

**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)

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Last name

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**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  $\pi$  button on your calculator or take  $\pi$  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.

Please note that these worked solutions have neither been provided nor approved by OCR and may not necessarily constitute the only possible solutions. Please refer to the original mark schemes for full guidance.

Any writing in blue indicates what must be written in order to answer the questions and get the marks. The worked solutions have been designed to show the smallest amount of work which needs to be done to answer the question.

Anything written in green in a cloud doesn't have to be written in the exam.

Anything written in orange in a rectangle doesn't have to be written in the exam and is there to show what should be put into a calculator or measured using a ruler or protractor.

If you find any mistakes or have any requests or suggestions, please send an email to [curtis@cgmaths.co.uk](mailto:curtis@cgmaths.co.uk)

Answer **all** the questions.

1 (a) Write these numbers in standard form.

(i) 6500

Entering 6500 into the calculator and converting it into ENG notation puts it in standard form, in this case

(a)(i) ..... [1]

(ii) 0.0584

Standard form is  $a \times 10^n$ , where  $1 \leq a < 10$  and  $n$  is an integer

(ii) ..... [1]

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

Putting it into the calculator and converting the answer into ENG notation puts it in standard form, in this case

(b) ..... [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.

Paper 1 can be assumed to be out of 80 marks and Paper 2 can be assumed to be out of 65 marks. Adding together the number of marks each of the papers is out of works out the total number of marks the whole exam is out of. Putting the 60 over 100 converts the percentage into a fraction, which when multiplied by the total number of marks the whole exam is out of finds 60% of the total marks. Subtracting the 43 and 38 marks achieved so far on Paper 1 and Paper 2 leaves the number of marks needed on Paper 3 to get 60% of the total marks

..... [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.

Multiplying the 3 people by the  $2\frac{1}{2}$  hours works out how many hours worth of work was done. Dividing this by the 270 houses works out how many hours worth of work are needed for each house. Multiplying this by the 405 works out how many hours worth of work are needed for 405 houses. Dividing this by the 5 people works out how long it will take in hours

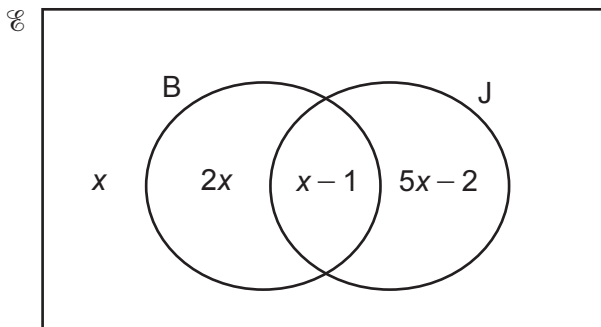
The answer in hours can be converted into hours and minutes using the calculator

..... hours ..... 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.

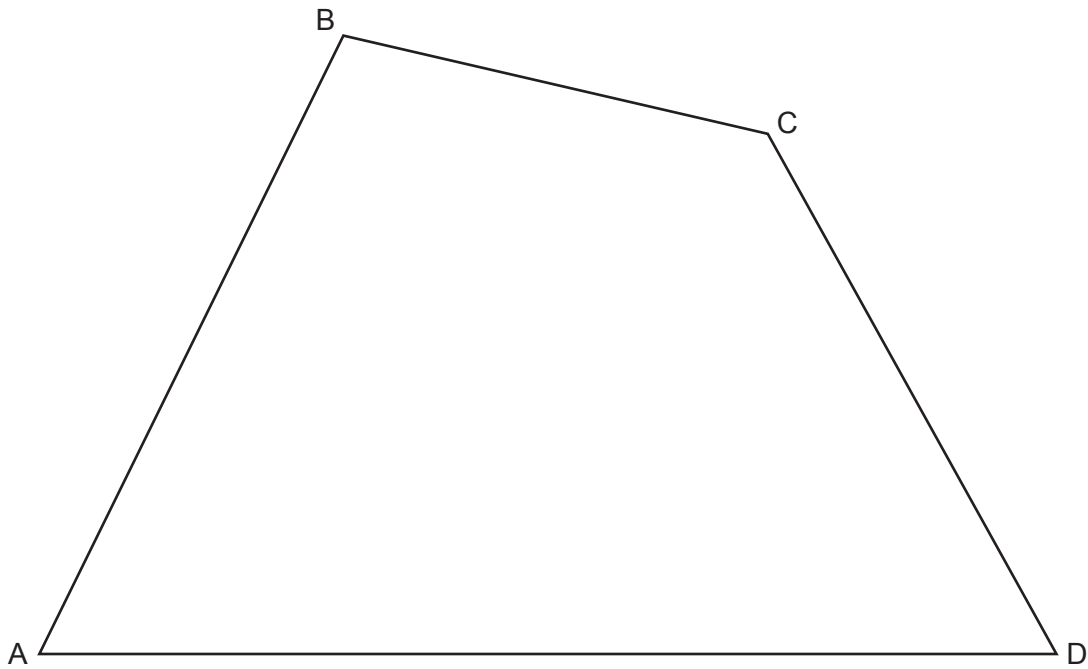
Find the probability that they have a bank account.

Show your working.

Adding together all of the expressions in the Venn diagram expresses the total number of students in terms of  $x$ . Simplify the expression by collecting like terms and set equal to the 60. Rearrange to find  $x$ . Substitute the value of  $x$  into the expressions within the B ring to find how many students have a bank account. Express the number of students who have a bank account as a fraction of the total number of students

..... [5]

5 ABCD is a quadrilateral.



For (a): Scribe two arcs from B using a compass and the same radius. Scribe two arcs of the same radius from the points these arcs cross AB and BC. Draw a straight line from B through the cross where the two second arcs meet.

For (b): Scribe an arc from B which is at more than half of the length of BC. Scribe an arc from C using the same radius. Draw a straight line through the two points where these arcs meet

(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.

← This is something to do with the lines drawn in (a) and (b)

[1]

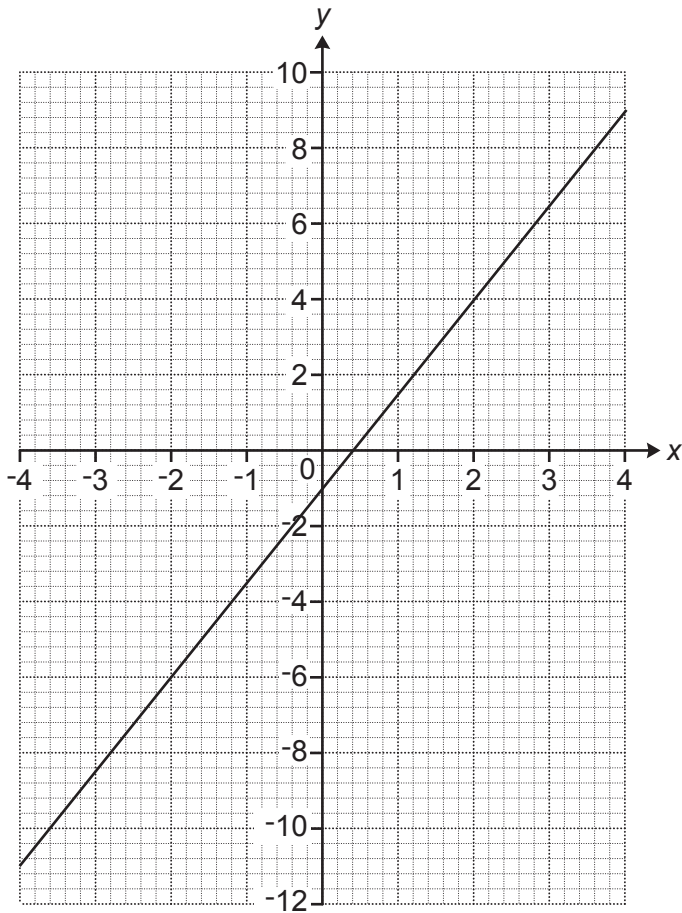
- 6 A cuboid measures 6 cm by 8 cm by 15 cm.  
A cube has the same volume as the cuboid.

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

Volume of cuboid = length  $\times$  width  $\times$  height. Volume of cube = length<sup>3</sup>. Each of the faces on the cube is a square. Area of square = length<sup>2</sup>. There are 6 square faces on a cube

..... cm<sup>2</sup> [4]

7 This graph shows part of a straight line.



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

[1]

Gradient = (change in y)/(change in x). Pick two points on the line which are on grid lines and as far away from each other as possible. Change in y is the y-coordinate of the first point subtracted from the y-coordinate of the second point. Change in x is the x-coordinate of the first point subtracted from the x-coordinate of the second point

(b) Write down the equation of the line.

The general equation of a straight line is  $y = mx + c$ , where  $m$  is the gradient and  $c$  is the y-intercept

(b) ..... [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.

Expected number of faulty microwaves:

Express the fraction of the microwaves which were faulty last month. We can estimate that the same fraction of microwaves will be faulty this month. So doing this fraction of the 133 then rounding the result to the nearest whole number gives the expected number of faulty microwaves

Expected costs:

Adding the cost of buying each microwave (£32) and the delivery cost (£7) gives the total initial cost of each microwave sold. Multiplying this by the 133 orders works out the total initial cost of all of the microwaves. Multiplying the number of faulty microwaves by the £25 cost to repair and redeliver each one gives the total cost of the faulty microwaves. Adding the total initial cost and the cost of the faulty ones gives the total expected costs

Income from sales:

Multiplying the price they are sold for (£60) by the number of orders (133) gives the total income from the sales

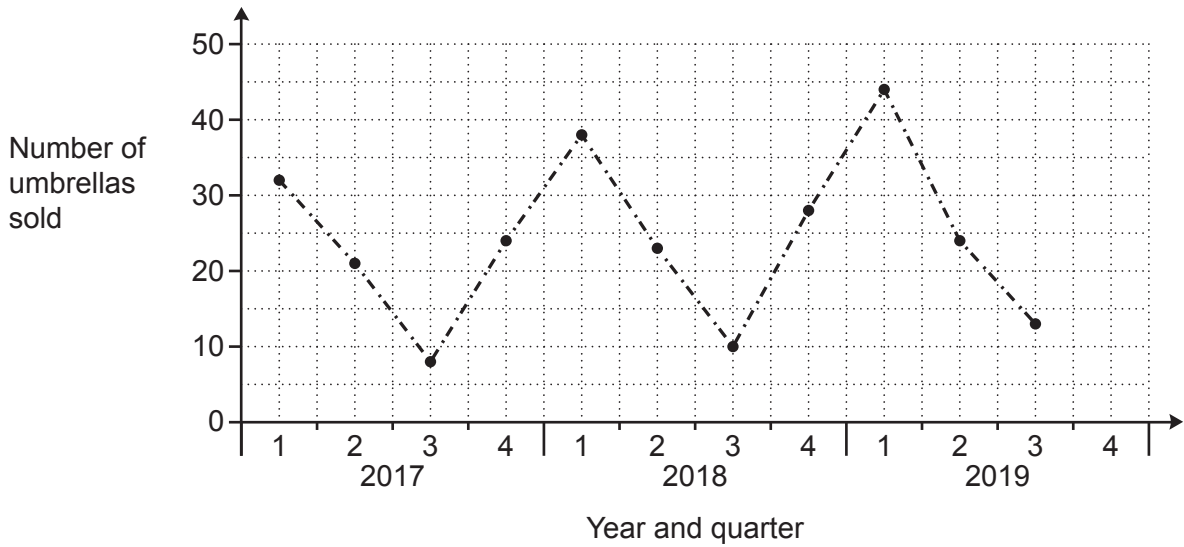
Expected percentage profit:

Subtracting the costs from the income gives the profit. Expressing this as a fraction of the costs gives the fraction profit. Multiplying this by 100 converts it into a percentage profit

..... % [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.

32 is just above 30

[1]

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

.....  
 Make a comment on which quarter it peaks  
 .....

[1]

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

.....  
 Does it generally increase or decrease each year?  
 .....

[1]

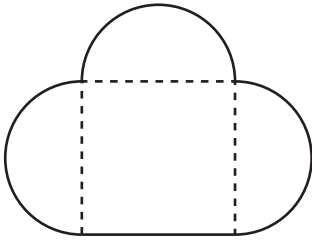
- (d) Ling predicts that she will sell 50 umbrellas in quarter 1 of 2020.

What assumption has she made?

The sales will continue to...  
 .....

[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.

Area of square = length<sup>2</sup>. Area of circle =  $\pi \times \text{radius}^2$ . The radius is half of the diameter of 36m. Dividing the area of the full circle by 2 works out the area of each semicircle. Multiplying this by 3 as there are 3 semicircles. Adding the area of the square and the 3 semicircles works out the total area of the garden. Convert the 30g into kg by using the fact there are 1000g in 1kg. Multiply the total area of the garden by the rate of kilograms used per square metre to work out how much fertiliser is needed. Dividing the amount of fertiliser needed by the 10kg bags works out how many bags are needed. This will need to be rounded up to the next whole number as there cannot be a decimal of a bag. Multiplying the number of bags needed by the cost of each bag gives the cost of buying the bags of fertiliser

£ ..... [6]

- 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,  $d$ .

Adding and subtracting half of the resolution (what it goes up in) works out the upper and lower bound. The resolution is 0.01 as it is correct to 2 decimal places

(a) .....  $\leq d <$  ..... [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.

Calculate the shortest possible time for Jamal's journey.

Give your answer correct to the nearest minute.

$s^d t$  ←

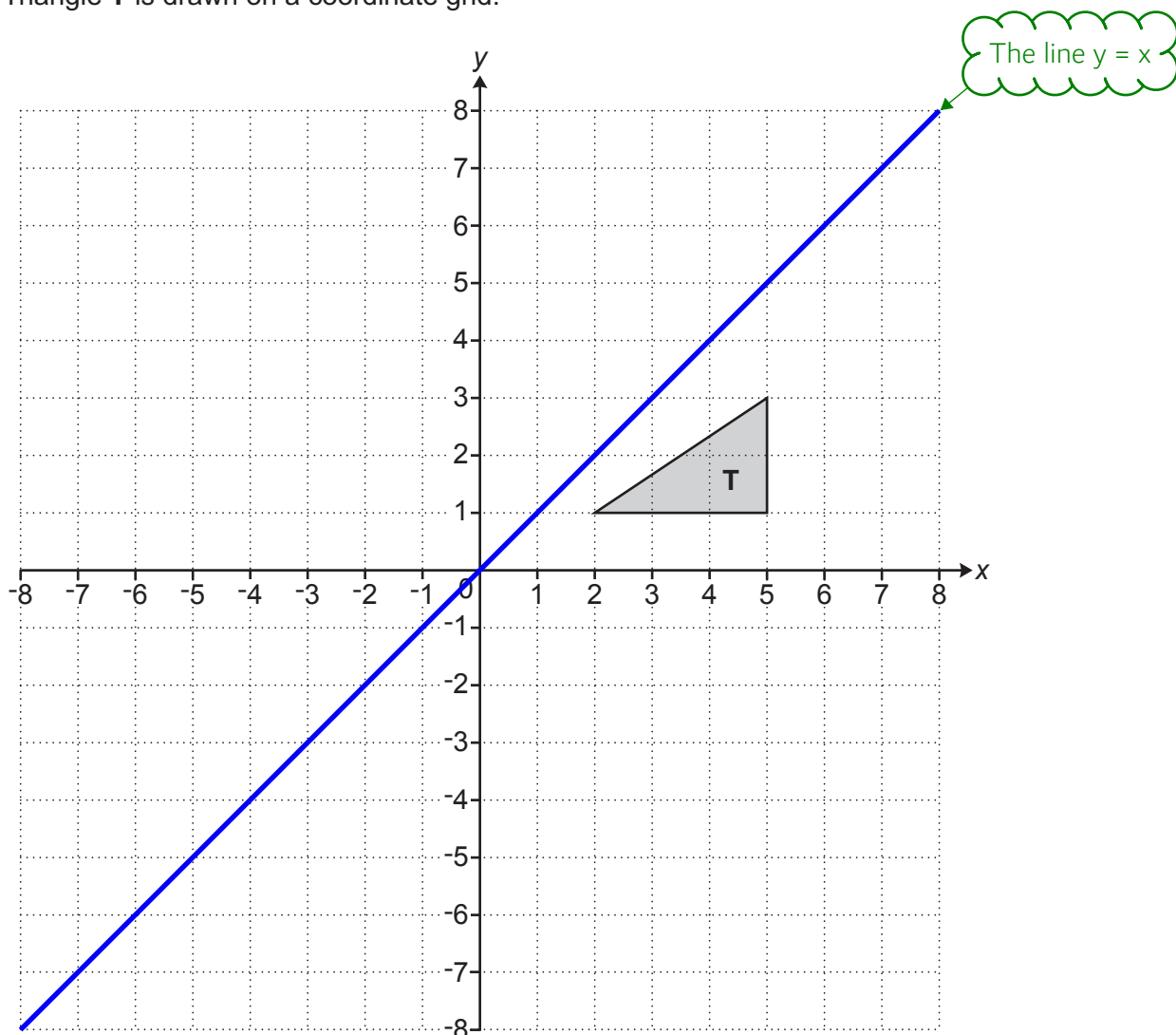
Writing the formula triangle for distance, speed, time

From the formula triangle, covering  $t$  tells us that time = ... In order to get the lower bound of the time, consider whether the upper or lower bound of the distance and the lower or upper bound of the speed is needed. Adding and subtracting half of the resolution (what it goes up in) works out the upper and lower bound

The calculator can be used to give a decimal number of hours into hours, minutes and seconds

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

12 Triangle T is drawn on a coordinate grid.



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

To reflect, count the number of perpendicular jumps to the line and do the same number on the other side for each corner then join the corners up

You may use the grid above to help you.

Rotation...

Describe the angle it has turned, the direction and the centre of rotation

[3]

Tracing paper can be used to work out the centre of rotation

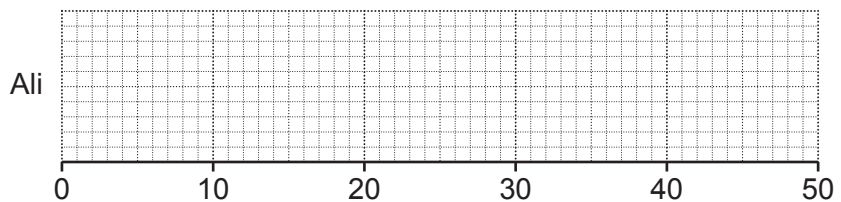
13 Ali and Beth take it in turns to play a computer game. On each turn, the player achieves a score out of 50. Ali and Beth play the computer game many times and record their scores.

(a) Ali's scores are summarised below.

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

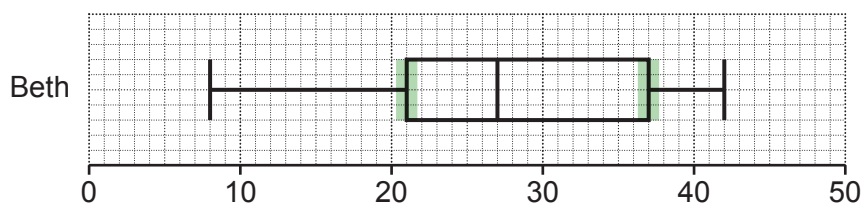
Draw a box plot to show the distribution of Ali's scores.

Draw vertical lines for the lowest, lower quartile, median, upper quartile and highest. Join up the quartiles in a box and connect horizontal lines going to the lowest and highest. The box plot should look like the one in (b). Subtracting the range from the highest score works out the lowest score. Adding the interquartile range to the lower quartile works out the upper quartile.



[3]

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



Find the interquartile range of Beth's scores.

Interquartile range = upper quartile - lower quartile

(b) ..... [2]

(c) Kareem says

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

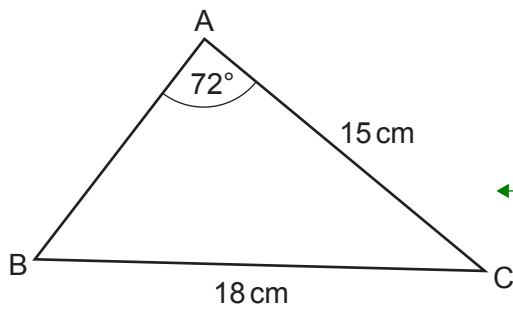
Is his statement correct?  
Explain your reasoning.

No, .....

.....

..... [2]

14 The diagram shows triangle ABC.



**Not to scale**

The triangle is not right angled so neither Pythagoras' theorem or right-angled trigonometry can be used. There is not enough information to use the sine or cosine rule to work out AB yet. Side a is opposite angle A, side b is opposite angle B and side c is opposite angle C

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

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

$$\frac{\sin B}{b} = \frac{\sin A}{a}$$

The sine rule can be used to work out angle B as there are opposite sides and angles

There are 180° in total in a triangle. So subtracting the other angles from 180 works out angle C. Use the exact value of B

$$\frac{c}{\sin C} = \frac{a}{\sin A}$$

The sine rule can now be used to work out side c, length AB

..... 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  $x = 1$

Error: .....  $(3x + 5)(x - 1)$  expands to  $3x^2 + 2x - 5$  .....

Correct solution:

The quadratic is in the form  $ax^2 + bx + c = 0$ . To factorise, find two numbers which multiply to  $ac$  and add to  $b$ . Split the middle  $x$  term into these number of  $x$ . Factorise the left two terms and right two terms separately. Bring into the factorised form. There should be two brackets multiplied together to equal 0. One of the two brackets must be 0 in order to multiply to 0. Set each bracket equal to 0 and rearrange to find  $x$

[3]

(b)

Question:

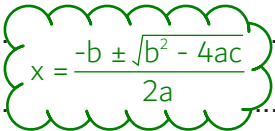
Solve, giving your answers correct to 3 significant figures.

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

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: .....  .....

.....

Correct solution:

[3]



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

Find a formula linking  $x$  and  $y$ .

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

Inversely means '1 over'. Writing out the proportion

The right side can be multiplied by anything and still be directly proportional. Multiplying by  $k$ , which represents a constant value, converts the proportion into an equation. Make  $k$  the subject then substitute in the value of  $x$  and  $y$  to find  $k$ . Substitute the value of  $k$  back into the original equation

..... [3]

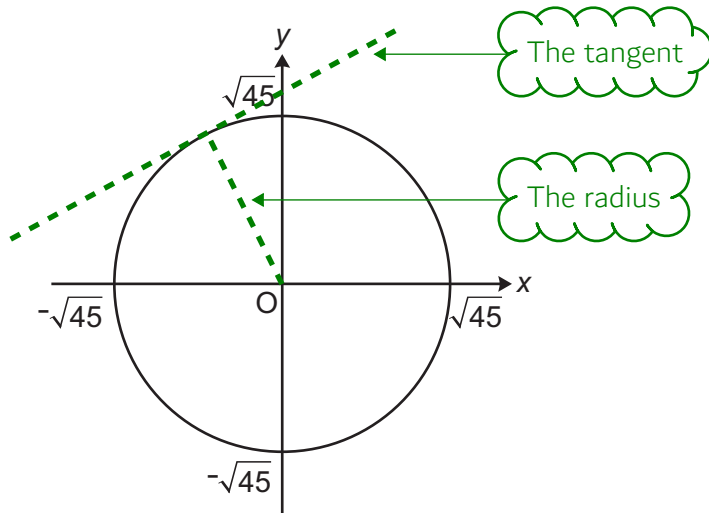
- 17 Expand and simplify.

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

Expand the first two brackets. Simplify the expansion by collecting like terms then write it multiplied by the third bracket. Expand out with the third bracket

..... [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]

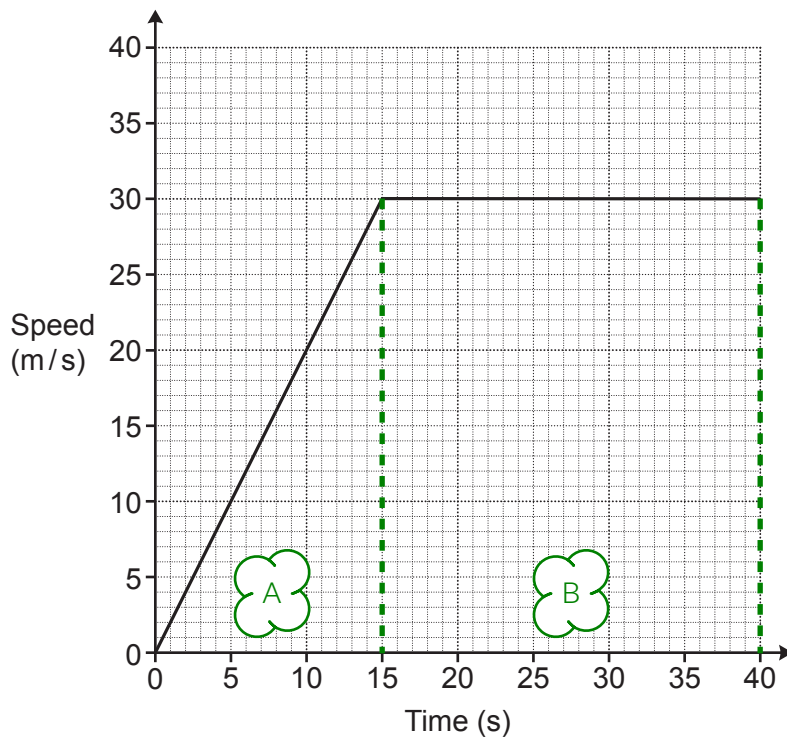
The tangent is perpendicular to the radius. Therefore its gradient is the negative reciprocal of the gradient of the radius. Negative reciprocal means '-1 over'. Gradient = (change in y)/(change in x)

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

The tangent is a straight line so its equation must be  $y = mx + c$ , where  $m$  is the gradient and  $c$  is the  $y$ -intercept. The gradient is  $1/2$ . Rearrange to find  $c$  and substitute in the  $x$  and  $y$ -coordinate from the point on the tangent

(b) ..... [2]

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

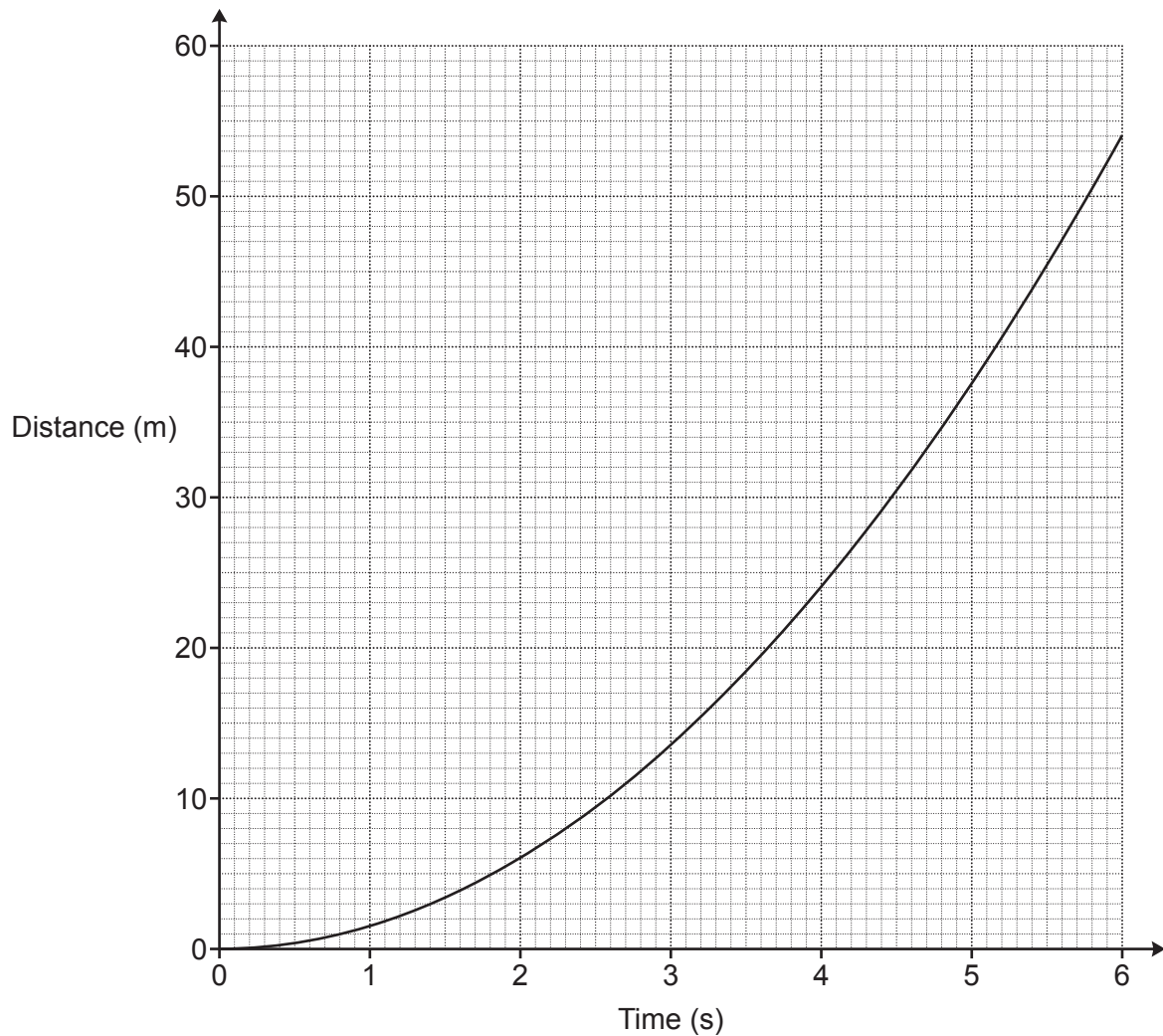


Calculate the distance travelled by the vehicle during the 40 seconds.

Distance on a speed-time graph is equal to the area under the line.  
 Adding the area of triangle A and rectangle B finds this. Area of triangle =  $\frac{1}{2} \times \text{base} \times \text{height}$ . Area of rectangle =  $\text{base} \times \text{height}$

(a) ..... 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.

The unit of m/s means to divide the distance in metres by the time in seconds

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

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

Speed is the gradient on a distance-time graph. Draw a tangent at 4 seconds and work out its gradient. Gradient = (change in y)/(change in x)

(ii) ..... 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.

Square both sides of  $y = x + 2$  to work out what  $y^2$  is in terms of  $x$ . Expand the square bracket by squaring the first term, doubling the product of the two terms and squaring the last term. Substitute the expansion for  $y^2$  in the top equation. There should now be an equation just in terms of  $x$ . This can be rearranged into the quadratic form  $ax^2 + bx + c = 0$  and solved using the quadratic formula. Then substitute the values of  $x$  into the second equation to find  $y$  for each

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$x = \dots\dots\dots y = \dots\dots\dots$$

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

**END OF QUESTION PAPER**

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