

Tuesday 03 November 2020 – Morning

GCSE (9–1) Mathematics

J560/04 Paper 4 (Higher Tier)

Time allowed: 1 hour 30 minutes



You can use:

- a scientific or graphical calculator
- geometrical instruments
- tracing paper



Please write clearly in black ink. **Do not write in the barcodes.**

Centre number

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Candidate number

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First name(s)

Last name

INSTRUCTIONS

- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. You can use extra paper if you need to, but you must clearly show your candidate number, the centre number and the question numbers.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.
- Use the π button on your calculator or take π to be 3.142 unless the question says something different.

INFORMATION

- The total mark for this paper is **100**.
- The marks for each question are shown in brackets [].
- This document has **20** pages.

ADVICE

- Read each question carefully before you start your answer.

Answer **all** the questions.

1 (a) Write these numbers in standard form.

(i) 6500

$$6.5 \times 10^3$$

(a)(i) 6.5×10^3 [1]

(ii) 0.0584

$$5.84 \times 10^{-2}$$

(ii) 5.84×10^{-2} [1]

(b) Work out $(4.2 \times 10^5) \times (1.8 \times 10^{-2})$, giving your answer in standard form.

7560

$$7.56 \times 10^3$$

(b) 7.56×10^3 [1]

2 James is taking three examination papers in Spanish.
Here are his first two results.

Paper 1: $\frac{43}{80}$

Paper 2: $\frac{38}{65}$

Paper 3 is out of 95.

The marks in each of the three papers are added together.

Find the lowest mark that James needs in Paper 3 to achieve 60% of the total marks.

$$\begin{aligned} \text{Total} &: 80 + 65 + 95 \\ &= 240 \end{aligned}$$

$$0.6 \times 240 = 144 \text{ marks needed}$$

$$144 - 43 - 38 = 63$$

..... **63** [4]

- 3 Three people take $2\frac{1}{2}$ hours to deliver leaflets to 270 houses.

Assuming all people deliver leaflets at the same rate, how long will it take five people to deliver leaflets to 405 houses?

Give your answer in hours and minutes.

$$3 \text{ people} = 2.5 \text{ h} = 270 \text{ houses}$$

$$\div 3 \quad \times 3$$

$$1 \text{ person} = 7.5 \text{ h} = 270 \text{ houses}$$

$$\times 5 \quad \div 5$$

$$5 \text{ people} = 1.5 \text{ h} = 270 \text{ houses}$$

$$\times 1.5 \quad \times 1.5$$

$$5 \text{ people} = 2.25 \text{ h} = 405 \text{ houses}$$

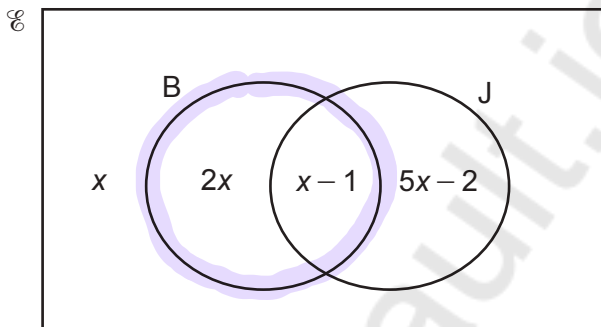
$$405 \div 270 = 1.5$$

$$2 \text{ h} + 0.25 \text{ h} = 2 \text{ h } 15 \text{ mins} \quad \dots\dots\dots 2 \text{ hours } \dots\dots\dots 15 \text{ minutes [4]}$$

- 4 In a survey, 60 students were asked whether they have a bank account (B) and whether they have a part-time job (J).

The number of students who had neither a bank account nor a part-time job was x .

The Venn diagram shows the results in terms of x .



One of the 60 students is chosen at random.

Find the probability that they have a bank account.

Show your working.

$$x + 2x + x - 1 + 5x - 2 = 60$$

$$9x - 3 = 60$$

$$+3 \quad +3$$

$$9x = 63$$

$$\div 9$$

$$\div 9$$

$$x = 7$$

$$B = 2x + x - 1$$

$$= 3x - 1$$

$$= 3(7) - 1$$

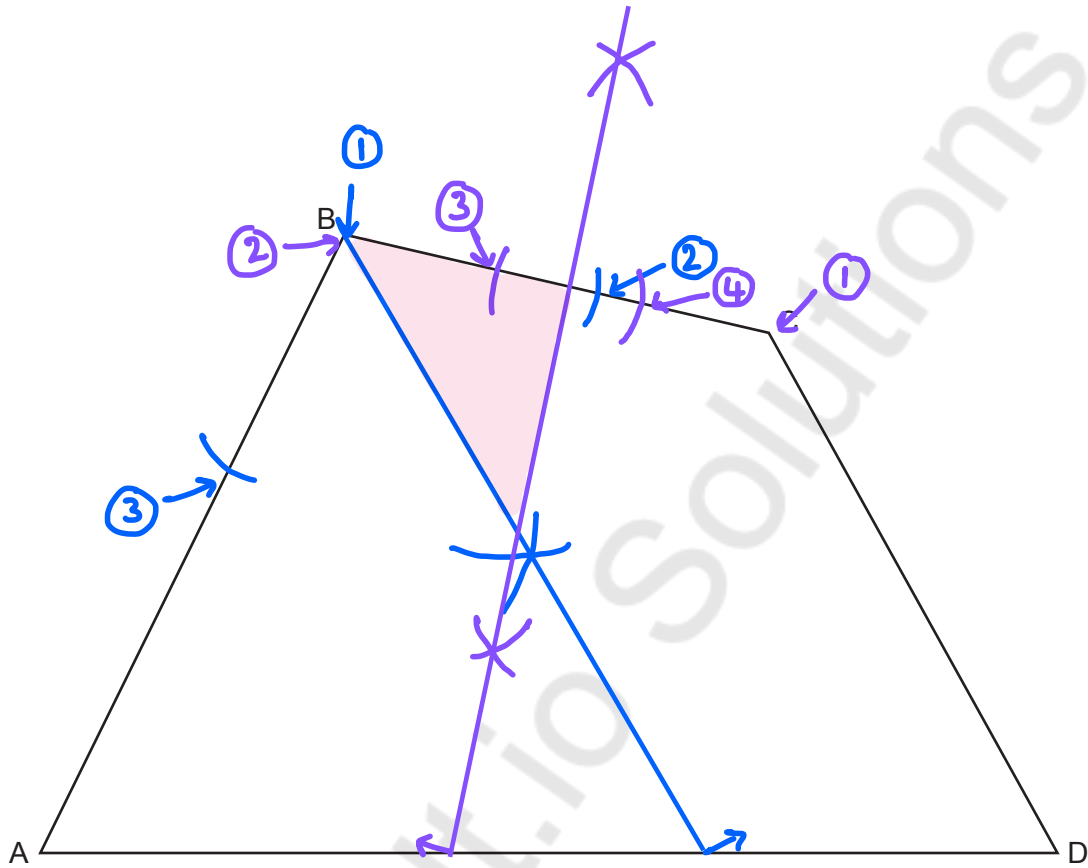
$$= 20$$

$$P(B) = \frac{20}{60} = \frac{1}{3}$$

$$\frac{1}{3}$$

..... [5]

5 ABCD is a quadrilateral.



(a) Construct the bisector of angle ABC.
Show all your construction lines.

[2]

(b) Construct the perpendicular bisector of BC.
Show all your construction lines.

[2]

(c) Shade the region which is

- nearer to BC than to AB
- and
- nearer to B than to C.

[1]

- 6 A cuboid measures 6 cm by 8 cm by 15 cm.
A cube has the same volume as the cuboid.

Find the surface area of the cube, giving your answer correct to 3 significant figures.

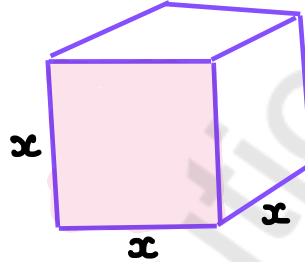
$$\begin{aligned}\text{Vol cuboid} &= l \times w \times h \\ &= 6 \times 8 \times 15 \\ &= 720 \text{ cm}^3\end{aligned}$$

$$\begin{aligned}\text{Vol cube} &= x \times x \times x \\ 720 &= x^3 \\ \sqrt[3]{\quad} &\quad \sqrt[3]{\quad}\end{aligned}$$

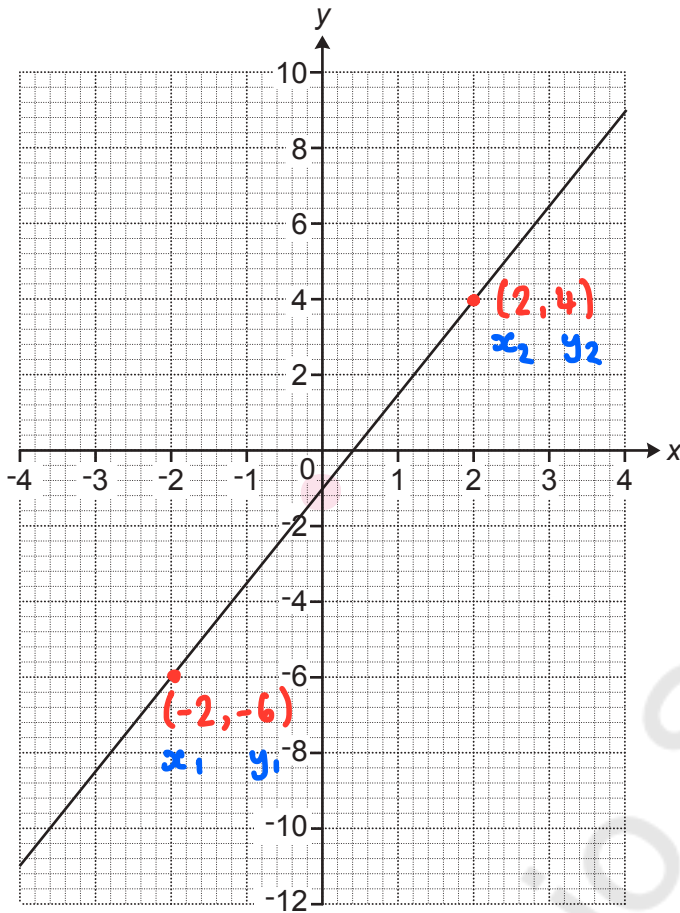
$$8.962\dots = x$$

$$\begin{aligned}\text{Area 1 face} &= 8.962\dots^2 \\ &= 80.331\dots \text{ cm}^2\end{aligned}$$

$$\begin{aligned}\text{Surface Area} &= 6 \times 80.331\dots \\ &= 481.9917241 \dots \dots \dots \mathbf{482} \dots \text{ cm}^2 [4] \\ &\approx 482\end{aligned}$$



7 This graph shows part of a straight line.



(a) Show that the gradient of the line is 2.5.

[1]

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{4 - -6}{2 - -2} = \frac{10}{4} = 2.5$$

(b) Write down the equation of the line.

$$y = mx + c$$

$$m = 2.5$$

$$c = -1$$

(b) $y = 2.5x - 1$ [2]

8 Lily buys and sells microwaves.

She buys each one for £32 and sells it for £60.
She also pays £7 for the delivery of each microwave she sells.

If she sells a microwave that is faulty then Lily must pay for its repair and redelivery.
This costs her another £25 for each faulty microwave.

Last month, 6 out of the 80 microwaves Lily sold were faulty.

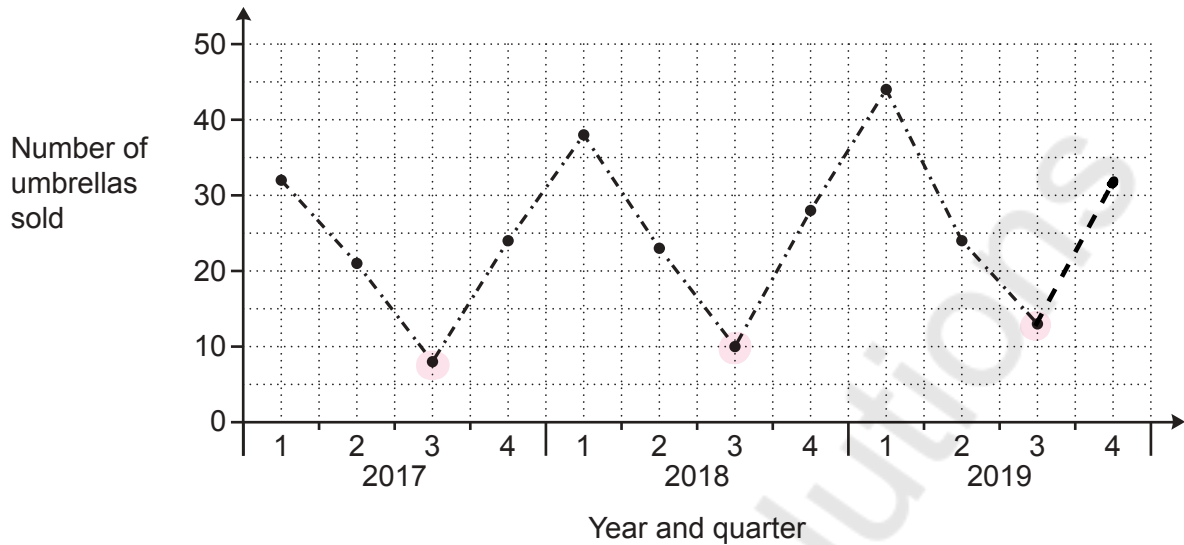
This month she has orders for 133 microwaves.

Calculate her expected percentage profit on this month's order.
Showing your working in the boxes below may help you present your work.

<p>Expected number of faulty microwaves:</p> $\frac{6}{80} \times 133 = 9.975$ $\approx 10 \text{ microwaves}$	<p>Expected costs:</p> $(32 + 7) \times 133 = \pounds 5187$ $25 \times 10 = \pounds 250$ <p>Total : $\pounds 5187 + \pounds 250$</p> $= \pounds 5437$
<p>Income from sales:</p> $\pounds 60 \times 133 = \pounds 7980$	<p>Expected percentage profit:</p> $\frac{7980 - 5437}{5437} \times 100$ $= 46.77\%$ $\approx 46.8\%$

..... **46.8** % [6]

- 9 The graph shows the number of umbrellas sold in Ling's shop for each quarter from quarter 1 of 2017 to quarter 3 of 2019.



- (a) The shop sold 32 umbrellas in quarter 4 of 2019.

Complete the graph.

[1]

- (b) Make one comment about the **seasonal** variation shown in this graph.

Sales peak in the first quarter of each year.

[1]

- (c) Make one comment about the **annual** variation shown in this graph.

There is a slight increase in sales each year.

[1]

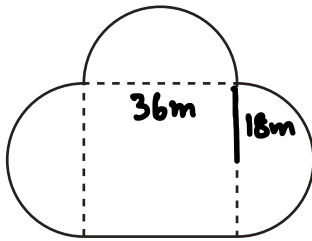
- (d) Ling predicts that she will sell 50 umbrellas in quarter 1 of 2020.

What assumption has she made?

The trend continues to increase.

[1]

- 10 The diagram shows Jane's lawn.
It is in the shape of a square of side 36m and three semi-circles.



Not to scale

She is going to spread fertiliser on the lawn at a rate of 30g per square metre.
The fertiliser is only sold in 10kg bags costing £15.80 each.

Calculate the cost of buying the bags of fertiliser for her lawn.
You must show all your working.

$$\begin{aligned} \text{Area square} &= 36 \times 36 \\ &= 1296 \text{ m}^2 \end{aligned}$$

$$\begin{aligned} \text{Area 1 semi-circle} &= \pi r^2 \div 2 \\ &= \pi (18)^2 \div 2 \\ &= 162\pi \text{ m}^2 \end{aligned}$$

$$\begin{aligned} \text{Area 3 semi-circles} &= 3 \times 162\pi \\ &= 1526.81 \text{ m}^2 \end{aligned}$$

$$\begin{aligned} \text{Total area} &= 1296 + 1526.81 \\ &= 2822.81403 \text{ m}^2 \end{aligned}$$

$$\begin{aligned} \text{Fertiliser} &= 30\text{g} \times 2822.8\dots \\ &= 84684.42089 \text{ g} \end{aligned}$$

$$\downarrow \div 1000$$

$$84.68442089 \text{ kg}$$

$$\text{£ } 142.20 \dots \dots \dots [6]$$

$$\downarrow \div 10$$

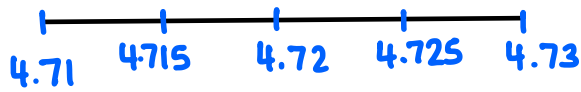
$$8.46\dots \text{ bags needed}$$

$$\approx 9 \text{ bags}$$

$$\begin{aligned} \text{Total cost} &= 9 \times \text{£}15.80 \\ &= \text{£}142.20 \end{aligned}$$

- 11 (a) The length, d , of Jamal's car is 4.72 m, correct to 2 decimal places.

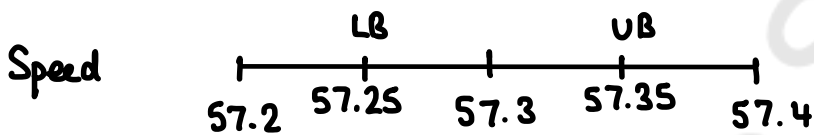
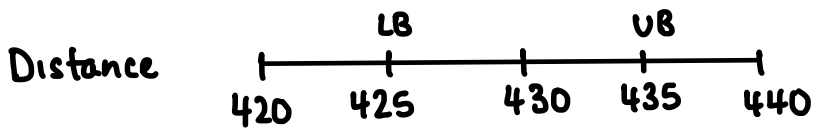
Complete the error interval for the length, d .



(a) **4.715** $\leq d <$ **4.725** [2]

- (b) Jamal travels 430 km, correct to the nearest 10 km.
His average speed is 57.3 km/h, correct to 1 decimal place.

Calculate the shortest possible time for Jamal's journey.
Give your answer correct to the nearest minute.

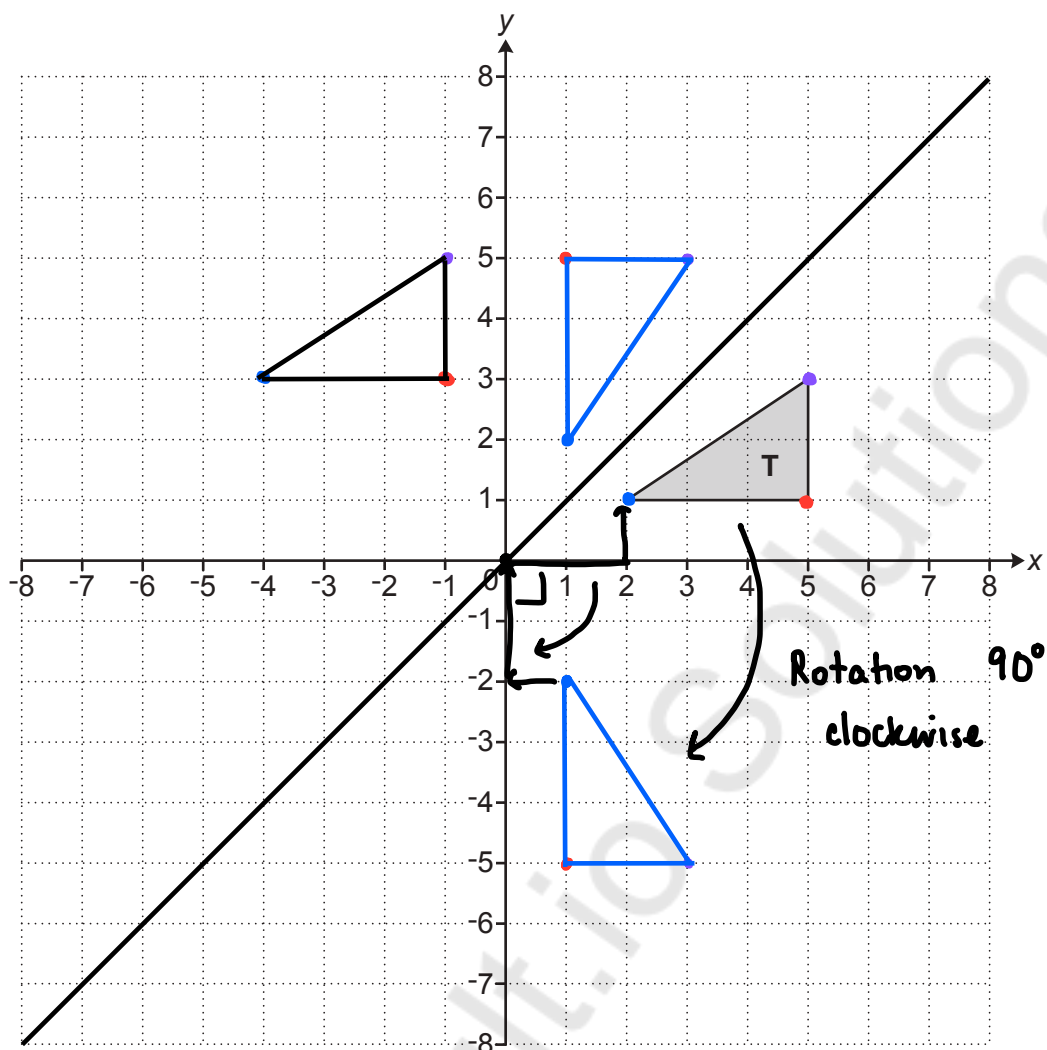


$$\begin{aligned} \text{Time} &= \frac{\text{Distance}}{\text{Speed}} & T_{LB} &= \frac{D_{LB}}{S_{UB}} \\ & & &= \frac{425}{57.35} \\ & & &= 7.41... \text{ h} \end{aligned}$$

$$\begin{aligned} 0.41... \times 60 \\ &= 24.638... \\ &\approx 25 \end{aligned}$$

(b) **7** hours **25** minutes [5]

12 Triangle T is drawn on a coordinate grid.



(a) Translate triangle T by vector $\begin{pmatrix} -6 \\ 2 \end{pmatrix}$. 6 left
2 up [2]

(b) Describe fully the **single** transformation that is equivalent to:

- a reflection in the line $y = x$, followed by
- a reflection in the x -axis.

You may use the grid above to help you.

..... Rotation 90° clockwise about $(0,0)$

..... [3]

13 Ali and Beth take it in turns to play a computer game. On each turn, the player achieves a score out of 50. Ali and Beth play the computer game many times and record their scores.

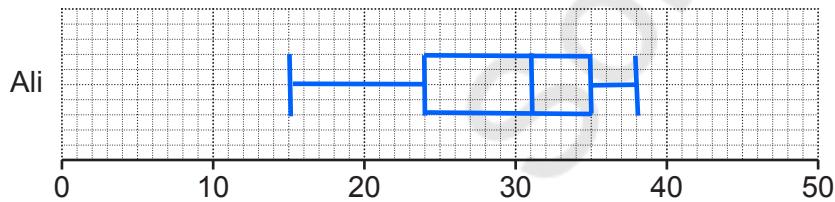
(a) Ali's scores are summarised below.

- median = 31
- highest score = 38
- range = 23
- lower quartile = 24
- interquartile range = 11

Draw a box plot to show the distribution of Ali's scores.

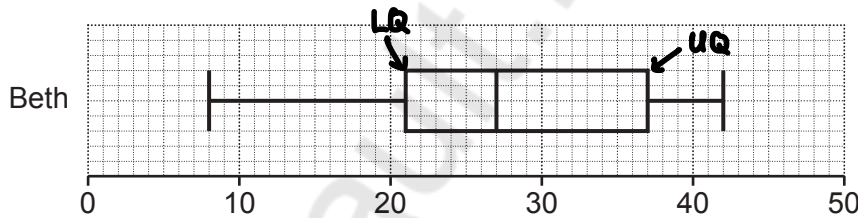
$$UQ = LQ + IQR = 24 + 11 = 35$$

$$\text{Lowest} = \text{highest} - \text{range} = 38 - 23 = 15$$



[3]

(b) This box plot shows the distribution of Beth's scores.



Find the interquartile range of Beth's scores.

$$\begin{aligned} IQR &= UQ - LQ \\ &= 37 - 21 \\ &= 16 \end{aligned}$$

(b) 16 [2]

(c) Kareem says

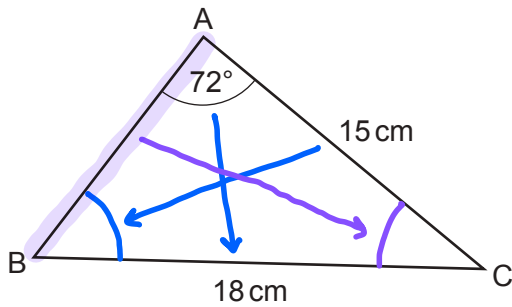
Beth was more consistent than Ali because Beth had a lower median score.

Is his statement correct?
Explain your reasoning.

..... No. The IQR for Ali is lower than Beth's.

.....
..... [2]

14 The diagram shows triangle ABC.



Not to scale

AC = 15 cm, BC = 18 cm and angle BAC = 72°.

Calculate length AB, giving your answer correct to 3 significant figures.
Show your working.

$$\frac{18}{\sin 72} = \frac{15}{\sin B}$$

$$18 \sin B = 15 \sin 72$$

$$\div 18 \qquad \div 18$$

$$\sin B = \frac{15 \sin 72}{18}$$

$$B = \sin^{-1} \left(\frac{15 \sin 72}{18} \right)$$

$$= 52.42418285^\circ$$

$$C = 180 - 52.4... - 72$$

$$= 55.57581715^\circ$$

$$\frac{AB}{\sin 55.5} = \frac{18}{\sin 72}$$

$$\times \sin 55.5 \qquad \times \sin 55.5$$

$$AB = \frac{18}{\sin 72} \times \sin 55.5...$$

$$= 15.61184765$$

$$\approx 15.6 \text{ cm}$$

.....15.6... cm [6]

15 Here are two pieces of work.

For each one, describe the error made and give the complete correct solution.

(a)

Question:

Solve by factorisation.

$$3x^2 - 2x - 5 = 0$$

Solution:

$$(3x + 5)(x - 1) = 0$$

Therefore $x = -5/3$ or $x = 1$

Handwritten notes in the image:
 An arrow points from the $(x - 1)$ bracket to the expression $3x^2 - 3x + 5x - 5$.
 Below that, the expression $3x^2 + 2x - 5$ is written.

Error: The signs in the bracket should be the other way round. $(3x - 5)(x + 1) = 0$

Correct solution:

$$(3x - 5)(x + 1) = 0$$

$$3x - 5 = 0$$

$$+5 \quad +5$$

$$3x = 5$$

$$\div 3$$

$$x = \frac{5}{3}$$

$$x + 1 = 0$$

$$-1 \quad -1$$

$$x = -1$$

[3]

(b)

Question:

Solve, giving your answers correct to 3 significant figures.

$$2x^2 - 8x + 3 = 0$$

Solution:

$$x = -(-8) \pm \frac{\sqrt{(-8)^2 - 4 \times 2 \times 3}}{2 \times 2}$$

Therefore $x = 6.42$ or $x = 9.58$ Error: $-(-8)$ should be in the numerator

Correct solution:

$$x = \frac{-(-8) \pm \sqrt{(-8)^2 - 4 \times 2 \times 3}}{2 \times 2}$$

$$= 3.581\dots \quad \text{or} \quad = 0.4189\dots$$

$$\approx 3.58 \quad \quad \quad \approx 0.419$$

[3]

- 16 y is inversely proportional to the square of x .
 $y = 2$ when $x = 5$.

Find a formula linking x and y .

$$y \propto \frac{1}{x^2}$$

$$y = \frac{k}{x^2} \longrightarrow y = \frac{50}{x^2}$$

$$2 = \frac{k}{5^2}$$

$$2 = \frac{k}{25}$$

$$\begin{array}{cc} \times 25 & \times 25 \end{array}$$

$$50 = k$$

$$y = \frac{50}{x^2} \quad [3]$$

- 17 Expand and simplify.

$$(x+1)(x-1)(x+2)$$

$$(x+1)(x-1)$$

$$x^2 - x + x - 1$$

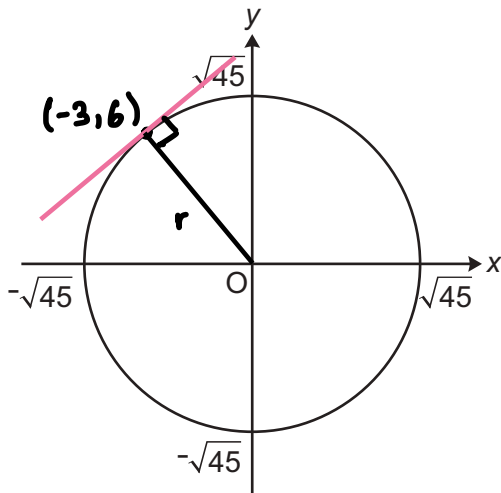
$$x^2 - 1$$

$$(x^2 - 1)(x + 2)$$

$$x^3 + 2x^2 - x - 2$$

$$x^3 + 2x^2 - x - 2 \quad [3]$$

18 Here is a sketch of the circle $x^2 + y^2 = 45$.



(a) Show that the tangent to this circle at the point $(-3, 6)$ has a gradient of $\frac{1}{2}$. [2]

$$\text{Gradient of radius} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{0 - 6}{0 - (-3)} = \frac{-6}{3} = -2$$

$$\begin{array}{ccc} (-3, 6) & \text{to} & (0, 0) \\ x_1, y_1 & & x_2, y_2 \end{array}$$

$$\begin{aligned} \text{Gradient of tangent} &= \text{negative reciprocal of } -2 \\ &= \frac{1}{2} \end{aligned}$$

(b) Find the equation of the tangent at the point $(-3, 6)$.

$$y = mx + c \quad \begin{array}{c} x \\ y \end{array}$$

$$y = \frac{1}{2}x + c$$

$$6 = \frac{1}{2}(-3) + c$$

$$6 = -\frac{3}{2} + c$$

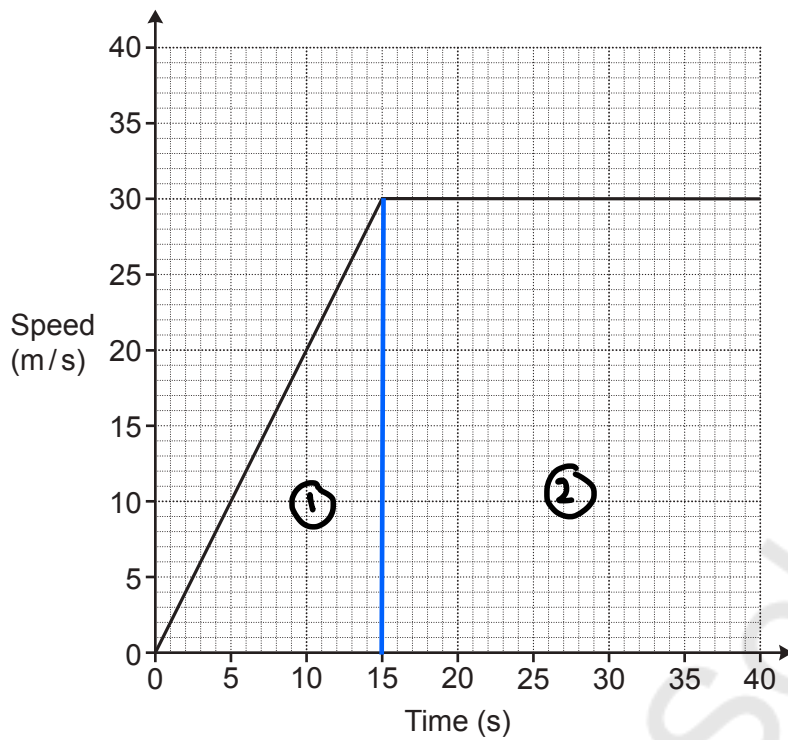
$$+\frac{3}{2} \quad +\frac{3}{2}$$

$$\frac{15}{2} = c$$

$$y = \frac{1}{2}x + \frac{15}{2}$$

(b) $y = \frac{1}{2}x + \frac{15}{2}$ [2]

- 19 (a) The graph shows the speed of a vehicle during the first 40 seconds of motion.



Calculate the distance travelled by the vehicle during the 40 seconds.

Distance = area under graph

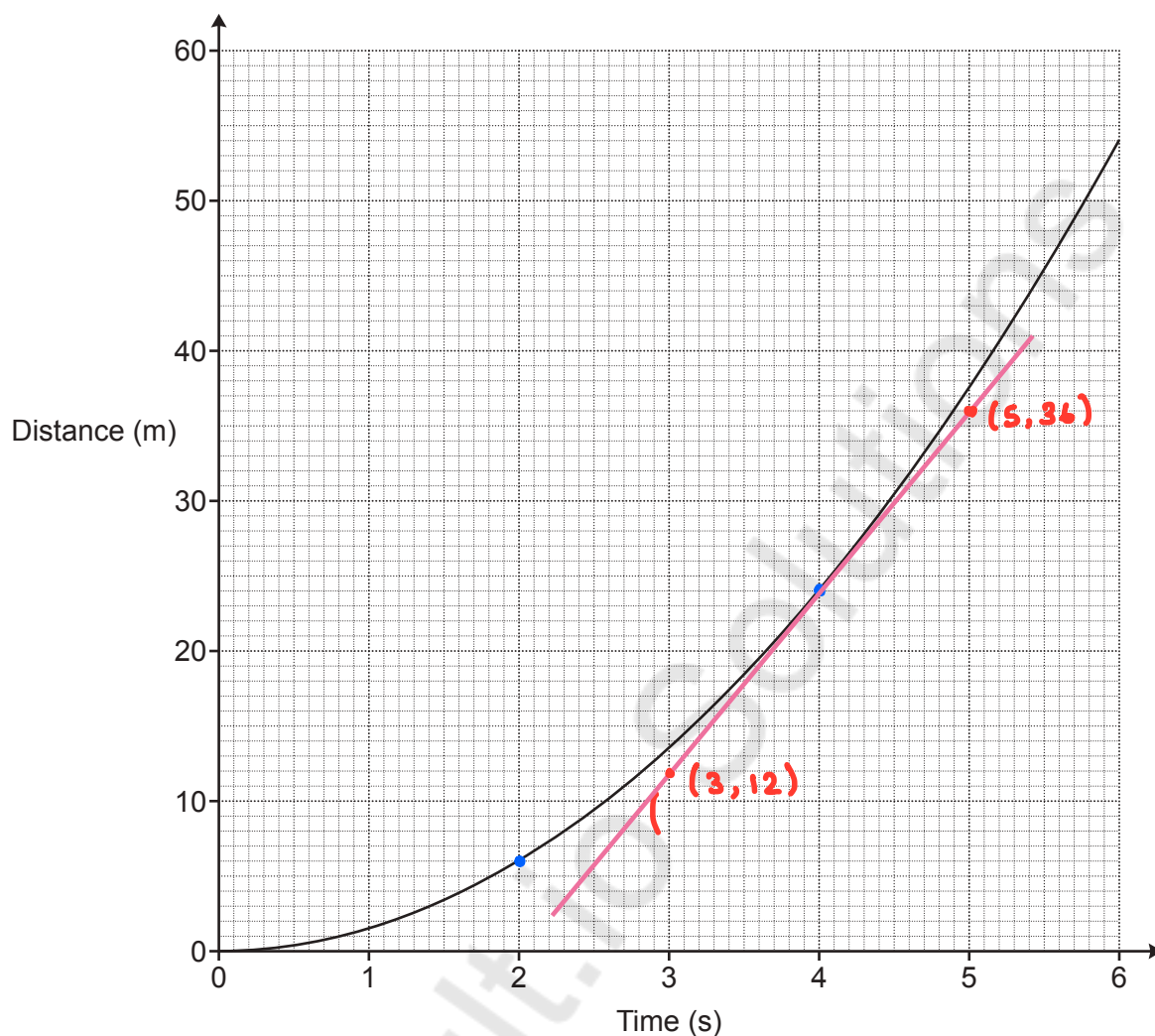
$$\begin{aligned}
 \text{Area of } \textcircled{1} &= \frac{1}{2}bh \\
 &= \frac{1}{2} \times 15 \times 30 \\
 &= 225 \text{ m}
 \end{aligned}$$

$$\begin{aligned}
 \text{Area of } \textcircled{2} &= l \times w \\
 &= 25 \times 30 \\
 &= 750 \text{ m}
 \end{aligned}$$

$$\begin{array}{r}
 \text{Total area} = 225 \\
 + 750 \\
 \hline
 975
 \end{array}$$

(a) 975 m [3]

(b) The graph shows the distance travelled by a particle over 6 seconds.



(i) Work out the average speed of the particle between 2 and 4 seconds.

$$m = \frac{\begin{matrix} (2, 6) \\ x_1, y_1 \end{matrix} - \begin{matrix} (4, 24) \\ x_2, y_2 \end{matrix}}{x_2 - x_1} = \frac{24 - 6}{4 - 2} = \frac{18}{2} = 9$$

(b)(i) 9 m/s [2]

(ii) Estimate the speed of the particle at 4 seconds.

$$m = \frac{\begin{matrix} (3, 12) \\ x_1, y_1 \end{matrix} - \begin{matrix} (5, 36) \\ x_2, y_2 \end{matrix}}{x_2 - x_1} = \frac{36 - 12}{5 - 3} = \frac{24}{2} = 12$$

(ii) 12 m/s [4]

Turn over for Question 20

20 Solve.

$$\begin{aligned}x^2 + y^2 &= 34 \\ y &= x + 2\end{aligned}$$

Show your working.

$$x^2 + (x+2)^2 = 34$$

$$x^2 + (x+2)(x+2) = 34$$

$$x^2 + x^2 + 2x + 2x + 4 = 34$$

$$\begin{aligned}2x^2 + 4x + 4 &= 34 \\ -34 \quad -34\end{aligned}$$

$$\begin{aligned}2x^2 + 4x - 30 &= 0 \\ \div 2 \quad \quad \quad \div 2\end{aligned}$$

$$x^2 + 2x - 15 = 0$$

$$\frac{5}{-3} \times \frac{-3}{5} = -15$$

$$(x+5)(x-3) = 0$$

$$\frac{5}{-3} + \frac{-3}{5} = 2$$

$$\begin{aligned}x + 5 &= 0 & \text{or} & & x - 3 &= 0 \\ -5 \quad -5 & & & & +3 \quad +3\end{aligned}$$

$$x = -5$$

$$x = 3$$

$$y = x + 2$$

$$= -5 + 2 \quad = 3 + 2$$

$$y = -3$$

$$y = 5$$

$$x = \dots -5 \dots \quad y = \dots -3 \dots$$

$$x = \dots 3 \dots \quad y = \dots 5 \dots \quad [6]$$

END OF QUESTION PAPER

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