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Model Answers

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H

Tuesday 03 November 2020 – Morning

GCSE (9–1) Mathematics

J560/04 Paper 4 (Higher Tier)

Time allowed: 1 hour 30 minutes

8182187365

You can use:
- a scientific or graphical calculator
- geometrical instruments
- tracing paper

J560/04

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

Centre number | | | | | | Candidate number | | | | |

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.

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2

Answer **all** the questions.

1 **(a)** Write these numbers in standard form.

(i) 6500

$6500 = 6.5 \times 10^3$

(a)(i) 6.5×10^3 **[1]**

(ii) 0.0584

$0.0584 = 5.84 \times 10^{-2}$

(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.

$= 4.2 \times 10^5 \times 1.8 \times 10^{-2}$

$= 4.2 \times 1.8 \times 10^5 \times 10^{-2}$

$= 7.56 \times 10^{5-2}$

$= 7.56 \times 10^3$

(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.

Total full marks of all three papers : $80 + 65 + 95$

$= 240$

$\frac{60}{100} \times 240 = 144$ (marks needed across all 3 papers)

Lowest mark that James need for paper 3 : $144 - 43 - 38 = 63$

63 marks **[4]**

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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.

$\frac{270 \text{ houses}}{3 \text{ people}} = 90$

$\frac{405 \text{ houses}}{5 \text{ people}} = 81$

$\times 9/10$ (90 : 2.5 hours ; 81 : x hours) $\times \frac{9}{10}$

$2.5 \times \frac{9}{10} = 2.25$ hours

$= 2.25$ hours

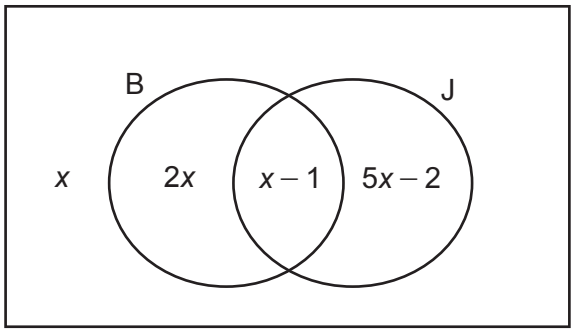
$= 2$ hours (0.25×60) mins

$= 2$ hours 15 mins

..... 2 ..... hours ..... 15 ..... 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.



number of students with a bank account $= 2x + (x-1)$

$= 2x + x - 1$

$= 3x - 1$

$= 3(7) - 1$

$= 21 - 1 = 20$

One of the 60 students is chosen at random.

Find the probability that they have a bank account.
Show your working.

Total number of students $= x + 2x + x - 1 + 5x - 2$

$60 = 9x - 3$

$60 + 3 = 9x$

$63 = 9x$

$x = 7$

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

$\frac{1}{3}$

..... **[5]**

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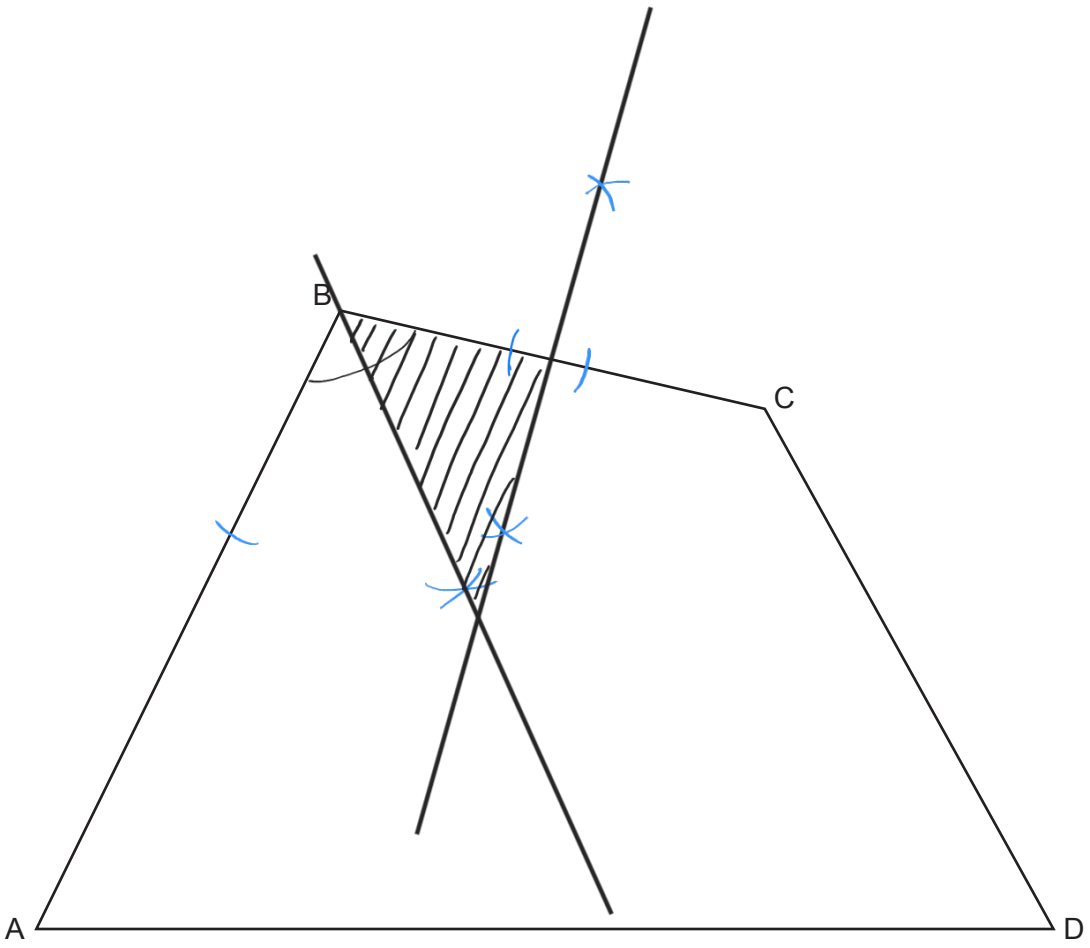
5 ABCD is a quadrilateral.



(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]

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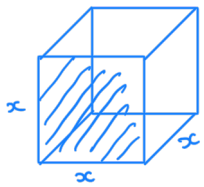
6 A cuboid measures 6 cm by 8 cm by 15 cm.
A cube has the same volume as the cuboid.

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

Volume of cuboid $= 6 \times 8 \times 15$

$= 720 \text{ cm}^3$



Volume of cube $= x^3$

$720 = x^3$

$x = \sqrt[3]{720}$

$= 8.963 \text{ cm}$

Area of one face $= 8.963 \times 8.963$

$= 80.3319 \text{ cm}^2$

cube has 6 equal faces

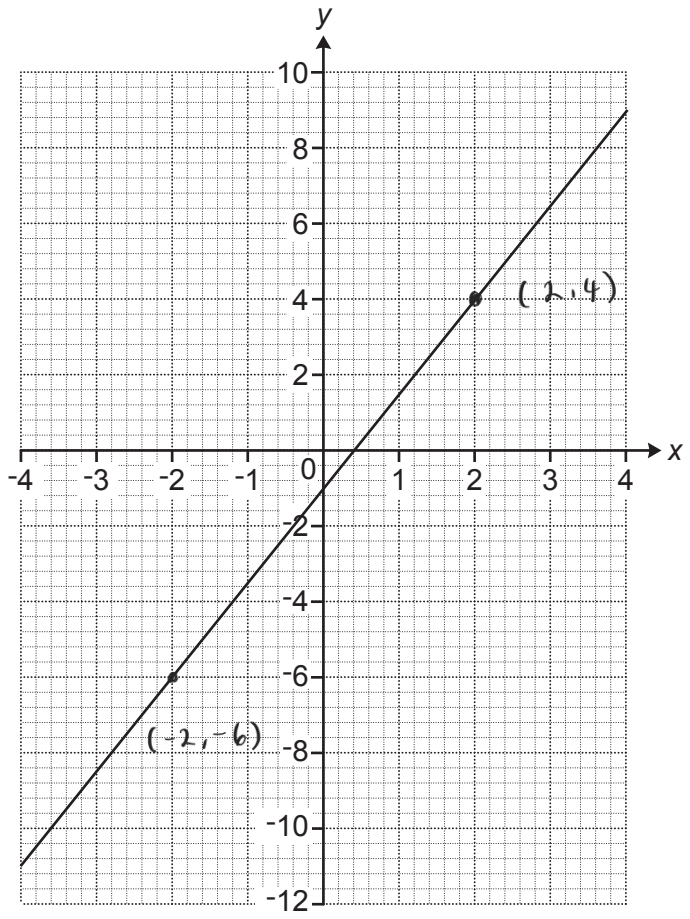
Total surface area of cube $= 80.3319 \times 6$

$= 481.992$

$\approx 482 \text{ cm}^2$ (3 sf) — round up (>5)

482 ..... cm^2 **[4]**

7 This graph shows part of a straight line.



(a) Show that the gradient of the line is 2.5. **[1]**

Point 1 = (2, 4)

Point 2 = (−2, −6)

$$m = \frac{y_1 - y_2}{x_1 - x_2} = \frac{4 - (-6)}{2 - (-2)} = \frac{10}{4} = \frac{5}{2} = 2.5$$

(b) Write down the equation of the line.

y-intercept from graph = −1

gradient = 2.5

$y = mx + c$

$y = 2.5x - 1$

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

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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.

Expected number of faulty microwaves: $\frac{6}{80} \times 133 = 9.975$ ≈ 10 microwaves	Expected costs: Total cost for 1 microwave = £32 + £7 = £39 Cost for 133 microwaves = 133 × £39 = £5187 Additional cost for faulty microwaves = £25 × 10 = £250 Total cost = £5187 + £250 = £5437
Income from sales: £60 × 133 = £7980	Expected percentage profit: Profit = £7980 − £5437 = £2543 Percentage profit = $\frac{£2543}{£5437} \times 100$ = 46.77%

46.77 ..... % **[6]**

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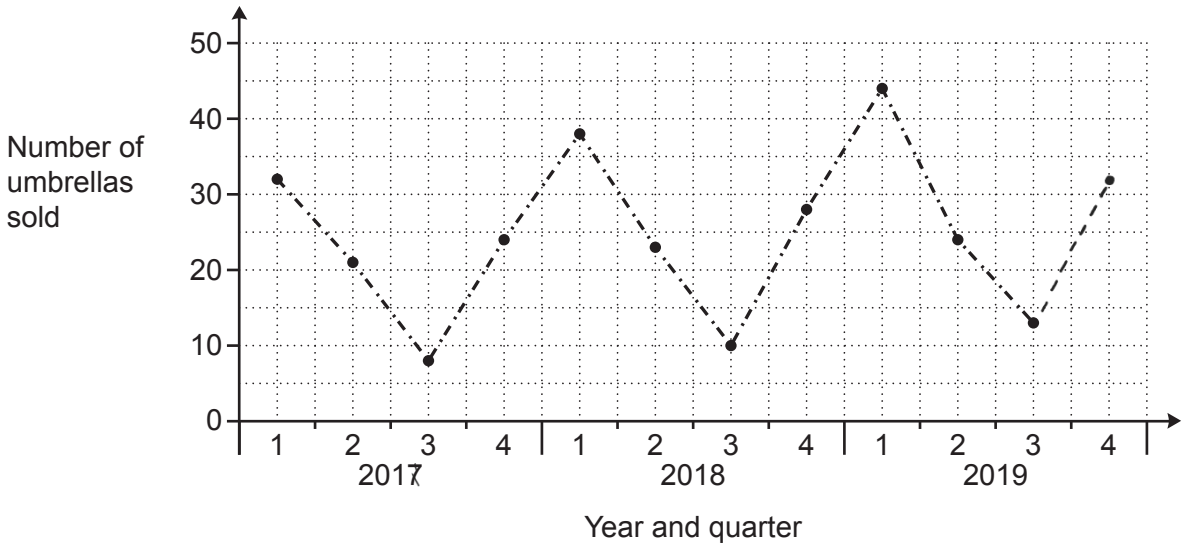
9 The graph shows the number of umbrellas sold in Ling's shop for each quarter from quarter 1 of 2017 to quarter 3 of 2019.



(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.

The sales usually peak at the first quarter in each year

..... **[1]**

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

There is a slight increase in the number of sales year after year.

..... **[1]**

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

What assumption has she made?

The trend of the sales continue at a constant rate

..... **[1]**

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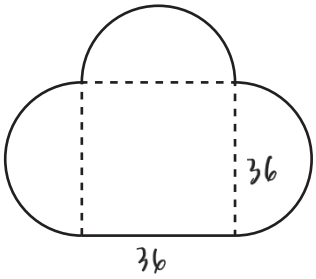
10 The diagram shows Jane's lawn.
It is in the shape of a square of side 36 m and three semi-circles.



Not to scale

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

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

Area of the square base : $36 \times 36 = 1296\ m^2$

Area of 1 semicircle : $\frac{1}{2} \times \pi r^2$

$= \frac{1}{2} \times \pi (36 \div 2)^2$

$= \frac{1}{2} \times \pi (18)^2$

$= 162\pi$

Area of 3 semicircles : $3 \times 162\pi = 1526.81\ m^2$

Total surface area : $1526.81 + 1296 = 2822.81\ m^2$

Total fertiliser needed : $2822.81 \times 30\ g = 84684.3\ g$

$84684.3\ g \xrightarrow{\div 1000} 84.6843\ kg \approx 90\ kg$ fertiliser bags needed

$\times 9$ (10 kg : £15.80) $\times 9$
90 kg : £142.20

£ 142.20 **[6]**

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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.

$4.72 - 0.005 \leqslant d < 4.72 + 0.005$

$4.715 \leqslant d < 4.725$

2 dp = 0.01

Error interval = $0.01 \div 2 = 0.005$

(a) ..... $\leqslant d <$ ..... **[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.

(use the lower limit)

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

Error interval for distance : 10 km ÷ 2 = 5 km

Lower limit for distance : 430 − 5 = 425 km

Error interval for speed : 0.1 ÷ 2 = 0.05 km/h

Upper limit for : 57.3 + 0.05 = 57.35 km/h

$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$

$\text{Time} = \frac{\text{Distance}}{\text{Speed}}$

$= \frac{425}{57.35}$

$\approx 7.410\ldots$ hours

LB = LB / UB

Time = 7.410... hours

= 7 hours (0.410... × 60) mins

= 7 hours 25 mins

(b) ..... hours ..... minutes **[5]**

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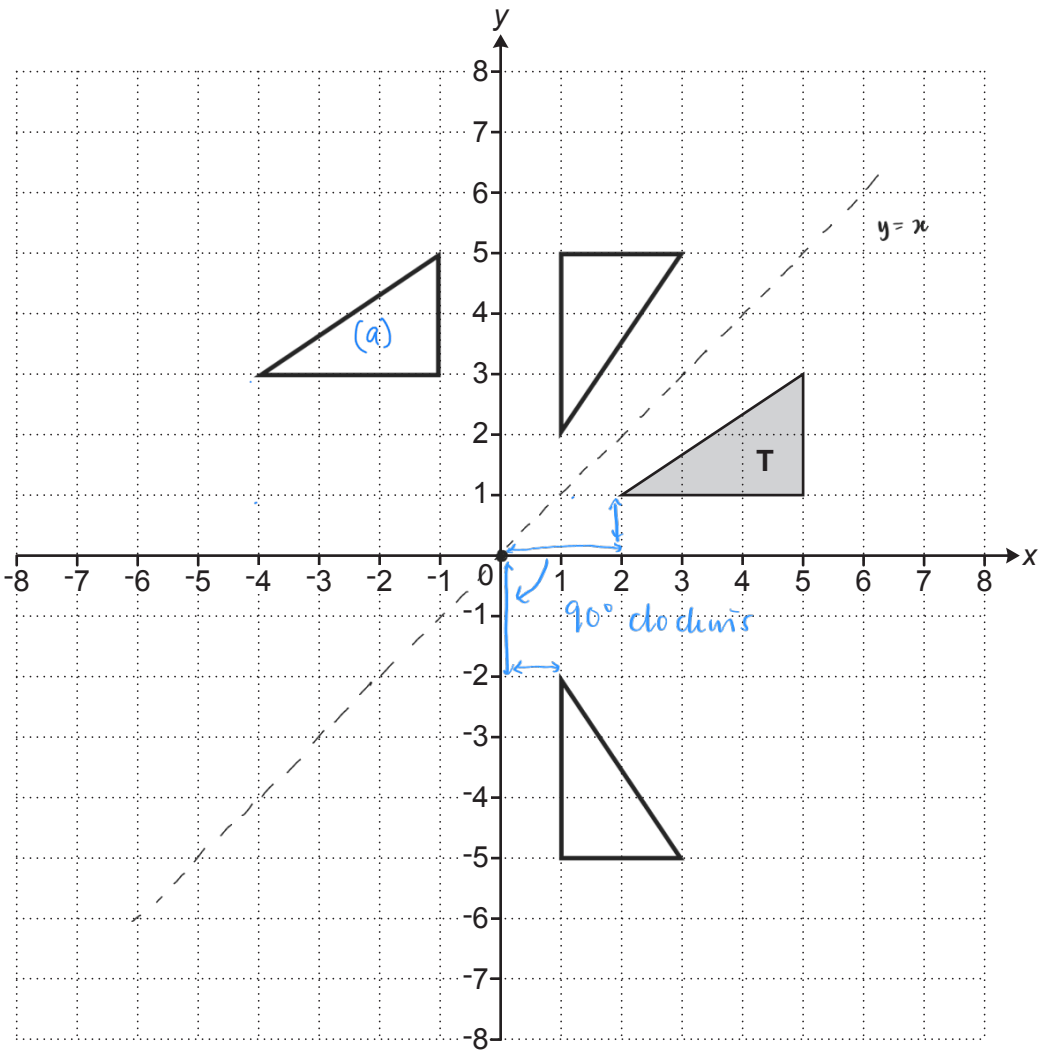
12 Triangle **T** is drawn on a coordinate grid.



(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 at centre of rotation (0,0)

..... **[3]**

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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.

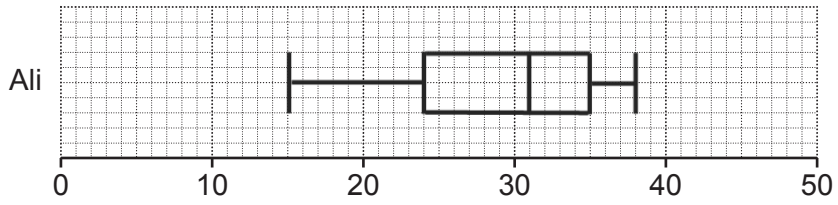
(a) Ali's scores are summarised below.

- 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.

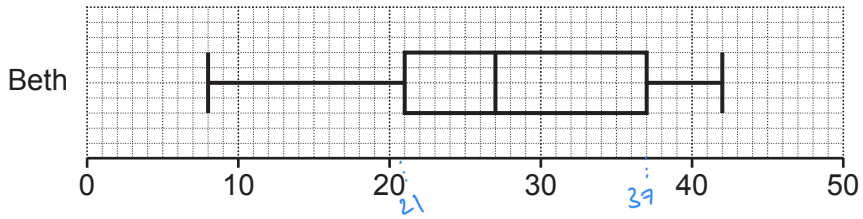
Upper quartile = 11 + 24 = 35 (interquartile = upper quartile − lower quartile)

lowest score = 38 − 23 = 15 (range = highest score − lowest score)



[3]

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



Find the interquartile range of Beth's scores.

interquartile range = 37 − 21 = 16

(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.

His statement is incorrect because consistency is measured by interquartile range instead of median score. Since Beth's interquartile range is greater than Ali, Beth is considered more inconsistent. **[2]**

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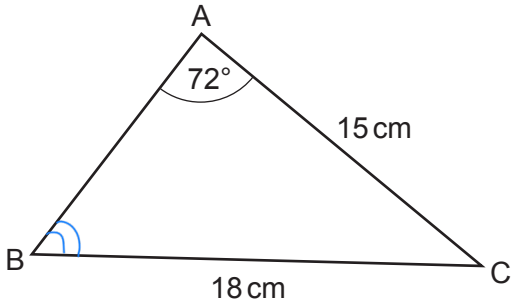
14 The diagram shows triangle ABC.



Not to scale

Sine Rule : $\frac{a}{\sin A} = \frac{b}{\sin B}$

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

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

$$\frac{18}{\sin 72^\circ} = \frac{15}{\sin \angle B}$$

$$\sin \angle B = \frac{15 \sin 72^\circ}{18}$$

$$= 0.792547$$

$$\angle B = \sin^{-1}(0.792547)$$

$$= 52.42^\circ...$$

(never round until the final step)

$$180^\circ = 72^\circ + 52.42...^\circ + \angle C$$

$$\angle C = 180^\circ - 72^\circ - 52.42...^\circ$$

$$= 55.57...^\circ$$

$$\frac{AB}{\sin 55.57...^\circ} = \frac{18}{\sin 72^\circ}$$

$$AB = \frac{18 (\sin 55.57...^\circ)}{\sin 72^\circ} = 15.613$$

$$\approx 15.6 \text{ (3 sf)}$$

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

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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 $x = 1$

Error: The signs should be the other way around.

It should be $(3x - 5)(x + 1) = 0$

Correct solution:

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

$3x - 5 = 0$ or $x + 1 = 0$

$3x = 5$ $x = -1$

$x = 5/3$

The solutions are $x = \frac{5}{3}$ and $x = -1$

[3]

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(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: The -b term should be in the numerator.

.....

Correct solution:

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

$$x = \frac{8 \pm \sqrt{40}}{4}$$

$$x = \frac{8 + \sqrt{40}}{4} \quad \text{or} \quad x = \frac{8 - \sqrt{40}}{4}$$

$x = 3.581\ldots$ round down

$x = 0.4189\ldots$ round up

The solutions are $x = 3.58$ or $x = 0.419$

[3]

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

Find a formula linking x and y.

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

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

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

$k = 2 \times 25$

$k = 50$ (substitute k into the initial equation)

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

..... **[3]**

17 Expand and simplify.

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

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

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

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

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

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

..... **[3]**

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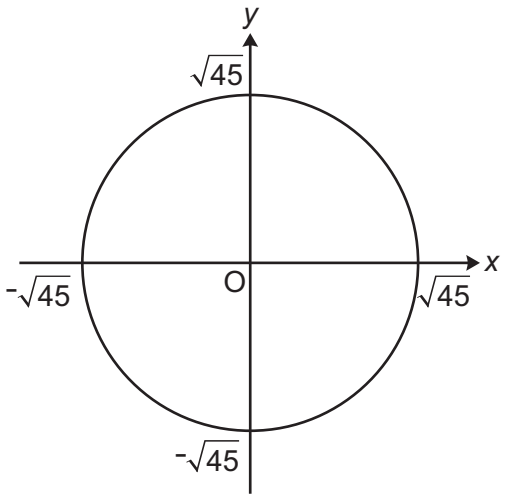
18 Here is a sketch of the circle $x^2 + y^2 = 45$.



$m = \frac{y_1 - y_2}{x_1 - x_2}$

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

gradient of radius $= \frac{6 - 0}{-3 - 0}$

$= \frac{6}{-3}$

$= -2$

(negative reciprocal)

gradient of tangent $= \frac{-1}{\text{gradient of radius}}$

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

$= \frac{1}{2}$

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

$y = mx + c$

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

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

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

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

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

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

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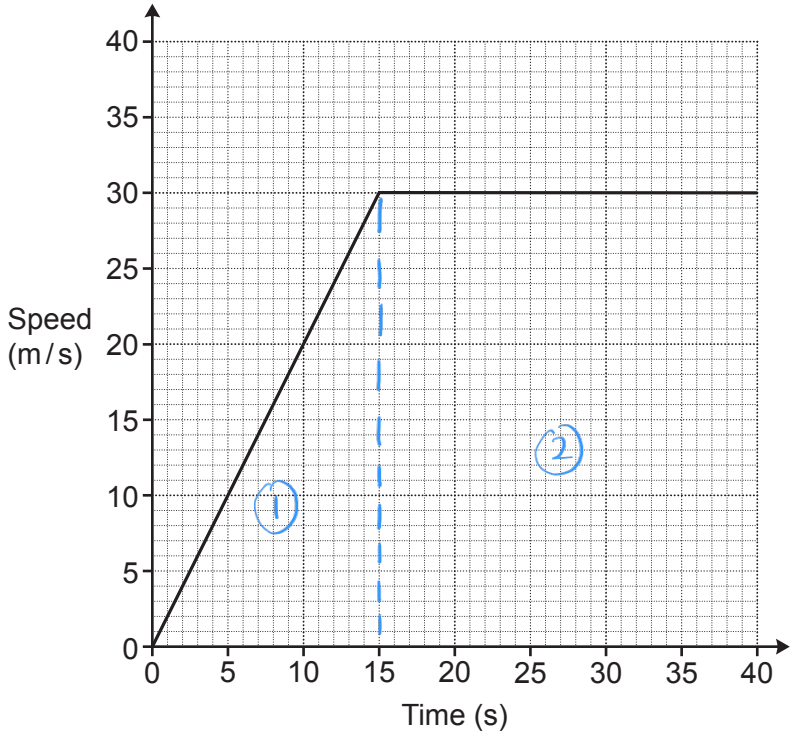
19 **(a)** The graph shows the speed of a vehicle during the first 40 seconds of motion.



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

Distance travelled = Area under the graph

= Area of triangle + Area of rectangle

= $\frac{1}{2} \times 15 \times 30 + (40 - 15) \times 30$

= $225 + 25 \times 30$

= $225 + 750$

= 975 m

(a) 975 ..... m **[3]**

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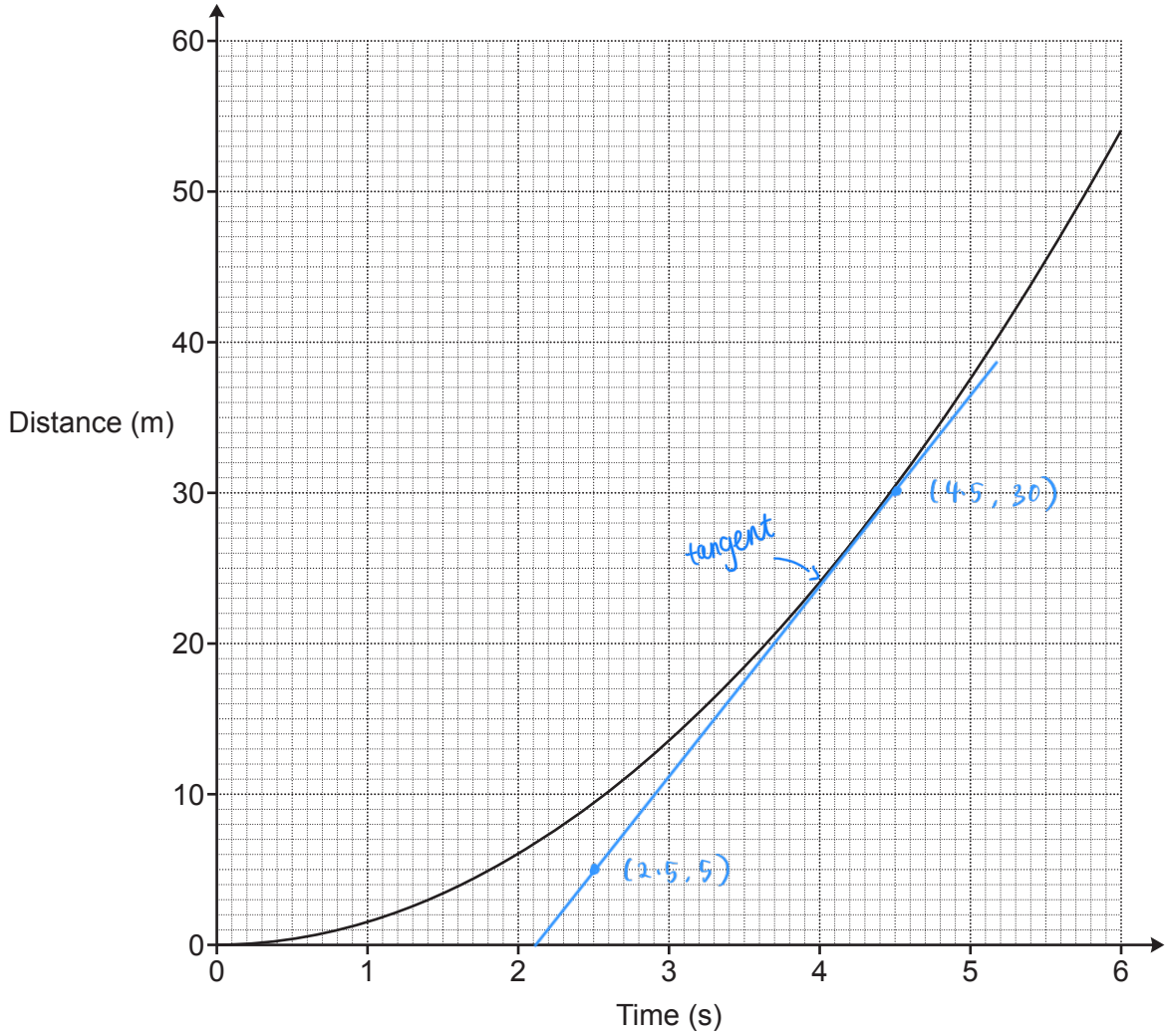
(b) The graph shows the distance travelled by a particle over 6 seconds.



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

$$\text{Average speed} = \frac{24 - 6}{4 - 2}$$

$$= \frac{18}{2} = 9$$

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

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

Point 1 : (4.5, 30)

Point 2 : (2.5, 5)

$$\text{gradient} = \frac{30 - 5}{4.5 - 2.5} = \frac{25}{2} = 12.5$$

(ii) 12.5 ..... m/s **[4]**

Turn over for Question 20

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20 Solve.

$x^2 + y^2 = 34$
$y = x + 2$

Show your working.

$x^2 + y^2 = 34$ — ①

$y = x + 2$ — ②

substitute ② into ①

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

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

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

$2x^2 + 4x + 4 - 34 = 0$

$2x^2 + 4x - 30 = 0$

$2(x^2 + 2x - 15) = 0$ ÷2

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

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

$x + 5 = 0$ or $x - 3 = 0$

$x = -5$ $x = 3$

$y = x + 2$

when $x = -5$,

$y = -5 + 2$

$= -3$

when $x = 3$

$y = x + 2$

$= 3 + 2$

$= 5$

$x =$ ..... -5 ..... $y =$ ..... -3 .....

$x =$ ..... 3 ..... $y =$ ..... 5 ..... **[6]**

END OF QUESTION PAPER

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