Write your name here

Surname	Other names

Pearson Edexcel
Level 1/Level 2 GCSE (9-1)

Centre Number | Candidate Number

Mathematics

Paper 2 (Calculator)

Higher Tier

Thursday 7 June 2018 – Morning
Time: 1 hour 30 minutes

Paper Reference
1MA1/2H

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 ▶

P48528A

©2018 Pearson Education Ltd.

6/7/7/7/8/7/

P 4 8 5 2 8 A 0 1 2 4

Pearson

Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

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

Laws of Indices

$x^a \times x^b = x^{a+b}$

$m^{3+4} = m^7$

m^7

(1)

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

$(5 \times n \times p^3)^3$ = raise each term to the power of 3 (individually)

$= 5^3 \times n^3 \times (p^3)^3$

$= 125 \times n^3 \times p^9$

$= 125n^3p^9$

$(x^a)^b = x^{ab}$

$(p^3)^3 = p^{3\times3} = p^9$

1 2 correct terms

$125n^3p^9$ 1

(2)

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

Laws of Indices

$\dfrac{x^a}{x^b} = x^{a-b}$

$\dfrac{32 \times q^9 \times r^4}{4 \times q^3 \times r} = \dfrac{32}{4} \times \dfrac{q^9}{q^3} \times \dfrac{r^4}{r}$

$= 8 \times q^6 \times r^3$

1 2 correct terms

$8q^6r^3$ 1

(2)

(Total for Question 1 is 5 marks)

DO NOT WRITE IN THIS AREA

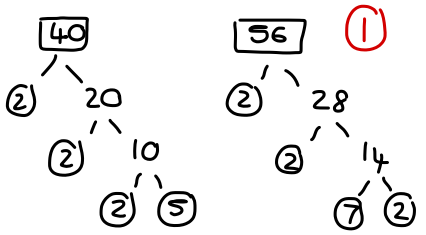
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

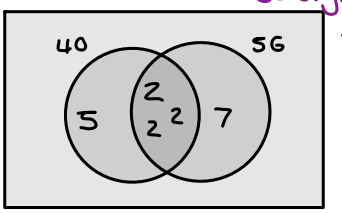
2 (a) Find the lowest common multiple (LCM) of 40 and 56

Prime Factorisation



1

LCM = Product of all numbers in venn diagram (only counting those in the intersection once)



LCM = 2×2×2×5×7
= 280

280 1

(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.

HCF = product of shared prime factors

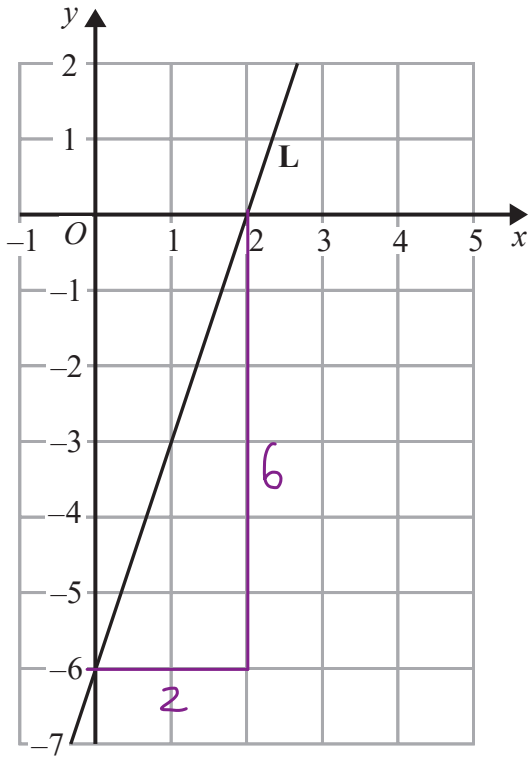
2×2×3×5 = 60

60 1

(1)

(Total for Question 2 is 3 marks)

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



Find an equation for **L**.

Equation of a straight Line

$y = mx + c$

gradient:

$m = \frac{\Delta y}{\Delta x} = \frac{6}{2} = 3$ (1)

$y = 3x + c$ (1)

when $x = 0$ $y = -6$ ← $+c = y$-intercept

$y = 3x - 6$

$y = 3x - 6$ (1)

(Total for Question 3 is 3 marks)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

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.

A) Total cost of van:
= 120% of £8500
1.2 × 8500 = £10 200 (1)

B) Total cost of payments:
12 × £531.25 = £6375 (1)

C) Deposit : Van cost − payment cost
A − B
= 10200 − 6375
= £3825 (1)

Deposit : Total of 12 payments
C : B
3825 : 6375 (1)

Simplify Ratio
3825 : 6375 ÷3825
÷3825
1 : $\frac{5}{3}$
×3
3 : 5 ×3
Whole number ratio

3 : 5 (1)

(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

Substitute each x value into $y = x^2 - x - 6$ to obtain the corresponding y value (same column in table)

e.g. when $x = -2$

$y = x^2 - x - 6$
$= (-2)^2 - (-2) - 6$
$= 4 + 2 - 6$
$y = 0$

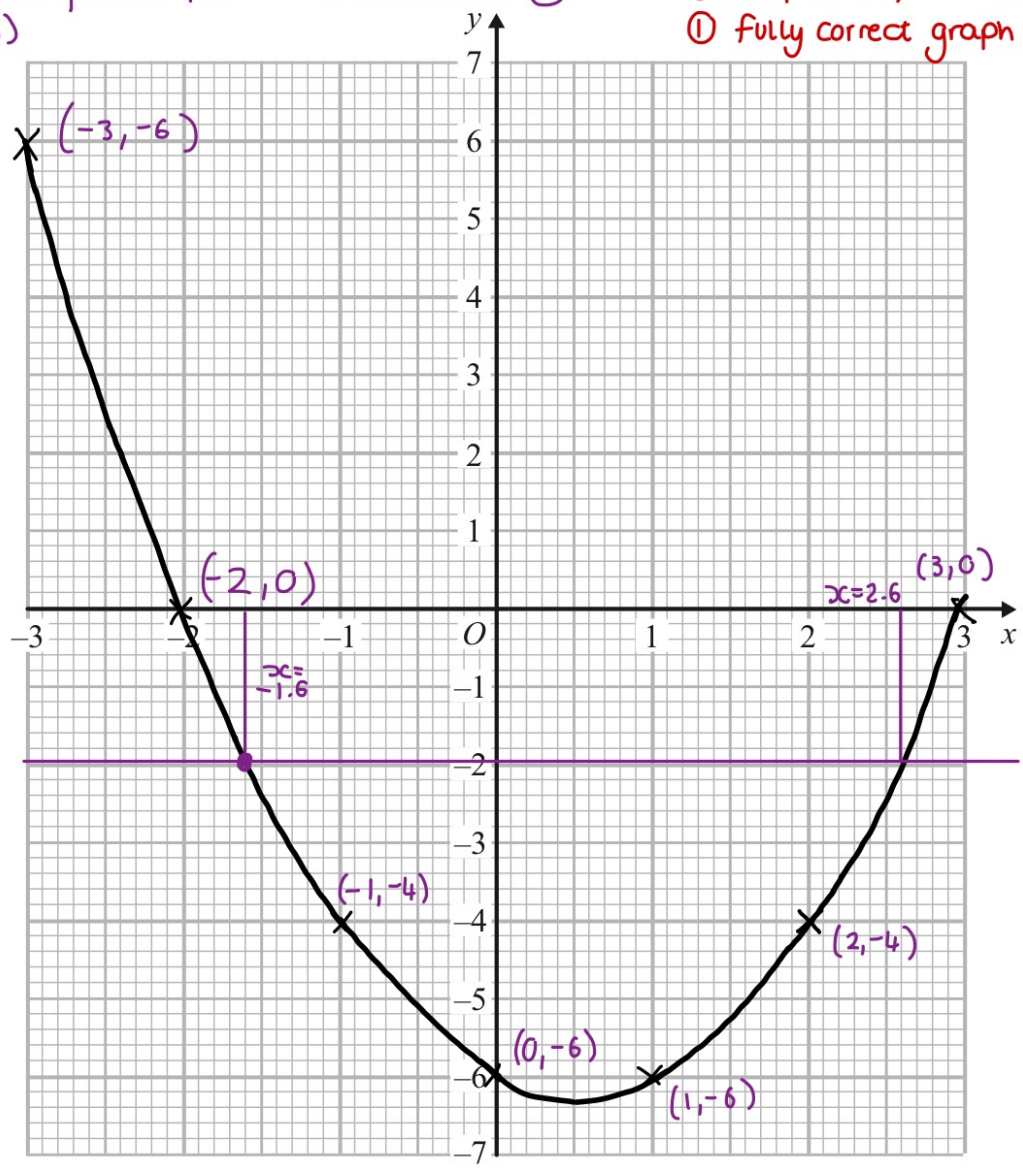
(2)

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

(2)

Plot each point from the table in (a) (x, y)

① ⩾5 points plotted correctly
① fully correct graph



P 4 8 5 2 8 A 0 6 2 4

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

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

$y = x^2 - x - 6$

- Draw the line $y = -2$ onto the graph (1)
- Find the x values of the 2 points at which the line $y = -2$ and the curve $y = x^2 - x - 6$ cross

-1.6 and 2.6 (1)

(2)

(Total for Question 5 is 6 marks)

---

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

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

The force is increased by 10 newtons.
The area is increased by 10 cm^2

Helen says,

"The pressure decreases by less than 20%"

Is Helen correct?
You must show hc

Initial Pressure:

$P = \frac{F}{A} = \frac{70}{20} = 3.5$ (1)

These values both have the same unit (Ncm^{-1})

New Pressure:

$P = \frac{F}{A} = \frac{70+10}{20+10} = \frac{80}{30} = 2.\dot{6}$

Initial Pressu

$P = \frac{F}{A}$

me unit (Ncm^{-1})

20% less than the initial pressure = 80% of initial pressure

80%

$3.5 \times 0.8 = 2.8$ (1)

New Pressure

$P = \frac{F}{A} = 2.8 > 2.\dot{6}$ (1)

80% of initial > new pressure

No, Helen is incorrect. The decrease is greater than 20%

20% less than the initial pressure = 80% of initial pressure

80%

$3.5 \times 0.8 = 2.8$ (1)

80% of initial > new pressure

$2.8 > 2.\dot{6}$ (1)

No, Helen is incorrect. The decrease is greater than 20%

(Total for Question 6 is 3 marks)

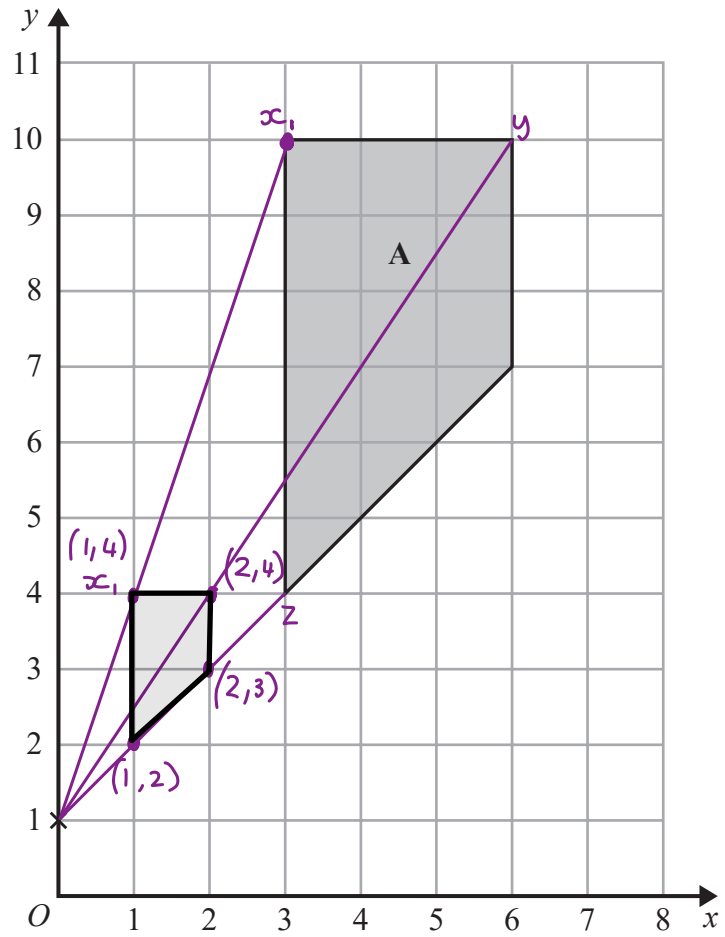
7

e.g. for the new Point x_2, we need to travel $\frac{1}{3}$ of the distance between the centre and x_2

So if $(0,1) \to (3,10)$ is a shift of $\begin{pmatrix}3\\9\end{pmatrix}$

$\begin{pmatrix}3\\9\end{pmatrix} \times \frac{1}{3} = \begin{pmatrix}1\\3\end{pmatrix}$ from the centre point $(0,1)$

$\therefore x_2 = (0+1, 1+3)$
$= (1,4)$



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

positive SF = expecting a shape in the same orientation

SF < 1 = smaller shape - closer to centre

(Total for Question 7 is 2 marks)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

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
M			8	38
F	11	?.3	8	22
Total	32	12	16	60

1

Total for I = 60 - 32 - 12 = 16 1

F choosing I = 16 - 8 = 8 1

Total F = 60 - 38 = 22

F choosing S = 22 - 11 - 8 = 3

P (the chosen female said Spain) = $\frac{\text{Females who chose Spain}}{\text{Total number of females}} = \frac{3}{22}$

$\frac{3}{22}$ 1

(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 $x\%$ $\left(1 + \frac{x}{100}\right)$ x % increase written as a decimal multiplier

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?

Set up equation for interest in year 1:

$12000 \times \left(1 + \frac{x}{100}\right) = 12\,336$ (1)

$1 + \frac{x}{100} = 1.028...$

$\frac{x}{100} = 0.028...$

$x = 2.8$ (1)

Find year 2 rate of interest:

$\frac{x}{2} = \frac{2.8}{2} = 1.4$ % (1)

1.4% increase written as a decimal multiplier

Year 2 interest:

$12336 \times 1.014 = 12508.70$ (1)

'Compound interest' so we work with the value at the end of the first year

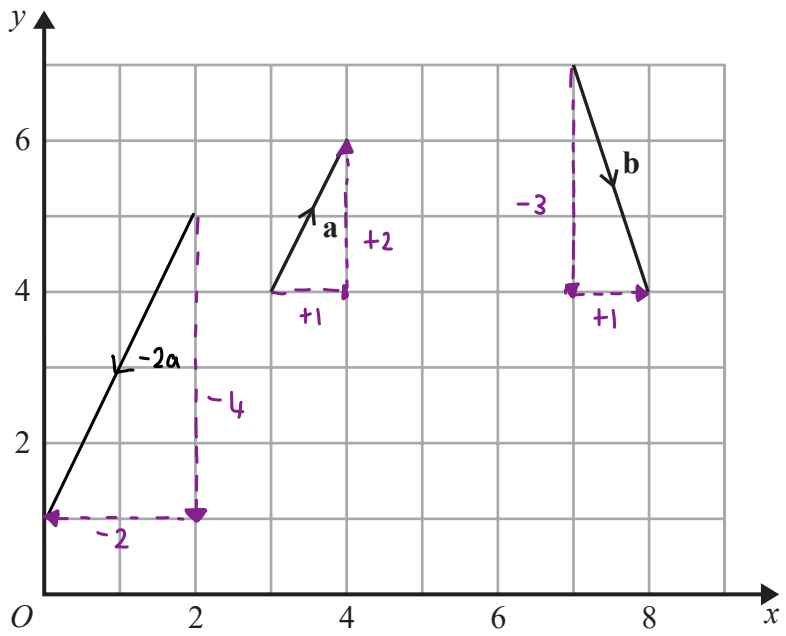
£ 12508.70 (1)

(Total for Question 9 is 4 marks)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

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



a as a column vector

(a) On the grid, draw and label vector –2**a**

$-2(a) = -2\begin{pmatrix}1\\2\end{pmatrix} = \begin{pmatrix}-2\times1\\-2\times2\end{pmatrix} = \begin{pmatrix}-2\\-4\end{pmatrix}$

(1)

(b) Work out **a** + 2**b** as a column vector.

Vectors only show magnitude and direction, so can be drawn anywhere on the grid.

Work out a and b as column vectors: $\begin{pmatrix}x\\y\end{pmatrix}$

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

$a + 2b = \begin{pmatrix}1\\2\end{pmatrix} + 2\begin{pmatrix}1\\-3\end{pmatrix}$ 1

$= \begin{pmatrix}1\\2\end{pmatrix} + \begin{pmatrix}2\times1\\2\times-3\end{pmatrix}$

$= \begin{pmatrix}1+2\\2-6\end{pmatrix}$

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

$\begin{pmatrix}3\\-4\end{pmatrix}$ 1

(2)

(Total for Question 10 is 3 marks)

11 f and g are functions such that

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

(a) Find f(–5)

Substitute $x = -5$ into $f(x)$ function.

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

$\frac{2}{25}$

(1)

(b) Find fg(1)

Composite function

'do g then do f' $= f(g(x)) = f(g(1))$

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

$= 4$

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

$\frac{1}{8}$ 1

(2)

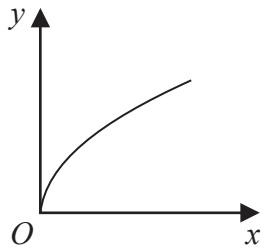
(Total for Question 11 is 3 marks)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

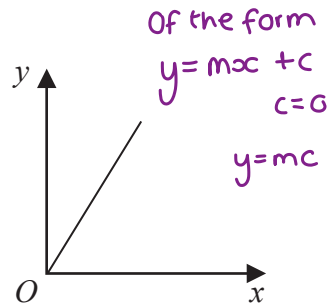
DO NOT WRITE IN THIS AREA

12

Graph A

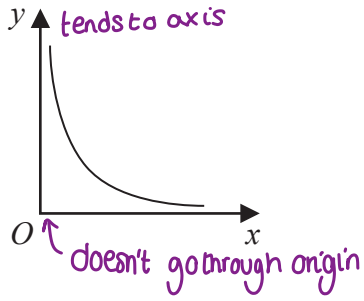


Graph B

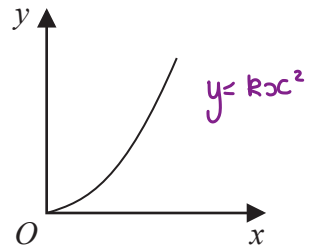


Of the form
$y = mx + c$
$c = 0$
$y = mc$

Graph C



Graph D



$y = kx^2$

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

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

constant of proportionality

$y = kx$

Straight line graph → $y = mx + c$

$y = kx^2$
+ quadratic

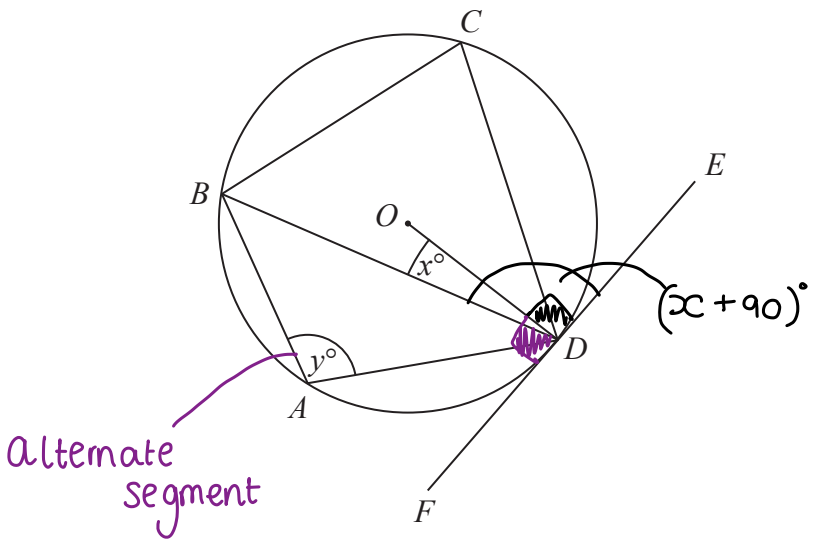
Type of proportionality	Graph letter
$y \propto x$	B
$y \propto x^2$	D
$y \propto \sqrt{x}$	A
$y \propto \frac{1}{x}$	C

(1) 2 correct
(1) 4 correct

inversely proportional
as y increases, x decreases proportionally
– will not go through the origin
There are no real solutions for y when $x = 0$ $\left(\frac{1}{0} \times\right)$, so the graph will tend to the y axis.

(Total for Question 12 is 2 marks)

13



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.

The tangent of the circle is perpendicular to its radius

$\therefore \angle ODE = \angle ODF = 90$ (1)

$\angle BDE = x + \angle ODE$
$= x + 90$

$\angle BDE = y$ due to the alternate segment theorem
(1) Correct circle theorems for chosen method

$\therefore \angle BDE = y = x + 90$

$y = x + 90$
$y - x = 90$ as required (1)

(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, y must be less than 180 as it is an angle in a triangle

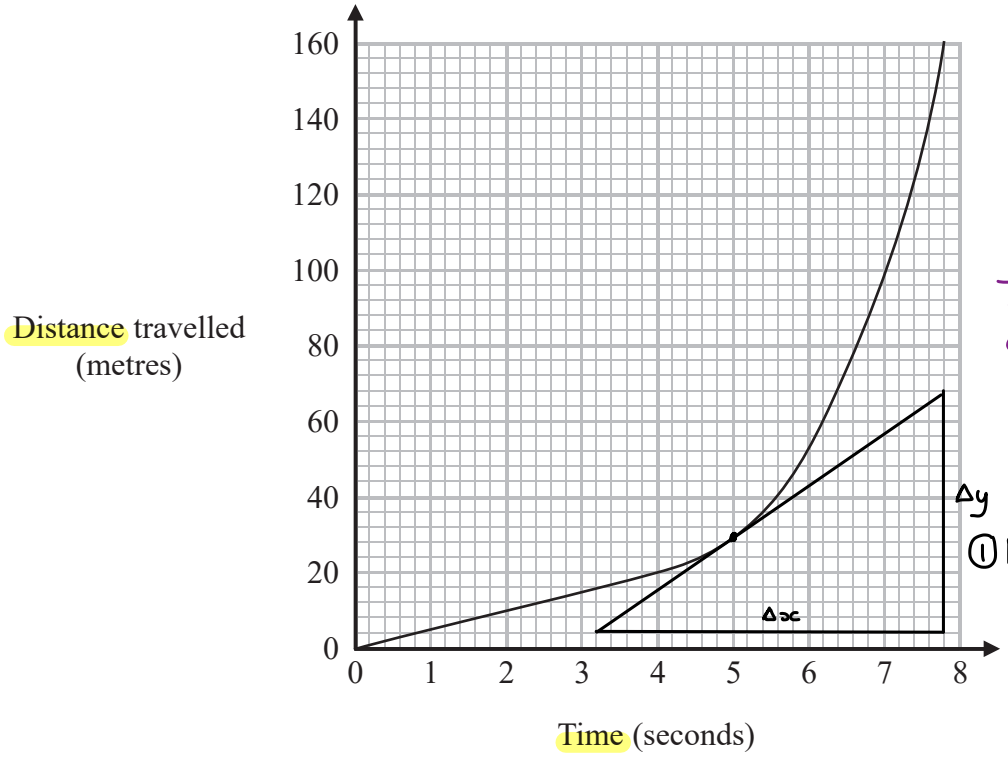
(1)

(Total for Question 13 is 4 marks)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

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



$S = \frac{d}{t} = \frac{y}{x}$

$m = \frac{\Delta y}{\Delta x}$

The gradient of a distance-time graph at a given point will give us a value for the speed.

① Draw a tangent at t=5 ①

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

Finding the gradient of the tangent:

$m = \text{Speed} = \frac{\Delta y}{\Delta x} = \frac{68 - 4}{7.8 - 3.2}$

$= \frac{64}{4.6}$ ①

$= 13.9$

Any value in the range 11–19 m/s ①

13.9 m/s

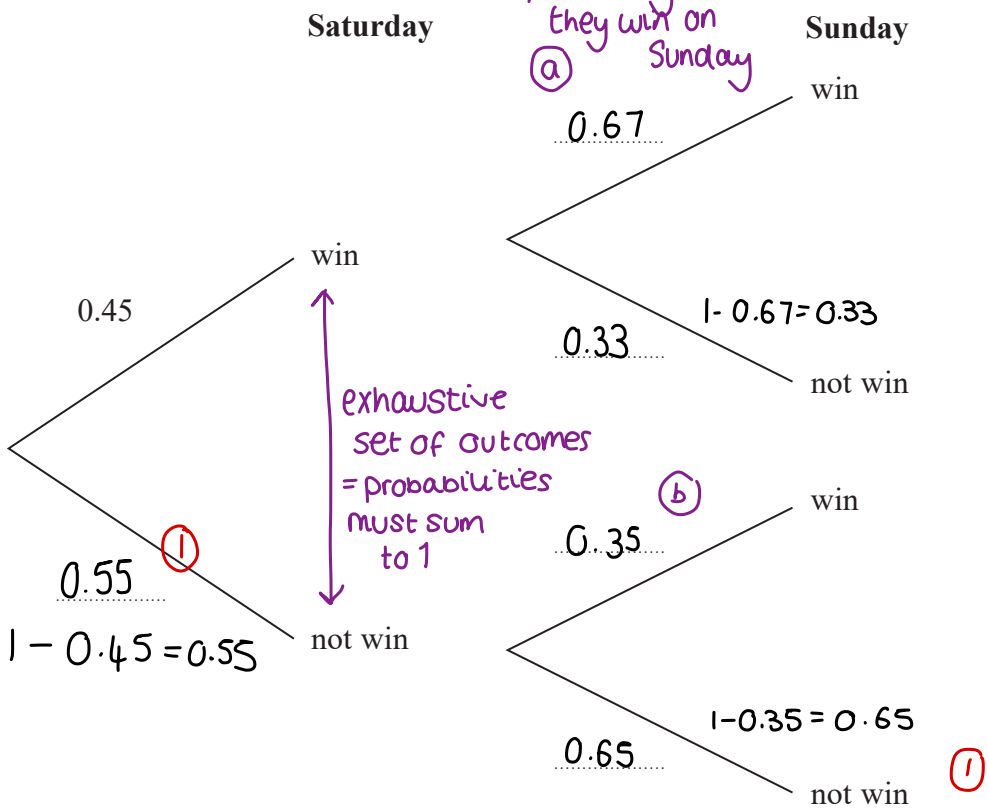
(Total for Question 14 is 3 marks)

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

(a) Complete the probability tree diagram.

following a win on Saturday, they win on Sunday (a)



(2)

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

Working across (horizontally) → tree diagram, so we multiply probabilities.

P(win on Sat, lose on sun) = 0.45 × 0.33 = 0.1485

P(lose on sat, win on sun) = 0.55 × 0.35 = 0.1925

Total probability = 0.1485 + 0.1925
= 0.3410

0.341

(3)

(Total for Question 15 is 5 marks)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

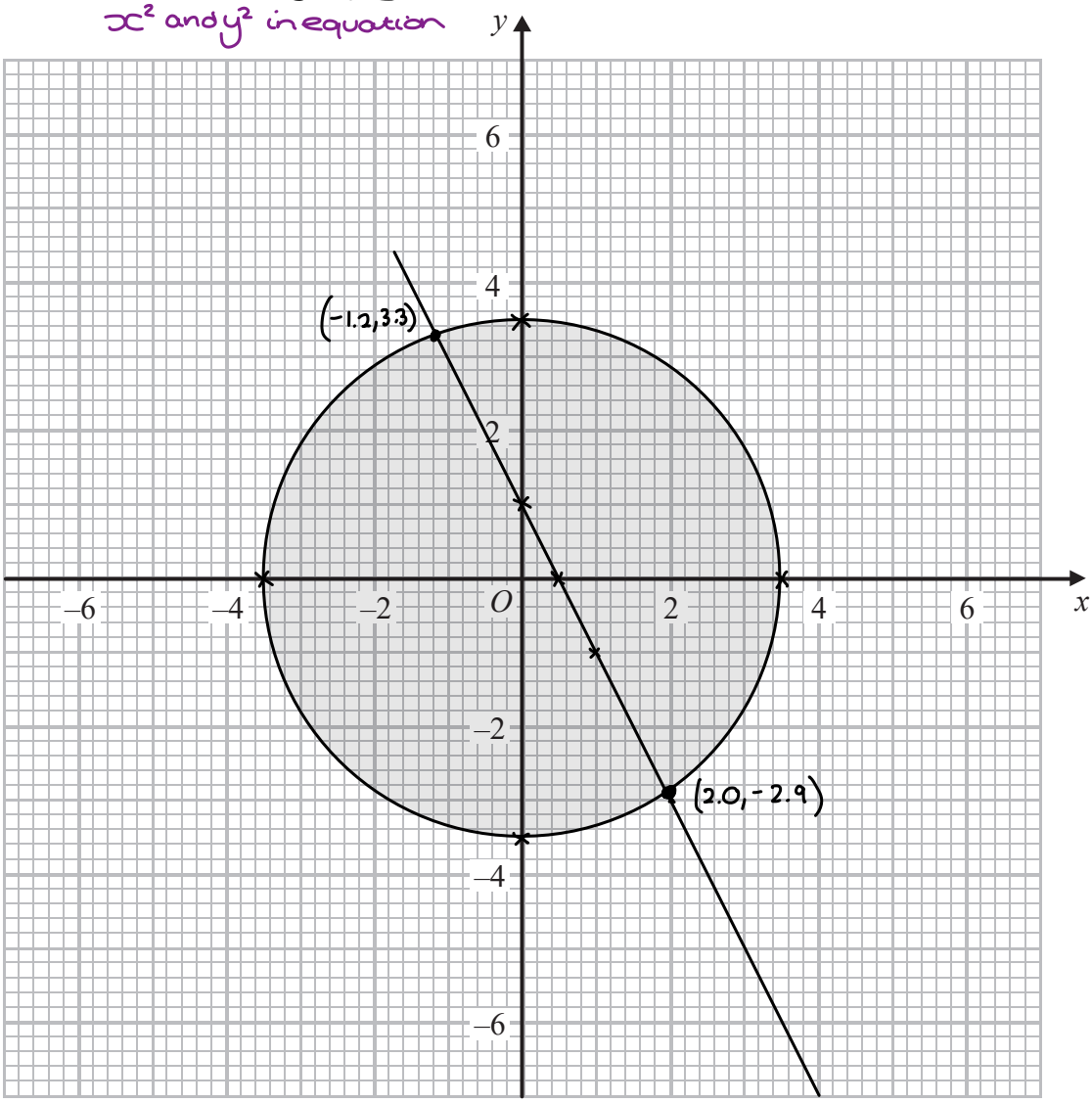
DO NOT WRITE IN THIS AREA

centre (0,0)

16 (a) On the grid, draw the graph of $x^2 + y^2 = 12.25$ radius $= \sqrt{12.25} = 3.5$

Circle

x^2 and y^2 in equation



(2)

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

$$x^2 + y^2 = 12.25$$
$$2x + y = 1$$

1 Draw on grid - find where it meets the circle

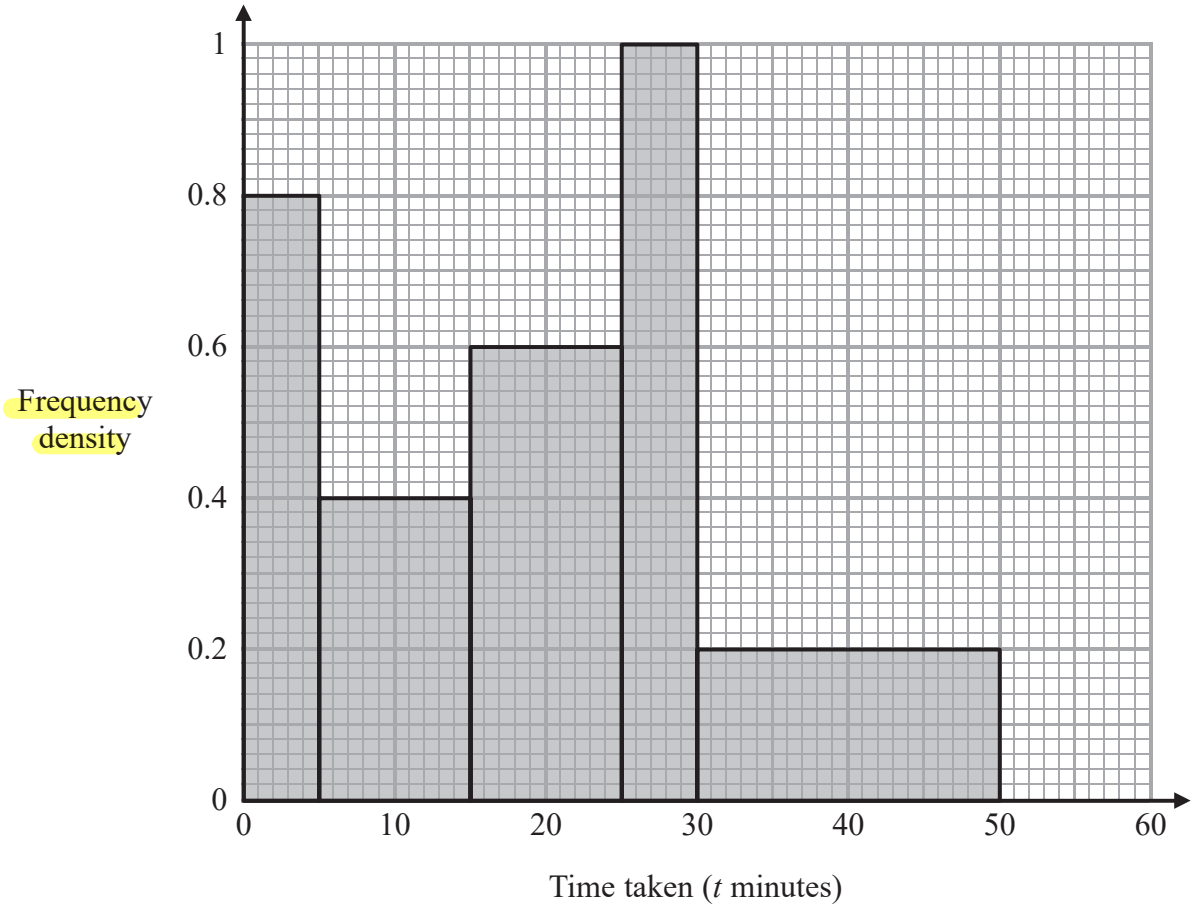
2 correct

$x = 2.0$ 1 $y = -2.9$, $x = -1.2$ 1 $y = 3.3$

(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.

Frequency = Frequency density × Class width

Class width = 15 - 5 = 10

Time taken (t minutes)	Frequency	
$0 < t \leqslant 5$	4	
$5 < t \leqslant 15$	4	0.4 × 10
$15 < t \leqslant 25$	6 (1)	0.6 × 10
$25 < t \leqslant 30$	5	1 × 5
$30 < t \leqslant 50$	4	0.2 × 20

(1)

(2)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

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

Time taken (t minutes)	Frequency	CF
$0 < t \leqslant 5$	4	4
$5 < t \leqslant 15$	4	8
$15 < t \leqslant 25$	6	14
$25 < t \leqslant 30$	5	19
$30 < t \leqslant 50$	4	23

$n = \Sigma f = 23$

$Q_1 = \frac{n+1}{4}$ th value

$\frac{23+1}{4} = \frac{24}{4} = 6$th (1)

6th value is in the $5 < t \leq 15$ interval

$\frac{6-4}{4} = \frac{1}{2}$

halfway through interval

$15 - 5 = 10$ $\quad 5 + \left(\frac{10}{2}\right) = 10$

lower bound of interval

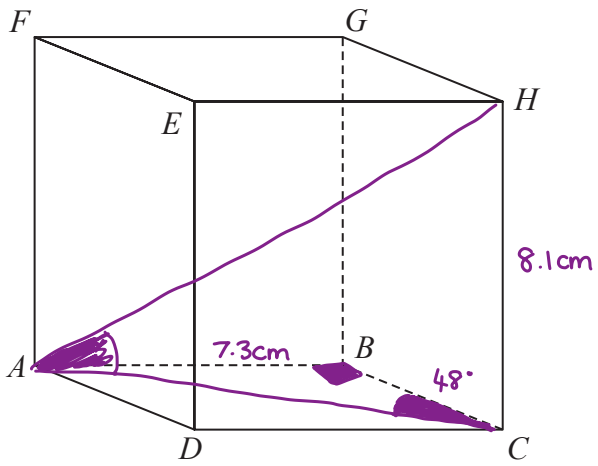
(1)

10 minutes

(2)

(Total for Question 17 is 4 marks)

18 *ABCDEFGH* is a cuboid.

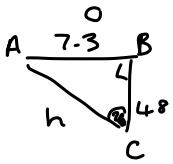


$AB = 7.3$ cm
$CH = 8.1$ cm
Angle $BCA = 48°$

∠HCA and ∠ABC must be 90° as we are working with a cuboid.

Find the size of the angle between *AH* and the plane *ABCD*.
Give your answer correct to 1 decimal place.

Calculating AC:



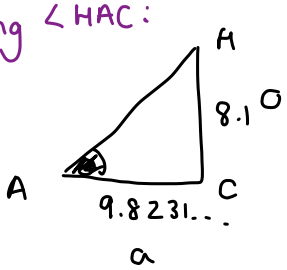
$\sin\theta = \frac{o}{h}$

$\sin 48 = \frac{7.3}{AC}$ (1)

$AC = \frac{7.3}{\sin 48} = 9.8231...$ (1)

Use the exact value in calculations

Finding ∠HAC:



$\tan\theta = \frac{o}{a}$

$\tan\theta = \frac{8.1}{9.8231..}$ (1)

$\theta = \tan^{-1}\left(\frac{8.1}{9.8231...}\right)$

$= 39.508$

$= 39.5$ round to 1dp.

39.5 (1) °

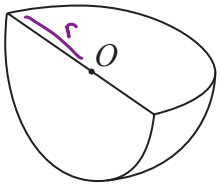
(Total for Question 18 is 4 marks)

P 4 8 5 2 8 A 0 2 0 2 4

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

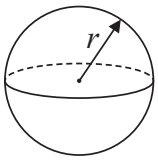
19 Shape **S** is one quarter of a solid sphere, centre O.



Shape **S**

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

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



The volume of **S** is 576π cm^3

Find the surface area of **S**.
Give your answer correct to 3 significant figures.
You must show your working.

Finding r:

volume of a whole sphere = 4 × volume of S

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

$2304 = \frac{4}{3} r^3$

$r^3 = \frac{3 \times 2304}{4}$

$r = \sqrt[3]{1728}$

$r = 12$ cm (1)

SA of curved (outer) face:

$\frac{1}{4} \times 4\pi r^2 = \pi r^2$ (1)

SA of Other faces: half circles with radius r

$\frac{\pi r^2}{2} \times 2 = \pi r^2$

Total SA $= \pi r^2 + \pi r^2 = 2\pi r^2$ (1)

$2\pi r^2 = 2 \times \pi \times 12^2$

$= 288\pi$

$= 904.779\ldots$

(1) to 3sf

905 cm^2

(Total for Question 19 is 5 marks)

20 Martin did this question.

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

Here is how he answered the question.

$$\frac{14}{2+\sqrt{3}} = \frac{14 \times (2-\sqrt{3})}{(2+\sqrt{3})(2-\sqrt{3})}$$

$$= \frac{28 - 14\sqrt{3}}{4 + 2\sqrt{3} - 2\sqrt{3} + 3}$$

$$= \frac{28 - 14\sqrt{3}}{7}$$

$$= 4 - 2\sqrt{3}$$

$(2+\sqrt{3})(2-\sqrt{3})$

$= (2\times2) + (2\times\sqrt{3}) + (2\times-\sqrt{3}) + (\sqrt{3}\times-\sqrt{3})$

$= 4 + 2\sqrt{3} - 2\sqrt{3} - 3$

$\sqrt{3}\times-\sqrt{3} = -\sqrt{9} = -3$

Martin's answer is wrong.

(a) Find Martin's mistake.

$\sqrt{3} \times -\sqrt{3} = -3$, not 3

(1)

Sian did this question.

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

Here is how she answered the question.

$$\frac{5}{\sqrt{12}} = \frac{5\sqrt{12}}{\sqrt{12} \times \sqrt{12}}$$

$$= \frac{5 \times 3\sqrt{2}}{12}$$

$$= \frac{5\sqrt{2}}{4}$$

$\sqrt{12} = \sqrt{4}\sqrt{3}$

$= 2\sqrt{3}$

Sian's answer is wrong.

(b) Find Sian's mistake.

$\sqrt{12} = 2\sqrt{3}$, not $3\sqrt{2}$

(1)

(Total for Question 20 is 2 marks)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

21 Jackson is trying to find the density, in g/cm³, 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

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

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.

$m_U = 1972.5$ (1) $m_L = 1967.5$ $\frac{5}{2} = 2.5g$ Mass = $1970 \pm 2.5g$

$V = l \times w \times h$ $V_U = l_U \times w_U \times h_U$ ← The product of larger numbers is a larger number

	3SF	UB	LB
l	13.2	13.25	13.15
w	16.0	16.05	15.95
h	21.7	21.75	21.65

$V_{UB} = 13.25 \times 16.05 \times 21.75$
$= 4\ 625.4...$

$V_{LB} = 4540.9...$ (1)

$d = \frac{m}{V}$

greater numerator

$d_U = \frac{m_U}{V_L}$ = largest value

lower denominator

$d_L = \frac{m_L}{V_U}$

$d_U = \frac{1972.5}{4540.9...} = 0.4344...$ $d_L = \frac{1967.5}{4625.4...} = 0.4254...$ (1)

$0.43\ g/cm^3$ Both the upper and lower bounds for density round to 0.43 to 2 dp. (1)

(Total for Question 21 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

BLANK PAGE