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Centre Number					Candidate Number				
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Pearson Edexcel Level 1/Level 2 GCSE (9–1)

Wednesday 14 June 2023

Morning (Time: 1 hour 30 minutes) **Paper reference** **1MA1/3H**

Mathematics
PAPER 3 (Calculator)
Higher Tier



You must have: Ruler graduated in centimetres and millimetres, protractor, pair of compasses, pen, HB pencil, eraser, calculator, Formulae Sheet (enclosed). 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.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

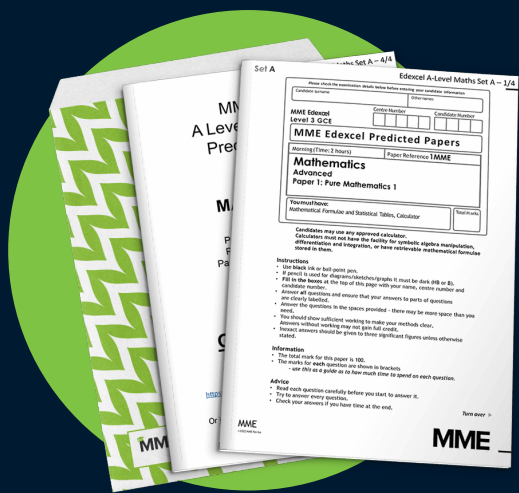
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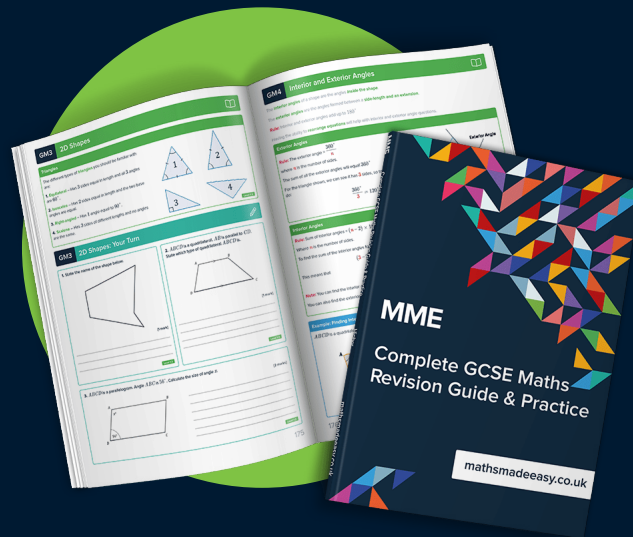



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Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 (a) Simplify $(m^2)^3$

$$m^6$$

(1)

(b) Simplify $x^5 \times x^8$

$$x^{13}$$

(1)

(c) Expand $4p(p^2 + 3p)$

$$4p^3 + 12p^2$$

(2)

(Total for Question 1 is 4 marks)

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2 Jonny wants to know how much coffee he will need for 800 people at a meeting.

Each person who drinks coffee will drink 2 cups of coffee.
10.6 g of coffee is needed for each cup of coffee.

Jonny assumes 68% of the people will drink coffee.

(a) Using this assumption, work out the amount of coffee Jonny needs.
Give your answer correct to the nearest gram.

$68\% \text{ of } 800 = 0.68 \times 800 = 544 \text{ people will have coffee}$

$\text{Each has 2 cups, so } 544 \times 2 = 1088 \text{ cups}$

$10.6 \text{ g per cup so } 1088 \times 10.6 = 11532.8 \text{ g of coffee needed}$
 $11533 \text{ g to nearest gram}$

.....11,533..... g
(4)

Jonny's assumption is wrong.
72% of the people will drink coffee.

(b) How does this affect your answer to part (a)?

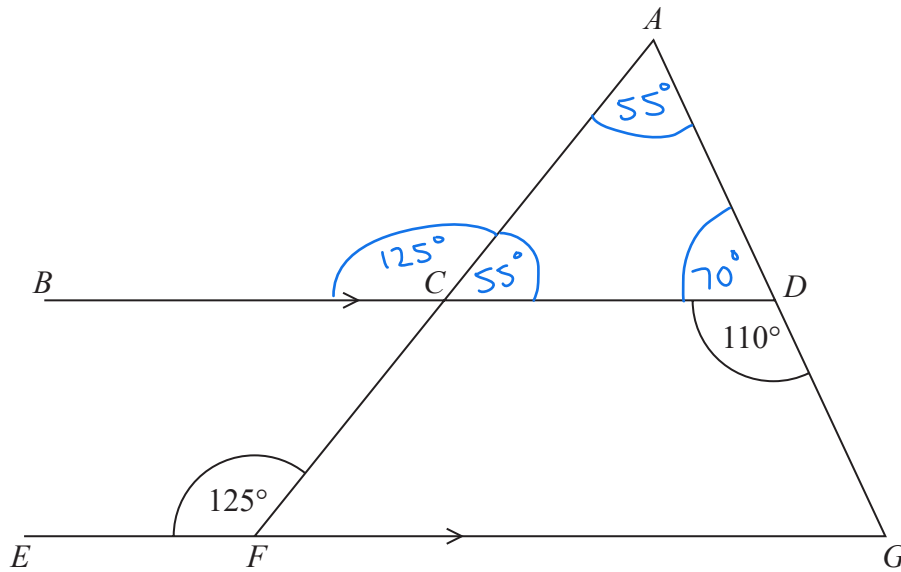
$\text{He will need more coffee}$

(1)

(Total for Question 2 is 5 marks)



- 3 ACF and ADG are straight lines.
 BCD and EFG are parallel lines.



Show that triangle ACD is isosceles.
 Give a reason for each stage of your working.

Angle $BCA = 125^\circ$ as corresponding angles are equal

Angle $DCA = 180 - 125 = 55^\circ$ as angles on a straight line add to 180°

Angle $CDA = 180 - 110 = 70^\circ$ as angles on a straight line add to 180°

Angle $CAD = 180 - 55 - 70 = 55^\circ$ as angles in a triangle add to 180°

As triangle ACD has two equal angles it must be isosceles

(Total for Question 3 is 5 marks)



- 4 It takes 14 hours for 5 identical pumps to fill a water tank.

How many hours would it take 4 of these pumps to fill another water tank of the same size?

$$\begin{array}{l} \div 5 \left\{ \begin{array}{l} 5 \text{ pumps} \rightarrow 14 \text{ hours} \\ 1 \text{ pump} \rightarrow 70 \text{ hours} \end{array} \right. \times 5 \\ \times 4 \left\{ \begin{array}{l} 1 \text{ pump} \rightarrow 70 \text{ hours} \\ 4 \text{ pumps} \rightarrow 17.5 \text{ hours} \end{array} \right. \div 4 \end{array}$$

..... 17.5 hours

(Total for Question 4 is 2 marks)

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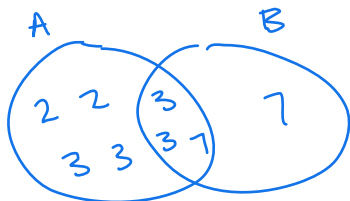


5 A and B are numbers such that

$$A = 2^2 \times 3^4 \times 7$$

$$B = 3^2 \times 7^2$$

(a) Find the highest common factor (HCF) of A and B .



$$\begin{aligned} \text{HCF} &= 2 \times 2 \times 3 \times 3 \times 3 \times 3 \times 7 \times 7 \\ &= 15,876 \end{aligned}$$

$$\underline{15,876}$$

(1)

(b) Find the lowest common multiple (LCM) of A and B .

$$\begin{aligned} \text{LCM} &= 3 \times 3 \times 7 \\ &= 63 \end{aligned}$$

$$\underline{63}$$

(2)

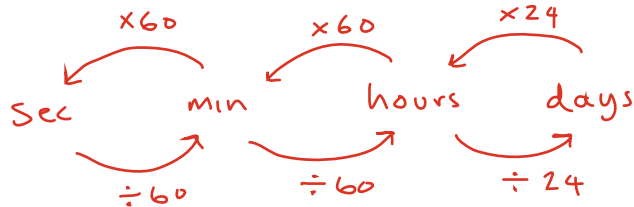
(Total for Question 5 is 3 marks)



- 6 Lava flows from a volcano at a constant rate of $11.9 \text{ m}^3/\text{s}$

How many days does it take for $67\,205\,600 \text{ m}^3$ of lava to flow from the volcano?
Give your answer correct to the nearest day.

$$67,205,600 \div 11.9 = 5,647,529.412 \text{ seconds to flow}$$



$$5,647,529.412 \div 60 \div 60 \div 24 = 65.3649... \text{ days}$$

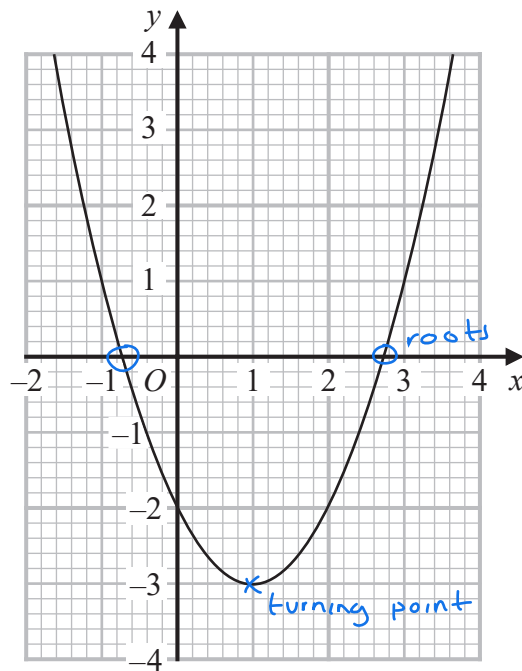
65 to nearest day

.....65 days

(Total for Question 6 is 3 marks)



7 Here is the graph of $y = x^2 - 2x - 2$



(a) Write down the coordinates of the turning point on the graph of $y = x^2 - 2x - 2$

(.....1.....,-3.....)
(1)

(b) Write down an estimate for one of the roots of $x^2 - 2x - 2 = 0$

.....2.7.....
(1)

(Total for Question 7 is 2 marks)

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- 8 A solid cuboid is made of metal.

The metal has a density of 9 g/cm^3
The volume of the cuboid is 72 cm^3



Work out the mass of the cuboid.

$$\begin{aligned} \text{mass} &= \text{density} \times \text{volume} \\ &= 9 \times 72 \\ &= 648 \text{ g} \end{aligned}$$

..... 648 g

(Total for Question 8 is 2 marks)

- 9 Some people were asked if they wanted a new television.

70% of the people said yes. 0.7

80% of the people who said yes wanted a television with a large screen. 0.8

What percentage of the people asked said they wanted a television with a large screen?

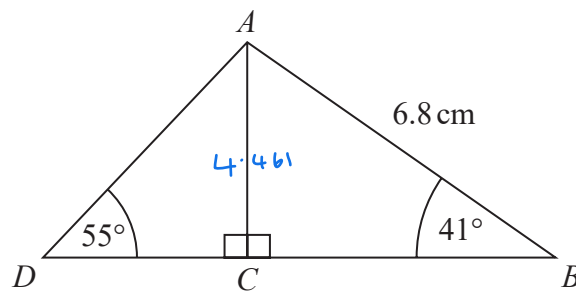
$$\begin{aligned} 0.7 \times 0.8 &= 0.56 \\ &= 56\% \end{aligned}$$

..... 56 %

(Total for Question 9 is 2 marks)



- 10 ABD is a triangle.
 C is a point on BD .



Work out the length of DC .
 Give your answer correct to 1 decimal place.

$$\sin 41 = \frac{AC}{6.8}$$

$$\sin 41 \times 6.8 = AC$$

$$AC = 4.461 \dots \text{ cm}$$

$$\tan 55 = \frac{4.461}{DC}$$

$$DC = \frac{4.461}{\tan 55}$$

$$DC = 3.1237 \dots$$

$$DC = 3.1 \text{ cm (1 dp)}$$

..... 3.1 cm

(Total for Question 10 is 3 marks)



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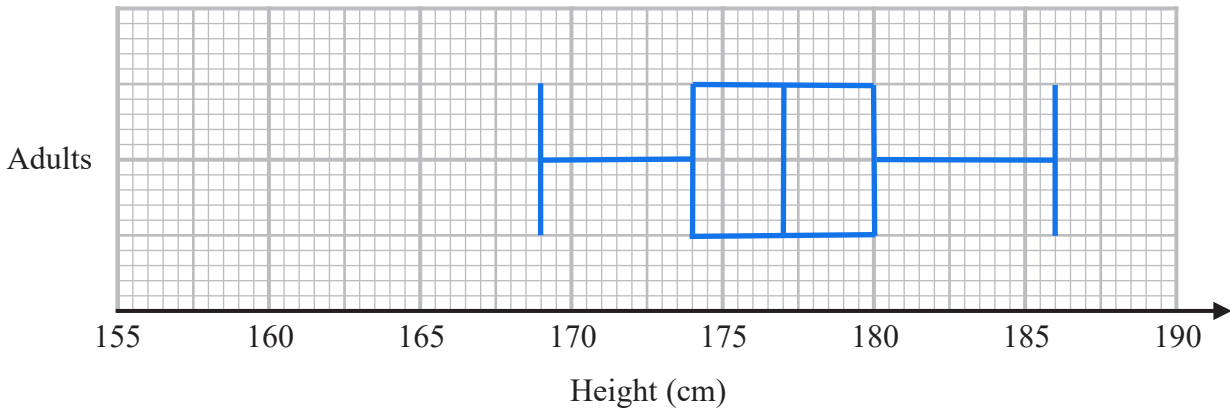
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11 The table shows some information about the heights of a group of adults.

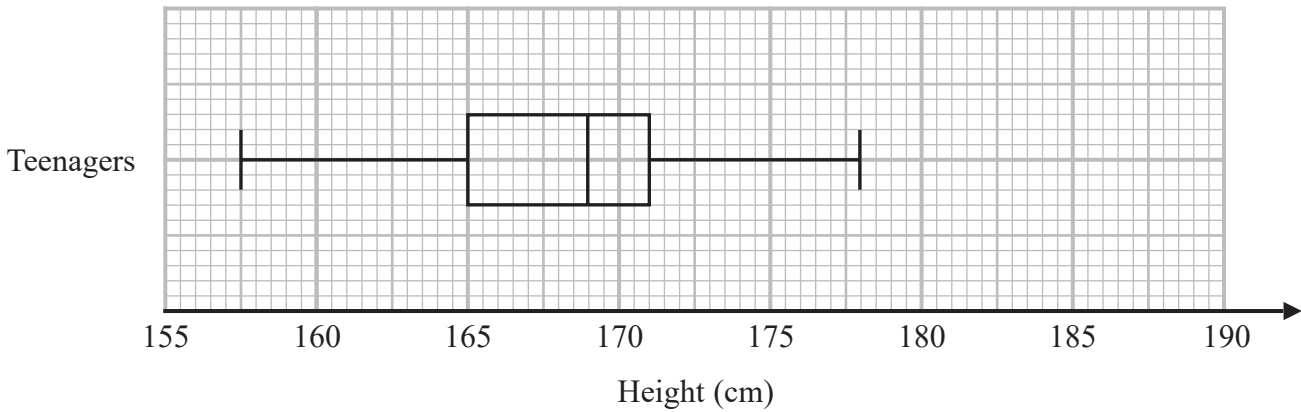
least height	169 cm
greatest height	186 cm
median	177 cm
lower quartile	174 cm
upper quartile	180 cm

(a) On the grid, draw a box plot for the information in the table.



(3)

The box plot below shows the distribution of the heights of a group of teenagers.



(b) Compare the distribution of the heights of the adults with the distribution of the heights of the teenagers.

Median for adults is greater than median for teenagers

Interquartile range is the same for adults and teenagers

(2)

(Total for Question 11 is 5 marks)



- 12 Show that $(x-1)(x+3)(x-5)$ can be written in the form $ax^3 + bx^2 + cx + d$ where a, b, c and d are integers.

$$(x-1)(x^2 + 3x - 5x - 15)$$

$$(x-1)(x^2 - 2x - 15)$$

$$x^3 - 2x^2 - 15x - x^2 + 2x + 15$$

$$x^3 - 3x^2 - 13x + 15$$

(Total for Question 12 is 3 marks)

- 13 An expression for the n th term of the sequence of triangular numbers is $\frac{n(n+1)}{2}$

Prove that the sum of any two consecutive triangular numbers is a square number.

Say first triangular number is $\frac{n(n+1)}{2}$

Then next consecutive triangular number is $\frac{(n+1)(n+2)}{2}$

The sum of these is $\frac{n(n+1)}{2} + \frac{(n+1)(n+2)}{2} = \frac{n(n+1) + (n+1)(n+2)}{2}$

$$= \frac{n^2 + n + n^2 + 3n + 2}{2}$$

$$= \frac{2n^2 + 4n + 2}{2}$$

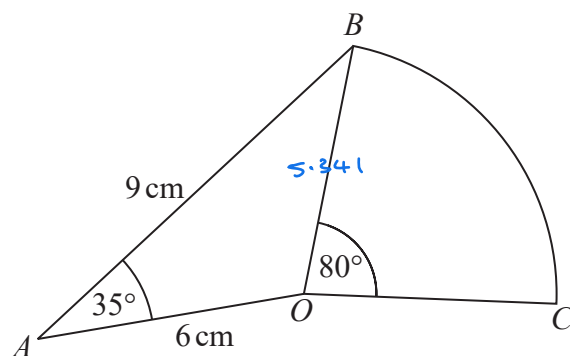
$$= n^2 + 2n + 1 = (n+1)^2$$

always a square number
↙

(Total for Question 13 is 3 marks)



- 14 OAB is a triangle.
 OBC is a sector of a circle, centre O .



Calculate the area of OBC .

Give your answer correct to 3 significant figures.

$$\text{using cosine rule, } OB^2 = 9^2 + 6^2 - 2 \times 9 \times 6 \times \cos 35$$

$$OB^2 = 28.531\dots$$

$$OB = 5.341\dots$$

So radius of circle is 5.341 cm

$$\text{Area of Sector} = \frac{80}{360} \times \pi \times 5.341^2$$

$$= 19.9 \text{ cm}^2 \text{ (3sf)}$$

.....19.9..... cm^2

(Total for Question 14 is 4 marks)



15 (a) Factorise $a^2 - b^2$

$$(a+b)(a-b)$$

(1)

(b) Show that $2^{40} - 1$ is the product of two consecutive odd numbers.

$$2^{40} - 1 = (2^{20} - 1)(2^{20} + 1)$$

2^{20} is even, so $2^{20} - 1$ must be odd

$2^{20} + 1$ must also be odd

So $(2^{20} - 1)(2^{20} + 1)$ is two odd numbers multiplied together

(2)

(Total for Question 15 is 3 marks)

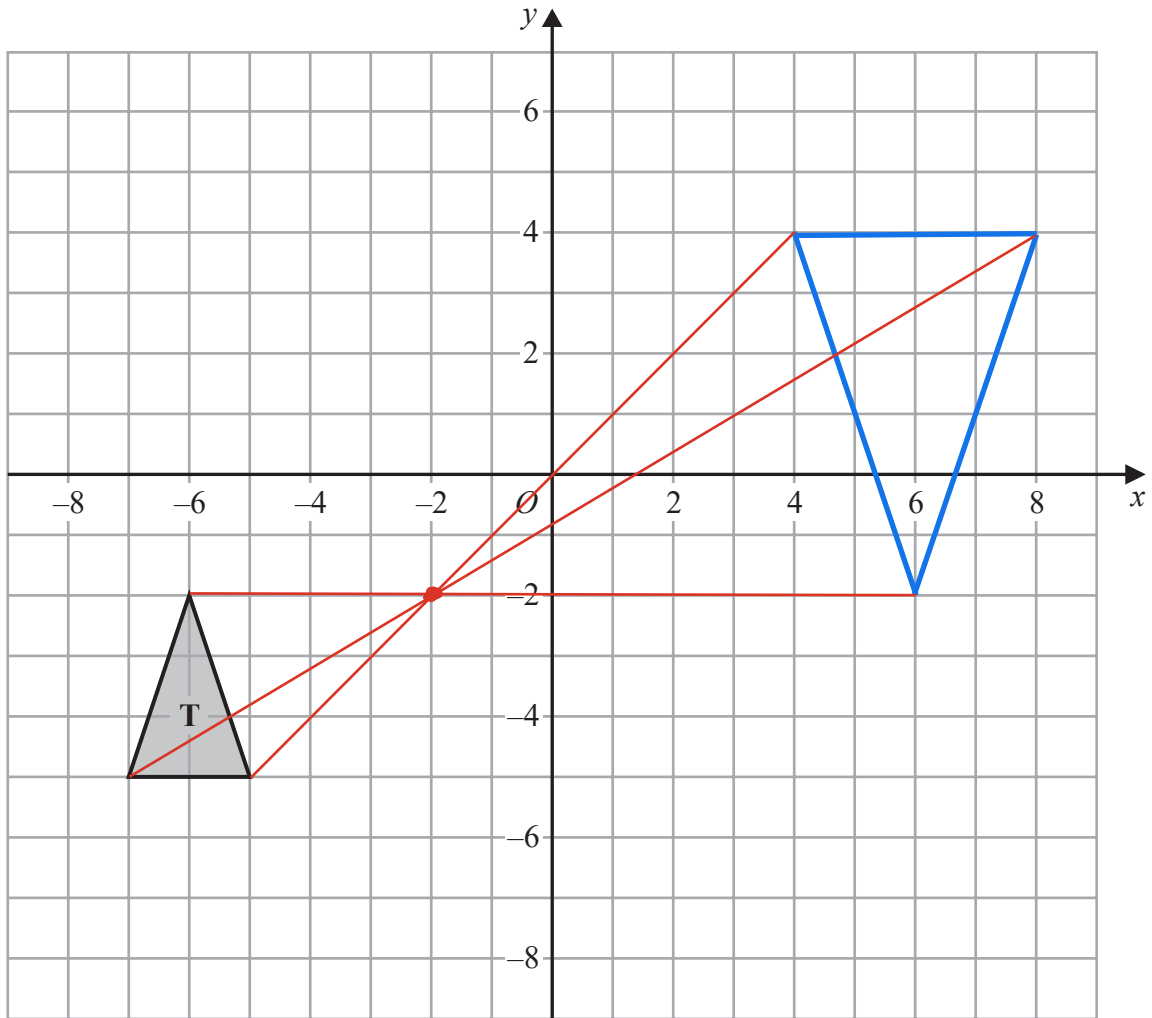
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16



On the grid, enlarge triangle **T** by scale factor -2 with centre of enlargement $(-2, -2)$

(Total for Question 16 is 2 marks)

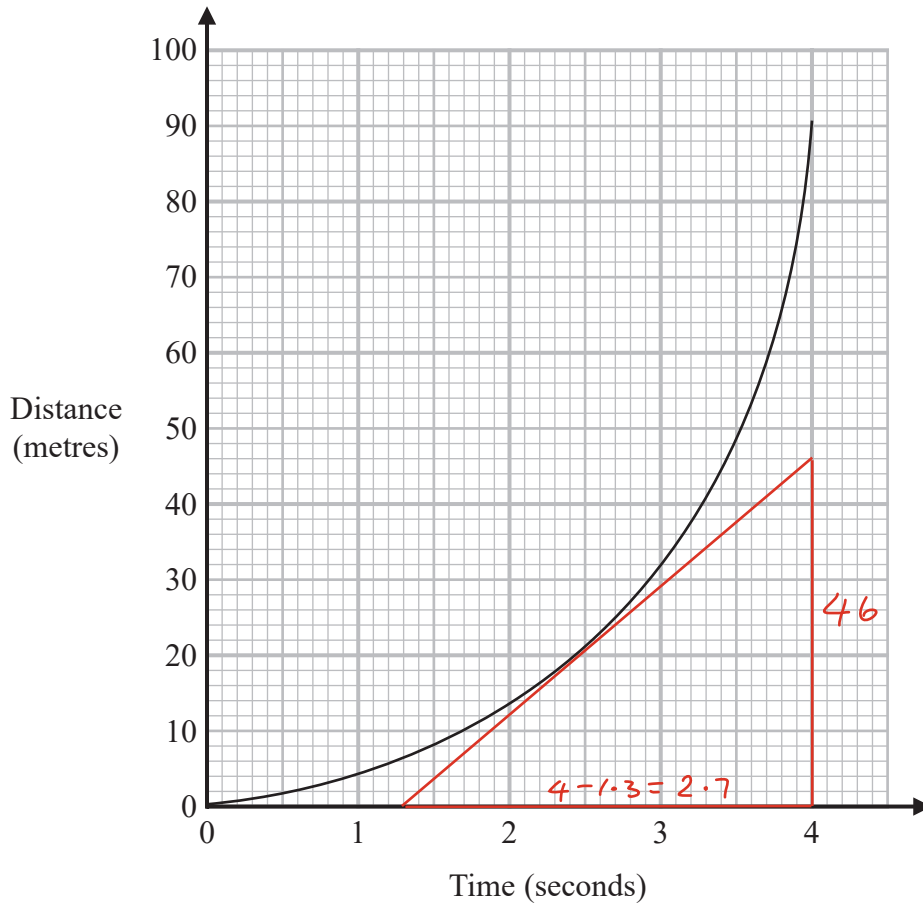
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17 Here is a distance-time graph.



- (a) Find an estimate of the gradient of the graph at time 2.5 seconds.
You must show how you get your answer.

$$\text{gradient of tangent} = \frac{46}{2.7} = 17.04 \quad (2 \text{ dp})$$

17.04
(3)

- (b) What does the gradient of the graph represent?

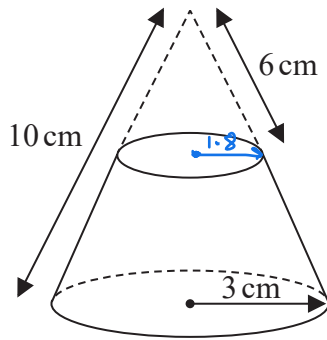
Speed

(1)

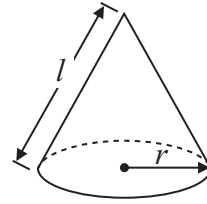
(Total for Question 17 is 4 marks)



- 18 A solid frustum is made by removing a small cone from a large cone as shown in the diagram.



Curved surface area of cone = $\pi r l$



The slant height of the small cone is 6 cm.
The slant height of the large cone is 10 cm.
The radius of the base of the large cone is 3 cm.

Calculate the total surface area of the frustum.
Give your answer correct to 3 significant figures.

length scale factor for large cone to small cone is $\frac{6}{10}$

So radius of small cone is $3 \times \frac{6}{10} = 1.8 \text{ cm}$

Curved surface area of large cone = $\pi \times 3 \times 10 = 30\pi$

curved surface area of small cone = $\pi \times 1.8 \times 6 = 10.8\pi$

curved surface area of frustum = $30\pi - 10.8\pi$
= 19.2π

base of frustum = $\pi \times 3^2 = 9\pi$

top of frustum = $\pi \times 1.8^2 = 3.24\pi$

Total surface area of frustum = $19.2\pi + 9\pi + 3.24\pi$
= 31.44π
= 98.8 cm^2 (3sf)

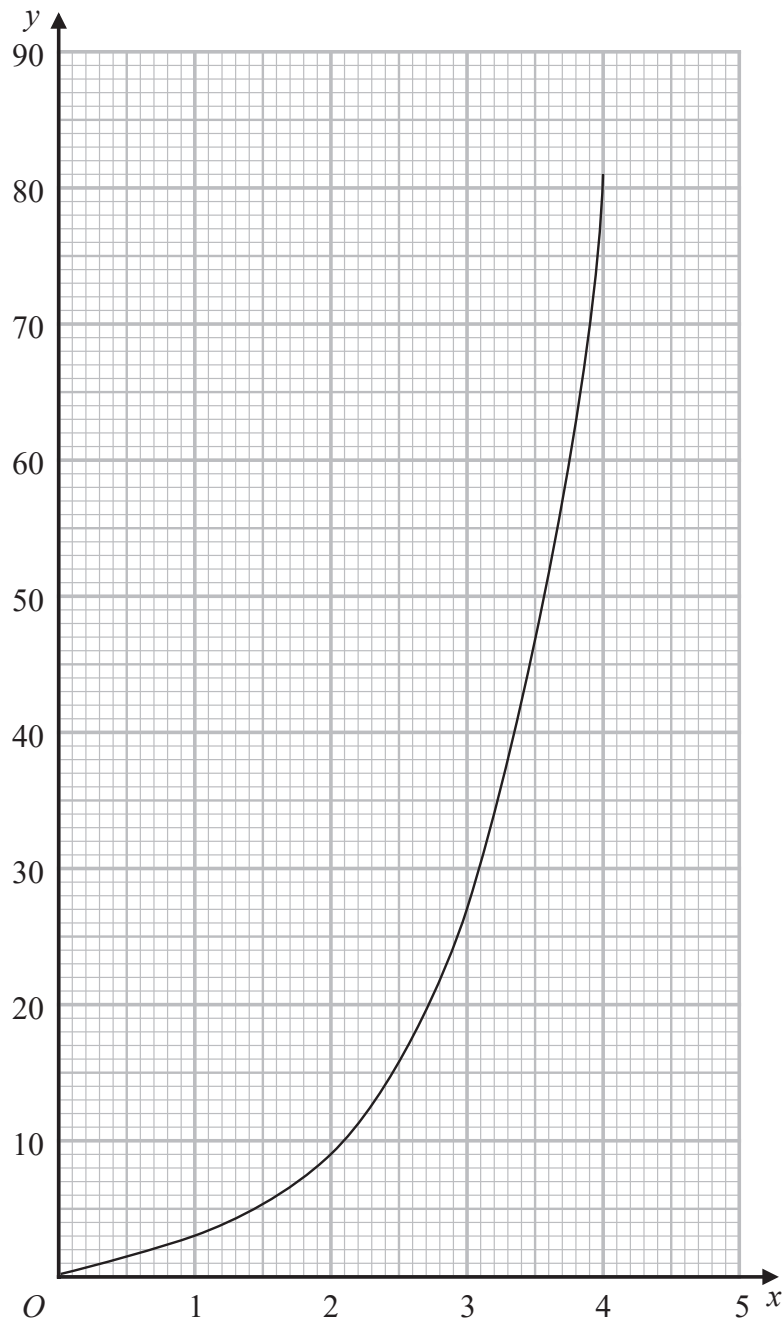
..... 98.8 cm^2

(Total for Question 18 is 5 marks)



19 Sana needs to draw the graph of $y = 3^x$ for $0 \leq x \leq 4$

She draws the graph shown on the grid.



Write down one thing Sana has done wrong.

$3^0 = 1$ and her graph shows $3^0 = 0$

(Total for Question 19 is 1 mark)



20 Prove algebraically that $0.1\dot{2}3$ can be written as $\frac{61}{495}$

$$x = 0.1232323\dots$$

$$100x = 12.3232323\dots$$

$$99x = 12.2$$

$$x = \frac{12.2}{99} = \frac{122}{990} = \frac{61}{495}$$

(Total for Question 20 is 3 marks)



21 Solve $\frac{1}{x+4} + \frac{3}{2-2x} = 1$

$$2 - 2x + 3(x+4) = (x+4)(2-2x)$$

$$2 - 2x + 3x + 12 = -2x^2 + 2x + 8 - 8x$$

$$x + 14 = -2x^2 - 6x + 8$$

$$2x^2 + 7x + 6 = 0$$

$$(2x+3)(x+2) = 0$$

$$2x+3=0 \quad \text{or} \quad x+2=0$$

$$2x = -3 \quad \quad \quad x = -2$$

$$x = -\frac{3}{2}$$

$$x = -2 \text{ or } x = -\frac{3}{2}$$

(Total for Question 21 is 4 marks)



22 Given that the vector $a\begin{pmatrix} 2 \\ 6 \end{pmatrix} + b\begin{pmatrix} 8 \\ 2 \end{pmatrix}$ is parallel to the vector $\begin{pmatrix} 13 \\ 6 \end{pmatrix}$

find an expression for b in terms of a .

$$a\begin{pmatrix} 2 \\ 6 \end{pmatrix} + b\begin{pmatrix} 8 \\ 2 \end{pmatrix} = k\begin{pmatrix} 13 \\ 6 \end{pmatrix}$$

← must be a multiple of $\begin{pmatrix} 13 \\ 6 \end{pmatrix}$
as parallel to it

$$2a + 8b = 13k \quad - (1) \quad (k \text{ cannot be } 0 \text{ or } 1)$$

$$6a + 2b = 6k \quad - (2)$$

$$(2) \times 4 \text{ gives } 24a + 8b = 24k \quad - (3)$$

$$(3) - (1) \text{ gives } 22a = 11k$$

$$2a = k$$

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

$$\text{Substitute into (1)} \quad 2\left(\frac{k}{2}\right) + 8b = 13k$$

$$b = 3a$$

$$k + 8b = 13k$$

(Total for Question 22 is 3 marks)

$$8b = 12k$$

$$b = \frac{12k}{8} = \frac{3k}{2} = 3 \times a$$

$$\text{So } b = 3a$$



23 A circle has equation $x^2 + y^2 = 25$ circle centre $(0,0)$ radius 5

The point P with coordinates $(-3, 4)$ lies on the circle.

Alex says that the tangent to the circle at P crosses the x -axis at the point $(-8, 0)$

Is Alex correct?

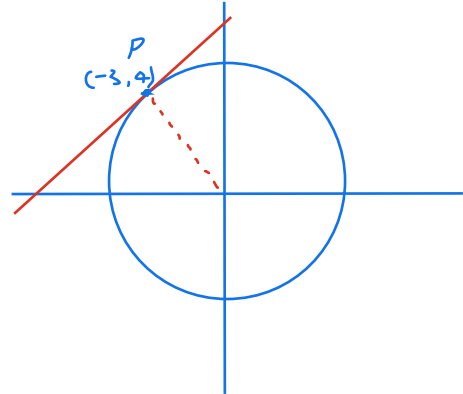
You must show how you get your answer.

gradient of normal (dotted line)

$$\text{is } \frac{4-0}{-3-0} = -\frac{4}{3}$$

so gradient of tangent is $\frac{3}{4}$

as tangent and normal are perpendicular



Equation of tangent is of the form $y = \frac{3}{4}x + c$

through the point $(-3, 4)$ so $4 = \frac{3}{4}x - 3 + c$

$$4 = -\frac{9}{4} + c$$

$$c = \frac{25}{4}$$

So tangent is $y = \frac{3}{4}x + \frac{25}{4}$

Using this equation, when $x = -8$, $y = \frac{3}{4}x - 8 + \frac{25}{4}$

$$y = \frac{1}{4}$$

← not 0, so tangent does not pass through $(-8, 0)$

Alex is not correct

(Total for Question 23 is 4 marks)



