



1 (a) Simplify $m^3 \times m^4$

$$m^7$$

(1)

(b) Simplify $(5np^3)^3$

$$125n^3p^9$$

(2)

(c) Simplify $\frac{32q^9r^4}{4q^3r}$

$$8q^6r^3$$

(2)

(Total for Question 1 is 5 marks)

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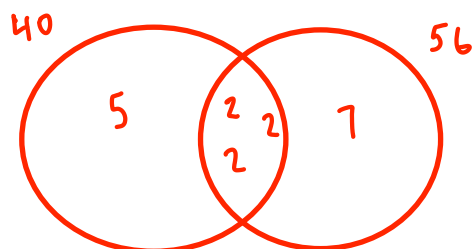
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- 2 (a) Find the lowest common multiple (LCM) of 40 and 56

$$40 = 2 \times 2 \times 2 \times 5$$

$$56 = 2 \times 2 \times 2 \times 7$$



$$\text{LCM} =$$

$$5 \times 2 \times 2 \times 2 \times 7 = 280$$

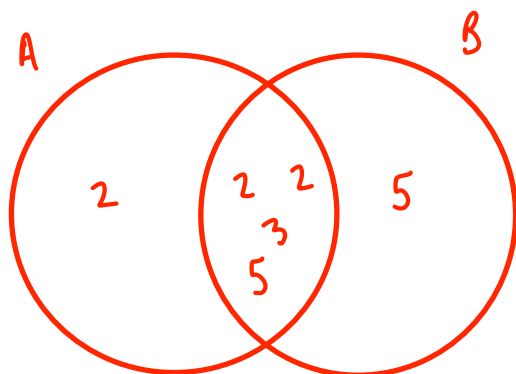
$$280$$

(2)

$$A = 2^3 \times 3 \times 5$$

$$B = 2^2 \times 3 \times 5^2$$

- (b) Write down the highest common factor (HCF) of A and B .



$$\begin{aligned} \text{HCF} &= 2 \times 2 \times 3 \times 5 \\ &= 60 \end{aligned}$$

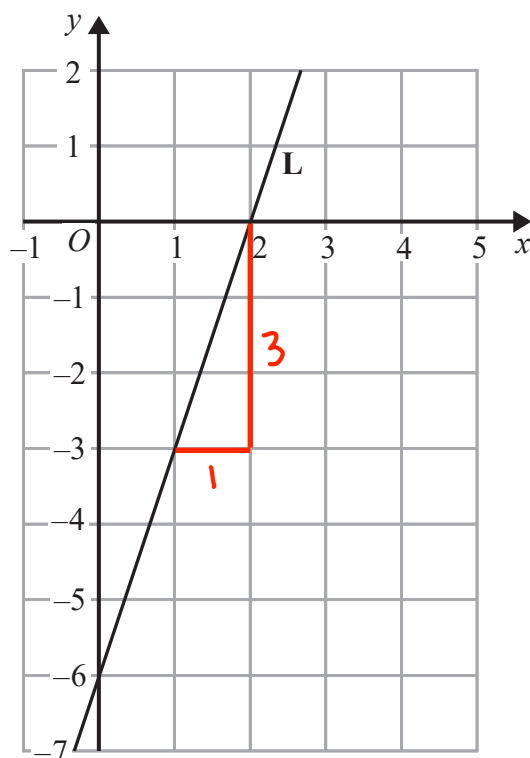
$$60$$

(1)

(Total for Question 2 is 3 marks)



3 The line **L** is shown on the grid.



Find an equation for **L**.

$$\text{Gradient} = \frac{\text{rise}}{\text{run}} = \frac{3}{1} = 3$$

$$y\text{-intercept} = -6$$

$$y = 3x - 6$$

(Total for Question 3 is 3 marks)

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- 4 Raya buys a van for £8500 plus VAT at 20%

Raya pays a deposit for the van.

She then pays the rest of the cost in 12 equal payments of £531.25 each month.

Find the ratio of the deposit Raya pays to the total of the 12 equal payments.

Give your answer in its simplest form.

$$20\% \text{ of } 8500 = £1700$$

$$8500 + 1700 = £10,200$$

← Cost including VAT

$$12 \times 531.25 = £6375$$

To find the deposit :

$$£10,200 - £6375 = £3825$$

Deposit : 12 payments

$$3825 : 6375$$

$$3 : 5$$

Tip: using your calculator

$$\frac{3825}{6375} = \frac{3}{5}$$

$$3 : 5$$

(Total for Question 4 is 5 marks)

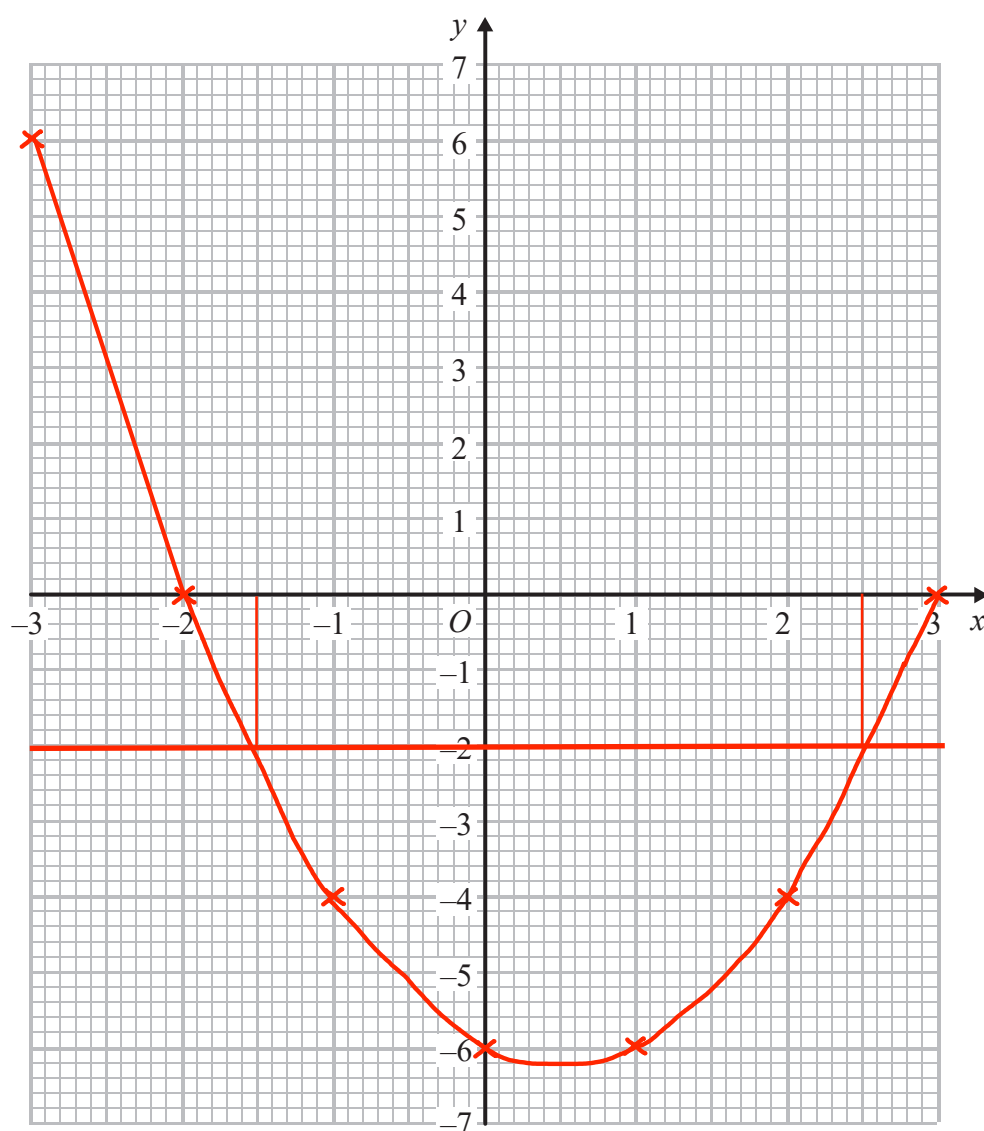
- 5 (a) Complete the table of values for $y = x^2 - x - 6$

x	-3	-2	-1	0	1	2	3
y	6	0	-4	-6	-6	-4	0

(2)

- (b) On the grid, draw the graph of $y = x^2 - x - 6$ for values of x from -3 to 3

(2)



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(c) Use your graph to find estimates of the solutions to the equation $x^2 - x - 6 = -2$

$$x = -1.5, 2.5$$
$$(-1.5 \text{ to } -1.7, 2.5^{(2)} \text{ to } 2.7)$$

(Total for Question 5 is 6 marks)

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- 6 A force of 70 newtons acts on an area of 20 cm^2

The force is increased by 10 newtons.

The area is increased by 10 cm^2

$\text{pressure} = \frac{\text{force}}{\text{area}}$
--

Helen says,

“The pressure decreases by less than 20%”

Is Helen correct?

You must show how you get your answer.

$$P = \frac{F}{A} = \frac{70}{20} = 3.5 \text{ N/cm}^2$$

$$\frac{80}{30} = 2.6 \text{ N/cm}^2$$

$$\frac{\text{Change}}{\text{original}} \times 100$$

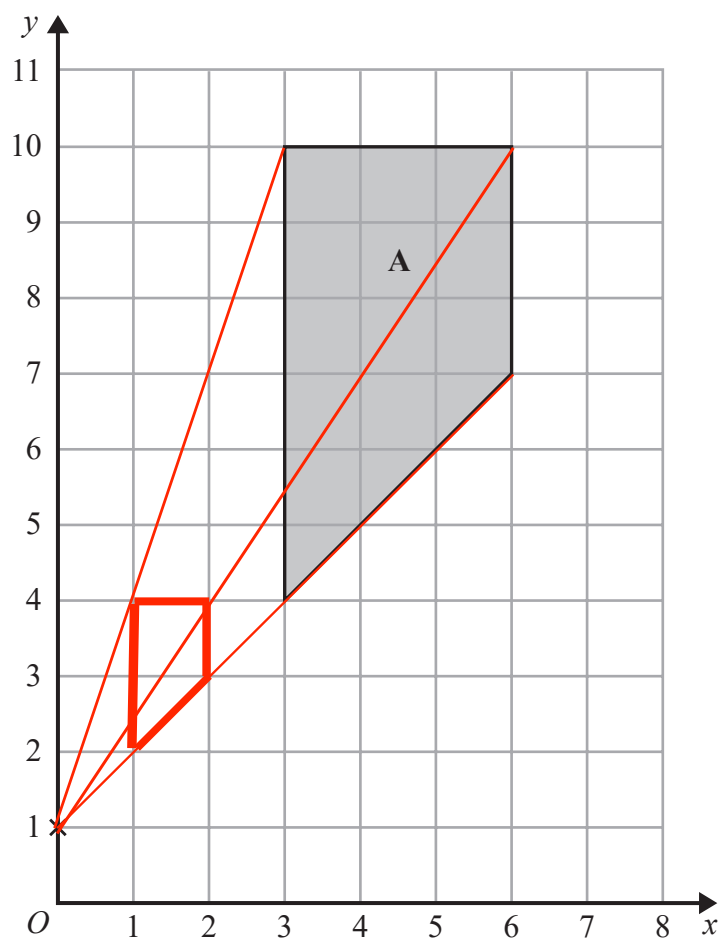
$$\frac{3.5 - 2.6}{3.5} \times 100 = 23.8 \%$$

NO, decreases by 23.8 %.

(Total for Question 6 is 3 marks)



7



Enlarge shape A by scale factor $\frac{1}{3}$ centre (0, 1)

(Total for Question 7 is 2 marks)

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- 8 60 people were asked if they prefer to go on holiday in Britain or in Spain or in Italy.

38 of the people were male.

11 of the 32 people who said Britain were female.

8 males said Italy.

12 people said Spain.

One of the females is chosen at random.

What is the probability that this female said Spain?

	B	S	I	Total
Male	21	9	8	38
female	11	3	8	22
total	32	12	16	60

$$\frac{3}{22}$$

(Total for Question 8 is 4 marks)

- 9 Jean invests £12 000 in an account paying compound interest for 2 years.

In the first year the rate of interest is $x\%$

At the end of the first year the value of Jean's investment is £12 336

In the second year the rate of interest is $\frac{x}{2}\%$

What is the value of Jean's investment at the end of 2 years?

$$\begin{array}{rcl} 12000 \times y & = & 12336 \\ \div 12000 & & \div 12000 \\ y & = & 1.028 \end{array}$$

$$x = 2.8\%$$

$$12336 \times 1.014 = 12508.70$$

£ 12 508.70

(Total for Question 9 is 4 marks)

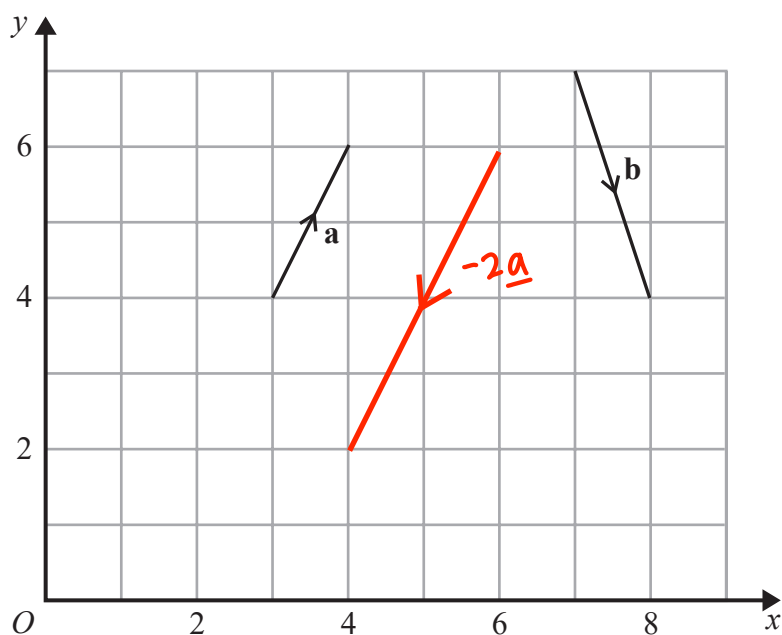
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10 The vector **a** and the vector **b** are shown on the grid.



(a) On the grid, draw and label vector $-2\mathbf{a}$

(1)

(b) Work out $\mathbf{a} + 2\mathbf{b}$ as a column vector.

$$\underline{\mathbf{a}} = \begin{pmatrix} 1 \\ 2 \end{pmatrix} \quad \underline{\mathbf{b}} = \begin{pmatrix} 1 \\ -3 \end{pmatrix} \quad 2\underline{\mathbf{b}} = \begin{pmatrix} 2 \\ -6 \end{pmatrix}$$

$$\underline{\mathbf{a}} + 2\underline{\mathbf{b}} = \begin{pmatrix} 1 + 2 \\ 2 + -6 \end{pmatrix}$$

$$\begin{pmatrix} 3 \\ -4 \end{pmatrix}$$

(2)

(Total for Question 10 is 3 marks)



11 f and g are functions such that

$$f(x) = \frac{2}{x^2} \quad \text{and} \quad g(x) = 4x^3$$

(a) Find $f(-5)$

$$\frac{2}{(-5)^2} = \frac{2}{25}$$

$$\frac{2}{25}$$

(1)

(b) Find $fg(1)$

$$g(1) = 4(1)^3 \\ = 4$$

$$f(4) = \frac{2}{(4)^2} = \frac{2}{16} = \frac{1}{8}$$

$$\frac{1}{8}$$

(2)

(Total for Question 11 is 3 marks)

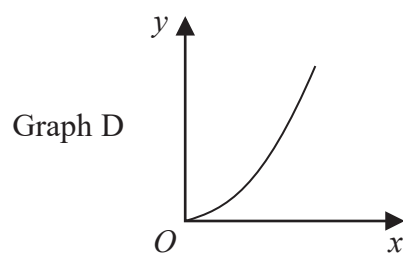
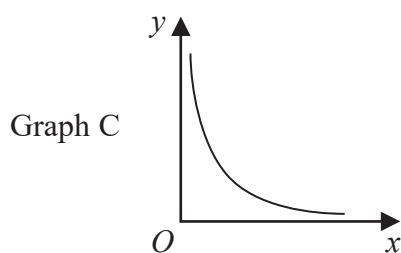
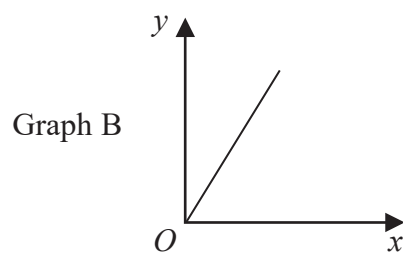
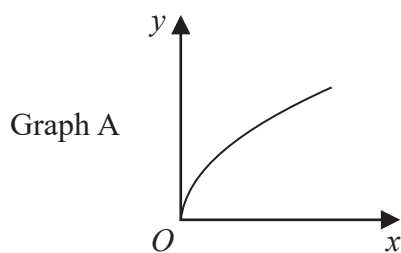
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12



The graphs of y against x represent four different types of proportionality.

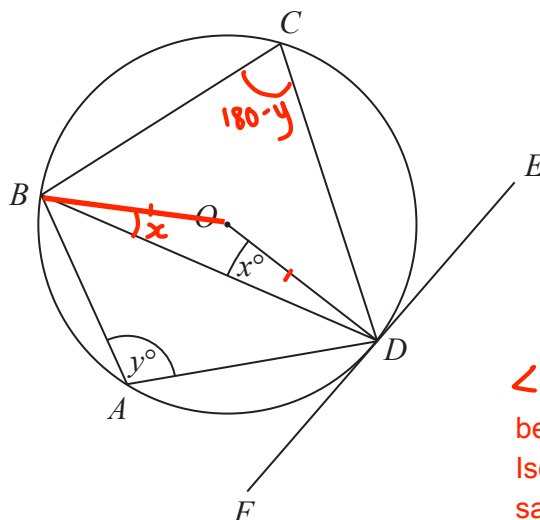
Match each type of proportionality in the table to the correct graph.

Type of proportionality	Graph letter
$y \propto x$	B
$y \propto x^2$	D
$y \propto \sqrt{x}$	A
$y \propto \frac{1}{x}$	C

(Total for Question 12 is 2 marks)



13



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A, B, C and D are points on the circumference of a circle, centre O .
 FDE is a tangent to the circle.

- (a) Show that $y - x = 90$
 You must give a reason for each stage of your working.

$$\angle BCD = 180 - y \quad \text{because opposite angles in a cyclic quadrilateral add to } 180^\circ$$

$$\angle BOD = 360 - 2y \quad \text{angles at the centre of a circle are twice the angle at the circumference}$$

$$360 - 2y + x + x = 180 \quad \text{because angles in a triangle add to } 180^\circ$$

$$360 - 2y + 2x = 180$$

$$180 = 2y - 2x$$

$$\div 2 \quad 90 = y - x$$

(3)

Dylan was asked to give some possible values for x and y .

He said,

“ y could be 200 and x could be 110, because $200 - 110 = 90$ ”

- (b) Is Dylan correct?

You must give a reason for your answer.

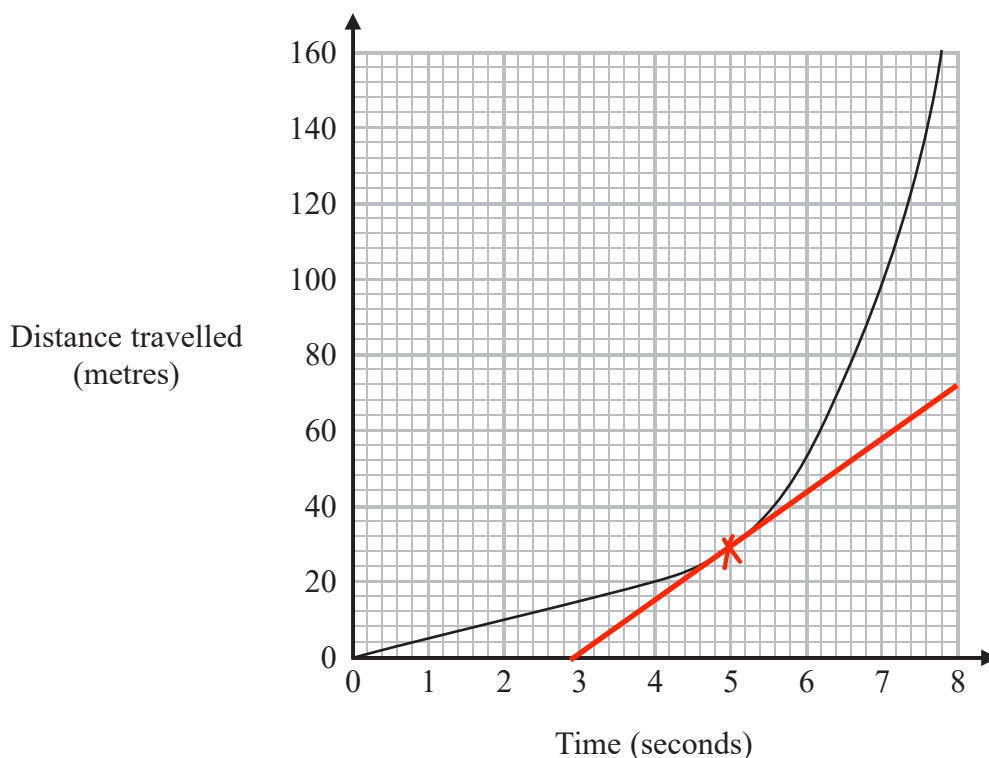
No as y must be less than 180° as it is an angle in a triangle

(1)

(Total for Question 13 is 4 marks)



- 14 The distance-time graph shows information about part of a car journey.



Use the graph to estimate the speed of the car at time 5 seconds.

$$S = \frac{D}{T} = \text{gradient of line}$$

$$= 66 \div 5 = 13.2$$

13.2 m/s
(11 to 19)

(Total for Question 14 is 3 marks)



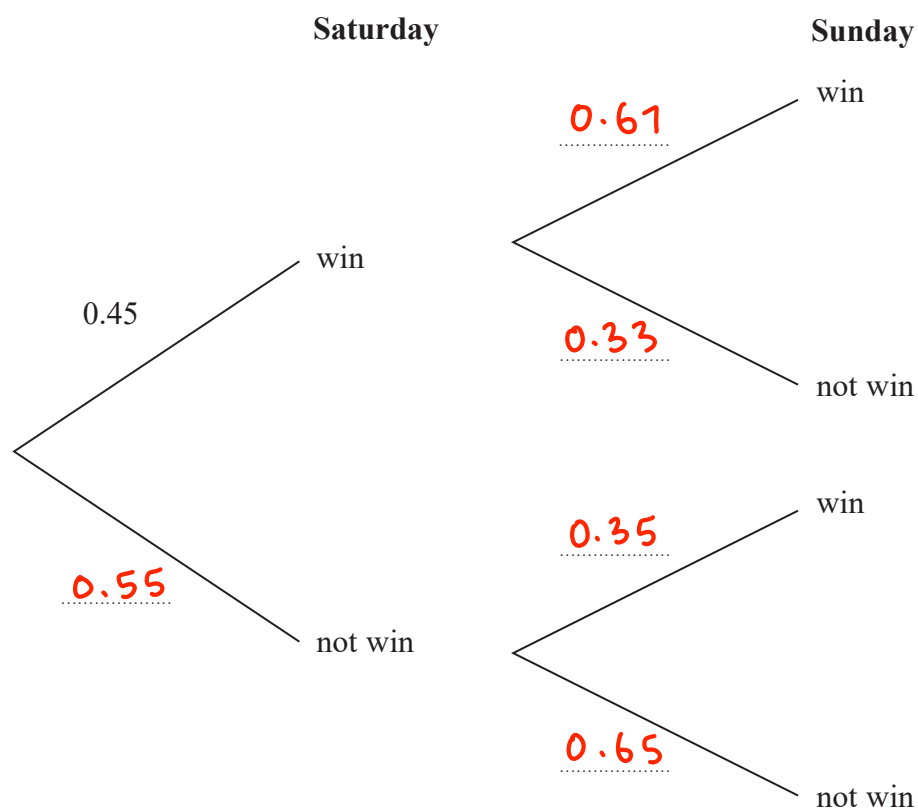
15 A darts team is going to play a match on Saturday and on Sunday.

The probability that the team will win on Saturday is 0.45

If they win on Saturday, the probability that they will win on Sunday is 0.67

If they do **not** win on Saturday, the probability that they will win on Sunday is 0.35

(a) Complete the probability tree diagram.



(2)

(b) Find the probability that the team will win exactly one of the two matches.

$$\begin{aligned}
 P(W, W') &= 0.45 \times 0.33 = 0.1485 \\
 P(W', W) &= 0.55 \times 0.35 = 0.1925 \\
 &\quad \underline{\hspace{1cm}} \\
 &\quad \quad 0.341
 \end{aligned}$$

0.341

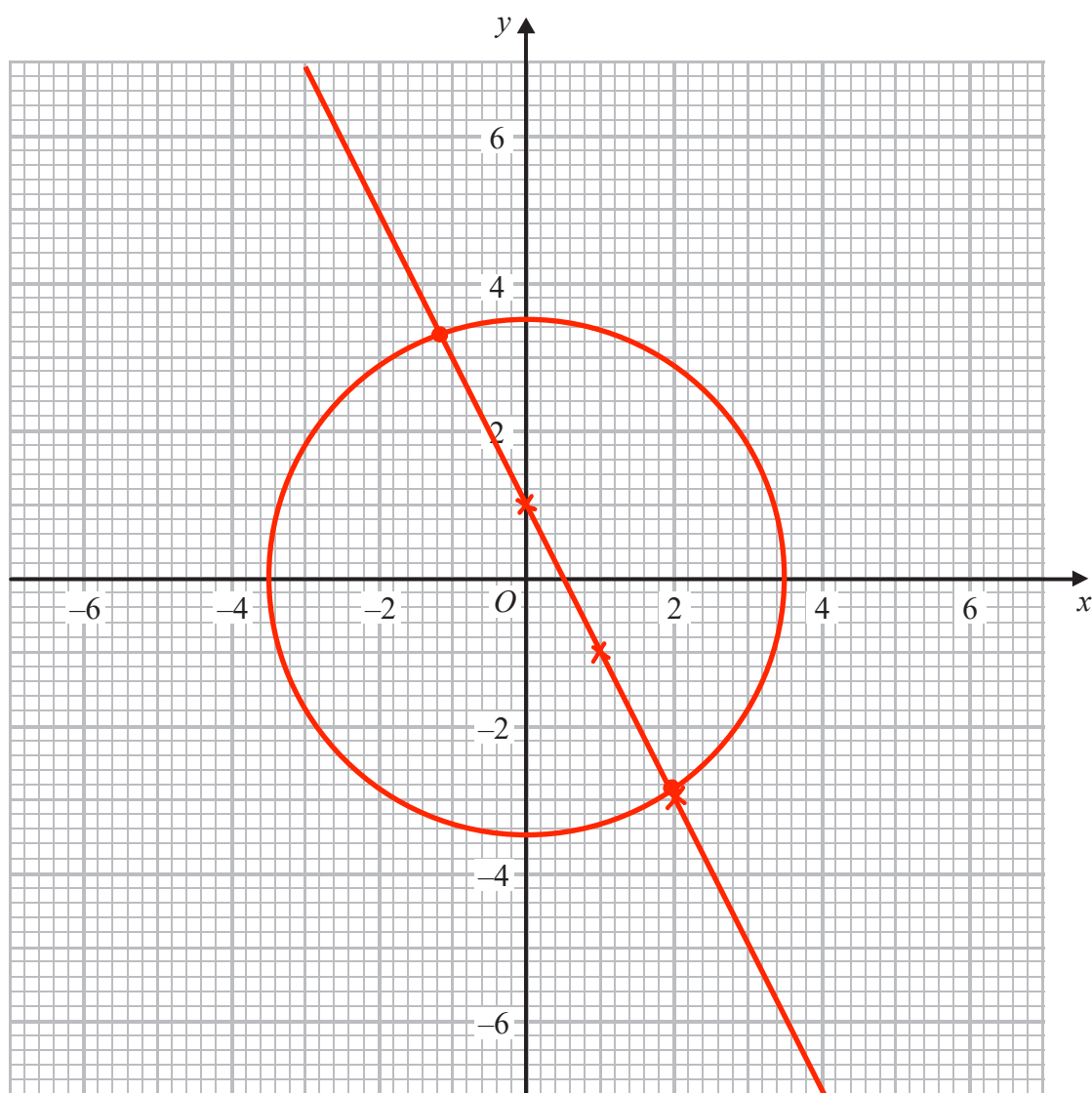
(3)

(Total for Question 15 is 5 marks)



16 (a) On the grid, draw the graph of $x^2 + y^2 = 12.25$

$$\sqrt{2.25} = 3.5$$



(2)

(b) Hence find estimates for the solutions of the simultaneous equations

$$x^2 + y^2 = 12.25$$

$$2x + y = 1$$

$$y = 1 - 2x$$

x	0	1	2
y	1	-1	-3

$$x = 2, y = -2.8$$

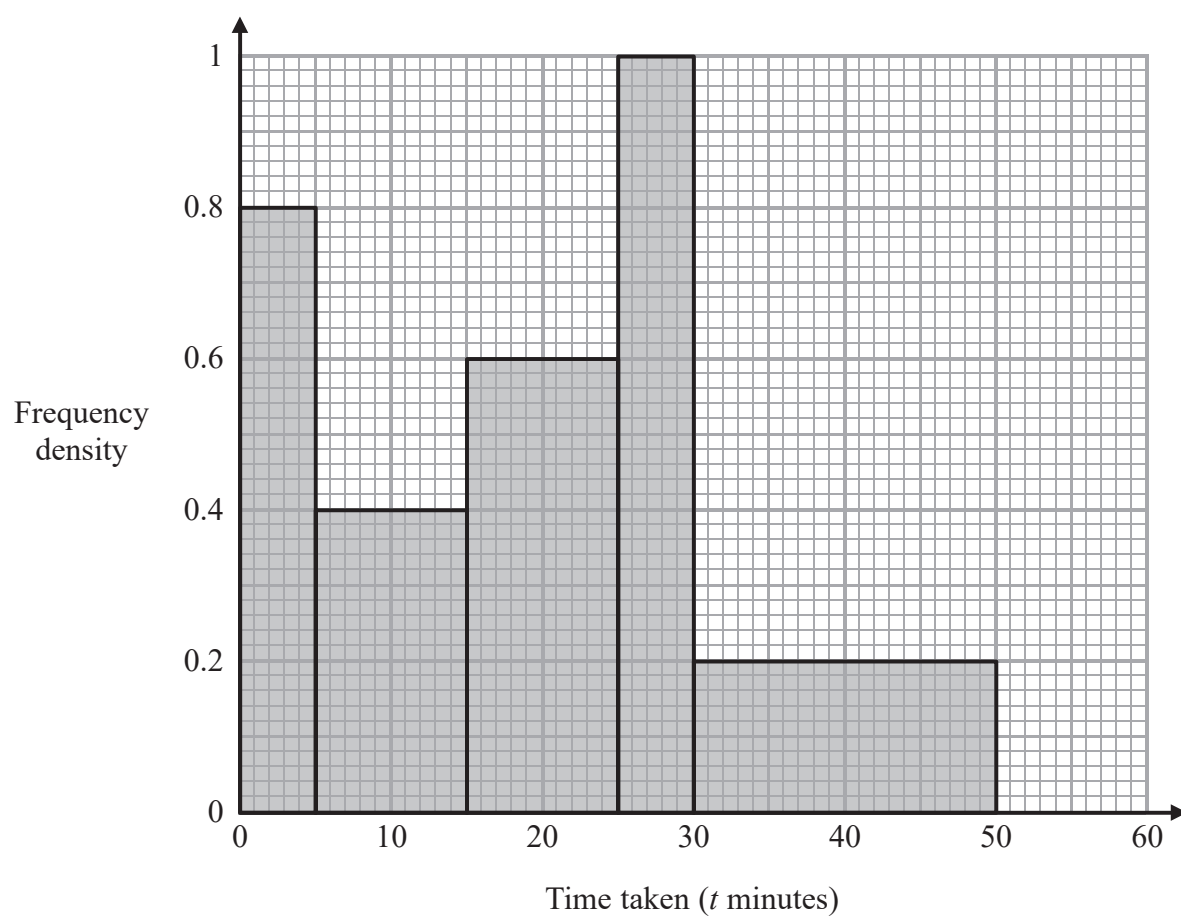
$$x = -1.2, y = 3.3$$

(3)

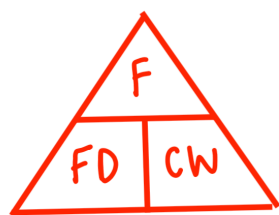
(Total for Question 16 is 5 marks)



17 The histogram shows information about the times taken by some students to finish a puzzle.



(a) Complete the frequency table for this information.



$$F = FD \times CW$$

Time taken (t minutes)	Frequency
$0 < t \leq 5$	4
$5 < t \leq 15$	4
$15 < t \leq 25$	6
$25 < t \leq 30$	5
$30 < t \leq 50$	4

23

(2)

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(b) Find an estimate for the lower quartile of the times taken to finish the puzzle.

$$\frac{23 + 1}{4} = 6^{\text{th}}$$

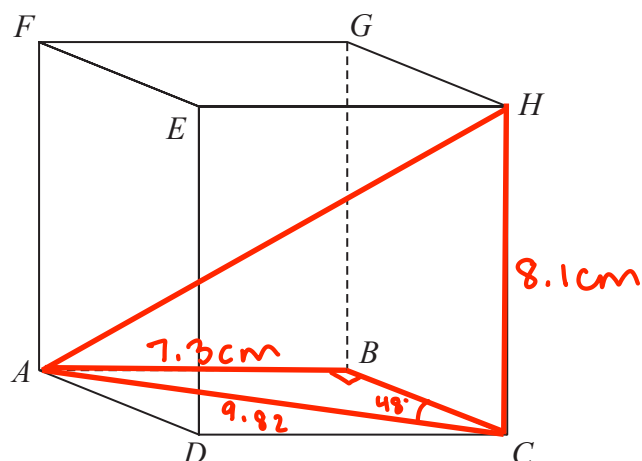
$$5 + \frac{2}{4} \times 10 = 10$$

..... **10** minutes
(2)

(Total for Question 17 is 4 marks)



18 $ABCDEFGH$ is a cuboid.



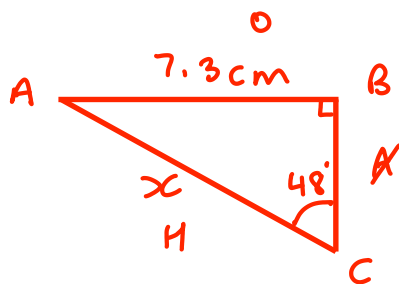
$$AB = 7.3 \text{ cm}$$

$$CH = 8.1 \text{ cm}$$

$$\text{Angle } BCA = 48^\circ$$

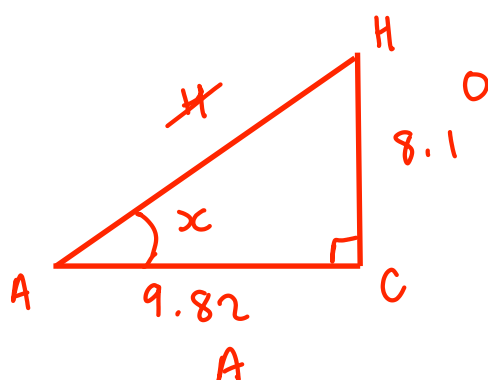
Find the size of the angle between AH and the plane $ABCD$.

Give your answer correct to 1 decimal place.



$$\sin \theta = \frac{\text{opposite}}{\text{hypotenuse}}$$

$$x = \frac{7.3}{\sin(48)} = 9.823..$$



$$\tan \theta = \frac{\text{opposite}}{\text{adjacent}}$$

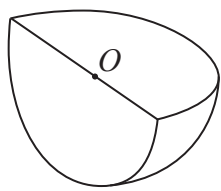
$$\tan^{-1} \left(\frac{8.1}{9.82} \right) = 39.5$$

39.5

(Total for Question 18 is 4 marks)



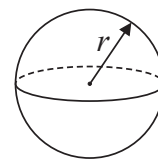
19 Shape S is one quarter of a solid sphere, centre O .



Shape S

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

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



The volume of S is $576\pi \text{ cm}^3$

Find the surface area of S.

Give your answer correct to 3 significant figures.

You must show your working.

$$\frac{1}{4} \times \frac{4}{3} \pi r^3 = 576\pi$$

$$\begin{array}{r|l} \frac{1}{3} \pi r^3 & = 576\pi \\ \times 3 & \times 3 \\ \hline \pi r^3 & = 1728\pi \\ r^3 & = 1728 \\ \sqrt[3]{} & \sqrt[3]{} \\ r & = 12 \end{array}$$

$$\begin{aligned} \text{SA} &: \frac{1}{4} \times 4\pi(12)^2 + \pi(12)^2 \\ &= 144\pi + 144\pi = 288\pi \\ &= 904.77\dots \end{aligned}$$

905

cm²

(Total for Question 19 is 5 marks)

20 Martin did this question.

Rationalise the denominator of $\frac{14}{2 + \sqrt{3}}$

Here is how he answered the question.

$$\begin{aligned}\frac{14}{2 + \sqrt{3}} &= \frac{14 \times (2 - \sqrt{3})}{(2 + \sqrt{3})(2 - \sqrt{3})} \\ &= \frac{28 - 14\sqrt{3}}{4 + 2\sqrt{3} - 2\sqrt{3} + 3} \\ &= \frac{28 - 14\sqrt{3}}{7} \\ &= 4 - 2\sqrt{3}\end{aligned}$$

Martin's answer is wrong.

(a) Find Martin's mistake.

$$\sqrt{3} \times -\sqrt{3} = -3$$

He has missed the negative number

(1)

Sian did this question.

Rationalise the denominator of $\frac{5}{\sqrt{12}}$

Here is how she answered the question.

$$\begin{aligned}\frac{5}{\sqrt{12}} &= \frac{5\sqrt{12}}{\sqrt{12} \times \sqrt{12}} \\ &= \frac{5 \times 3\sqrt{2}}{12} \\ &= \frac{5\sqrt{2}}{4}\end{aligned}$$

Sian's answer is wrong.

(b) Find Sian's mistake.

$$\sqrt{12} = \sqrt{4} \times \sqrt{3} = 2\sqrt{3} \quad \text{not } 3\sqrt{2}$$

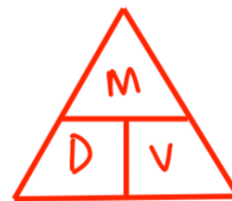
(1)

(Total for Question 20 is 2 marks)



- 21 Jackson is trying to find the density, in g/cm^3 , of a block of wood.
The block of wood is in the shape of a cuboid.

He measures
the length as 13.2 cm, correct to the nearest mm
the width as 16.0 cm, correct to the nearest mm
the height as 21.7 cm, correct to the nearest mm



LB = 13.15 UB = 13.25
15.95, 16.05
LB = 21.65 UB = 21.75

He measures the mass as 1970 g, correct to the nearest 5 g.

LB = 1967.5 UB = 1972.5

By considering bounds, work out the density of the wood.
Give your answer to a suitable degree of accuracy.

You must show all your working and give a reason for your final answer.

$$D = \frac{M}{V}$$

$$D_u = \frac{M_u}{V_L}$$

$$D_L = \frac{M_L}{V_u}$$

$$\begin{aligned} \text{Volume upper} &= 13.25 \times 16.05 \times 21.75 = 4625.409 \\ \text{Volume lower} &= 13.15 \times 15.95 \times 21.65 = 4540.925 \end{aligned}$$

$$D_u = \frac{1972.5}{4540.925} = 0.43438\dots$$

$$D_L = \frac{1967.5}{4625.409} = 0.42536\dots$$

$$D = \underline{\underline{0.43 \text{ g/cm}^3}}$$

Both UB and LB round to 0.43 to 2.d.p

(Total for Question 21 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS