

Please check the examination details below before entering your candidate information

Candidate surname

StemUp Model Solution

Other names

Centre Number

Candidate Number

Pearson Edexcel

Level 1/Level 2 GCSE (9–1)

Tuesday 11 June 2019

Morning (Time: 1 hour 30 minutes)

Paper Reference **1MA1/3H**

Mathematics

Paper 3 (Calculator)

Higher Tier

You must have: Ruler graduated in centimetres and millimetres, protractor, pair of compasses, pen, HB pencil, eraser, calculator. Tracing paper may be used.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- You must **show all your working**.
- Diagrams are **NOT** accurately drawn, unless otherwise indicated.
- **Calculators may be used.**
- If your calculator does not have a π button, take the value of π to be 3.142 unless the question instructs otherwise.



Information

- The total mark for this paper is 80
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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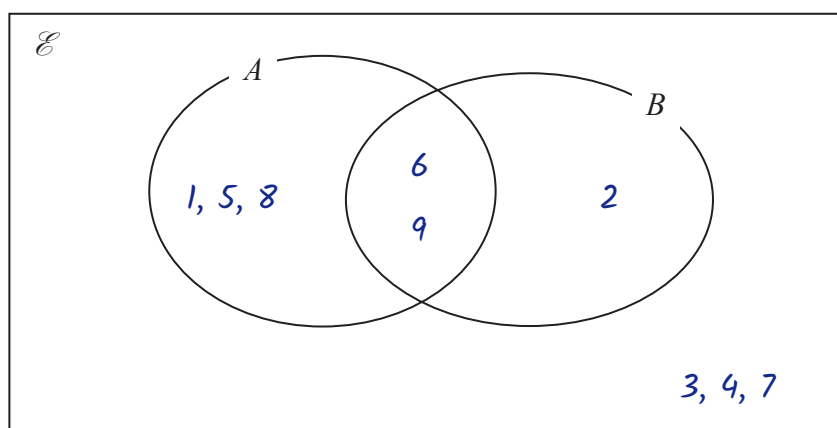
stemup.co.uk

Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

- 1 $\mathcal{E} = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$
 $A = \{1, 5, 6, 8, 9\}$
 $B = \{2, 6, 9\}$



- (a) Complete the Venn diagram to represent this information.

(3)

A number is chosen at random from the universal set $\mathcal{E}$.

- (b) Find the probability that the number is in the set $A \cap B$

$$A \cap B = \{6, 9\}$$

2 numbers out of 9 in $\mathcal{E}$

$$\frac{2}{9}$$

(2)

(Total for Question 1 is 5 marks)



- 2 Katy invests £200 000 in a savings account for 4 years.
The account pays compound interest at a rate of 1.5% per annum.

Calculate the total amount of interest Katy will get at the end of 4 years.

$$\text{Multiplier} = 1 + 0.015 = 1.015$$

$$200000 \times 1.015^4 = 212272.7101...$$

$$\text{Interest} = 212272.71 - 200000$$

$$= 12272.71$$

£.....12272.71

(Total for Question 2 is 3 marks)



- 3 The table shows information about the heights of 80 plants.

Height (h cm)	Frequency
$10 < h \leq 20$	7
$20 < h \leq 30$	13
$30 < h \leq 40$	14
$40 < h \leq 50$	12
$50 < h \leq 60$	16
$60 < h \leq 70$	18

- (a) Find the class interval that contains the median.

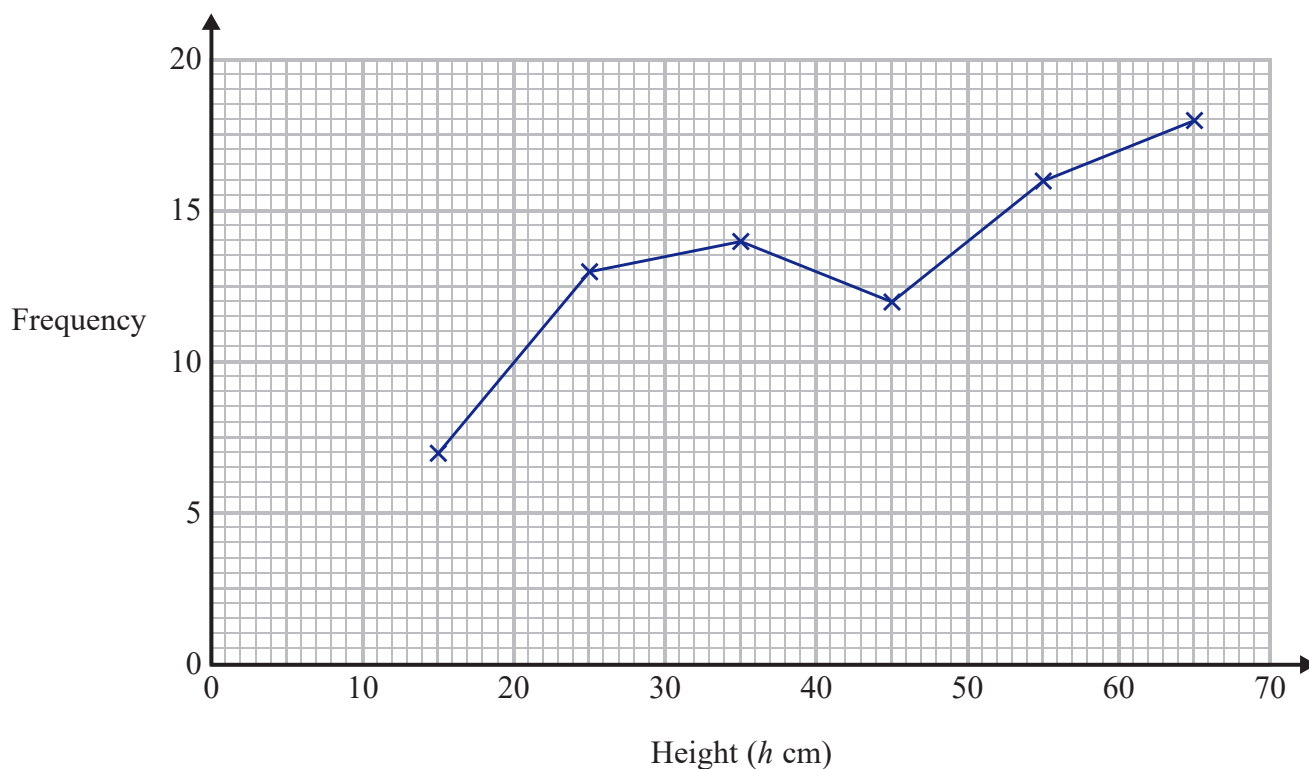
$$80 \div 2 = 40\text{th value}$$

$$7 + 13 + 14 = 34, \quad 34 + 12 = 46 \text{ so the 40th value is in } 40 < h \leq 50$$

$$40 < h \leq 50$$

(1)

- (b) On the grid, draw a frequency polygon for the information in the table.



(2)

(Total for Question 3 is 3 marks)

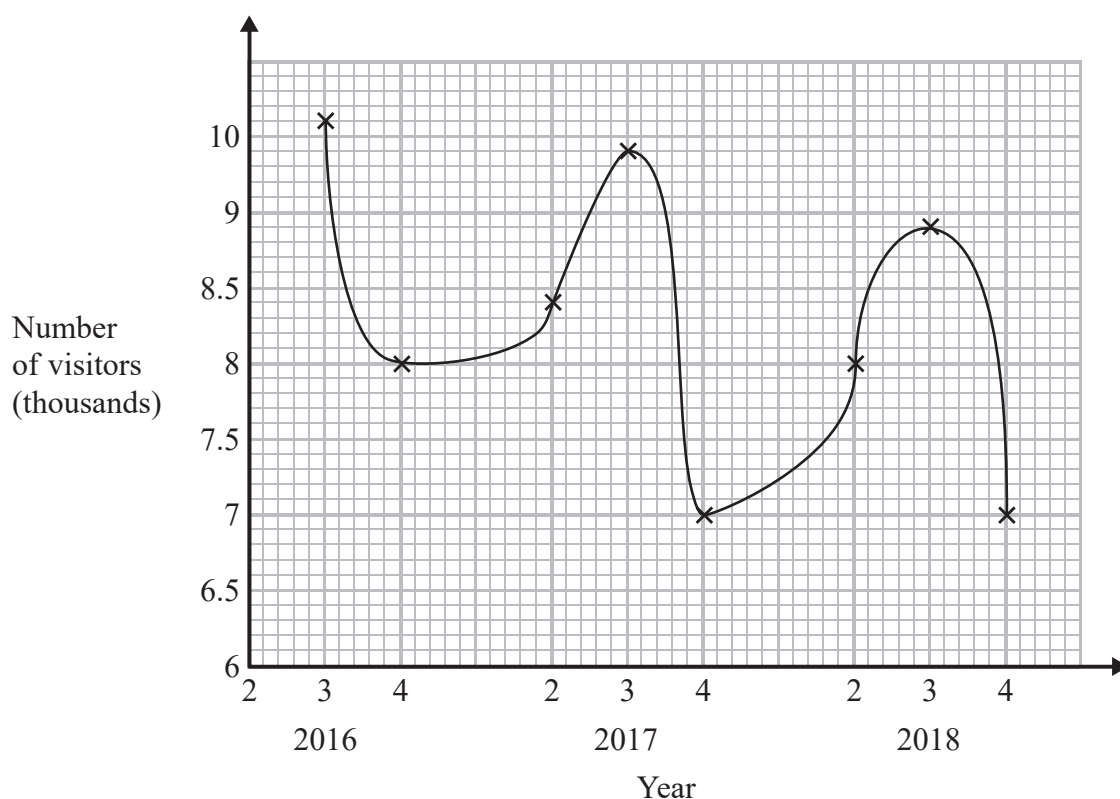


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- 4 Sean has drawn a time series graph to show the numbers, in thousands, of visitors to a fun park.



Write down two things that are wrong or could be misleading with this graph.

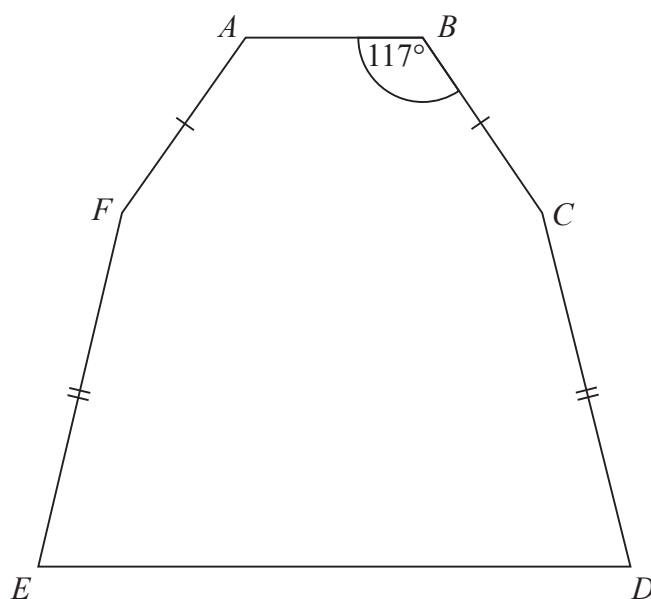
- 1 *The points have been joined with a curve; they should be joined with straight line segments.*

- 2 *The 1st quarter is missing for every year (only 2, 3, 4 are shown), so the graph does not show all 4 seasons.*

(Total for Question 4 is 2 marks)



- 5 The diagram shows a hexagon.
The hexagon has one line of symmetry.



$$FA = BC$$

$$EF = CD$$

$$\text{Angle } ABC = 117^\circ$$

$$\text{Angle } BCD = 2 \times \text{angle } CDE$$

Work out the size of angle AFE .

You must show all your working.

$$\text{Sum of interior angles} = (6 - 2) \times 180 = 720^\circ$$

$$\text{By symmetry, angle } BAF = \text{angle } ABC = 117^\circ$$

$$\text{Let angle } CDE = x, \text{ so angle } BCD = 2x$$

$$\text{By symmetry, angle } FED = x \text{ and angle } AFE = 2x$$

$$117 + 117 + 2x + 2x + x + x = 720$$

$$6x = 720 - 234 = 486, \quad x = 81$$

$$\text{Angle } AFE = 2 \times 81 = 162^\circ$$

162

(Total for Question 5 is 4 marks)



- 6 Jeremy has to cover 3 tanks completely with paint.

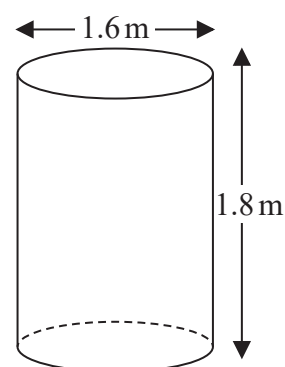
Each tank is in the shape of a cylinder with a top and a bottom.
The tank has a diameter of 1.6 m and a height of 1.8 m.

Jeremy has 7 tins of paint.

Each tin of paint covers 5 m^2

Has Jeremy got enough paint to cover completely the 3 tanks?

You must show how you get your answer.



$$\text{Radius} = 1.6 \div 2 = 0.8 \text{ m}$$

$$\text{Area of top} = \pi \times 0.8^2 = 2.0106... \text{ m}^2$$

$$\text{Top and bottom} = 2 \times 2.0106... = 4.0212... \text{ m}^2$$

$$\text{Curved surface} = 2 \times \pi \times 0.8 \times 1.8 = 9.0477... \text{ m}^2$$

$$\text{Area of 1 tank} = 4.0212... + 9.0477... = 13.0690... \text{ m}^2$$

$$\text{Area of 3 tanks} = 3 \times 13.0690... = 39.207... \text{ m}^2$$

$$7 \text{ tins cover } 7 \times 5 = 35 \text{ m}^2$$

$$39.2 \text{ m}^2 > 35 \text{ m}^2 \quad (39.207... \div 5 = 7.84, \text{ so 8 tins are needed})$$

No, Jeremy has not got enough paint.

(Total for Question 6 is 5 marks)



7 Work out

$$\sqrt{\frac{2.5 \times \sin 43^\circ}{8.2^2 - 50.5}}$$

Give your answer correct to 3 significant figures.

$$2.5 \times \sin 43^\circ = 1.70499...$$

$$8.2^2 - 50.5 = 67.24 - 50.5 = 16.74$$

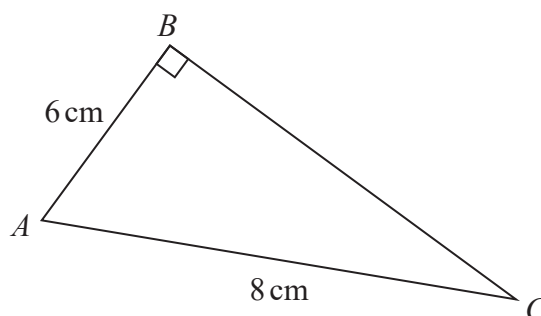
$$1.70499... \div 16.74 = 0.101851...$$

$$\sqrt{0.101851...} = 0.319141985...$$

0.319

(Total for Question 7 is 2 marks)

8 ABC is a right-angled triangle.



Here is Sarah's method to find the length of BC .

$$\begin{aligned} BC^2 &= AB^2 + AC^2 \\ &= 6^2 + 8^2 \\ &= 100 \\ BC &= 10 \end{aligned}$$

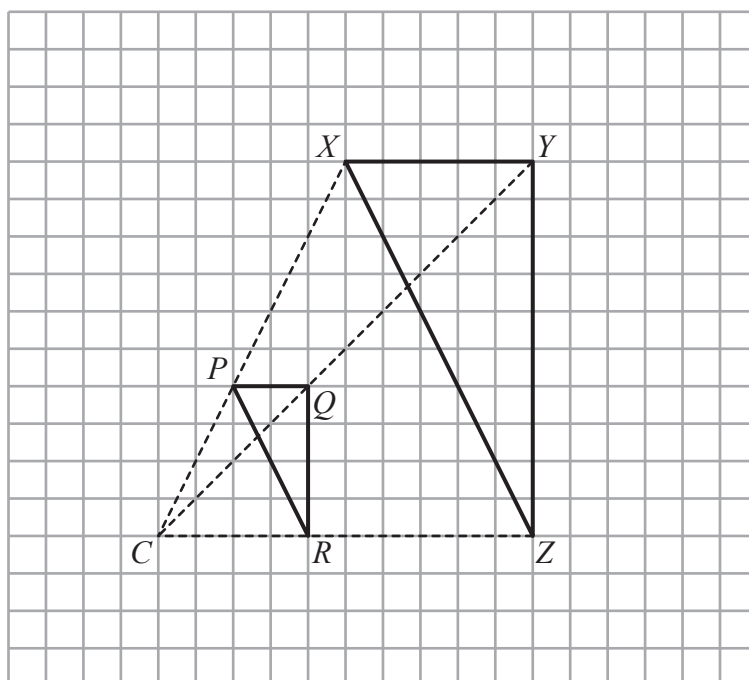
(a) What mistake has Sarah made in her method?

AC is the hypotenuse, not BC, so she should subtract, not add:

$$BC^2 = AC^2 - AB^2 = 8^2 - 6^2 = 28$$

(1)





Roy is going to enlarge triangle PQR with centre C and scale factor $1\frac{1}{2}$

He draws triangle XYZ .

(b) Explain why Roy's diagram is **not** correct.

CR is 4 squares but CZ is 10 squares, so the scale factor he used is

$10 \div 4 = 2.5$, not 1.5 (CZ should be 6 squares).

(1)

(Total for Question 8 is 2 marks)



- 9 A company has to make a large number of boxes.

The company has 6 machines.

All the machines work at the same rate.

When all the machines are working, they can make all the boxes in 9 days.

The table gives the number of machines working each day.

	day 1	day 2	day 3	all other days
Number of machines working	3	4	5	6

Work out the total number of days taken to make all the boxes.

$$\text{Machine days needed} = 6 \times 9 = 54$$

$$\text{Days 1 to 3: } 3 + 4 + 5 = 12 \text{ machine days}$$

$$\text{Still needed: } 54 - 12 = 42 \text{ machine days}$$

$$42 \div 6 = 7 \text{ more days}$$

$$\text{Total} = 3 + 7 = 10 \text{ days}$$

10

(Total for Question 9 is 3 marks)



- 10 Marie invests £8000 in an account for one year.
At the end of the year, interest is added to her account.

Marie pays tax on this interest at a rate of 20%
She pays £28.80 tax.

Work out the percentage interest rate for the account.

$$\text{Interest} = 28.80 \div 0.2 = \text{£}144$$

$$\text{Rate} = 144 \div 8000 \times 100$$

$$= 1.8\%$$

.....1.8..... %

(Total for Question 10 is 3 marks)



11 In May 2019, the distance between Earth and Mars was 3.9×10^7 km.

In May 2019, a signal was sent from Earth to Mars.

Assuming that the signal sent from Earth to Mars travelled at a speed of 3×10^5 km per second,

(a) how long did the signal take to get to Mars?

$$\begin{aligned} \text{Time} &= \text{distance} \div \text{speed} \\ &= (3.9 \times 10^7) \div (3 \times 10^5) \\ &= 130 \end{aligned}$$

130 seconds
(2)

The speed of the signal sent from Earth to Mars in May 2019 was actually less than 3×10^5 km per second.

(b) How will this affect your answer to part (a)?

The time will be longer, so my answer to (a) will be too small.

(1)

(Total for Question 11 is 3 marks)

12 Patrick has to work out the exact value of $64^{\frac{1}{4}}$

Patrick says,

$$\text{“}\frac{1}{4}\text{ of }64\text{ is }16\text{ so }64^{\frac{1}{4}} = 16\text{”}$$

Explain what is wrong with what Patrick says.

$64^{\frac{1}{4}}$ means the fourth root of 64, not a quarter of 64.

The fourth root of 64 is 2.828... ($= 2\sqrt{2}$), not 16.

(Total for Question 12 is 1 mark)



- 13 The density of ethanol is 1.09 g/cm^3
The density of propylene is 0.97 g/cm^3

60 litres of ethanol are mixed with 128 litres of propylene to make 188 litres of antifreeze.

Work out the density of the antifreeze.

Give your answer correct to 2 decimal places.

$$\text{Ethanol: } 60 \text{ litres} = 60000 \text{ cm}^3$$

$$\text{mass} = 1.09 \times 60000 = 65400 \text{ g}$$

$$\text{Propylene: } 128 \text{ litres} = 128000 \text{ cm}^3$$

$$\text{mass} = 0.97 \times 128000 = 124160 \text{ g}$$

$$\text{Total mass} = 65400 + 124160 = 189560 \text{ g}$$

$$\text{Density} = 189560 \div 188000$$

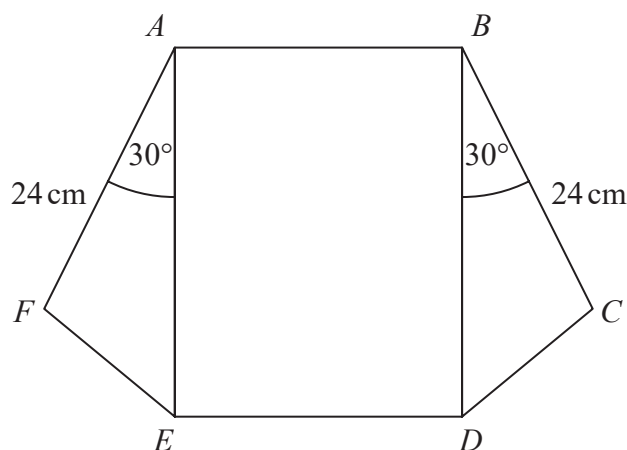
$$= 1.00829... \text{ g/cm}^3$$

.....1.01..... g/cm^3

(Total for Question 13 is 4 marks)



- 14 The diagram shows a rectangle, $ABDE$, and two congruent triangles, AFE and BCD .



area of rectangle $ABDE$ = area of triangle AFE + area of triangle BCD

$$AB : AE = 1 : 3$$

Work out the length of AE .

$$\text{Let } AB = x, \text{ so } AE = 3x$$

$$\text{Area of rectangle} = x \times 3x = 3x^2$$

$$\text{Area of triangle } AFE = \frac{1}{2} \times 24 \times 3x \times \sin 30^\circ = 18x$$

$$\text{Area of both triangles} = 2 \times 18x = 36x$$

$$3x^2 = 36x$$

$$x = 12$$

$$AE = 3 \times 12 = 36 \text{ cm}$$

..... 36 cm

(Total for Question 14 is 4 marks)



- 15 The graph of the curve C with equation $y = f(x)$ is transformed to give the graph of the curve S with equation $y = f(-x) - 3$

The point on C with coordinates (7, 2) is mapped to the point Q on S.

Find the coordinates of Q.

$f(-x)$: reflection in the y-axis, $(7, 2) \rightarrow (-7, 2)$

-3 : translation 3 units down, $(-7, 2) \rightarrow (-7, -1)$

(.....-7....., ...-1.....)

(Total for Question 15 is 2 marks)

- 16 Here are the first six terms of a quadratic sequence.

-1 5 15 29 47 69

Find an expression, in terms of n , for the n th term of this sequence.

n	1	2	3	4	5	6
term	-1	5	15	29	47	69
1st diff		6	10	14	18	22
2nd diff			4	4	4	4
$2n^2$	2	8	18	32	50	72
term - $2n^2$	-3	-3	-3	-3	-3	-3

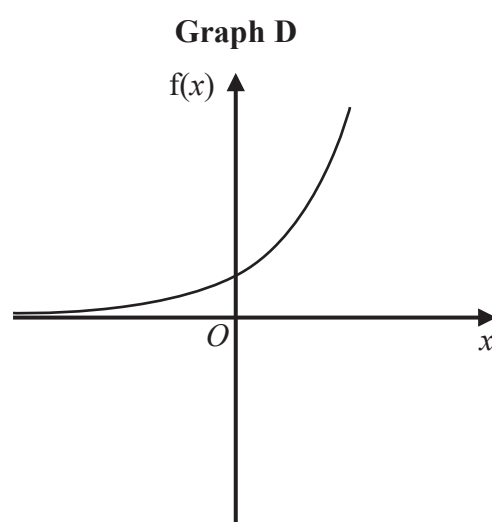
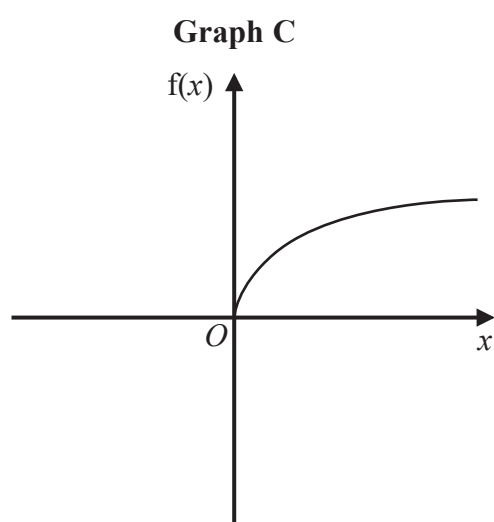
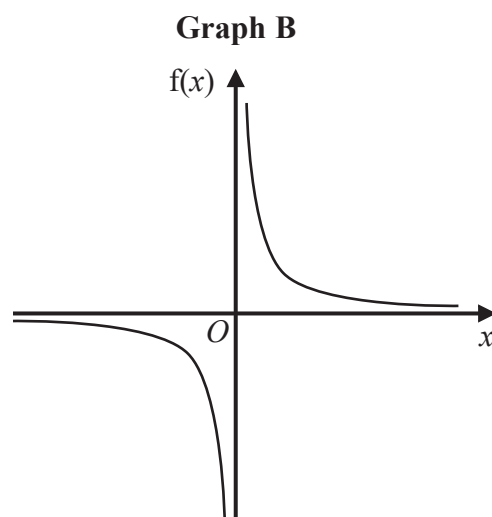
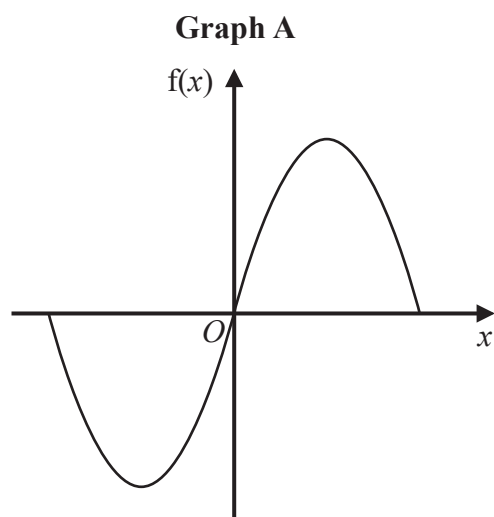
2nd difference 4, so $2n^2$; n th term = $2n^2 - 3$

..... $2n^2 - 3$

(Total for Question 16 is 3 marks)



17 Here are four graphs.



The graphs represent four different types of function f .

Match each description of the function in the table to the letter of its graph.

Description of function	Graph
$f(x)$ is inversely proportional to x	<i>B</i>
$f(x)$ is a trigonometrical function	<i>A</i>
$f(x)$ is an exponential function	<i>D</i>
$f(x)$ is directly proportional to $\sqrt{x}$	<i>C</i>

(Total for Question 17 is 2 marks)



- 18 (a) Show that $(2x + 1)(x + 3)(3x + 7)$ can be written in the form $ax^3 + bx^2 + cx + d$ where a, b, c and d are integers.

$$(2x + 1)(x + 3) = 2x^2 + 6x + x + 3 = 2x^2 + 7x + 3$$

$$(2x^2 + 7x + 3)(3x + 7)$$

$$= 6x^3 + 14x^2 + 21x^2 + 49x + 9x + 21$$

$$= 6x^3 + 35x^2 + 58x + 21$$

$$\text{so } a = 6, b = 35, c = 58, d = 21 \text{ (all integers)}$$

(3)

(b) Solve $(1 - x)^2 < \frac{9}{25}$

$$\text{Square root both sides: } -\frac{3}{5} < 1 - x < \frac{3}{5}$$

$$1 - x = \frac{3}{5} \quad \text{gives} \quad x = \frac{2}{5}$$

$$1 - x = -\frac{3}{5} \quad \text{gives} \quad x = \frac{8}{5} = 1\frac{3}{5}$$

$$\frac{2}{5} < x < 1\frac{3}{5}$$

(3)

(Total for Question 18 is 6 marks)



19 $D = \frac{u^2}{2a}$

$u = 26.2$ correct to 3 significant figures

$a = 4.3$ correct to 2 significant figures

- (a) Calculate the upper bound for the value of D .
Give your answer correct to 6 significant figures.
You must show all your working.

Upper bound of $u = 26.25$

Lower bound of $a = 4.25$

$$\text{Upper bound of } D = \frac{26.25^2}{2 \times 4.25} = \frac{689.0625}{8.5}$$

$$= 81.0661764\dots$$

81.0662

(3)

The lower bound for the value of D is 78.6003 correct to 6 significant figures.

- (b) By considering bounds, write down the value of D to a suitable degree of accuracy.
You must give a reason for your answer.

$D = 80$, because the upper bound 81.0662 and the lower bound 78.6003

both round to 80 (to 1 significant figure).

(2)

(Total for Question 19 is 5 marks)



20 Solve algebraically the simultaneous equations

$$x^2 - 4y^2 = 9$$

$$3x + 4y = 7$$

$$4y = 7 - 3x, \text{ so } y = \frac{7 - 3x}{4}$$

$$x^2 - 4 \times \frac{(7 - 3x)^2}{16} = 9$$

$$x^2 - \frac{49 - 42x + 9x^2}{4} = 9$$

$$4x^2 - 49 + 42x - 9x^2 = 36$$

$$-5x^2 + 42x - 85 = 0$$

$$5x^2 - 42x + 85 = 0$$

$$(5x - 17)(x - 5) = 0$$

$$x = 17 \div 5 = 3.4 \text{ or } x = 5$$

$$x = 3.4: y = (7 - 3 \times 3.4) \div 4 = -3.2 \div 4 = -0.8$$

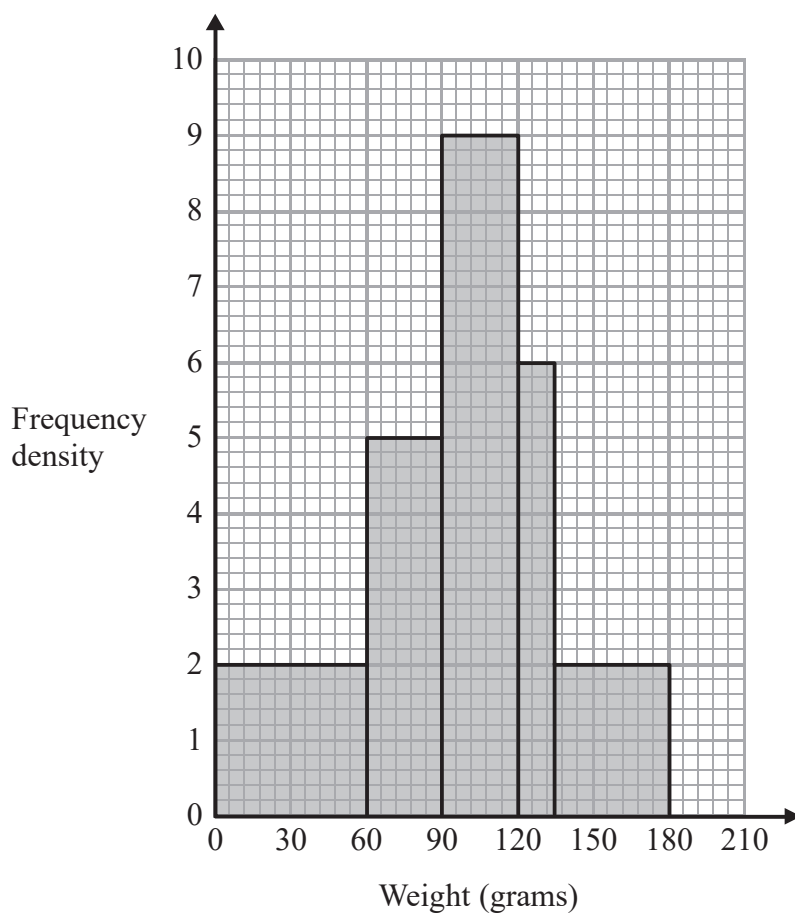
$$x = 5: y = (7 - 15) \div 4 = -8 \div 4 = -2$$

$$x = 3.4, y = -0.8 \text{ and } x = 5, y = -2$$

(Total for Question 20 is 5 marks)



- 21 The histogram gives information about the distribution of the weights of some onions grown by a farmer.



Onions less than 60 grams in weight are used for pickling.
Onions greater than 120 grams in weight are sold at the market.
The rest of the onions are sent to a food processing factory.

Frequency = frequency density $\times$ class width

0 to 60: $2 \times 60 = 120$

60 to 90: $5 \times 30 = 150$

90 to 120: $9 \times 30 = 270$

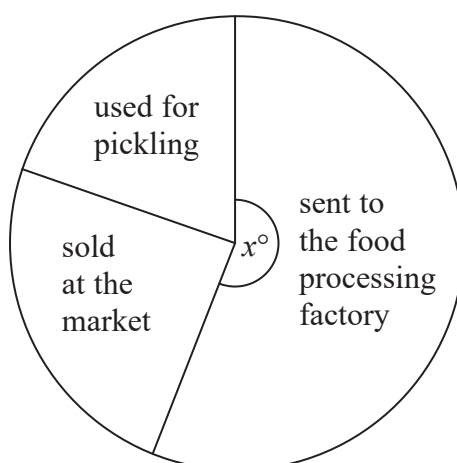
120 to 135: $6 \times 15 = 90$

135 to 180: $2 \times 45 = 90$

Total = $120 + 150 + 270 + 90 + 90 = 720$



A pie chart is drawn using the information opposite to show what the farmer does with the onions he grows.



The angle of the sector for the onions sent to the food processing factory is x° .

Work out the value of x .

$$\text{Factory (60 g to 120 g)} = 150 + 270 = 420$$

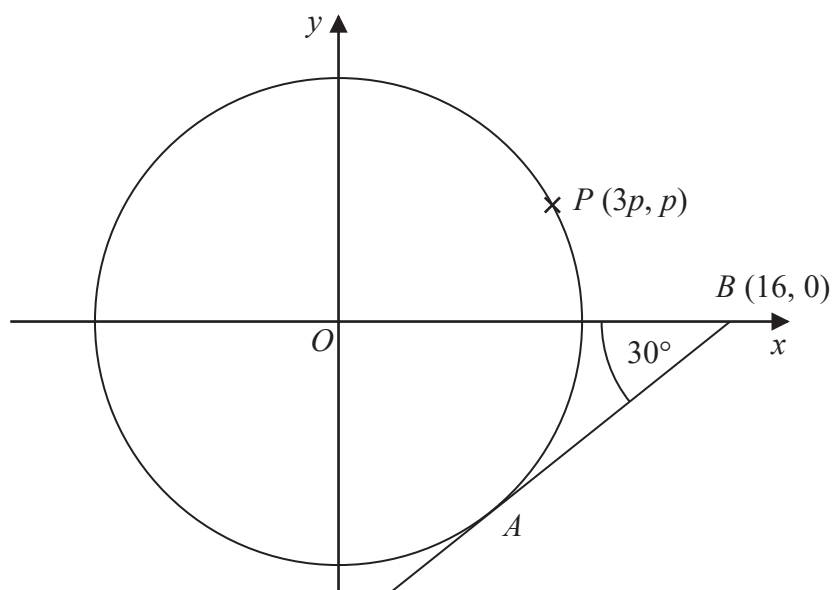
$$x = \frac{420}{720} \times 360 = 210$$

$$x = \dots\dots\dots 210$$

(Total for Question 21 is 4 marks)



22 The diagram shows a circle, centre O .



AB is the tangent to the circle at the point A .
Angle $OBA = 30^\circ$

Point B has coordinates $(16, 0)$

Point P has coordinates $(3p, p)$

Find the value of p .

Give your answer correct to 1 decimal place.

You must show all your working.

Angle $OAB = 90^\circ$ (tangent is perpendicular to radius)

$OA = 16 \times \sin 30^\circ = 8$, so the radius is 8

Equation of circle: $x^2 + y^2 = 8^2 = 64$

P on circle: $(3p)^2 + p^2 = 64$

$10p^2 = 64$

$p^2 = 6.4$

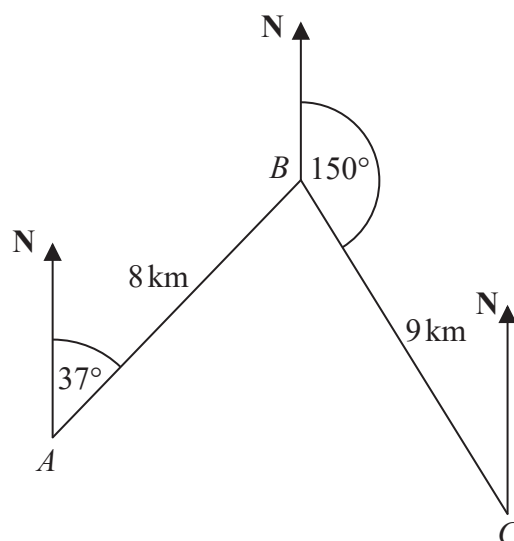
$p = \sqrt{6.4} = 2.5298\dots$

$p = \dots\dots\dots 2.5$

(Total for Question 22 is 4 marks)



- 23 The diagram shows the positions of three towns, Acton (A), Barston (B) and Chorlton (C).



Barston is 8 km from Acton on a bearing of 037°
 Chorlton is 9 km from Barston on a bearing of 150°

Find the bearing of Chorlton from Acton.
 Give your answer correct to 1 decimal place.
 You must show all your working.

$$\text{Bearing of A from B} = 37 + 180 = 217^\circ$$

$$\text{Angle ABC} = 217 - 150 = 67^\circ$$

$$AC^2 = 8^2 + 9^2 - 2 \times 8 \times 9 \times \cos 67^\circ$$

$$AC^2 = 88.7347\dots, \quad AC = 9.41991\dots \text{ km}$$

$$\frac{\sin BAC}{9} = \frac{\sin 67^\circ}{9.41991\dots}$$

$$\sin BAC = 9 \times \sin 67^\circ \div 9.41991\dots = 0.879471\dots$$

$$\text{Angle BAC} = 61.5786\dots^\circ$$

$$\text{Bearing} = 37 + 61.5786\dots = 98.5786\dots^\circ$$

098.6

(Total for Question 23 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS



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