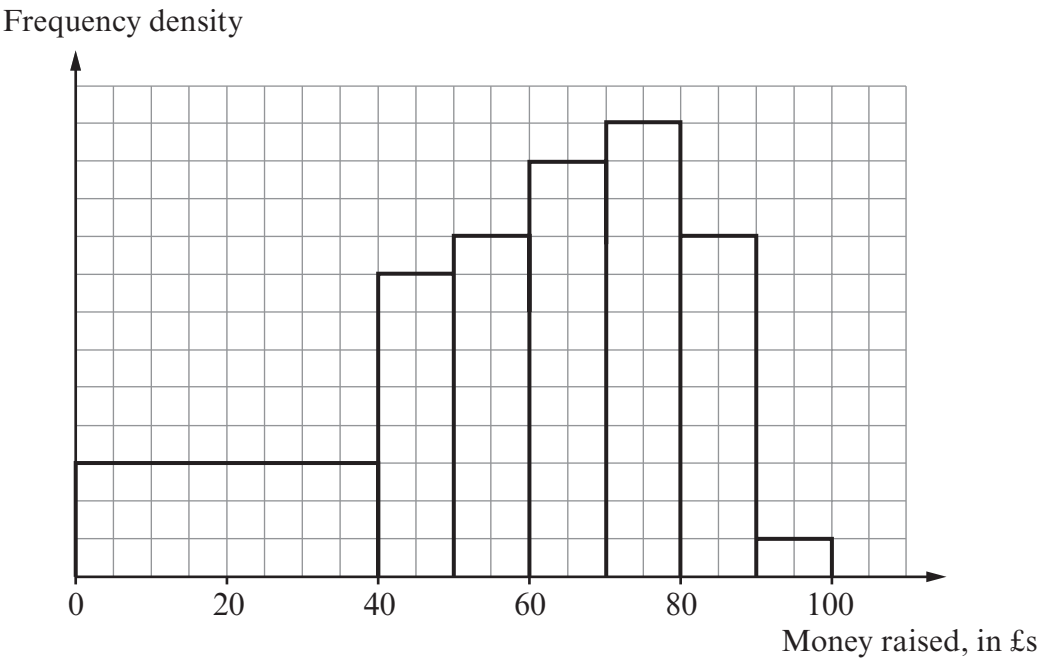
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[1]

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15. Jack arranged a raffle to raise money.
He has drawn a histogram to show the distribution of money raised from the raffle.



Jack has forgotten to write the scale on the vertical axis.
He knows that 40 people each raised £50 or less.
Calculate an estimate for the total money raised.

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[6]

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GCSE MARKING SCHEME

APPLICATIONS OF MATHEMATICS (LINKED PAIR PILOT)

SUMMER 2012

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INTRODUCTION

The marking schemes which follow were those used by WJEC for the Summer 2012 examination in GCSE APPLICATIONS OF MATHEMATICS (LINKED PAIR PILOT). They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

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UNIT 1 (FOUNDATION TIER)

Applications Unit 1 Foundation June 2012		FINAL
1. (a) 1580 (kg) (b) 6000 (cc) (c) (£) 230000 (d) 3 (seconds)	B1 B1 B1 B1 4	 Accept 3.0
2.(a) (i)650 (ii) 230 (iii) Arrow at 36cm (b) Correct use of scale 2 correct sides of the completed triangle	B1 B1 B1 B1 B2 6	 Must be unambiguous Sight of 45 ÷ 3 (=15), 33 ÷ 3 (=11) or 24 ÷ 3(=8) is evidence of use of scale OR 11 or 8 drawn Award B1 for 1 correct side of triangle OR for 2 correct lengths that do not create a triangle. *Use overlay*
3. (a) Attempt to count area Estimate of area within range 25 – 32 m^2 (b) 84(°) (c) circle of radius 5.7 cm	M1 A1 B1 B1 4	 ± 2° ± 2 mm
4. (a) (£)8.29 + (£)10.79 + (£)1.50 (=12.29) + 2 × (£)9.99 (=19.98) +(£)2.50 =(£)43.06 (b) Need 5 £10 notes	B1 B1 B1 B1 B1 B1 6	*When £2.50 added to each part of the order mark as a misread* *Award B4 for answer of (£)40.56* FT their 2 × 9.99 and/or their 10.79 + 1.50 FT their 43.06. Accept embedded answers.
5. (a)(i) 4.3 × 10 + 62 = 105 (cm) (ii) (191 – 62) ÷ 4.3 = 30 (cm) (b) (Estimate of) 8 Full explanation	M1 A1 M1 A1 B1 E1 6	Attempt to multiply **and** add correctly Attempt to subtract **and** then divide Eg. "Because 1/10 and 8/9 is nearly a whole one and 3 + 4 = 7, so 8 in total." 3 + 5 = 8 gets B1 E1 Only 8 gets B1 E0. An exact answer (7 89/90 or 7.988..) only gets B0 E0, however, if they then round to 8 award B1, E0

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Applications Unit 1 Foundation June 2012		FINAL
6. (cost of bricks =)1500 × (£)0.72 = (£)1080 (Charge for laying)(1500 ÷ 500) × (£)200 =(£)600 (Cost of sand=)(1.5 × 42 =) (£) 63 (Cost of cement=) (16 × 4.90 =) (£)78.4(0) (Total cost of the wall=) (£)1821.4(0) <u>Notes:</u> QWC2 can only be awarded if the correct unit is shown in the final answer and the zero is included in the final answer. QWC2 requires words throughout the response not just connected to the final answer. Look for • spelling • clarity of text explanations, • the use of notation (watch for the use of '=', '£' and '0' appropriately used) QWC2: Candidates will be expected to • Present work clearly, with words explaining process or steps. **AND** • Make few if any mistakes in mathematical form, spelling, punctuation and grammar and include units in their final answer. QWC1: Candidates will be expected to • Present work clearly, with words explaining process or steps. **OR** • Make few if any mistakes in mathematical form, spelling, punctuation and grammar and include units in their final answer.	M1 A1 M1 A1 B1 B1 B1 Q W C 2 9	FT their (£)1080, (£)600, (£)63 **AND** (£)78.4(0) QWC2 Presents relevant material in a coherent and logical manner, using acceptable mathematical form, and with few if any errors in spelling, punctuation and grammar. QWC1 Presents relevant material in a coherent and logical manner but with some errors in use of mathematical form, spelling, punctuation or grammar OR evident weaknesses in organisation of material but using acceptable mathematical form, with few if any errors in spelling, punctuation and grammar. QWC0 Evident weaknesses in organisation of material, and errors in use of mathematical form, spelling, punctuation or grammar.
7. (a) Uniform scale used for inches Uniform scale used for cm Plotting all points correctly **Correct** straight line (b) Approximately 22.5. Accept answer in range 22 – 23 (c) Full explanation given Approximately 28 inches	B1 B1 P1 L1 B1 E1 B1 7	*If reversed axes and labelled award marks. But if reversed axes and not labelled penalise -1* L0 for curve or "dog-leg" FT their straight line graph Eg use of graph or arithmetic method FT their graph
8. (a) amount spent on fruit (£)3 (b) Full description given on the trend in the amount spent on chocolate **and** the trend in the amount spent on fruit.	B1 E2 3	Award E1 for partial description OR for description for either fruit **or** chocolate.
9. Mean for Mrs Thomas = 600 ÷ 10 = 60 Mean for Mr Richards (402 ÷ 7 =) 57.(42857143) Mrs Thomas	M1 m1 A1 B1 B1 5	Attempt to add all given values for Mrs Thomas Award B1 if 60 × 7 = 420 used to compare with 402 Only award final B1 if an attempt has been made to calculate **both** means – has been awarded M1 & B1 FT their means

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Applications Unit 1 Foundation June 2012		FINAL
10. (a) All sectors correct and labelled	B2	Award B1 for 1 sector correct and labelled OR for all sectors correct but not labelled (±2°) *Use overlay*
(b)(i) 1/6	B1	*Penalise -1 once only for wrong notation used in (b)*
(ii) 1/6 or equivalent	B1	FT their (i) Do not accept 2/12 if shown 1/6 + 1/6 = 2/12
(c) E	B1	Accept 0.19 or 100 spins
Reason given eg More spins leads to a reliable probability	E1	Accept "it's closest value to 1/6"
	6	
11. 5x + 20 or equivalent	B4	Award B3 for 3(x + 5) or 3x + 15 Award B2 for 3 × x + 5 or x + 5 × 3 Award B1 for x + 5
	4	
12.(a) $\pi \times 0.75^2$	M1	
$= 1.7(67145868)$ (m^2)	A1	Allow answers between 1.7 and 1.8 inclusive
(b) $\pi \times 1.5$	M1	
$= 4.7(1238898)$ (m)	A1	
	4	
13.(a) 134° drawn from Start	M1	±2° *Use Overlay*
200° drawn from their first position	M1	±2°
Accurate chart with lengths (±2mm) and angles correct	A1	Within tolerance allowed FT to (b) for any 2-part journey, except for responses related to given information, e.g. leading to responses 200° and 4 nautical miles. Any bearing given in (b) must be 3 figures
(b) Bearing (±2°) from start to **their** 2nd position	B1	Approximately 160°
Distance (±2mm) from start to **their** 2nd position	B1	Approximately 8.5 nautical miles
	5	
14.	B6	Table correct B1 for Q4 **and** Q7 **both** 'Yes' B1 for each correct corrected answer
	6	
15.		*May all be completed by reasonable sketches*
Strategy, e.g. sketching an appropriate rectangle, (e.g. 5 cm by 4 cm)	S1	Intention, accuracy not demanded
Placing both boats at corners	S1	
Indicating one ¼ circle area inside the rectangle	B1	Intention, no need for accuracy Ignore extra ¾ outside the rectangle
Showing or stating boats at diagonally opposite corners, with 2 × ¼ circle areas either included in sketches or stated	B1	Ignore extra ¾ outside the rectangle
Conclusion diagonally opposite corners and based on not wanting overlapping areas	E1	Depends on previous B1. Needs to be stated or annotated on a diagram, e.g. 'look no overlaps' Accept 'covers more area' only if justified by clear diagrams (need to show a minimum of least one other situation the best solution)
	5	

Q	Y/N	Correct answer
1	Given	Given
2	No	5y
3	No	29a – 31b
4	Yes	
5	No	5x + 18
6	No	8(3x +1)
7	Yes	
8	No	24

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UNIT 1 (HIGHER TIER)

<table>
<tr><th>Applications Unit 1 Summer 2012</th><th></th><th>FINAL</th></tr>
<tr><td>1.(a) a = 62
b = 73
c = 62
d = 136
(b) All three angles given: 134(°), 46(°), 134(°),</td><td>B1
B1
B1
B1
B2
6</td><td>
FT 135 - a
FT a or 135 - b
FT 74 + c
B1 for sight of 134, or for the full process shown but 1 error in the calculation</td></tr>
<tr><td>2.(a) Realises that measurement could have been rounded down to 6 cm (may also give an example), e.g. ‘each box could be at upper bound, so height could be a much as 13 cm’

(b) 4a+4b+4c (cm) or 4(a+b+c) (cm)</td><td>E2

B2

4</td><td>For E2 both of the boxes should be mentioned
E1 for an example without an explanation, or statement such as ‘could be over 6cm’ or similar without mention of rounding down

If B2 penalise further incorrect working -1
B1 for correct expression but not in simplified form, or na + nb + nc where n is a whole number but n≠1 or n≠0
If B2, mark final answer, do not ignore further incorrect work</td></tr>
<tr><td>3 (1,1) (1,2) (1,4) (1,8) (1,16)
(3,1) (3,2) (3,4) (3,8) (3,16)
(9,1) (9,2) (9,4) (9,8) (9,16)</td><td>B3

3</td><td>With no incorrect dots (3,4) was given
B2 for any 8 to 13 correct with no more than 1 or 2 incorrect plots
B1 for any 5 to 7 correct with no more than 3 incorrect
SC1 for all 14 reversed, or sight of all factors of 9 and 16</td></tr>
<tr><td>4.
<table><tr><td>Q</td><td>Y/N</td><td>Correct answer</td></tr><tr><td>1</td><td>Given</td><td>Given</td></tr><tr><td>2</td><td>No</td><td>29a – 31b</td></tr><tr><td>3</td><td>Yes</td><td></td></tr><tr><td>4</td><td>No</td><td>5x + 18</td></tr><tr><td>5</td><td>No</td><td>8(3x +1)</td></tr><tr><td>6</td><td>Yes</td><td></td></tr><tr><td>7</td><td>No</td><td>24</td></tr></table></td><td>B5

5</td><td>Table correct

B1 for Q3 and Q6 both ‘Yes’
B1 for each correct corrected answer</td></tr>
<tr><td>5.(a) 134° drawn from Start
200° drawn from their first position
Accurate chart with lengths (±2mm) and angles correct

(b) Bearing (±2°) from start to their 2nd position
Distance (±2mm) from start to their 2nd position</td><td>M1
M1
A1

B1
B1
5</td><td>±2°
±2°
Within tolerance allowed
FT to (b) for any 2-part journey, except for responses related to given information, e.g. leading to responses 200° and 4 nautical miles.
Any bearing given in (b) must be 3 figures
Approximately 160°
Approximately 8.5 nautical miles</td></tr>
</table>

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Applications Unit 1 Summer 2012		FINAL
6.(a)(i) **Vertical** plots accurate for at least 5 years Horizontal & vertical plots accurate for at least 5 years All points accurately plotted	P1 P1 P1	 Ignore any joining of points
(ii) Appropriate method, e.g. considering an appropriate point on their graph (perhaps approximately ½ way) between 2008 and 2009 plots, or (248 + 300)/2	M1	FT their graph, taking forward the idea of joining points with a straight line or a curve
Answers in the range 254 to 294	A1	
(b) Sight of (640,) 320, 160, (80, …) Realising equal numbers during **2006** Method to establish the quarter, e.g. plotting ordinary light bulb numbers on low energy graph and look for intersection, or comparing 172, 178.5, 185, 191.5, 198 with 320, 280, 240, 200, 160, or arithmetic method, or method based on a curve	M1 A1 m1	FT from their graph drawn in (a) Do not accept a comparison with a 'line of best fit' given in (a)
4th (quarter) 2006	A1	Accept October, November or December 2006 Do not FT from a 'line of best fit' given in (a) *SC3 for unsupported answer 4th quarter of 2006* *SC2 if error in division by 2 of 640, but FT appropriate method and accuracy* *SC1 for conclusion 'January 2007', also possible M1 and if stated 'equal number during 2006' A1, but m0 or final A0. This does <u>not</u> apply to conclusion '1st quarter 2007'*
	9	
7(a) Idea of scale is match of units, 1cm=25 000 cm	S1	Or equivalent initial idea
80 × 25000	M1	Accept sight of 80 × 25000 with a place value error in the 25000
= 2 000 000 (cm)	A1	Maybe embedded with change of units (20 000m) If units are given they must be correct The unit 'cm' also implies previous S1
1km = 100 000cm	B1	Or 1m = 100cm with 1000m = 1km
20 (km)	A1	If units are given they must be correct
(b) 80 cm is 20 km OR 4 cm is 1 km OR equivalent	B1	FT their 20km from (a) leading to 24 × 80/(a)
24 × 4 or equivalent	M1	
96 (cm)	A1	If units are given they must correct *Alternative: 24 (km) ÷25 000* *Unit conversion (× 100 000)* *96 (cm)* *If units are given they must correct*
(c) 24/6 Cycled 20 (km) AND Pushed bike uphill 4 (km)	M1 A1	Answers reversed allow M1
24/12 Cycled 22 (km) AND Pushed bike uphill 2 (km)	M1 A1	Answers reversed allow M1 *If no marks in (c) then SC1 for all answers in correct ratio but not with a total of 24, but not the answers 5 and 1 or 11and 1*
	12	

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Applications Unit 1 Summer 2012		FINAL
8. Strategy, e.g. sketching an appropriate rectangle, (e.g. 5 cm by 4 cm) Placing both boats at corners Indicating one ¼ circle area inside the rectangle Showing or stating boats at diagonally opposite corners, with 2 × ¼ circle areas either included in sketches or stated Conclusion diagonally opposite corners and based on not wanting overlapping areas Look for • relevance • spelling • clarity of text explanations • diagrams or sketches QWC2: Candidates will be expected to • present work clearly, with words explaining process or steps AND • make few if any mistakes in mathematical form, spelling, punctuation and grammar and include units in their final answer QWC1: Candidates will be expected to • present work clearly, with words explaining process or steps OR • make few if any mistakes in mathematical form, spelling, punctuation and grammar and include units in their final answer	 S1 S1 B1 B1 E1 Q W C 2 <

Applications Unit 1 Summer 2012		FINAL
10. 7.2	B4 <

Applications Unit 1 Summer 2012		FINAL
15. Strategy, e.g. noticing 0 to 40 is 1.5 times 40 to 50, or first rectangle 3/5 with second 2/5 of a quantity	S1	or £25 with 20 people, or 40 squares for £50 may be seen on the histogram, or 30 written adjacent to 20
$40\times3x + 10\times8x = 40$ or equivalent, or 24 written adjacent to 16,	B1	Award of this B1 implies the award of the S1 also
Uniform scale 0.2, 0.4, 0.6, …, implied or shown (height of first rectangle is 0.6, 2nd height is 1.6, etc.)	B1	or sight of 0.2, or 'each person is 1 square', or sight of any 6 of 24, 16, 18, 22, 24, 18, 2 Award of this B1 implies the award of the S1 and previous B1 also *If M1 or M2 awarded, this implies previous S1, B1 and B1*
20×24+45×16+55×18+65×22+75×24+85×18+95×2 (or with the first term split 12×10+12×30) OR 0.6×20×40 + 1.6×45×10 + 1.8×55×10 + 2.2×65×10 + 2.4×75×10 + 1.8×85×10 + 0.2×95×10	M2	M1 for • any 3 correct products within the overall sum, or • the appropriate sum of products but with bounds used instead of mid points, or • use of mid points 55, 65, 75, 85 and 95 within a product sum
(£)7140	A1 6	CAO

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Surname	Centre Number	Candidate Number
Other Names		0

GCSE LINKED PAIR PILOT

4361/02

APPLICATIONS OF MATHEMATICS
UNIT 1: APPLICATIONS 1
HIGHER TIER

A.M. MONDAY, 16 January 2012

2 hours

ADDITIONAL MATERIALS

A calculator will be required for this paper.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** the questions in the spaces provided.

Take π as 3·14 or use the π button on your calculator.

INFORMATION FOR CANDIDATES

You should give details of your method of solution when appropriate.

Unless stated, diagrams are not drawn to scale.

Scale drawing solutions will not be acceptable where you are asked to calculate.

The number of marks is given in brackets at the end of each question or part-question.

You are reminded that assessment will take into account the quality of written communication (including mathematical communication) used in your answer to question **3***(b)*.

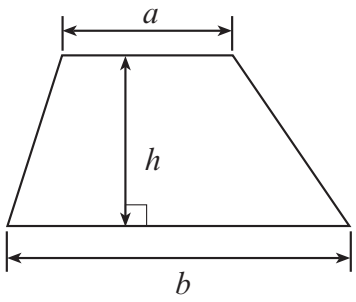
For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1	**8**	
2	**7**	
3	**12**	
4	**14**	
5	**10**	
6	**10**	
7	**5**	
8	**7**	
9	**7**	
10	**5**	
11	**3**	
12	**12**	
TOTAL MARK		

4361
020001

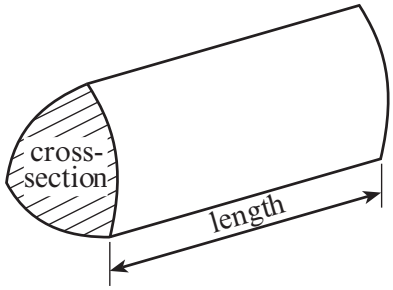
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Formula List

Area of trapezium = $\frac{1}{2}(a + b)h$

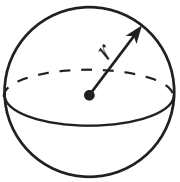


Volume of prism = area of cross-section × length



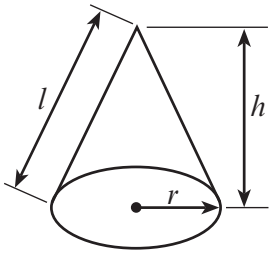
Volume of sphere = $\frac{4}{3}\pi r^3$

Surface area of sphere = $4\pi r^2$



Volume of cone = $\frac{1}{3}\pi r^2 h$

Curved surface area of cone = $\pi r l$

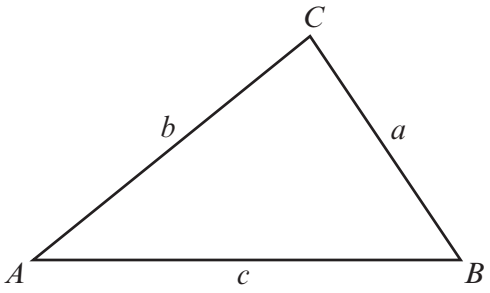


In any triangle ABC

Sine rule $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Cosine rule $a^2 = b^2 + c^2 - 2bc\cos A$

Area of triangle = $\frac{1}{2}ab\sin C$



The Quadratic Equation

The solutions of $ax^2 + bx + c = 0$

where $a \neq 0$ are given by

$$x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$$

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Examiner only

1. Write down expressions for each of the following.

(a) The total cost of 10 pencils at g pence each and 5 pens at h pence each.

.....

.....

[2]

(b) The mean height of the three boys listed below.

	Height in cm
Adam	x
Tommy	y
Joseph	z

.....

.....

[2]

(c) The perimeter of a rectangle with length l cm and width w cm.

.....

.....

[2]

(d) The smaller share when £q is shared in the ratio 1:3.

.....

.....

[2]

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2. Sasha has designed a new two dimensional logo for her company.
The logo is to be printed on all official company paper.
A sketch of the logo is shown below.

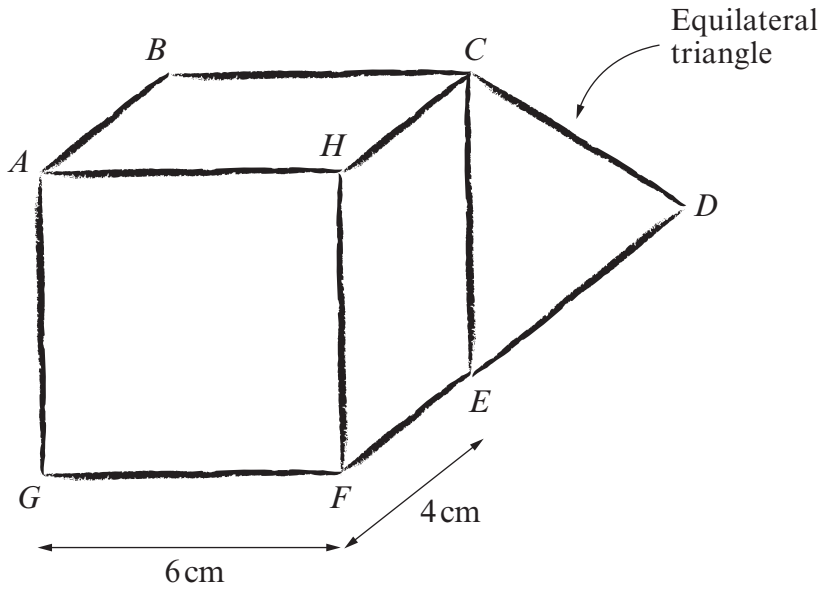


Diagram not drawn to scale

The idea for the logo is based on a 2-D representation of a cube with an accurate equilateral triangle attached to one edge.
On the logo, ***DEF* is a straight line**.

To help Sasha to draw an accurate version of the logo, she needs to identify what the actual lengths and angles will be on the logo.

(a) Write down the actual

size of $\hat{CED}$ on the logo ..... °

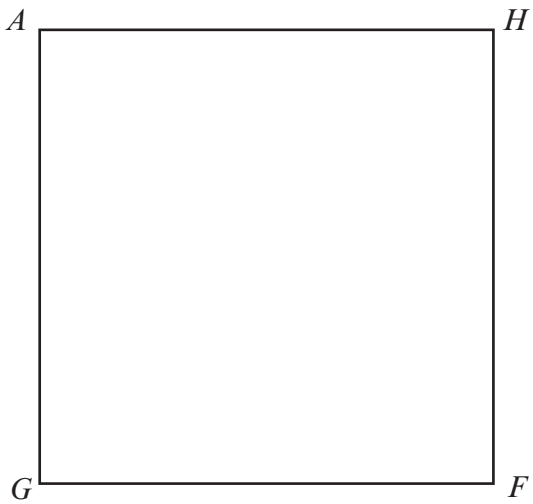
length of CE on the logo ..... cm

length of AB on the logo ..... cm.

[3]

(b) Complete the accurate drawing of the logo on the opposite page.
$AHFG$ has been drawn for you. [4]

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Examiner only

3. Mr Smith needs to buy boxes for necklaces that he makes.
There are two possible suppliers he can use, Boxes Galore or Box Clever.



BOXES GALORE

Order 1 to 100 boxes pay 40p for each box

Need more than 100 boxes? ..... Special Offer:

MORE than 100 boxes get **all boxes for just** 15p each!

PLUS standard delivery charge of £3 per order.



BOX CLEVER

First 1 to 50 boxes	30p each
Every extra box then just	25p each

PLUS standard delivery charge of £2 per order

(a) Mr Smith placed orders for boxes in June, July and August with Boxes Galore.
Complete the chart below.

Month	June	July	August
Number of boxes bought	8	95	105
Company used	**Boxes Galore**	**Boxes Galore**	**Boxes Galore**
Total cost (including the delivery charge)	£	£	£

.....

.....

.....

.....

.....

[4]

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(b) *You will be assessed on the quality of your written communication in this part of the question.*

Mr Smith notices that he has not been wise with his order from Boxes Galore.
In September he intends to buy 96 boxes from Boxes Galore.
What advice would you give Mr Smith?
You must give a reason for your answer.

.....

.....

.....

.....

.....

.....

.....

.....

.....

[4]

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Examiner only

(c) Use the graph paper below to show the costs for ordering up to 130 boxes from **Box Clever**.

.....

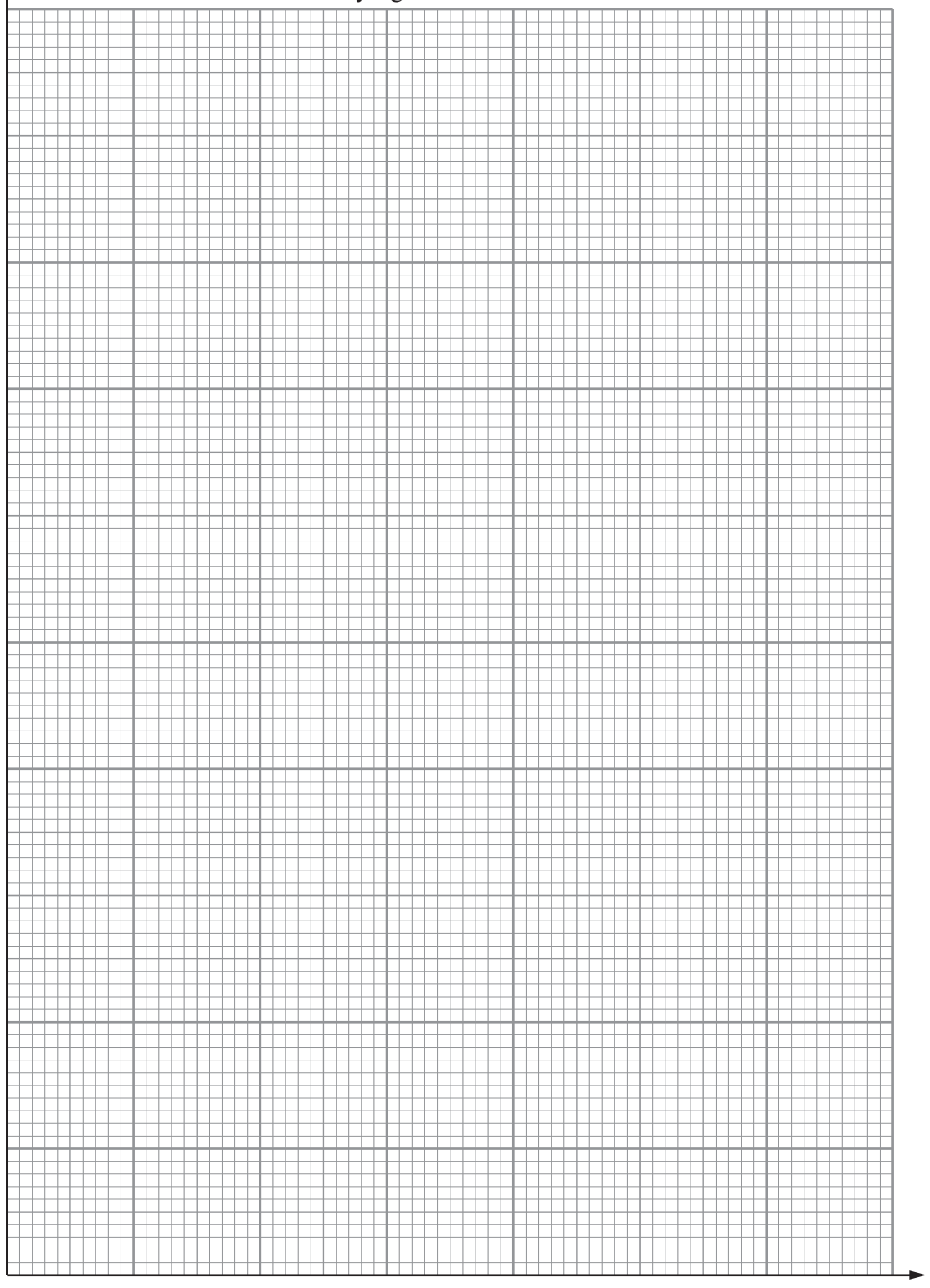
.....

.....

..... [3]

Buying from **Box Clever**

Cost in £s, including delivery charge



Number of boxes

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Examiner only

(d) Complete the chart below to give recommendations for Mr Smith.

Number of boxes	Better company to buy from
Fewer than 8	
Between 50 and 54	
More than 110	

.....

.....

.....

[1]

4361 020009

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4. A machine is used to pack boxes of chocolate beans.
To check the machine, 10 boxes of beans are selected on the hour for 10 consecutive hours.
There should be exactly 55 chocolate beans in each box.
Each hour the number of boxes containing exactly 55 chocolate beans is recorded.

Time	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00
Number of the 10 boxes with exactly 55 beans	8	7	6	9	8	10	8	6	9	9

(a) Is a statement on the box that says

"Contains at least 55 chocolate beans"

always true?
You must give a reason for your answer.

.....

.....

.....

[2]

(b) If the experiment were to be carried out again would you expect the results to be exactly the same?
You must give a reason for your answer.

.....

.....

.....

.....

[2]

(c) It is decided to record and plot the relative frequencies for the information shown in the previous table.

(i) Complete the table below.

Time, by	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00
Total number of boxes with exactly 55 beans	8	15	21							
Total number of boxes checked	10	20								
Relative frequency										

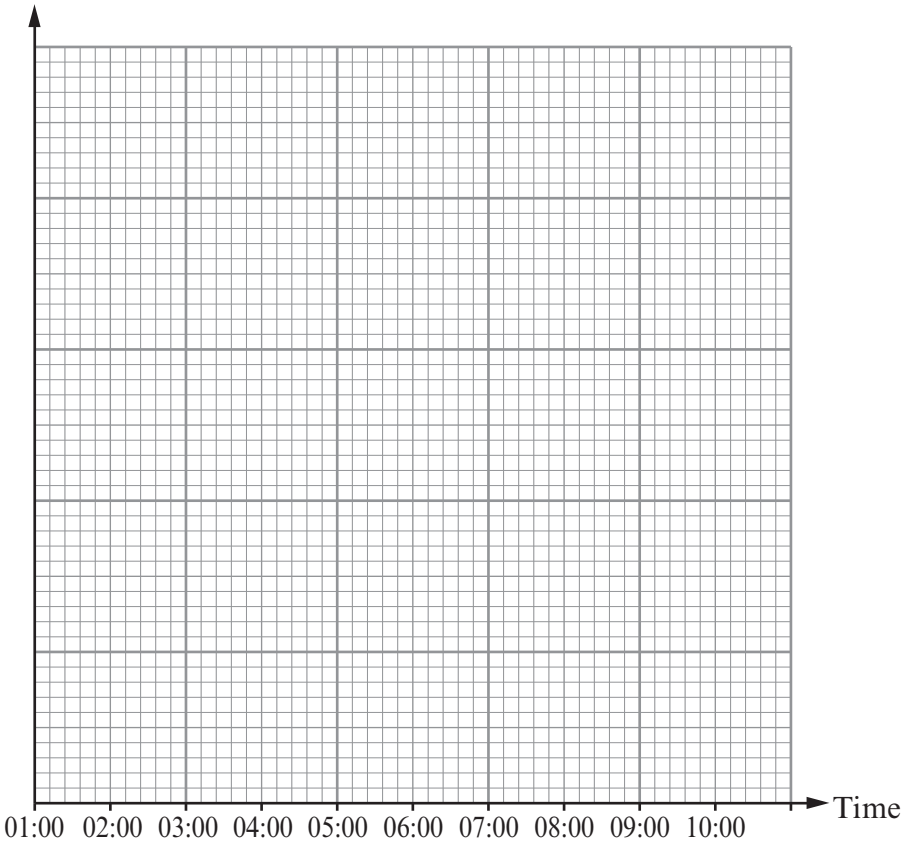
[4]

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(ii) Use the graph paper below to plot the relative frequencies.

Relative frequency



[3]

(iii) Write down the best estimate for the probability that a box selected at random will contain exactly 55 chocolate beans. Give a reason for your answer.

.....

.....

.....

.....

[2]

(iv) How would you improve on your estimate?

.....

.....

[1]

4361 020011

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5. *(a)* A number of people were asked how much they would be willing to pay to go on a fairground ride.
The results are summarised in the table.

Amount of money, £x	Number of people
$0 \leqslant x < 2$	24
$2 \leqslant x < 4$	16
$4 \leqslant x < 6$	42
$6 \leqslant x < 8$	18

(i) Calculate an estimate for the mean amount of money.

.....

.....

.....

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[4]

(ii) Find the greatest possible value of the range.

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[1]

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(b) The fairground owner recorded the number of people coming into his fairground during the different seasons.

Season	Winter 2010	Spring 2010	Summer 2010	Autumn 2010	Winter 2011	Spring 2011	Summer 2011
Number of people	234	156	316	230	326	456	324

(i) Calculate the 4-point moving averages and complete the table below.

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4-point period ending:	Autumn 2010	Winter 2011	Spring 2011	Summer 2011
4-point moving average				

[3]

(ii) The fairground owner looks at the moving average with his staff.
Explain why considering the moving average is worthwhile.

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[1]

(iii) The fairground owner states
"we were as busy in Summer 2011 as we were in Spring 2011".
Explain fully the mathematical error in his statement.

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[1]

Turn over.

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Examiner only

6. The table gives a grouped frequency distribution of the arm lengths of 100 women each measured correct to the nearest centimetre.

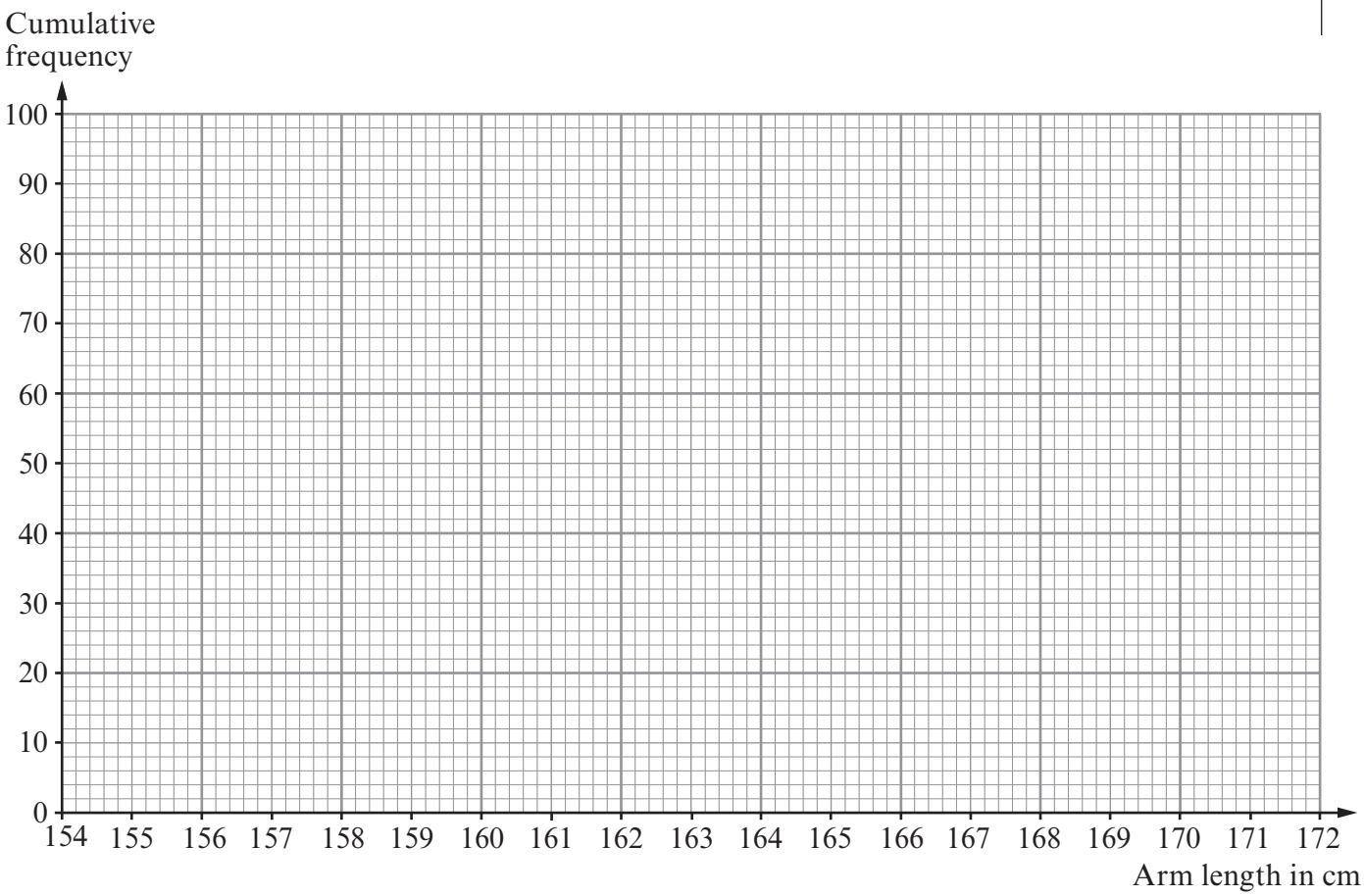
Arm length, a cm	156 to 158	159 to 161	162 to 164	165 to 167	168 to 170
Number of women	5	15	35	40	5

(a) Complete the following cumulative frequency table.

Arm length, a cm	$a < 155.5$	$a < 158.5$	$a < 161.5$	$a < 164.5$	$a < 167.5$	$a < 170.5$
Cumulative frequency	0	5				

[1]

(b) On the graph paper below, draw a cumulative frequency diagram to show this information. [2]



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Examiner only

(c) Use your cumulative frequency diagram to estimate the median and the interquartile range.

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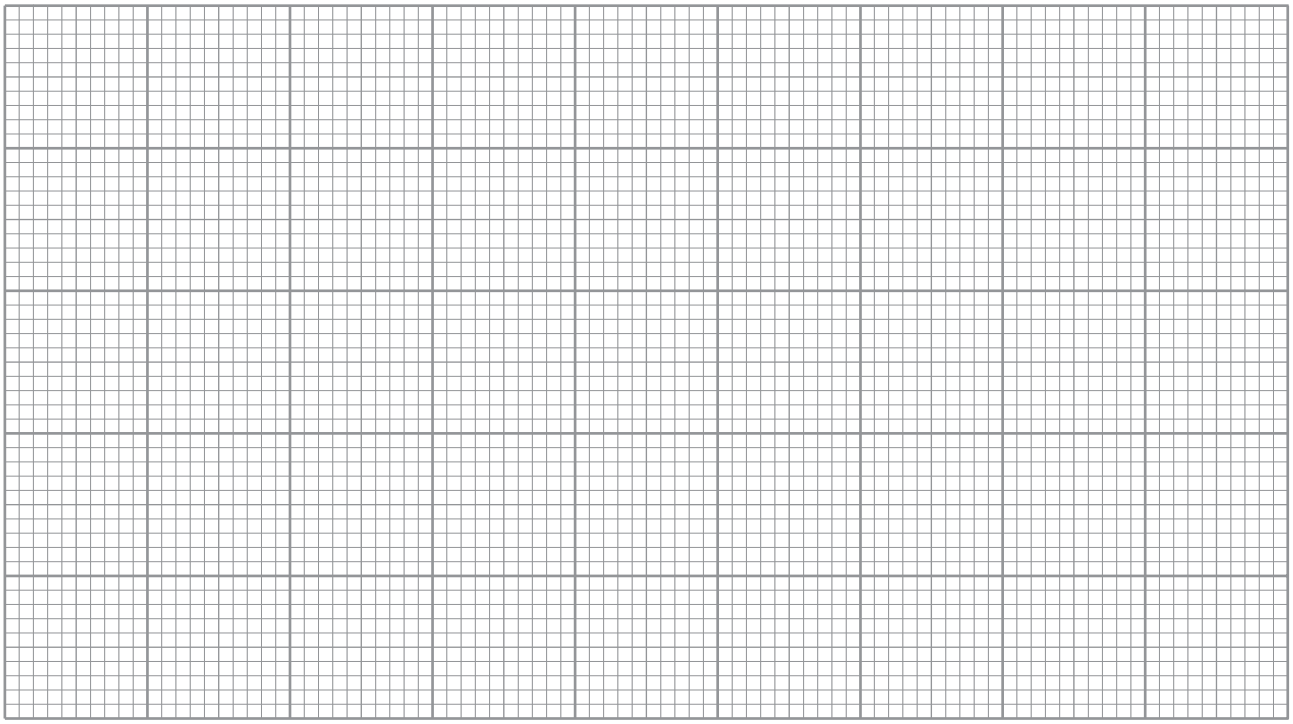
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Median ..... Interquartile range .....

[3]

(d) Use the graph paper below to draw a box-and-whisker diagram to show these results.



[4]

Turn over.

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Examiner only

7. A valuable statue is on display.



To protect the statue a glass cuboid is built around it.

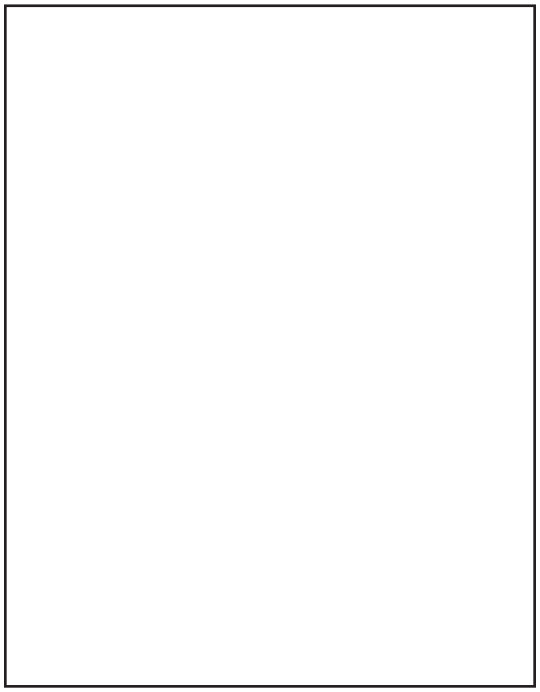
A scale drawing of the plan view (bird's eye or aerial view) of the cuboid is shown below.

Scale 1 cm : 20 cm

A barrier is built around the cuboid so that no one can stand within 60 cm of the cuboid.

Using the given scale, draw accurately the locus of the barrier on the scale drawing shown below.

[5]



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Examiner only

8. Tom and Zen have new bikes.



The diameters of the wheels on Tom's bike are 70 cm.
The diameters of the wheels on Zen's bike are 60 cm.

Calculate the difference in the number of revolutions of the wheels over a distance of 1 km.
Give your answer correct to 2 significant figures.

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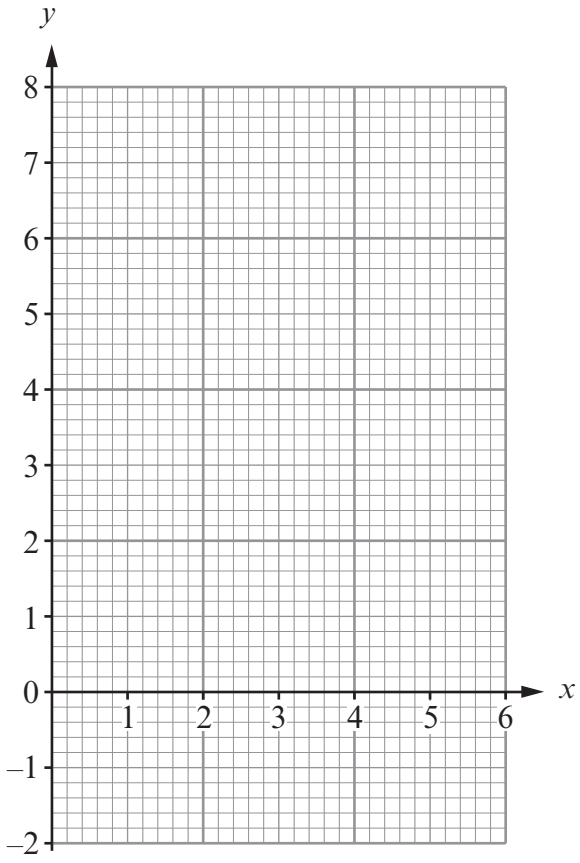
[7]

Turn over.

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Examiner only

9. Lucy is a scientist. During an investigation she needs to find the points of intersection of two equations to solve a problem.
The equations are $y = x^2 - 6x + 8$ and $x + y = 4$.
Draw graphs to solve Lucy's problem.



[5]

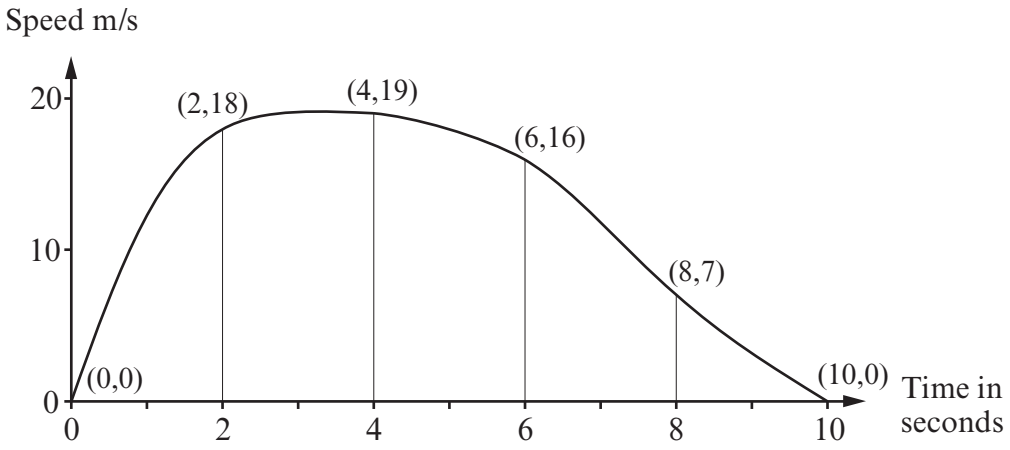
Points of intersection .....

[2]

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Examiner only

10. Dani is researching speed, distance and time.
She carries out an experiment using a computer to generate a graph to show the speed of a particle over a 10 second time interval.
The computer display is shown below.



By calculating the area, enclosed between the curve and the time axis, Dani can estimate the distance the particle travelled.
Find an estimate for the distance travelled by the particle.
You must state the unit of your answer.

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[5]

11. The reciprocal of the speed of light squared is 2.22×10^{-18}.
Find the speed of light in standard form correct to two significant figures.

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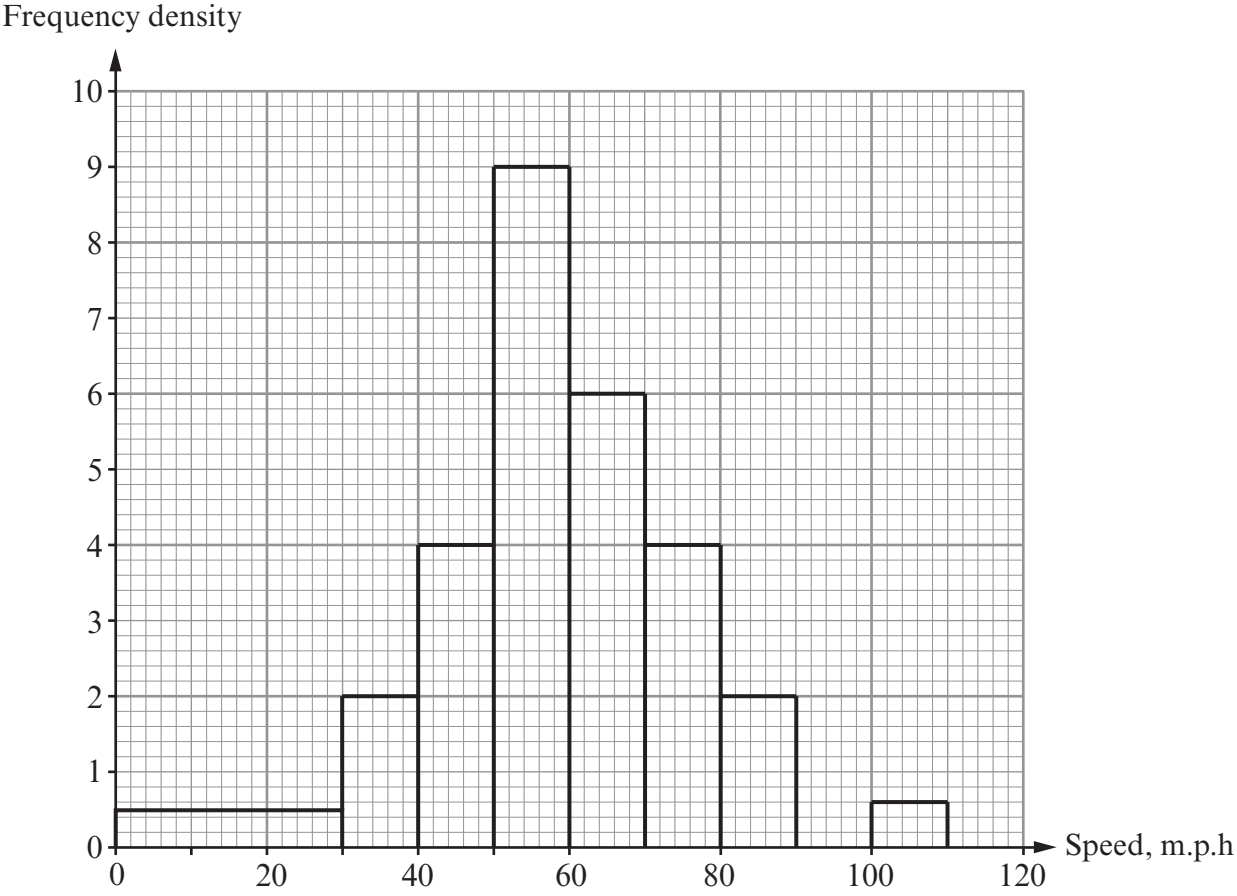
[3]

Turn over.

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Examiner only

12. The histogram below shows the speeds of motorists as they enter a tunnel between 1 a.m. and 2 a.m.



(a) The speed limit on entering the tunnel is 70 m.p.h.
How many motorists were exceeding the speed limit on entering the tunnel?

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[3]

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(b) In order to compare the speeds of motorists between 1 a.m. and 2 a.m. with other 1 hour periods, it is decided to group the data in equal intervals of width 30 m.p.h., starting at 0 m.p.h.
Construct a histogram to display these results meeting this new requirement.

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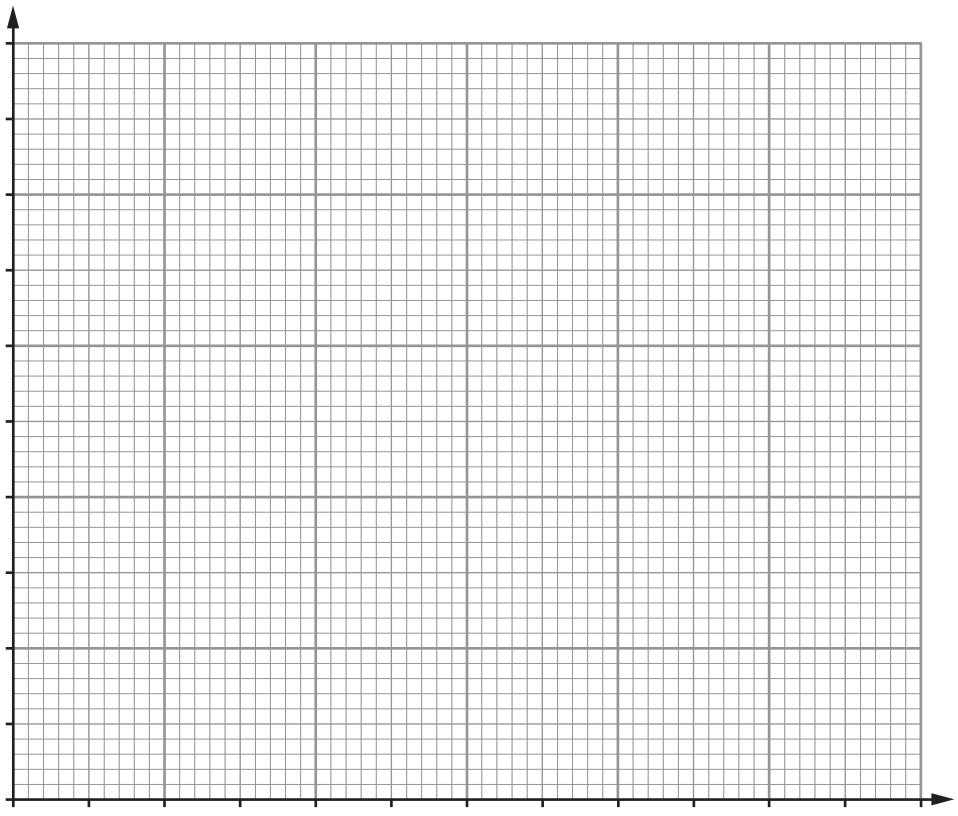
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[8]



(c) Given that the speed limit is 70 m.p.h., which of the two histograms is the more appropriate for the display of the data? You must give a reason for your answer.

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[1]

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WJEC
CBAC

GCSE MARKING SCHEME

APPLICATIONS OF MATHEMATICS (LINKED PAIR PILOT)

JANUARY 2012

INTRODUCTION

The marking schemes which follow were those used by WJEC for the January 2012 examination in GCSE APPLICATIONS OF MATHEMATICS. They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

	Page
Unit 1 – Foundation Tier	1
Unit 1 – Higher Tier	4

Unit 1 – Foundation Tier

Applications U1 Foundation Tier January 2012	Mark	Comment
1.7319 + 6327 + 4978 + 1093 = 19717 19700	M1 A1 B1 3	Attempt to add 3 or 4 numbers CAO FT their total
2. (78 + 41 =) (£)119 (14.99 + 58.49=) (£)73.48 (119 – 73.48=) (£)45.52 left Valid reason eg he only has £45.52 left which is not enough money to buy the ticket and No stated or implied Look for • Correct units used • Spelling in at least 1 statement/sentence • Clarity of text explanation • Correct terminology • the use of simplified notation (watch for the use '=' being appropriate) QWC2: Candidates will be expected to • present work clearly, with words explaining process or steps AND • make few if any mistakes in mathematical form, spelling, punctuation and grammar in their answer QWC1: Candidates will be expected to • present work clearly, with words explaining process or steps OR • make few if any mistakes in mathematical form, spelling, punctuation and grammar in their answer	B1 B1 B1 E1 QWC 2 6	 Accept needs (£)138.48FT 'their 119' and 'their 73.48' FT for their calculations QWC2 Presents relevant material in a coherent and logical manner, using acceptable mathematical form, and with few if any errors in spelling, punctuation and grammar. QWC1 Presents relevant material in a coherent and logical manner but with some errors in use of mathematical form, spelling, punctuation or grammar OR evident weaknesses in organisation of material but using acceptable mathematical form, with few if any errors in spelling, punctuation and grammar. QWC0 Evident weaknesses in organisation of material, and errors in use of mathematical form, spelling, punctuation or grammar.
3. Evidence of at least one car's information substituted into formula correctly with the correct answer For the correct times for all 3 cars Statement saying the least time taken was the 2nd car	M1 A1 E1 3	Any one correct answer implies M1 Time for: 1st car = 1.2 hours 2nd car = 0.8 hours 3rd car = 0.88 hours FT if M1 awarded Award SC1 for answers of 0.8, 1.25 & 1.1 and 1st car being shortest time.
4. (a) Wednesday (b) Adding numbers (= 791) 791÷7 Mean = 113 Put in order 30, 68, 68, 80, 120, 185, 240 Median = 80 Mode = 68 Range = 210	B1 M1 m1 A1 M1 A1 B1 B1 8	 Attempt to add numbers FT 'their 791' CAO
5. (a) circle drawn r = 4.5cm (b) (i) 8.6 (cm) or 86(mm) (ii) Identifying midpoint of base Correct position of top of triangle (c) 360 – (56 + 90 + 90) or implied equivalent eg 180 - 56 = 124 (°)	B2 B1 B1 B2 M1 A1 8	± 2mm B1 for circle radius 9cm ± 2mm ± 2mm. Look on diagram for evidence ± 2mm. Use overlay. For B2 FT 'their midpoint'. Award B1 for any perpendicular line drawn OR for any indication (dot) of being perpendicularly above 'their midpoint' at any height.

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Applications U1 Foundation Tier January 2012	Mark	Comment
6.(a) rectangle drawn Rectangle overlapping y-axis Rectangle with area > 31 cm^2 4 correct coordinates (b)Attempt to count area Estimate of area of their leaf within the range of 15 - 18	B1 B1 B1 B2 M1 A1 7	Accept square used. FT from their diagram. B1 for 2 or 3 coordinates correct. Reversed coordinates B0.
7. (a) slippers (b) 4/40 (c) Correct explanation given	B1 B1 E1 3	 ISW eg. No because you are asking more people and this may change the probability OR No when doing an experiment again it could give a different result OR any explanation of different proportion liking flip flops. Eg No because 7 could like flip flops
8. 3 × 16 + 1× 15 = 63 (99 – 63) = 36 (36 ÷ 12 =) 3 nights	M1 A1 B1 B1 4	 FT their 63 if M1 awarded FT their 36. Not dependent on M1
9. Idea of buying 4 for price of 3 or evidence of buying 4 lots of 4 tickets ((4.70 × 3) × 3 =)14.1(0) × 3 or 42.3(0) seen or implied (6.20 + 4.70 + 4.70 =) 15.6(0) seen £57.9(0) CAO	S1 B1 B1 B1 4	Eg. 4 free tickets Alternative method 11× 4.70 (=51.7(0)) B1 FT 'Their 51.7(0)' + 6.2(0) B1 £57.9(0) B1 CAO (£)76.7(0) B1 'their 76.70' – (4 × 4.70) or 18.8(0) seen B1 57.9(0) B1 CAO Award SC2 for answer of 62.6(0) from 15 × 4.7(0) + 6.2(0) – 3 × 4.7(0) (use of 3 free tickets) Award SC1 for incorrect answer to the above method
10. (a) 10119.74 (b) 10000	B2 B1 3	B1 for 10119.7(361) or 10120 FT their (a) rounded to 1 significant figure
11. (a) 062 (°) 150 (°) (b) Correct line from The Seabreeze Correct line from The Catcher Lines intersecting (c) 8 (cm) Multiplying by 5 = 40 cm or other correct units	B1 B1 M1 M1 A1 B1 M1 A1 U1 9	±2° ±2° Use Overlay. *If only 1 line drawn, the position of the harbour must be marked* FT if at least one M1 given ±2mm (accept 7.8 – 8.2 inclusive) FT their length
12.(a) 10g + 5h (p) (b) 2l + 2w (cm) or l + l ~+ w + w or 2(l + w) or equivalent	B2 B2 4	B1 for either 10g (or 10×g) or 5h (or 5×h) If B2, penalise further incorrect work -1 B1 for 2l or 2w or 2 × l + w If B2, penalise further incorrect work -1
13. (a) Journey from Brian's home to friends 1 ¾ hour stay at friends Journey home (b) 37-38 miles	B1 B1 B1 B1 4	Use Overlay FT 'their 1st part of the journey' FT 'their stay at friends' FT 'from their graph'

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Applications U1 Foundation Tier January 2012	Mark	Comment
14.(a) 60(°), 6(cm), 4 (cm) (b) Correct logo, all 3 areas, (see overlay) Tolerance in this question is $\pm$2mm,$\pm$2°	B3 B4 7	B1 for each correct answer *FT if at all possible from (a)* B3 2 areas correct with the other area slightly outside tolerance B2 2 of the areas correct B1 1 of the areas correct, but placement may be incorrect
15. 672 ÷ 16 = 42 Jane = (£)294 and Ian = (£)378	M1 A1 A1 3	
16. One correct evaluation (1dp) $1.8 \le x \le 1.9$ 2 correct evaluations $1.87 \le x \le 1.885$ One either side of 1 2 correct evaluations $1.875 \le x \le 1.885$ One either side of 1 1.88	B1 B1 M1 A1 4	x $x^3 - 3x$ 1.8 0.4(32) 1.81 0.4(997) 1.82 0.5(68) 1.83 0.6(38) 1.84 0.7(095) 1.85 0.7(81) 1.86 0.8(54) 1.87 0.9(29) 1.875 0.9(66) 1.88 1.0(0467) 1.89 1.0(81) 1.9 1.1(59) **1.885 1.0(428)** If values are not shown do not accept the use of statements such as 'greater than one and less than one' or 'too high and too low' Unsupported 1.88 gets B0 B0 M0 A0

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Unit 1 – Higher Tier

Applications U1 Higher Tier January 2012	Mark	Comment
1.(a) 10g + 5h (p)	B2	B1 for either 10g (or 10×g) or 5h (or 5×h) If B2, penalise further incorrect work -1
(b) x+y+z	B1	
(x+y+z)/3 or equivalent	B1	
(c) 2l + 2w (cm) or l + l + w + w or 2(l + w) or equivalent	B2	B1 for 2l or 2w or 2 × l + w or equivalent If B2, penalise further incorrect work -1
(d) Evidence of need to divide by 4	B1	
(£) q/4 or equivalent	B1 8	Accept q/(3+1)
2.(a) 60(°), 6(cm), 4 (cm)	B3	B1 for each correct answer *FT if at all possible from (a)*
(b) Correct logo, all 3 areas, (see overlay) Tolerance in this question is ±2mm,±2°	B4 7	B3 2 areas correct with the other area slightly outside tolerance B2 2 of the areas correct B1 1 of the areas correct, but placement may be incorrect
3(a) £6.2(0), £41, £18.75	B4	B3 for any 2 correct or £3.2(0), £38, £15.75 B2 for any 1 correct or any 2 of £3.2(0), £38, £15.75, B1 for correct working that could lead to any1 correct answer including the delivery charge Do not FT to (b) from incorrect prices in (a)
(b) Suitable explanation clearly mentions 101 boxes or more than 100	E2	E1 for a suitable explanation, but not referring to more than 100, perhaps refers to 100. Or for a partial explanation not mentioning the number of boxes exactly, just saying buy more Ignore inaccurate calculations
QWC2: Candidates will be expected to • present work clearly, with words explaining process or steps. Graph axes are both labelled, appropriate joining of points, clear which lines relate to Box Clever and Box Galore **AND** • make few if any mistakes in mathematical form, spelling, punctuation and grammar and include units in their final answer	QWC 2	QWC2 Presents relevant material in a coherent and logical manner, using acceptable mathematical form, and with few if any errors in spelling, punctuation and grammar.
QWC1: Candidates will be expected to • present work clearly, with words explaining process or steps. Graph axes are both labelled, appropriate joining of points, clear which lines relate to Box Clever and Box Galore **OR** • make few if any mistakes in mathematical form, spelling, punctuation and grammar and include units in their final answer		QWC1 Presents relevant material in a coherent and logical manner but with some errors in use of mathematical form, spelling, punctuation or grammar OR evident weaknesses in organisation of material but using acceptable mathematical form, with few if any errors in spelling, punctuation and grammar. QWC0 Evident weaknesses in organisation of material, and errors in use of mathematical form, spelling, punctuation or grammar.
(c) Both axes with suitable uniform scale	B1	Scale, i.e. > ¼ graph paper is used for plots
Accurate plots for Box Clever joined with a straight line from at least 10 to 50 and 50+ to 120 boxes	B2	FT scale. B1 for at least 3 correct plots, or plots and line would be accurate had the delivery charge not been omitted
(d) Box Clever Box Clever Boxes Galore	B1 12	CAO

Boxes Galore													
No.	*0*	*5*	*10*	*20*	*30*	*50*	*100*	*101*	*110*	*120*	*130*	*140*	*150*
£	*3*	*5*	*7*	*11*	*15*	*23*	*43*	*18.15*	*19.50*	*21*	*22.50*	*24*	*25.50*
Box Clever													
No.	0	5	10	20	30	50	51	60	70	80	100	120	150
£	2	3.50	5	8	11	17	17.25	19.50	22	24.50	29.50	34.50	42

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Applications U1 Higher Tier January 2012	Mark	Comment
4.(a) Explanation, e.g. "this information was not recorded", "don't know how many beans in the other boxes", "it doesn't say if more or less than 55"	M1	Do not accept 'No' with a reason related to specific data from the table demonstrating a misunderstanding of what the data tells the reader, M0, A0, i.e. using an argument based on 'not exactly 55' without engaging with 'least 55'
Conclusion: NO or DO NOT KNOW	A1	
(b) Explanation, e.g. "repeating an experiment usually gives different results", 'appears random'	M1	
Conclusion: NO	A1	
		Alternatively: Accept 'they could be similar as there is a small range', or 'similar as the machine is quite consistent', M1, A1 Allow SC1 for "No they are different", or equivalent statement– as an attempt to give a reason with 'no' stated, OR SC1 for 'similar' without giving a reason
(c)(i)		
(8) (15) (21) 30 38 48 56 62 71 80	B1	
(10) (20) 30 40 50 60 70 80 90 100	B1	
.8 .75 .7 .75 .76 .8 .8 .775 .788.. .8	B2	FT from their cumulative to last row Accept truncation to 2d.p.. Accept percentages B1 for any 6 correct, or all truncated to 1d.p.
		FT from (c) only if r.f.<1.5, %<150% (inverse from table) in (ii)
(ii) Uniform scale on vertical axis	B1	
Correct plots (allow joined or not joined)	B2	Need not start at 0. FT to plots if possible FT from (i) as condition stated above. B1 for 6 correct plots No FT to (iii) for either mark for r.f.>1
(iii) (0.8)	B1	
		Correct response or strict FT from their last relative frequency, but must be ≤ 1
Explanation: e.g. "last point plotted", "all data used"	B1	
		Do not accept references to most common, all round to 0.8, etc
(iv) Explanation: "more checks", or "collect more data", "re-do the experiment quite a few times to compare"	B1 14	
5.(a)(i) Mid points 1, 3, 5, 7	B1	
$1\times24 + 3\times16 + 5\times42 + 7\times18$ (=408)	M1	FT their mid-points (within & including bounds)
$\div 100$	m1	
(£)4.08	A1	Their $\Sigma fx \div 100$ Accept an answer of 4 from work seen. FT from their correct Σfx evaluated, M1 and m1
(ii) (£)7.99	B1	
(b)(i) 234, 257, 332, 334	B3	OR B2 for any two correct entries, OR B1 for a correct method seen, or one correct entry
(ii) Explanation: e.g "smoothed out data" , 'overview'	E1	
(iii) Noticing not true from raw data (but is from looking at moving average)	E1 10	Accept 'estimates (profit) over a period of time'
6.(a) Entries 20 55 95 100	B1	
(b) Correct cumulative frequency diagram, points plotted and joined with a curve or straight lines	B2	FT from cumulative (a). B1 points plotted but not joined, correct diagram with 1 point incorrectly plotted, or correct apart from be a 0.5 horizontal translation
(c) Median (approximately 164)	B1	From their cumulative diagram only
Intention to subtract horiz. reading for vertical 75 &25	M1	(Approximately 166 – 162)
Interquartile range (approximately 4)	A1	
		FT from (c) if possible, if LQ and UQ given
(d) Horizontal scale correctly indicated	B1	Do not penalise break in scale not indicated
Range correct as whiskers, from 155.5 to 170.5	B1	Accept 156 to 170
LQ, median, UQ to form box	B2 10	FT their answers. B1 if one error

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7.Straight lines parallel to all 4 sides and 3cm away (±2mm) Arcs with radius 3cm (±2mm) at all 4 vertices All arcs joined to straight lines to give the correct locus (±2mm)	B2 B2 B1 5	B1 for straight lines parallel to 2 sides and 3cm away (±2mm), OR straight lines parallel to all 4 sides but not at 3cm, but consistent distance B1 for arcs with radius 3cm (±2mm) at 2 vertices, OR arcs at all 4 vertices but not at 3cm CAO
8.Use of 1 km = 100 000 cm Use of 2Πr OR Πd for either wheel 100 000/ Πd or equivalent For 60cm, Zen: 530.5 to 530.8 (cm) For 70cm, Tom: 454.7 to 455 (cm) Difference 75.78 to 75. 83 (cm) 76 (cm to 2 s.f.)	B1 B1 M1 A1 A1 A1 A1 7	Or equivalent, e.g. all conversions to m *Πd is 188.4 to 188.5 and 219.8 to 220* FT their 100 000 (i.e. place value error), or their use of 60, 70 as r instead of d CAO. Maybe implied by final correct answer CAO. Maybe implied by final correct answer FT provided M1 awarded and units consistent FT provided M1 awarded and units consistent Premature rounding is PA-1 *Watch out for equivalent method, award A marks accordingly for similar stages*
9.For x+y = 4 : Any 2 points found correctly Correct straight line drawn For quadratic: Any 4 points found correctly All **necessary** points are plotted correctly Correct **curve** extending as a minimum between x= 1 and x=4 x = 4, y = 0 x = 1, y = 3	B1 B1 M1 P1 A1 B1 B1 7	<table><tr><td>x</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>y</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td><td>-1</td><td>-2</td></tr></table> <table><tr><td>x</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>y</td><td>8</td><td>3</td><td>0</td><td>-1</td><td>0</td><td>3</td><td>8</td></tr></table> FT from their line with a curve provided at least 1 intersection
10. Idea to find areas 2 triangles and 3 trapezia 18 + 37 + 35 + 23 + 7 120 m or metres	M1 A2 A1 U1 5	Or equivalent A1 for any 3 of the 5 areas correct Other A marks are included by sight of 120 Independent of other marks
11.Stages of working: evidence of understanding1/x inverse of squaring being √ 6.7×10^8	M1 M1 A1 3	In either order CAO
12.(a) Attempt to find area information for >70 4×10 + 2×10 +0.6×10 (= 40 + 20 + 6) = 66 (b) Groups of equal width 30 For the groups: 0 to 30, 30 to 60, 60 to 90, 90 to 120 15 150 120 6 Division by 30 Frequency densities: 0.5, 5, 4, 0.2 Suitable axes with scales and with label frequency density Attempt to construct histogram with groups of width 30 Correct histogram (c) Suitable explanation referring to the 1st being the more appropriate, e.g. 'more accurate', 'shows 70'	S1 M1 A1 S1 M1 A1 m1 A1 B1 M1 A1 E1 12	 Allow 1 error in an area CAO FT from (a) to (b) for all marks if 1 slip with area in (a), but must be working with areas Correct attempt to find 15, 150, 120, 6 (15 150 120 6) For their data, but not to suit15, 150, 120, 6. May be the same as in (a) Must have bars with no gaps. FT for their FD, but not 15, 150, 120, 6 FT their 1 slip in area from (a)

Candidate Name	Centre Number	Candidate Number
		0

GCSE LINKED PAIR PILOT

4361/02

APPLICATIONS OF MATHEMATICS

UNIT 1: APPLICATIONS 1

HIGHER TIER

A.M. TUESDAY, 21 June 2011

2 hours

4361
020001

ADDITIONAL MATERIALS

A calculator will be required for this paper.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** the questions in the spaces provided.

Take π as 3·14 or use the π button on your calculator.

INFORMATION FOR CANDIDATES

You should give details of your method of solution when appropriate.

Unless stated, diagrams are not drawn to scale.

Scale drawing solutions will not be acceptable where you are asked to calculate.

The number of marks is given in brackets at the end of each question or part-question.

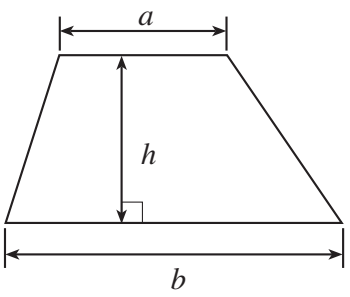
You are reminded that assessment will take into account the quality of written communication (including mathematical communication) used in your answer to question **7**.

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1	**7**	
2	**5**	
3	**6**	
4	**4**	
5	**8**	
6	**5**	
7	**8**	
8	**6**	
9	**4**	
10	**10**	
11	**10**	
12	**10**	
13	**7**	
14	**10**	
TOTAL MARK		

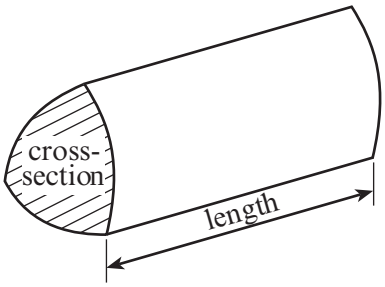
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Formula List

Area of trapezium = $\frac{1}{2}(a + b)h$

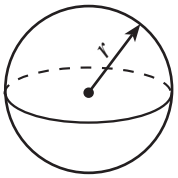


Volume of prism = area of cross-section × length



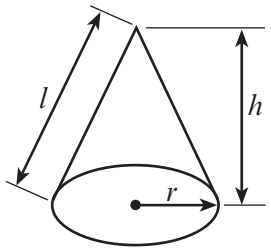
Volume of sphere = $\frac{4}{3}\pi r^3$

Surface area of sphere = $4\pi r^2$



Volume of cone = $\frac{1}{3}\pi r^2 h$

Curved surface area of cone = $\pi r l$

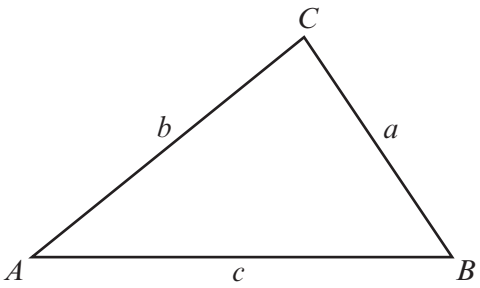


In any triangle ABC

Sine rule $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Cosine rule $a^2 = b^2 + c^2 - 2bc\cos A$

Area of triangle = $\frac{1}{2}ab\sin C$



The Quadratic Equation

The solutions of $ax^2 + bx + c = 0$

where $a \neq 0$ are given by

$$x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$$

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Examiner only

1. Simon has two fair dice in his pocket, one blue dice and one red dice.

The two dice are thrown and the two outcomes are added together to obtain the total score. The table below shows how all the possible outcomes together with the total scores are recorded.

		Blue dice					
		1	**2**	**3**	**4**	**5**	**6**
Red dice	**1**	2	3			6	7
	2	3	4			7	8
	3	4	5			8	9
	4	5	6			9	10
	5	6	7			10	11
	6	7	8			11	12

(a) Complete the table above.

[1]

(b) Write down the probability of throwing

(i) a 3 on both dice,

.....

[1]

(ii) a 2 on the red dice and a 4 on the blue dice,

.....

[1]

(iii) a total score of 6.

.....

[1]

(c) Which of the total scores are least likely to occur when the two dice are thrown?

.....

[2]

(d) Simon selects one of the dice at random from his pocket.
What is the probability that it is the red dice?

.....

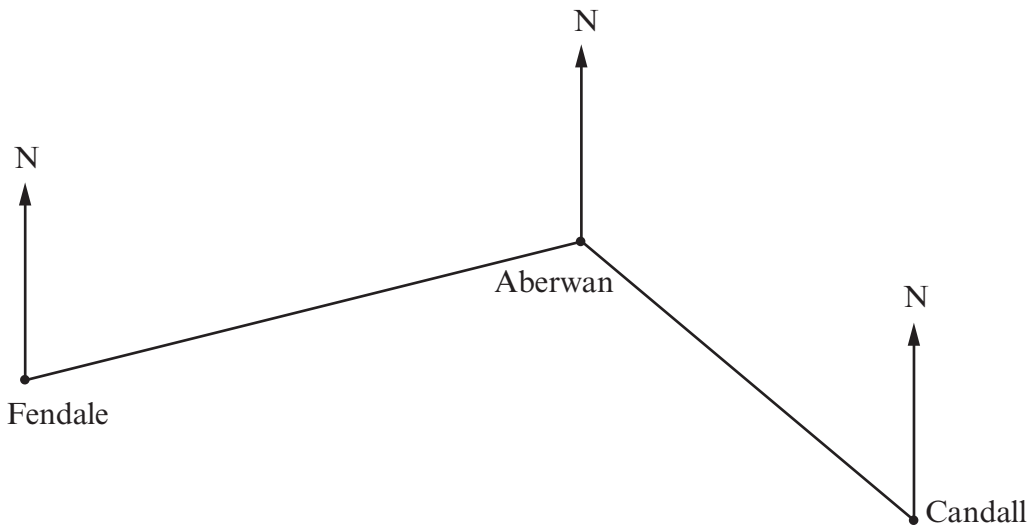
[1]

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2. The diagram shows three places Fendale, Aberwan and Candall in the positions that they would appear on a map drawn to scale.



(a) Find the bearing of

(i) Aberwan from Fendale,

.....

[2]

(ii) Fendale from Aberwan.

.....

[1]

(b) Find the bearing of Aberwan from Candall.

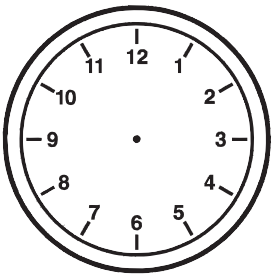
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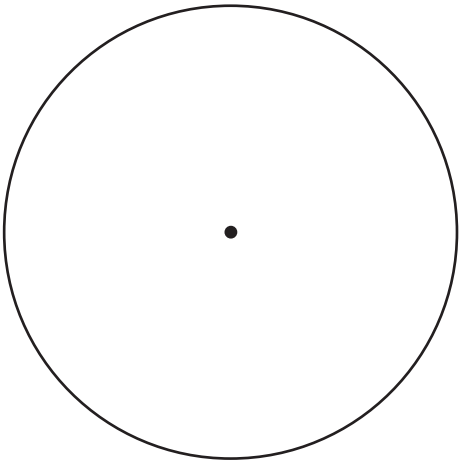
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Examiner only

3. *(a)* A clockface is to be designed using a single dot in place of each number.



Use the circle opposite to mark accurately the positions of the 12 dots on the clockface.
The centre of the clock has been marked for you.
You **must** show **all** your lines joining the centre of the clock to the dots.



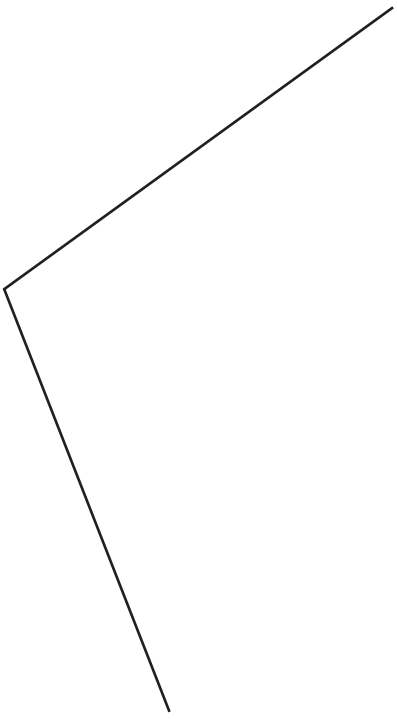
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[3]

(b) Use a pair of compasses and a ruler to bisect the obtuse angle shown below.
You **must** show **all** of your construction marks on the diagram.



[3]

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Examiner only

4.



Diagram not drawn to scale

A ribbon is tied around **all** the sides of a box as shown in the diagram.
The ribbon is placed across **each** face of the box and always meets the edges of the box at right angles.
The bow is tied on top of the box, as shown.

(a) Calculate the total length of ribbon required to decorate a box with length 8·5 cm, width 4·6 cm and height 2·2 cm. The bow is made using 18 cm of ribbon.

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[2]

(b) A different box is to be decorated with ribbon in the same way.
The bow is made using 18 cm of ribbon.
The box has length l cm, width w cm and height h cm.
Write down an expression for the total length of ribbon needed to decorate this box.

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[2]

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Examiner only

5. Miriam is working on a spreadsheet.
She has been asked to work with a number of formulae, but soon realises that some of the formulae are the same.

Here is the list of formulae given to Miriam:

Formula **A** $y = 3\,(a + b) - b$

Formula **B** $y = a\,(a + 1) + b$

Formula **C** $y = 5a - b - 2a + 3b$

Formula **D** $y = 2b\,(a + 1) + a\,(3 - 2b)$

(a) Simplify each of the above formulae.

Formula **A** $y = 3\,(a + b) - b$

.....

.....

Formula **B** $y = a\,(a + 1) + b$

.....

.....

Formula **C** $y = 5a - b - 2a + 3b$

.....

.....

Formula **D** $y = 2b\,(a + 1) + a\,(3 - 2b)$

.....

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[7]

(b) Which of the formulae are identical?

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[1]

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Examiner only

6. Davina is entering a kite flying competition.
To enter the competition, Davina's kite must meet all the requirements below.

- The diagonals of the kite are perpendicular.
- The shorter diagonal must be 25 cm.
- The longer diagonal must be 48 cm.
- The shorter diagonal of the kite must cut the longer diagonal in the ratio 3:5.

Using a scale of 1:5, construct a scale drawing of Davina's kite for the competition.
You **must** show **all** your working.

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[5]

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Examiner only

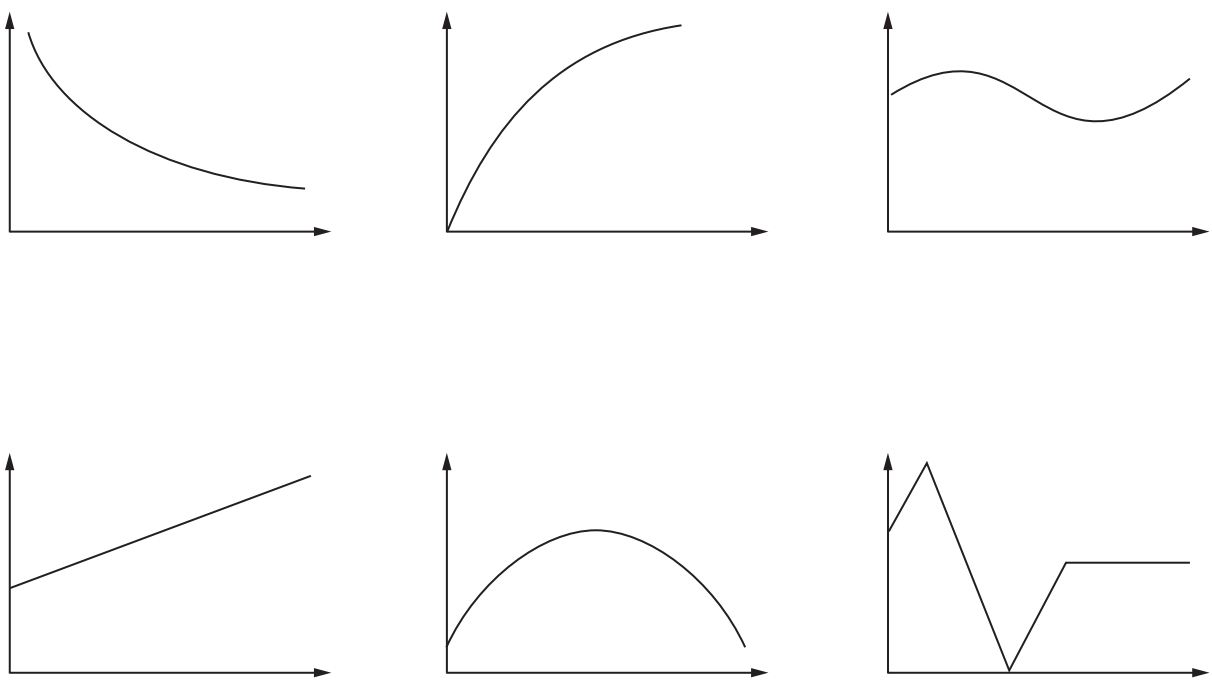
7. *You will be assessed on the quality of your written communication in this question.*

Michelle has cut out two headlines and a number of graphs from newspapers.
She has cut off the labels and scales from the graphs so that she is left with simple sketches of the original graphs.
Each headline originally had a matching graph.

Headlines

- More ice creams are sold in the summer than in the winter in South Wales.
- Vast increase in sales of bicycles in the South East of England.

Michelle's sketches of the graphs



On the opposite page, for **each** of the headlines

- select an appropriate sketch from above and draw it in the box opposite,
- label the axes,
- explain why the graph matches the headline.

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- More ice creams are sold in the summer than in the winter in South Wales.

Graph

Explanation

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- Vast increase in sales of bicycles in the South East of England.

Graph

Explanation

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[8]

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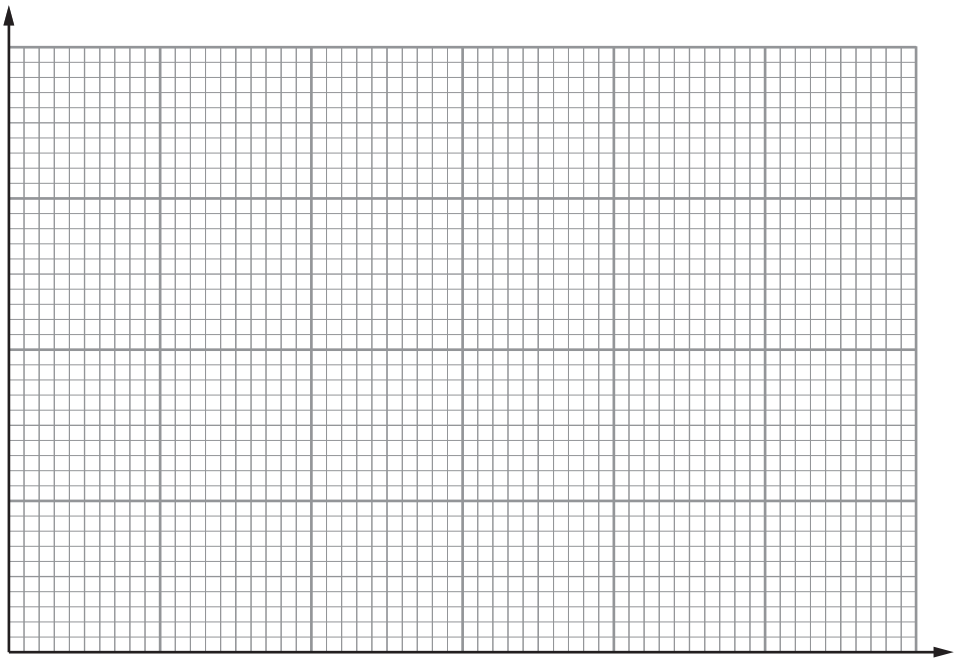
8. The cost of advertising on a radio station is given by the following formula.

Cost in £s = £500 + £20 × Advert airtime in minutes

(a) Use the graph paper below to show the cost of advertising for up to and including 10 minutes of airtime.

[3]

Cost, in £s



Advert airtime, in minutes

(b) (i) Calculate the cost of an advertisement with an airtime of $4\frac{1}{2}$ minutes.

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[1]

(ii) The small print on the contract has been changed to say that all part minutes are now to be charged as a whole minute.
Explain why a straight line drawn between the points plotted would not now be appropriate.

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[2]

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Examiner only

9. £22 600 is the cost, per metre, of building a new motorway.
Calculate the cost of building a new 85 km motorway.
Give your answer, in standard form, correct to 2 significant figures.

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[4]

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Examiner only

10. *(a)* The thickness of each of 100 books in a library is measured.
A summary of the measurements is given in the table below.

Thickness, t in mm	Frequency
$0 \leqslant t < 10$	2
$10 \leqslant t < 20$	20
$20 \leqslant t < 30$	44
$30 \leqslant t < 40$	28
$40 \leqslant t < 50$	6

(i) Calculate an estimate for the mean thickness of a library book.

[4]

(ii)



A bookshelf of length 10 000 mm is bought for the library.
Books are arranged on the shelf as shown in the picture.
How many books might you expect to be able to store on the shelf?
Show **all** your working.

[2]

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(b) Over a twelve week period the number of books borrowed from the library each week was recorded.

Week	1	2	3	4	5	6	7	8	9	10	11	12
Number of books	460	146	345	680	935	320	734	140	452	648	780	446

(i) Calculate the 10-point moving average and complete the table below.

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10 week period ending:	Week 10	Week 11	Week 12
10-point moving average:			

[3]

(ii) Explain why considering a moving average is worthwhile in reviewing the number of books borrowed.

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[1]

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Examiner only

11. The table gives a grouped frequency distribution for the lengths, each measured to the nearest millimetre, of 80 earthworms.

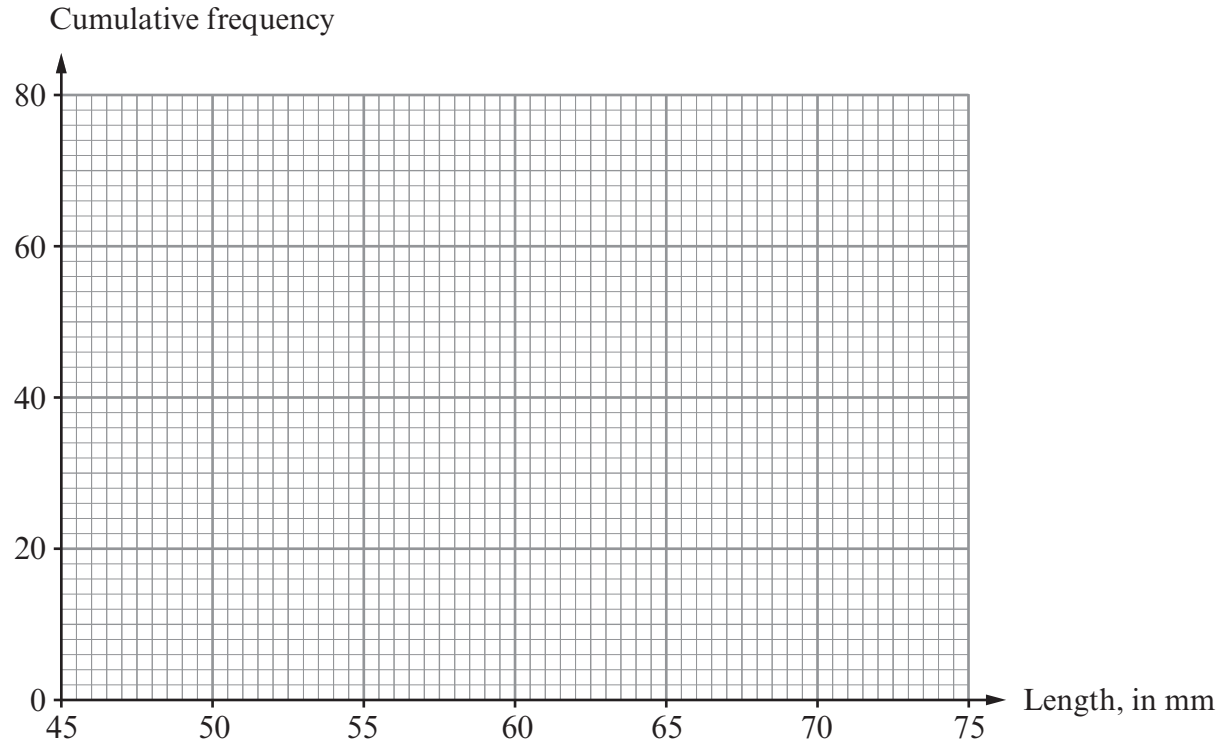
Length, to the nearest mm	47-53	54-60	61-67	68-74
Number of earthworms	10	18	40	12

(a) Complete the following cumulative frequency table.

Length, mm	< 46.5	< 53.5	< 60.5	< 67.5	< 74.5
Cumulative frequency	0	10			

[1]

(b) On the graph paper below, draw a cumulative frequency diagram to show this information.



[2]

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(c) Use your cumulative frequency diagram to find an estimate for the median and the interquartile range.
You **must** show your working.

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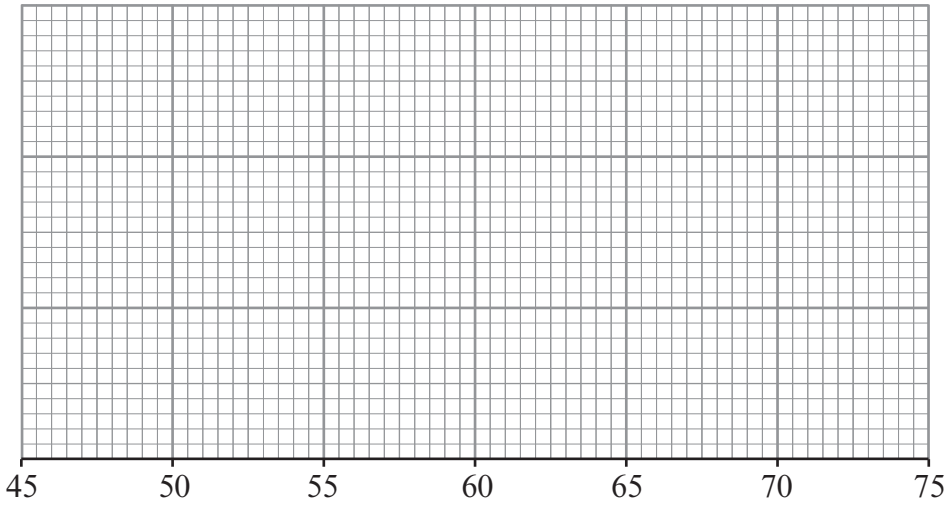
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Median ..... Interquartile range .....

[3]

(d) Draw a box and whisker diagram to illustrate this information.



[4]

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12. The Body Mass Indicator (BMI) is a formula that is sometimes used as an indicator of relative body fat.
A Belgian statistician developed the formula in the nineteenth century.

Imperial BMI Formula

$$BMI = \frac{W \times 703}{H^2}$$

W = weight in pounds
H = height in inches

1 foot = 12 inches
1 stone = 14 pounds

In America, the Department of Health have in the past used the BMI to give a Weight Status as follows:

BMI	Weight Status
Below 18.5	Underweight
18.5 to 24.9	Normal
25 to 29.9	Overweight
30 and above	Obese

(a) Joel is 5 foot 4 inches tall and weighs 12 stone 3 pounds.
Find Joel's Weight Status.
You **must** show **all** your calculations.

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Weight Status .....

[6]

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(b) Construct a version of the BMI formula so that it is possible to use values for weights in stone (s) and pounds (p) and for heights in feet (f) and inches (i) without any prior calculations.

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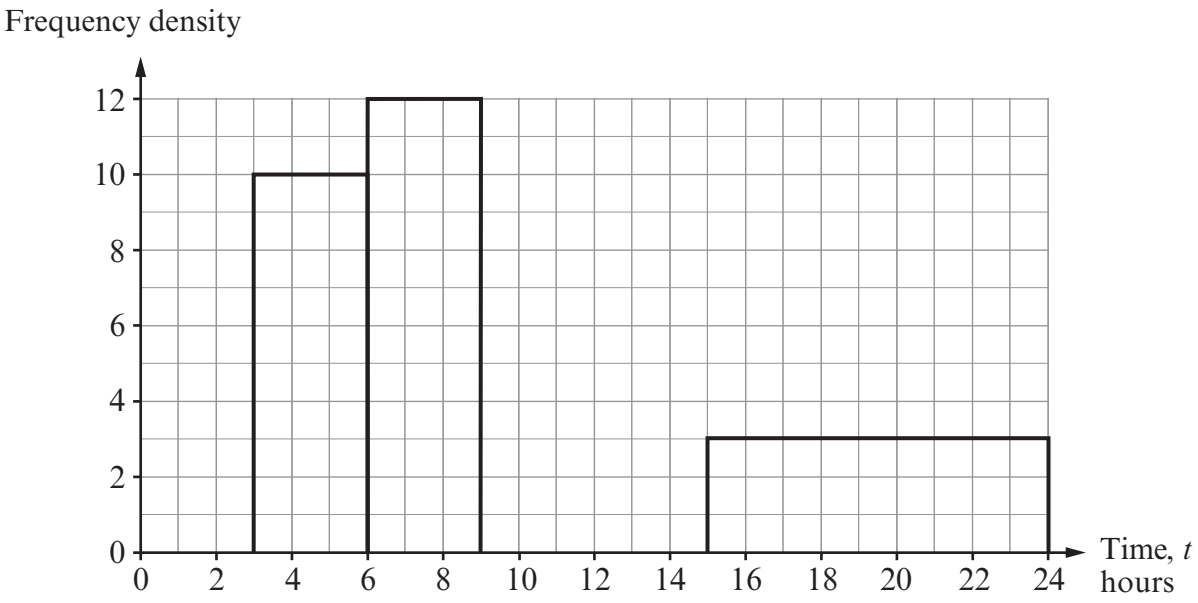
[4]

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13. The histogram and frequency table show some information about the time each person, from a group of people, spent using the Internet during one day in August.

Time, t hours	Number of people
$0 < t \leqslant 3$	24
$3 < t \leqslant 6$	.....
$6 < t \leqslant 9$	36
$9 < t \leqslant 15$	30
$15 < t \leqslant 24$	.....



(a) Complete the frequency table and the histogram shown above.

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[4]

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(b) There are 72 people who spent less than x hours using the Internet.
Calculate an estimate for x.

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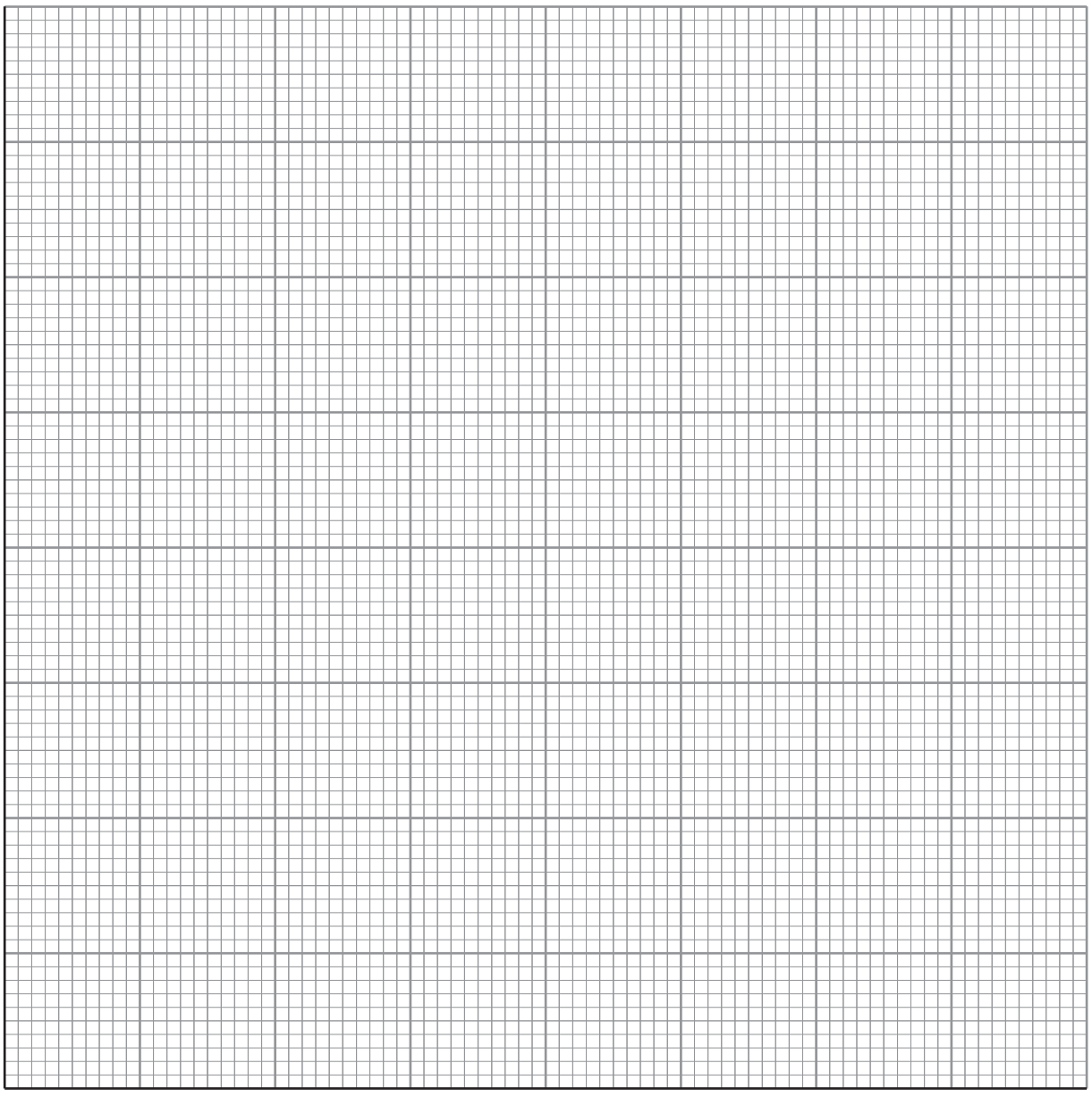
[3]

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14. As the sea comes in and out we have low tide and high tide.
At low tide, the depth of water in a harbour is 3 metres and at high tide the depth is 15 metres.
The tide takes approximately 6 hours to come in to high tide, and approximately 6 hours to go out to low tide.
Starting at low tide, $\frac{1}{12}$ of the tidal range comes in during the first hour, a further $\frac{1}{6}$ comes in during the second hour, a further $\frac{1}{4}$ during the third hour, a further $\frac{1}{4}$ during the fourth hour, a further $\frac{1}{6}$ during the fifth hour, and finally a further $\frac{1}{12}$ comes in during the sixth hour.
The pattern for the tide going out is the same in reverse.

(a) Draw a graph to show the approximate heights of the tides over **24 hours.** [6]



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(b) Estimate the height of the tide $4\frac{1}{2}$ hours after low tide.

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[2]

(c) State the period of your graph and state how you know this.

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[2]

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WJEC
CBAC

GCSE MARKING SCHEME

APPLICATIONS OF MATHEMATICS (LINKED PAIR PILOT)

SUMMER 2011

INTRODUCTION

The marking schemes which follow were those used by WJEC for the Summer 2011 examination in GCSE APPLICATIONS OF MATHEMATICS (LINKED PAIR PILOT). They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

	Page
Unit 1 - Foundation Tier	1
Unit 1 - Higher Tier	4

GCSE APPLICATIONS OF MATHEMATICS

UNIT 1 - FOUNDATION TIER

Applications of Mathematics June 2011 Unit 1 Foundation Tier	Mark	Comments Post conference version
1. (a) 639, 762, 574 762, 574 Answer = 762 (b) 2 × 3.20 + 3 × 2.30 (6.40 + 6.90) = 13.3(0) 2 × 6.40 + 3 × 4.30 (12.80 + 12.90) = 25.70 Saved (£)12.4(0)	B1 B1 B1 M1 A1 M1 A1 A1 8	 Alternative method 2 x 3.20 = 6.40 3 x 2 = 6 Total saving 12.40 Or (3×4.30) – (3×2.30) M1 = 6.40 A1 (2×6.40) – (2×3.20) M1 =6.00 A1 Saved (6.40 + 6.00) 12.40 A1 FT for one arithmetic error for final A1, both M marks must be awarded.
2. (a) 370 (grams) (b) Arrow at 48 m.p.h. (c) circle drawn, r=5cm (d) (i) 127° (ii) 8.3 cm (e) Triangular prism (f) A	B1 B1 B1 B1 B1 B1 B1 7	 Arrow >47 and <49 ± 2 mm ± 2° ± 2 mm
3. (a) 12 (cm^2) (b) Rectangle drawn with area of 12 (cm^2)	B1 B2 3	 Either 6 × 2, 12 × 1 or 4 × 3 B1 for drawing a rectangle. Or B1 for a shape of area 12(cm^2) FT 'Their area' if a rectangle drawn
4. (a) Moscow (b) Cape Town (c) 16° (d) Cardiff and Helsinki	B1 B1 B1 B1 4	Accept clear abbreviations for cities such as M, CT, C, H, S Accept -16
5. (a) Suitable explanation (b) Attepmt to add numbers (= 40) 40÷7 = 5.7(14……) (c) For 2 correct values that give a range of 7 AND a median of 6.	E1 M1 m1 A1 B2 6	Eg. 5 is the most popular number FT 'their total'÷ 7 CAO Accept answer of 6 from correct workings shown Eg 9 & 10, 10 & 10, 6 & 10, 7 & 10, 8 & 10 B1 for 2 values that either give a range of 7 or a median of 6. OR B1 for 10 shown.
6. (a) 24 × 1.80 + 3.10 = (£)46.3(0) (b) (37.30 – 3.10) ÷ 1.80 = 19	M1 A1 M1 A1 4	Multiplying and adding For 24 × 1.80 + 3.10 = 117.60 M0 A0 For showing a subtraction then a division Accept embedded 19.

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Applications of Mathematics June 2011 Unit 1 Foundation Tier	Mark	Comments Post conference version
7. Job 2 (= 2850 × 12) = 34 200 Job 3 (= 1300 × 26) = 33 800 Job 4 (= 652 × 52) = 33 904 Highest = £34 200 or Job 2	B1 B1 B1 B1 4	 If candidates correctly evaluate 24 and 48 weeks respectively for jobs 3 & 4 Award B0, B1. FT their answers No workings and Job 2 given as final answer award B0
8(a)(i) Suitable entry for the table (ii) Suitable suggestion (iii) Suitable diagram/chart (b) Appropriate comment.	B1 B1 B1 E1 4	Eg. Display/represents the data, analyses the data, find outcome of data, draws a graph, Adds up results, calculates results. B0 for Give out results Eg. Ask girls and boys or asks people in town or asks outside a computer store Eg. Tally chart/bar chart/line graph Eg. The sales have decreased.
9.Spinner 1 Suitable explanation.	B1 E1 2	 Eg. Ethan has 50% chance of a yellow & Kyle has 25% of a red.
10. Suitable strategy used (6, -3)	S1 B2 3	Evidence on diagram or if at least 1 correct coordinate B1 for either coordinate. If only one coordinate correct award S1 B1 *for (-3, 6) award S1 only*
11. (a) 13.39 (b) 57000	B2 B1 3	B1 for 13.3(9173312) or 13 or 13.4
12. Lisa = $x + 3$ ISW Julian = $2(x + 3)$ ISW Expansion of bracket = $2x + 6$ $4x + 9$	B1 B1 B1 B1 4	 Accept $2 \times x + 3$ or $x + 3 \times 2$. FT $2 \times$ their Lisa if Lisa $ax + b$ where $b \neq 0$ FT if $2(ax \pm b)$
13. Graph B **Reference to horizontal line representing a stop** **Reference to steeper line after stop or less steep before stop** 	B1 E1 E1 3	 This can be gained from graphs B, C, D
14. (a) x = 76° y = 50° (b)(i) 076 º (ii) 256 º (c) 360 – (50 $\pm$ 2º) 310º	B1 B1 B1 B1 M1 A1 6	±2° ±2° FT from 'their x' FT from 'their x' or FT 180 + their (i). Accept if re-measured $\pm$ 2º. FT 360 - 'their y' $\pm$ 2º

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Applications of Mathematics June 2011 Unit 1 Foundation Tier	Mark	Comments Post conference version
15.(a) Completely accurate (through the centre, 30° ± 2°) with lines towards circumference (need not touch the circumference) (b) Appropriate arcs (dashes) shown on both lines Intersection arcs shown, using first set of arcs Angle bisector drawn	B3 M1 M1 A1 6	B2 for at least 6 of the sectors accurate ± 2°, towards but not necessarily touching the circumference or shown by dots, OR B1 for sight of (360÷12 =) 30 ± 2 mm ± 2 mm. FT from their arcs if ± 3 mm. FT from 'holes' from where arcs should be. FT if M0, M1 awarded SC1 if steps of process seen but slightly outside tolerance, OR SC1 if assumed lines are equal with 1 set of arcs with bisector shown
16. Longer diagonal 9.6cm (drawn as a diagonal or in working) Longer diagonal split 3.6cm & 6cm or calculated as 18cm & 30cm Diagonals intersect at right angles Shorter diagonal 5 cm (drawn as a diagonal or in working) Correct scale drawing of the kite	 B1 B1 B1 B1 B1 5	Watch for answers in the information table given All measurements ±2 mm or ±2° SC1 for a drawing with sides 9.6cm, 9.6cm, 5cm and 5cm(±2 mm). Candidates awarded this SC1 can also access the B1 for the diagonals shown intersecting at right angles.
17. Appropriate choice of sketch Axes labelled appropriately Appropriate reason for their choice of sketch Look for • relevance • spelling • clarity/flow of text explanations Ignore previous errors in not labelling axes or in their reasoning For QWC2 need at least 1 statement/sentence in both parts of the question, otherwise maximum is QWC1 if the spelling and flow of text is satisfactory QWC2: Candidates will be expected to • present work clearly, with words explaining choices AND • make few if any mistakes in mathematical form, spelling, punctuation and grammar in their answer QWC1: Candidates will be expected to • present work clearly, with words explaining choices OR • make few if any mistakes in mathematical form, spelling, punctuation and grammar in their answer	B1 B1 B1 **×2** QWC 2 <

UNIT 1 - HIGHER TIER

Applications of Mathematics Unit 1 June 2011 Higher Tier		Comments Post conference version
1.(a) Completing the table correctly (b)(i) 1/36 (ii) 1/36 (iii) 5/36 (c) 2 AND 12 (d) 1/2	B1 B1 B1 B1 B2 B1 7	 ISW. FT for their completed table in (b) and (c) ISW ISW B1 for each answer. Accept double 1 AND double 6 ISW
2.(a)(i) 076 (º) (ii) 256 (º) (b) 360 – (50 ± 2º) 310(º)	B2 B1 M1 A1 5	± 2º. Award B1 if 0 omitted FT 180 + their (i). Accept if re-measured ± 2º. ± 2º
3.(a) Completely accurate (through the centre, 30° ± 2°) with lines towards circumference (need not touch the circumference) (b) Appropriate arcs (dashes) shown on both lines Intersection arcs shown, using first set of arcs Angle bisector drawn	B3 M1 M1 A1 6	B2 for at least 6 of the sectors accurate ± 2°, towards but not necessarily touching the circumference or shown by dots, OR B1 for sight of (360÷12 =) 30 ± 2 mm ± 2 mm. FT from their arcs if ± 3 mm. FT from 'holes' from where arcs should be. FT if M0, M1 awarded SC1 if steps of process seen but slightly outside tolerance, OR SC1 if assumed lines are equal with 1 set of arcs with bisector shown
4.(a) $2\times(8.5 + 4.6) + 4 \times 2.2$ (+ 18) and no others = 53 (cm) (b) $2\times l + 2\times w + 4 \times h + 18$ (and no extras)	M1 A1 B2 4	Or equivalent. Attempt to consider all 6 sides (+ 18) CAO. *An answer of 35 implies M1* B1 for 1 error or 1 slip in notation. Treat an answer of l + w + 4×h + 18 is 1 error (omit bottom), hence award B1. If B2 penalise extra incorrect working -1
5. (a) A $y = 3a + 3b - b$ $y = 3a + 2b$ B $y = a^2 + (1)a + b$ C $y = 3a + 2b$ D $y = 2ab + 2b + 3a – 2ab$ $y = 3a + 2b$ (b) A, C and D	 B1 B1 B1 B1 B2 B1 B1 8	In this question do not ignore further incorrect working, mark final answer FT until second error CAO CAO B1 for each bracket expanded correctly FT from one error in 1 of the 4 terms FT provided at least two of the three are correct
6. Longer diagonal 9.6cm (drawn as a diagonal or in working) Longer diagonal split 3.6cm & 6cm or calculated as 18cm & 30cm Diagonals intersect at right angles Shorter diagonal 5 cm (drawn as a diagonal or in working) Correct scale drawing of the kite	 B1 B1 B1 B1 B1 5	Watch for answers in the information table given All measurements ±2 mm or ±2° SC1 for a drawing with sides 9.6cm, 9.6cm, 5cm and 5cm(±2 mm). Candidates awarded this SC1 can also access the B1 for the diagonals shown intersecting at right angles.

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7. Appropriate choice of sketch Axes labelled appropriately Appropriate reason for their choice of sketch Look for • relevance • spelling • clarity/flow of text explanations Ignore previous errors in not labelling axes or in their reasoning For QWC2 need at least 1 statement/sentence in both parts of the question, otherwise maximum is QWC1 if the spelling and flow of text is satisfactory QWC2: Candidates will be expected to • present work clearly, with words explaining choices AND • make few if any mistakes in mathematical form, spelling, punctuation and grammar in their answer QWC1: Candidates will be expected to • present work clearly, with words explaining choices OR • make few if any mistakes in mathematical form, spelling, punctuation and grammar in their answer	B1 B1 B1 <u>×2</u> QWC 2 8	 Minimum is label for axes, not scales, or vv If no scale, the scale must be described in order to get the reason mark. Ignore extra incorrect reasoning, if appropriate reasoning seen <u>NO marks for an inappropriate choice of sketch</u> QWC2 Presents relevant material in a coherent and logical manner, using acceptable mathematical form, and with few if any errors in spelling, punctuation and grammar. QWC1 Presents relevant material in a coherent and logical manner but with some errors in use of mathematical form, spelling, punctuation or grammar OR evident weaknesses in organisation of material but using acceptable mathematical form, with few if any errors in spelling, punctuation and grammar. QWC0 Evident weaknesses in organisation of material, and errors in use of mathematical form, spelling, punctuation or grammar.
8.(a) Suitable uniform scales on both axes with vertical to at least 700 & horizontal to at least 10 At least 3 points plotted accurately including times at (1 or 2) and 10 minutes (b)(i) (£)590 Explanation that intermediate points between whole number are invalid, or mentions 'jumps' in the graph or similar	B1 P2 B1 E2 6	Any break in scale must be indicated, or labelled to the end Maybe implied by a correct straight line through times 1 and 10 P1 for one point correct (maybe 0,500) Not a FT from an incorrect graph E1 if explained using values rather than generalised, OR E1 for correct but includes incorrect element, e.g. mentions rounding up and down, OR E1 for mention of always rounding up, OR E1 for a partial explanation
9. 22600×85 $\times 1000$ 1.9×10^9	M1 A1 B2 4	Sight of digits 19(21) implies this M1 B1 for $1.92(1)\times10^9$ or 1 900 000 000 **Also FT** from M1 A0: e.g. B2 for 1.9×10^6, or B1 for $1.92(1)\times10^6$ or 1 900 000 OR from their incorrect value 2s.f and standard form, B2 both, B1 for either
10.(a) (i) Mid points 5, 15, 25, 35, 45 $\frac{5\times2 + 15\times20 + 25\times44 + 35\times28 + 45\times6}{100}$ 26.6 (ii) $10\,000 \div 26.6$ Either 375 or 376 (b) (i) 486, 518, 548 (ii) Explanation including implication of "smoothing out" or reducing impact of large or small numbers	B1 M1 m1 A1 M1 A1 B3 E1 10	 FT their midpoints, including bounds. Attempts Σfx FT their Σfx /100 Only accept 27 from working. 26 gets A0 FT from (i) Accept rounding up or down on FT FT from their first entry, +32 and +30. B2 for any 2 correct entries, B1 for a correct method towards at least 2 of the entries seen, or B1 for 1 correct entry, or B1 for sight of 4860, 5180 and 5480 Do not accept 'estimates number of books', nor 'rough average'

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11.(a) 28, 68, 80	B1	
(b) Correct cumulative frequency diagram, points plotted at bounds and joined by a curve or straight line	B2	FT only if cumulative in (a) B1 for points correct but not joined, OR B1 correct apart from 0.5 translation, OR B1 if one error in plotting but joined correctly
(c) Median (approx. 62.5 (mm))	B1	FT from their cumulative entries. Not cumulative means no FT
Intention to subtract readings from horizontal axis for vertical 60 & 20 (approx. 66 – approx. 57.5)	M1	
Interquartile range (approx 8.5(mm))	A1	
(d) General idea of what box – whisker should be	S1	Needs to show a box and whiskers
Range ends correctly indicated (46.5 and 74.5)	B1	
Median line correctly indicated (approx 62.5)	B1	FT their median
UQ and LQ correctly indicated (approx 66 and 57.5)	B1 10	FT their UQ and LQ readings
12.(a) $5\times12 + 4$	M1	
$12\times14 + 3$	M1	
64 **and** 171	A1	Both correct, maybe implied in later working
BMI = $\frac{171 \times 703}{64^2}$	M1	FT their 64 and 171 provided M1 award
= 29.3(4887...)	A1	Accept 29 from correct working
Overweight	B1	FT interpretation of their BMI provided at least M2 awarded previously
(b) Sight of $14s + p$ or equivalent	M1	
Sight of $12f + i$ or equivalent	M1	
(BMI =) $\frac{703(14s + p)}{(12f + i)^2}$	A2	Mark final answer A1 if correct formula seen before incorrect simplification, or A1 if 1 error in notation, or A1 for either numerator or denominator correct SC1 for $\frac{703(12s + p)}{(14f + i)^2}$
	10	
13. (a) Entries in frequency table: 30 and 27	B2	B1 for each correct entry
Histogram: 0 to 3 f.d. **8**, 9 to 15 f.d. **5**	B2	B1 for each correct bar
(b) Identifying that the answer is in the range >6 and <9	M1	Maybe shown on the histogram
Realising need ½ of the entry for $6<t\leq9$	M1	Maybe shown on the histogram
(x =) 7.5 (hours) or equivalent	A1 7	
14. (a)		<table><tr><td>Hr</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td></tr><tr><td>Ht</td><td>3</td><td>4</td><td>6</td><td>9</td><td>12</td><td>14</td><td>15</td><td>14</td><td>12</td><td>9</td><td>6</td><td>4</td><td>3</td></tr></table>
Height of tide 12(m)	S1	Or 12(m) between highest and lowest plots
2 of the 3 answers to 1/12, 1/6 & 1/4 of 12 (1, 2 & 3)	B1	Or …. of 15 (1.25, 2.5 and 3.75)
Graph paper axes showing upto 15(m) and 24(hrs)	S1	
Suitable labels for the axes	S1	Units maybe omitted No further marks if not using the 3m low tide start or not using 12m tide
Heights of tides correct for at least 12 hours	B1	Shown in working or on the graph
Plots correct for the 24 hour period (joined or not)	B1	
(b) Method, e.g. use of graph or linear between 4 and 5 hours	M1	FT for M1 only if at least 3 marks awarded in (a)
An answer that rounds to13 (m)	A1	CAO. If units are given they must be corrct
(c) 12 hours	B1	Hours must be stated. An answer of 12 gets B0
Explanation, e.g. complete cycle	E1 10	SC1 for 'tide goes in and out twice in 24 hours'

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