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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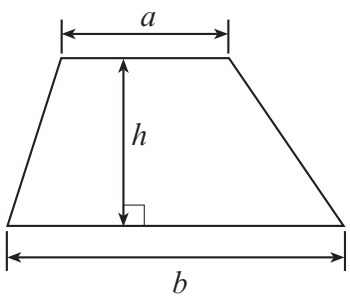
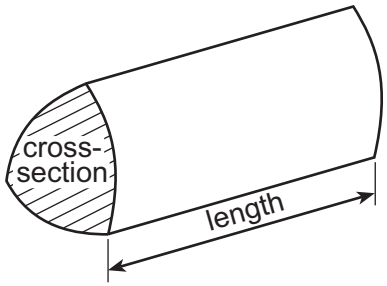
Formula List

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

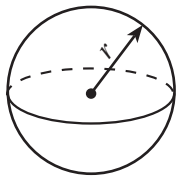


Volume of prism = area of cross-section × length



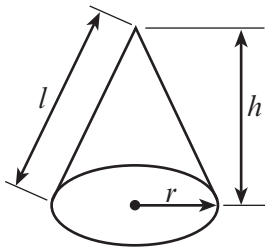
Volume of sphere = $\frac{4}{3}\pi r^3$

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



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

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

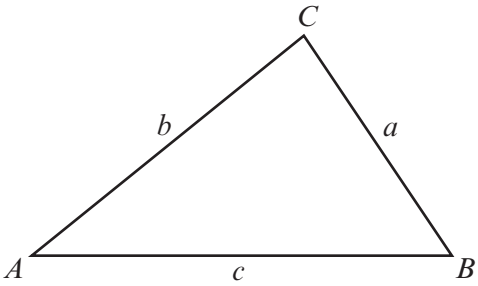


In any triangle ABC

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

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

Examiner only

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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Examiner only

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.

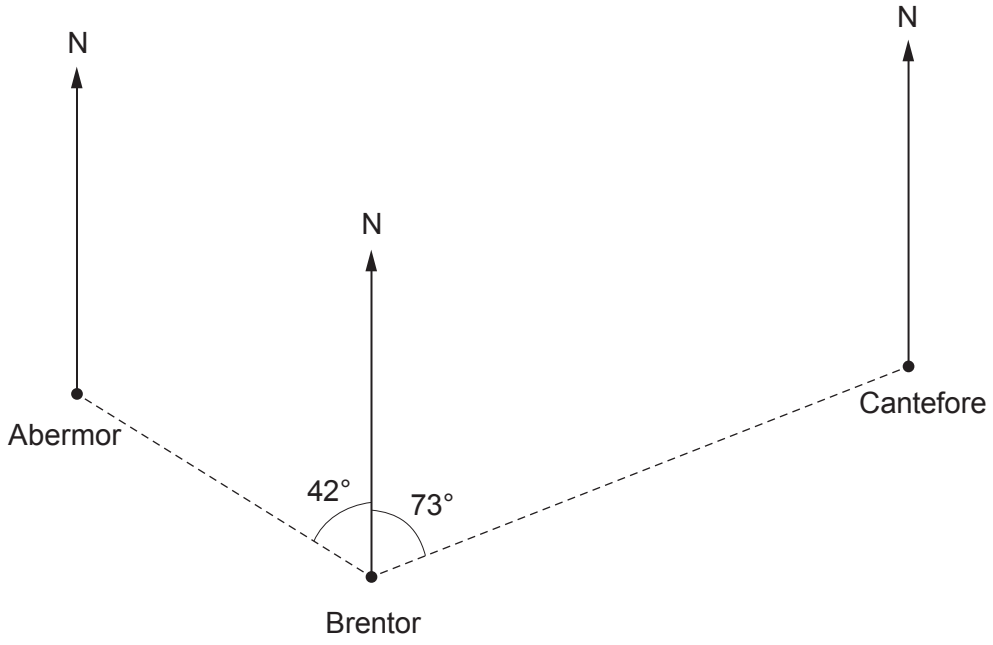

Diagram not drawn to scale

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

(i) Brentor from Cantefore, [2]

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(ii) Abermor from Brentor. [2]

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Examiner only

(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.

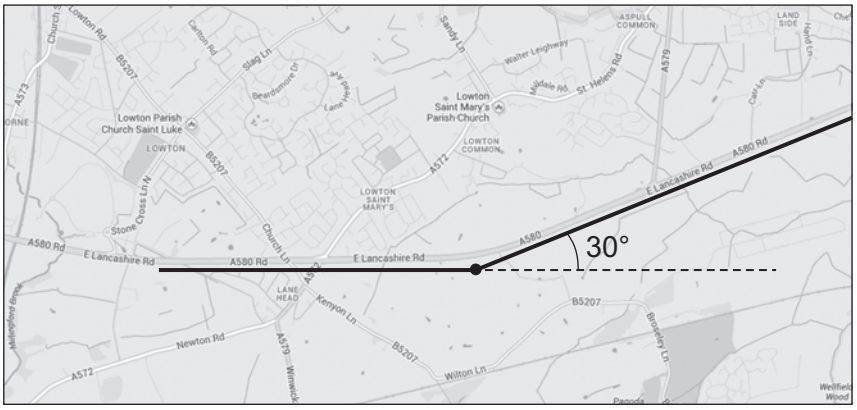

Diagram not drawn to scale

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.

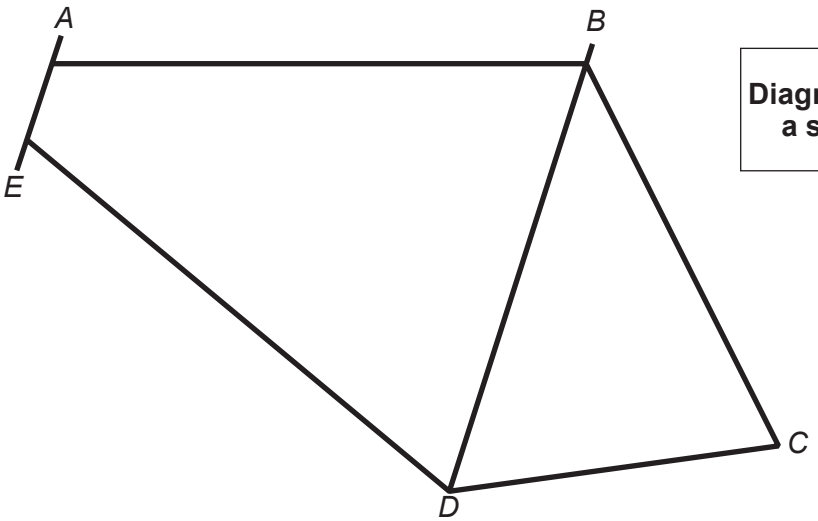

Diagram drawn to a scale of 1:8

(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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Examiner only

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]

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(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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Examiner only

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]

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

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

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(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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Examiner only

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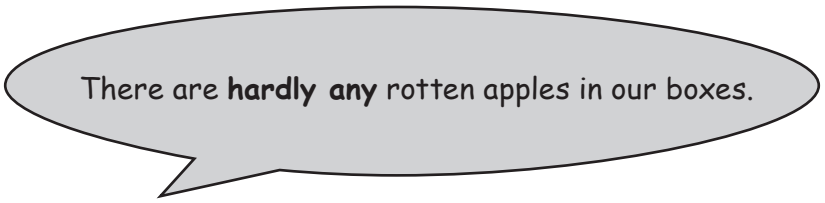
(b) A different company delivers boxes with 24 apples in each box.

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.



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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Examiner only

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]

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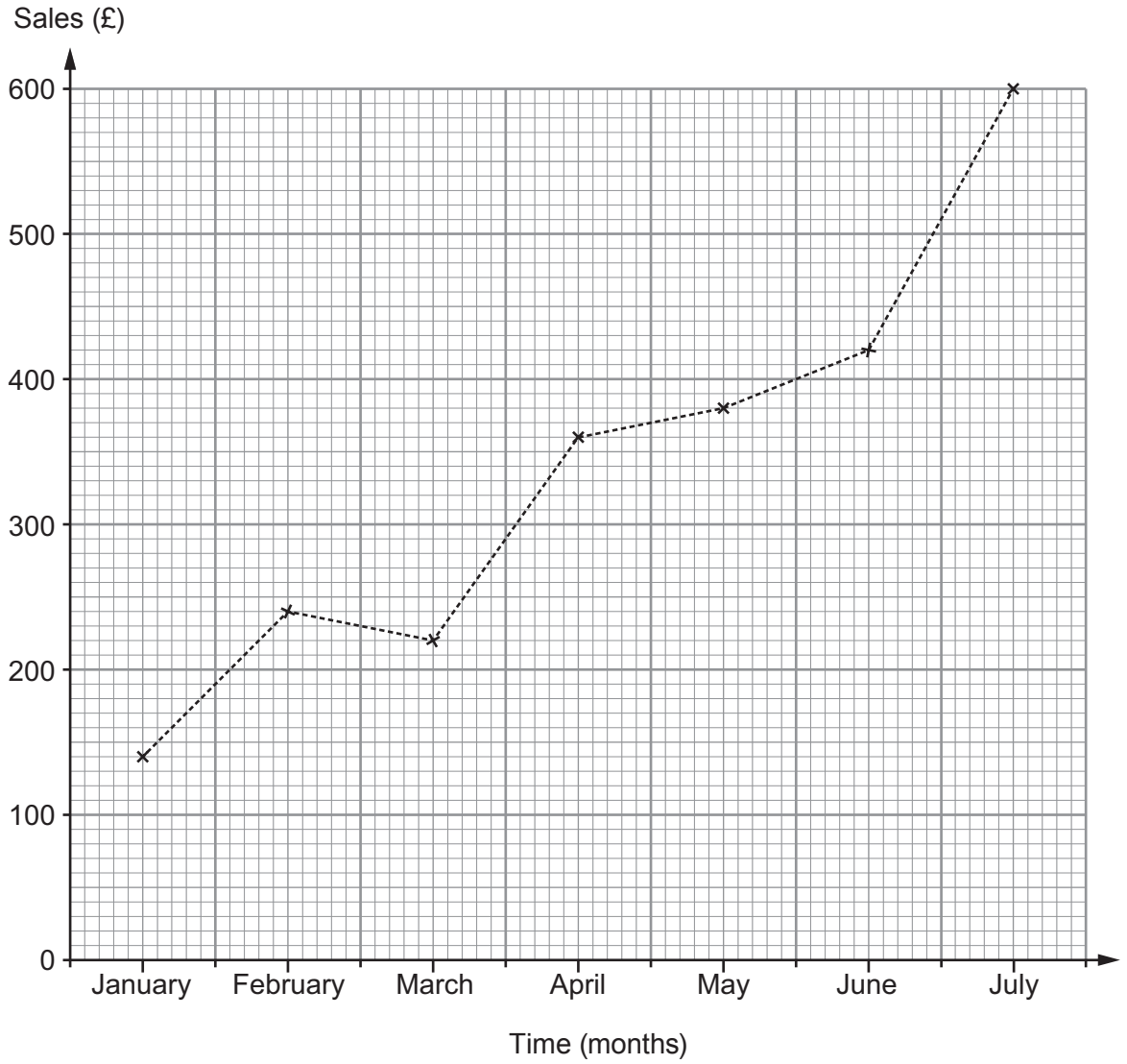
4-point period	January to April	February to May	March to June	April to July
4-point moving average (£)				

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

Examiner only



(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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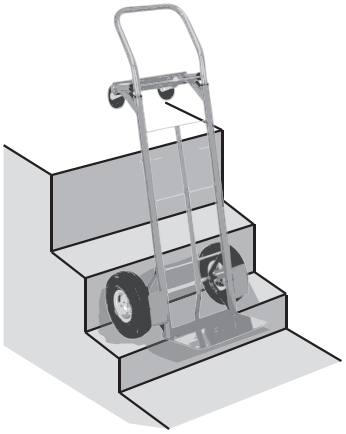
8. A trolley is pulled up a few steps.



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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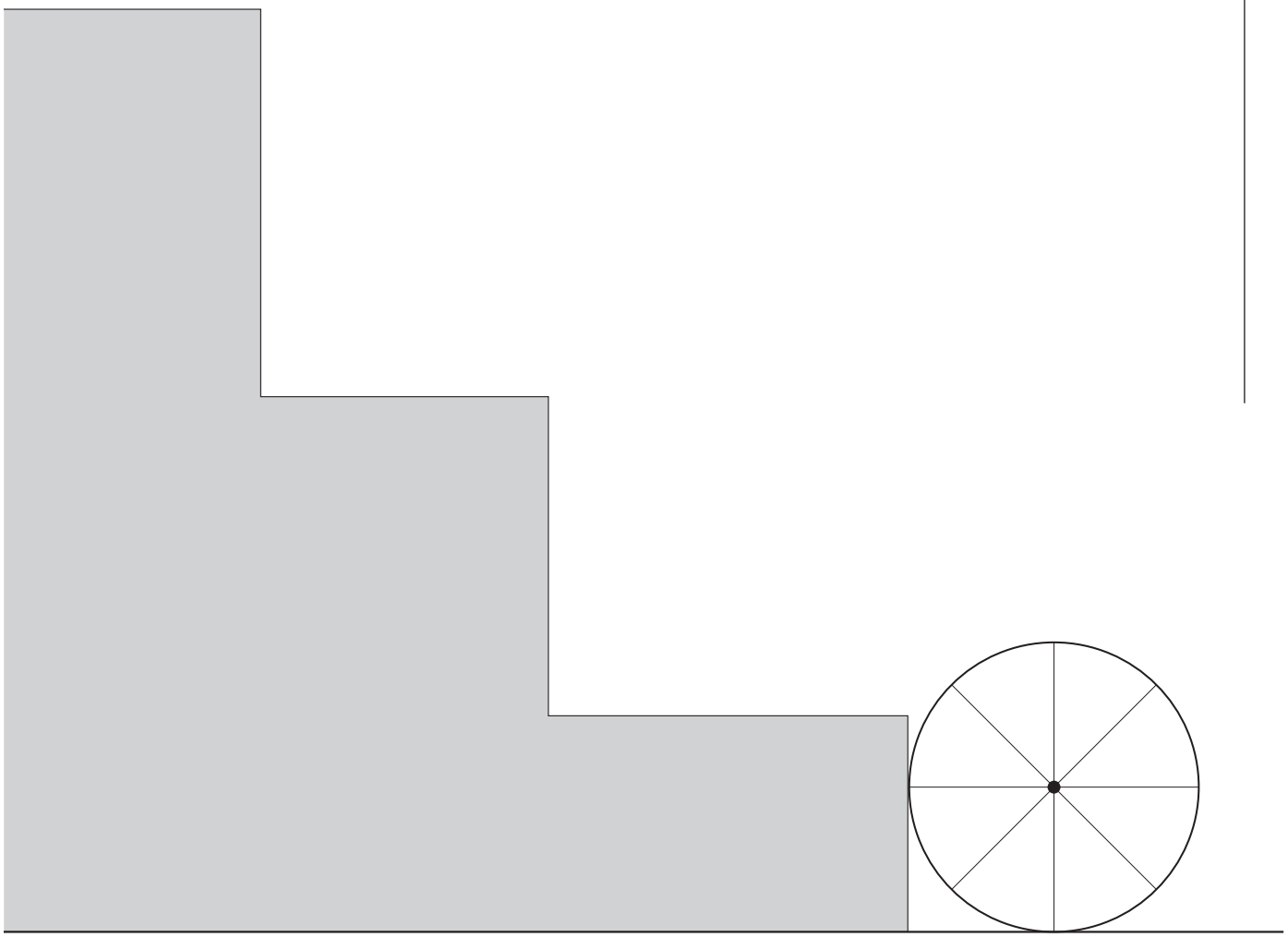
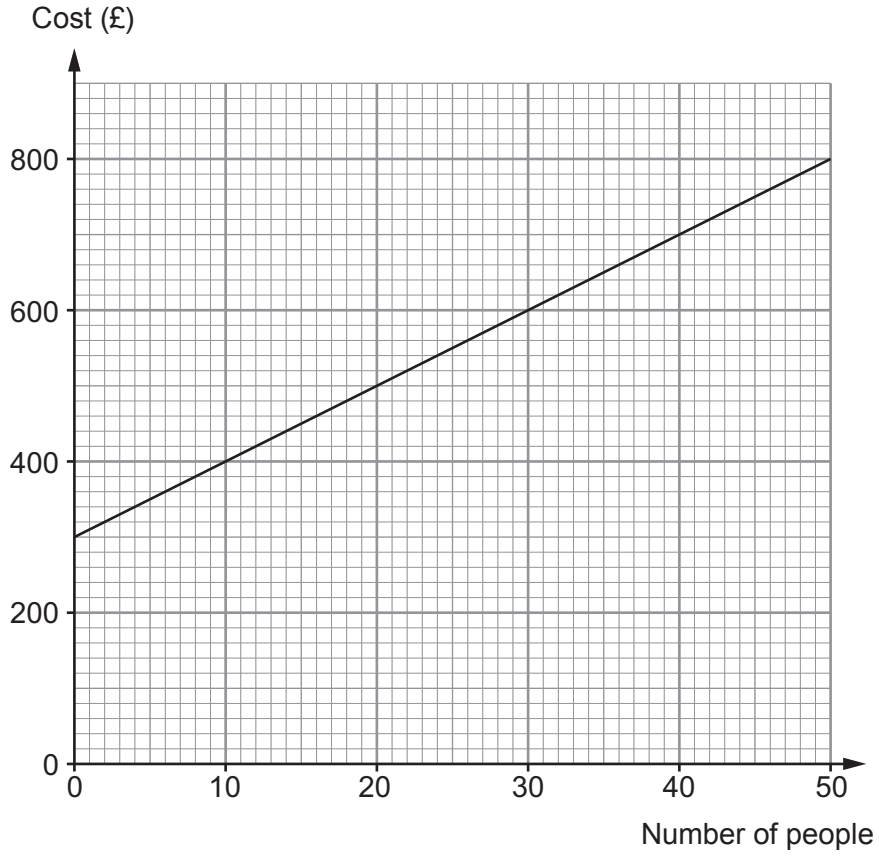


Examiner only

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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Examiner only

(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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Examiner only

10.

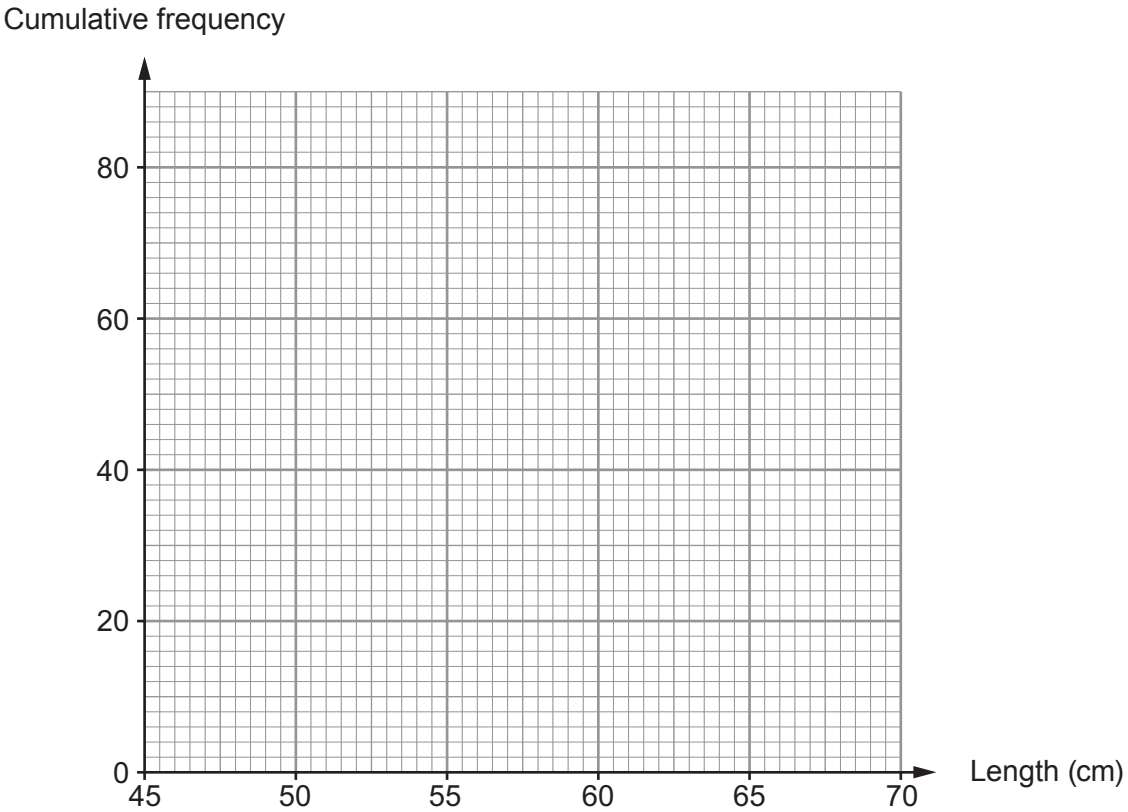
The table gives the grouped frequency distribution for the lengths of the electrical cords of 80 toasters.

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]



Examiner only

(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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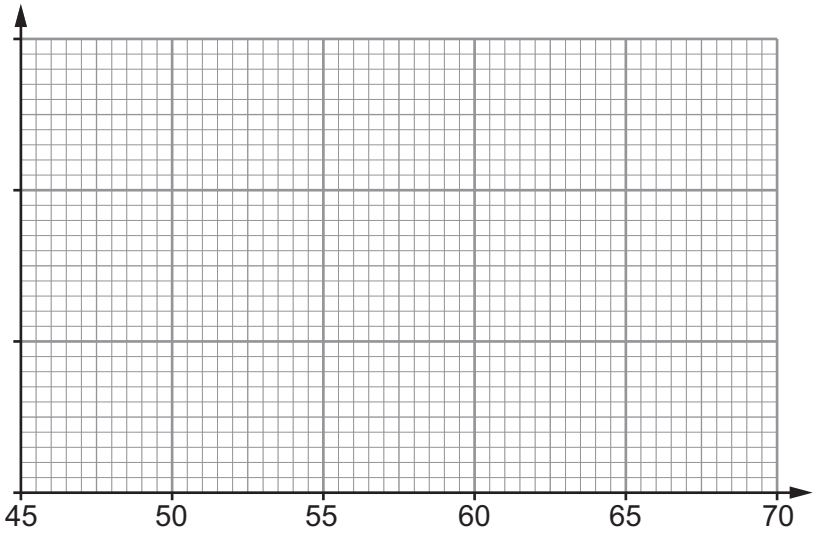
Median	
Lower quartile	
Upper quartile	
Interquartile range	

(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]



Examiner only

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.

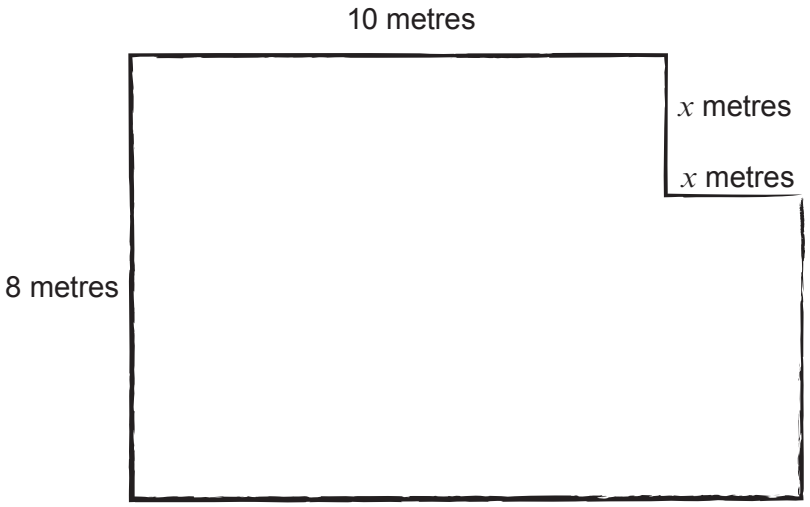


Diagram not drawn to scale

(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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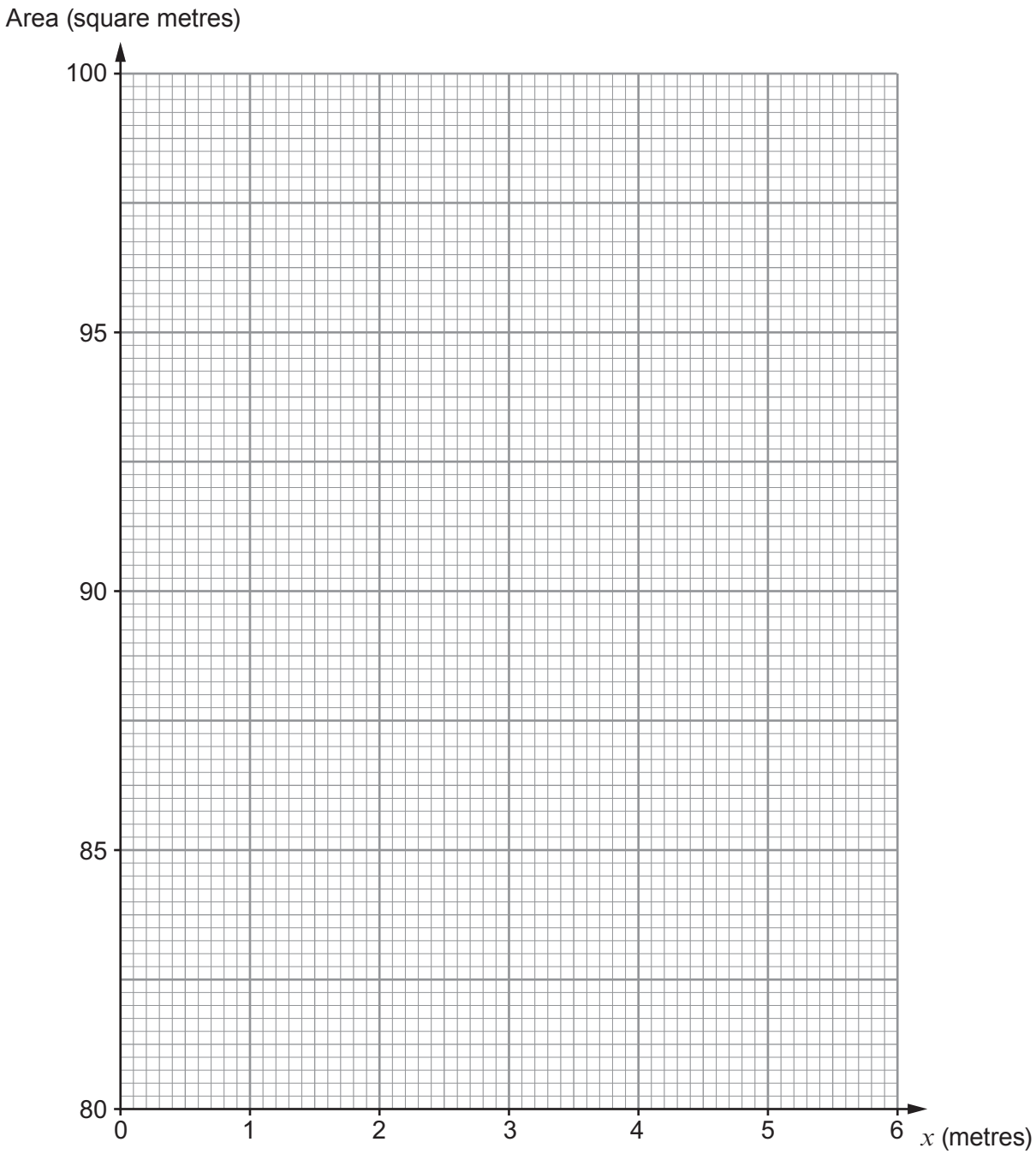

(c) Gerry calculated the area of the floor in the room before she lost some of measurements.
The area is 83·75 square metres. Find the value of x. [2]

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Examiner only

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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Turn over for Question 13.

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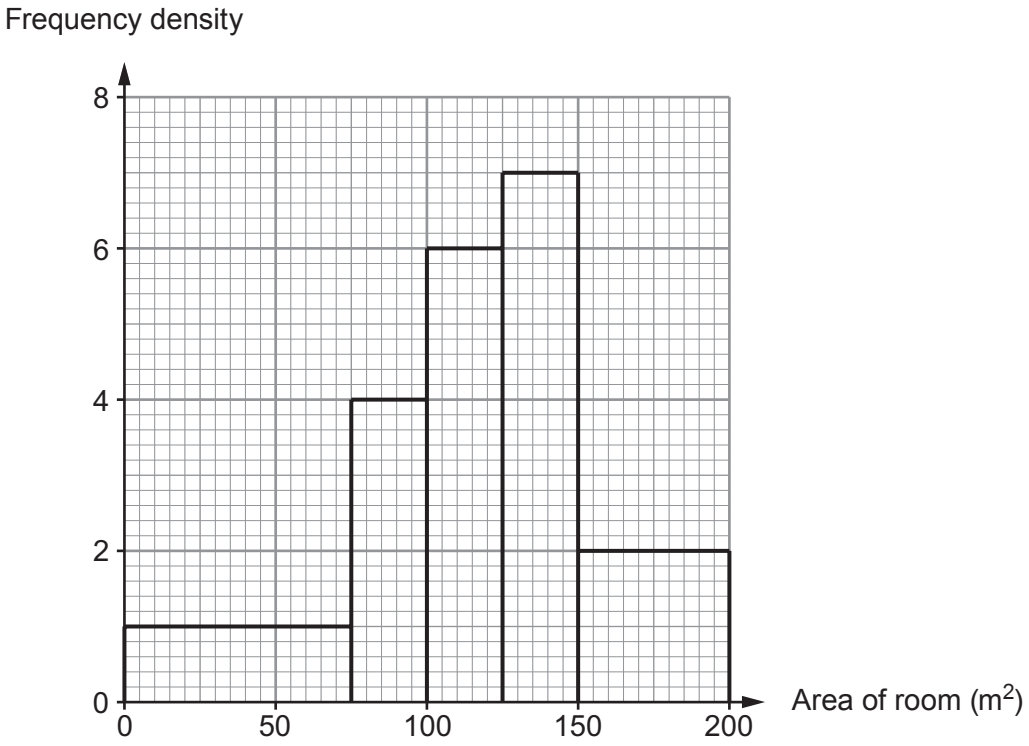
13. The histogram illustrates the floor areas of the offices available to let by *Office Space UK* letting agency.



(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]

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(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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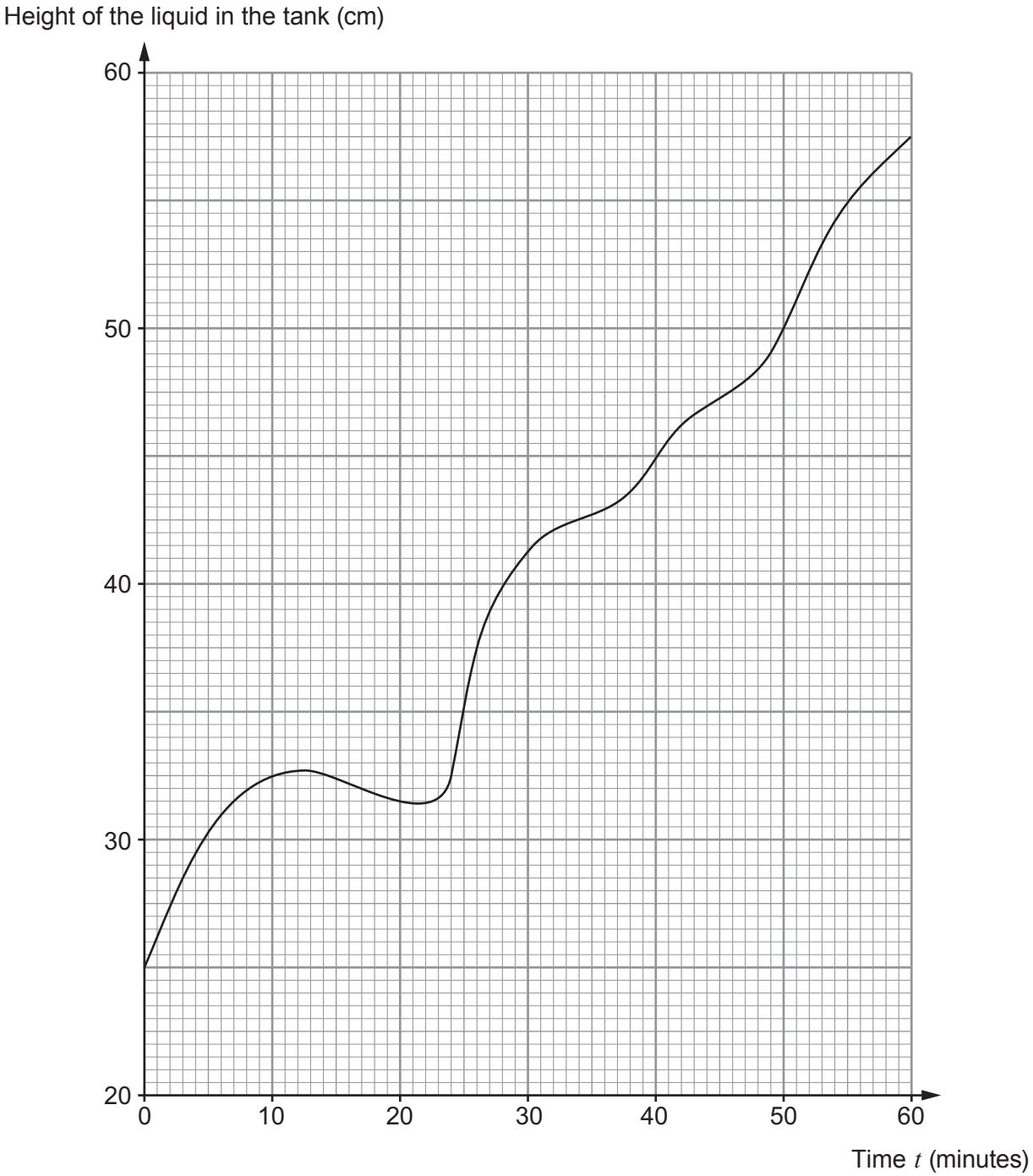
Examiner only

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]

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

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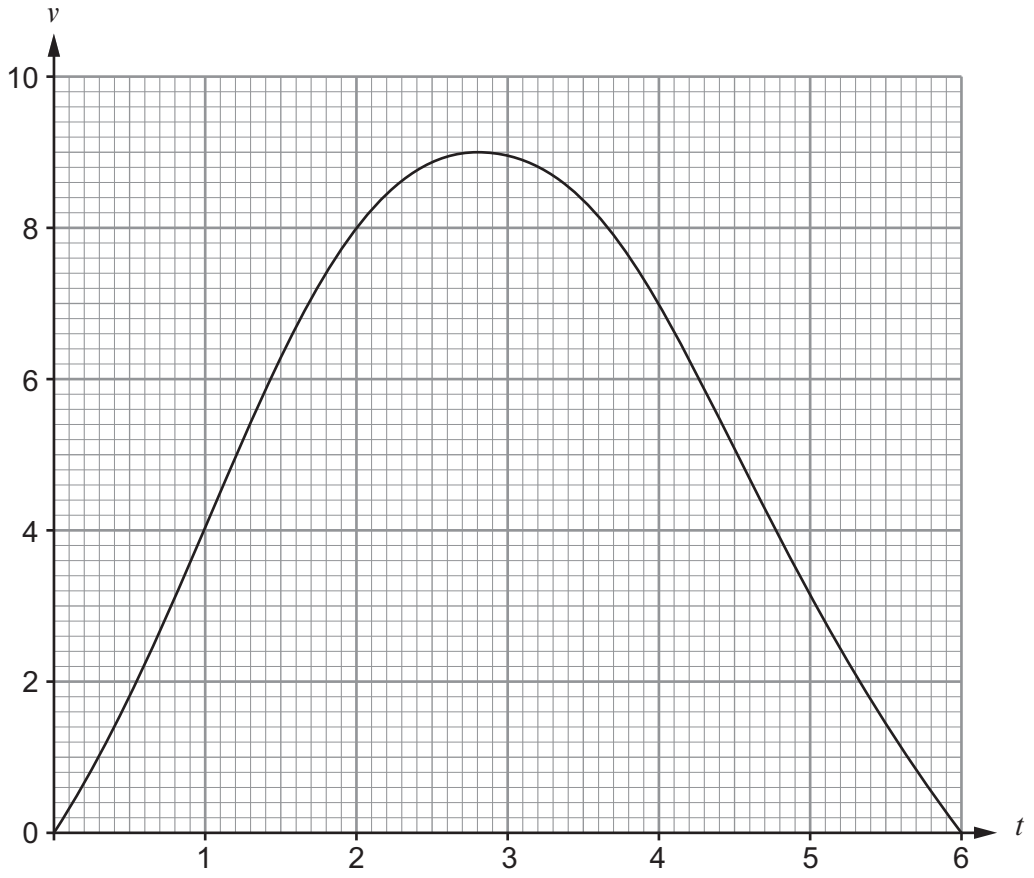
Examiner only

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