

Please check the examination details below before entering your candidate information

Candidate surname

Other names

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  $\pi$  button, take the value of  $\pi$  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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P 7 5 1 5 2 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  $(m^2)^3$

$$\begin{array}{r} m^6 \\ \hline (1) \end{array}$$

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

$$\begin{array}{r} x^{13} \\ \hline (1) \end{array}$$

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

$$\begin{array}{r} 4p^3 + 12p^2 \\ \hline (2) \end{array}$$

(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.

$$2 \times 10.6 = 21.2 \quad (\text{grams of coffee})$$

$$0.68 \times 800 = 544 \quad (\text{people})$$

$$544 \times 21.2 = 11532.8$$

$$\begin{array}{r} 11533 \\ \hline \end{array} \text{ g}$$

(4)

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

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

He will need more coffee

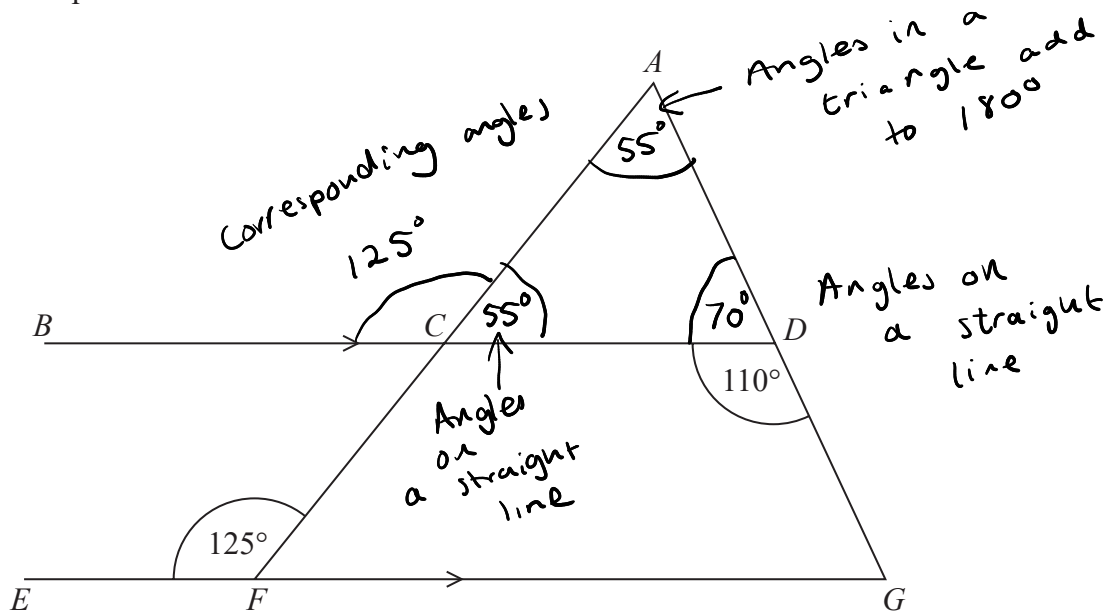
(1)

(Total for Question 2 is 5 marks)



P 7 5 1 5 2 A 0 3 2 4

- 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.

2 equal angles  $\therefore$  isosceles

(Total for Question 3 is 5 marks)



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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?

$$14 \times 5 = 70 \quad (\text{hours needed})$$

$$\frac{70}{4} = \underline{\underline{17.5}}$$

17.5 hours

(Total for Question 4 is 2 marks)

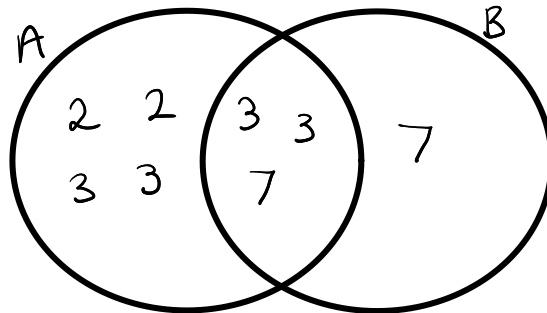


5  $A$  and  $B$  are numbers such that

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

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

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



$$3 \times 3 \times 7$$

63

(1)

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

$$A \times 7$$
$$2268 \times 7 = 15876$$

15876

(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  $67205600\text{m}^3$  of lava to flow from the volcano?  
Give your answer correct to the nearest day.

$$\frac{67205600}{11.9} = 5647529.4 \text{ seconds}$$

$$\frac{5647529.4}{60} = 94125 \text{ minutes}$$

$$\frac{94125.5}{60} = 1568.758... \text{ hours}$$

$$\frac{1568.7}{24} = 65 \text{ days} \dots\dots\dots 65 \text{ days}$$

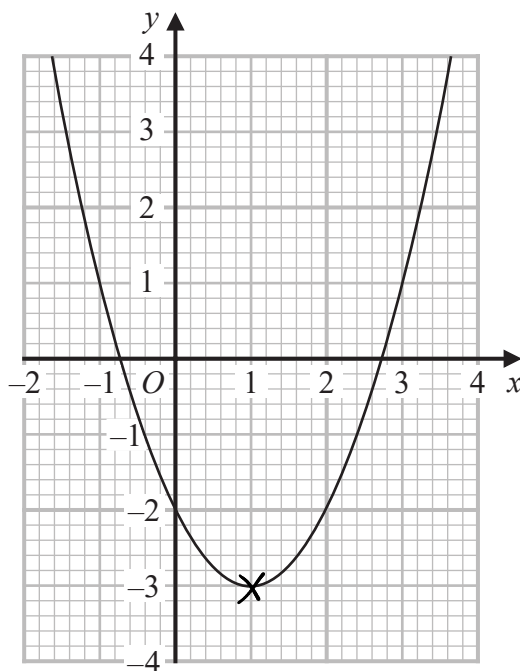
(Total for Question 6 is 3 marks)

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P 7 5 1 5 2 A 0 7 2 4

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)

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

.....  
(1)  
(..... or .....)

(Total for Question 7 is 2 marks)

-0.8 to -0.6 or 2.6 to 2.8

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8 A solid cuboid is made of metal.

The metal has a density of  $9 \text{ g/cm}^3$   
The volume of the cuboid is  $72 \text{ cm}^3$

$$d = \frac{m}{v}$$
$$m = d \times v$$

Work out the mass of the cuboid.

$$9 \times 72$$

..... 648 .....

(Total for Question 8 is 2 marks)

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

70% of the people said yes.  
80% of the people who said yes wanted a television with a large screen.

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

$$0.7 \times 0.8 = 0.56$$
$$(56\%)$$

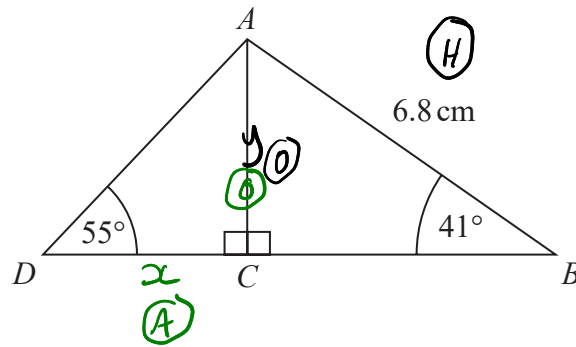
..... 56 .....

(Total for Question 9 is 2 marks)



P 7 5 1 5 2 A 0 9 2 4

- 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.

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

$$y = 6.8 \sin 41$$

$$= 4.46 \text{ cm}$$

$$\tan 55 = \frac{4.46}{x}$$

$$x = \frac{4.46}{\tan(55)}$$

$$= \underline{\underline{3.1}} \text{ cm}$$

..... 3.1 ..... cm

(Total for Question 10 is 3 marks)

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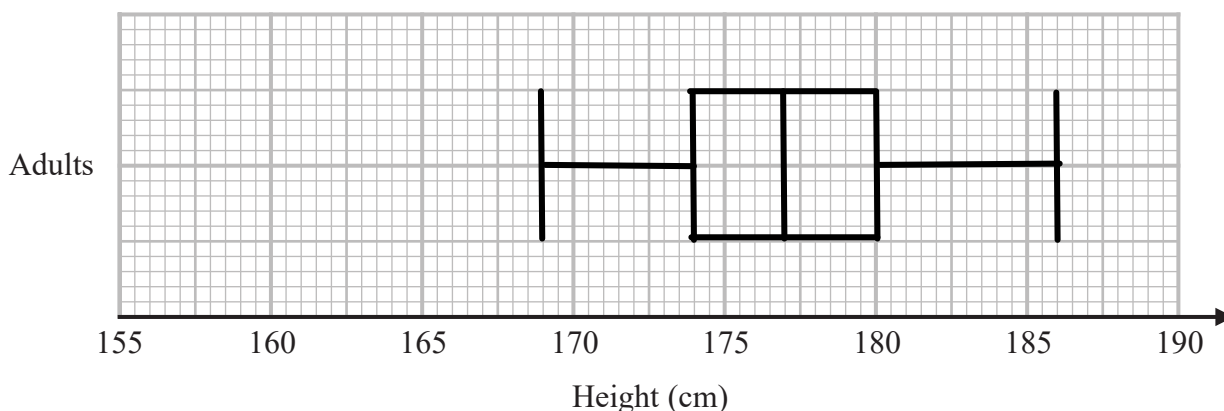
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11 The table shows some information about the heights of a group of adults.

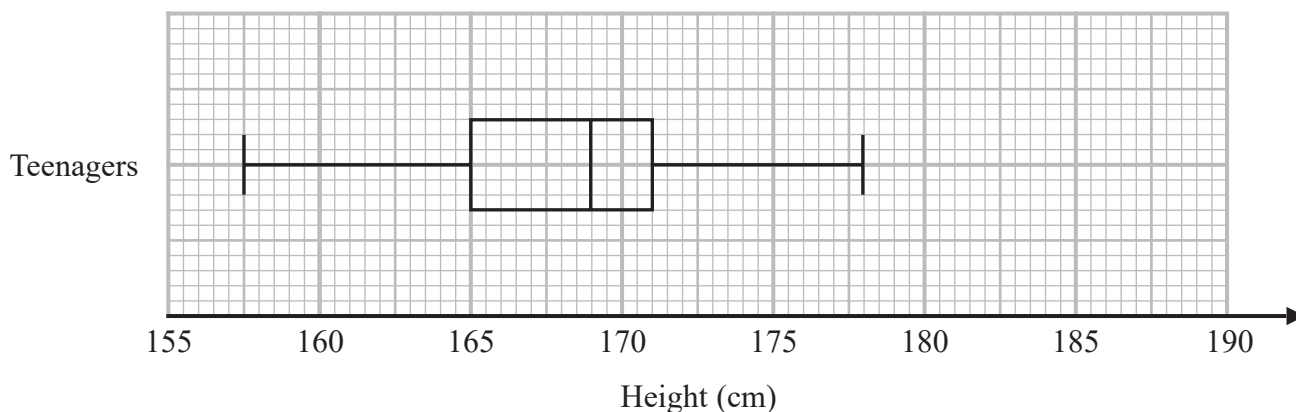
least height	169 cm
greatest height	186 cm
median	177 cm
lower quartile	174 cm
upper quartile	180 cm

(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.

The adults have a higher median height.

The interquartile range is the same for both groups - same spread of heights.

(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.

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

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

$$x^3 - 5x^2 + 2x^2 - 10x - 3x + 15$$

$$\underline{\underline{x^3 - 3x^2 - 13x + 15}}$$

(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.

$$\frac{n(n+1)}{2} + \frac{(n+1)(n+2)}{2}$$

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

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

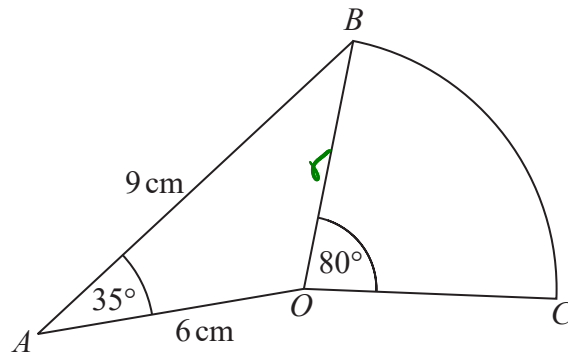
$$\begin{aligned} \frac{2n^2 + 4n + 2}{2} &= n^2 + 2n + 1 \\ &= (n+1)(n+1) \\ &= (n+1)^2 \end{aligned}$$

$\therefore$  Square number  $\longrightarrow$  (Total for Question 13 is 3 marks)



$$a^2 = b^2 + c^2 - 2bc \cos A$$

- 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.

$$r^2 = 9^2 + 6^2 - 2(9)(6) \cos(35)$$

$$r^2 = 28.53$$

$$r = 5.34$$

$$\begin{aligned} \text{Area of } OBC &= \frac{80}{360} \times \pi (5.34)^2 \\ &= \underline{\underline{19.9 \text{ cm}^2}} \end{aligned}$$

.....19.9 cm<sup>2</sup>

(Total for Question 14 is 4 marks)



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

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

$$\underline{(a + b)(a - b)}$$

(1)

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

$$2^{40} = (2^{20})^2$$

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

$2^{20}$  must be even  $\therefore 2^{20} - 1$  and  $2^{20} + 1$  are consecutive odd numbers

(2)

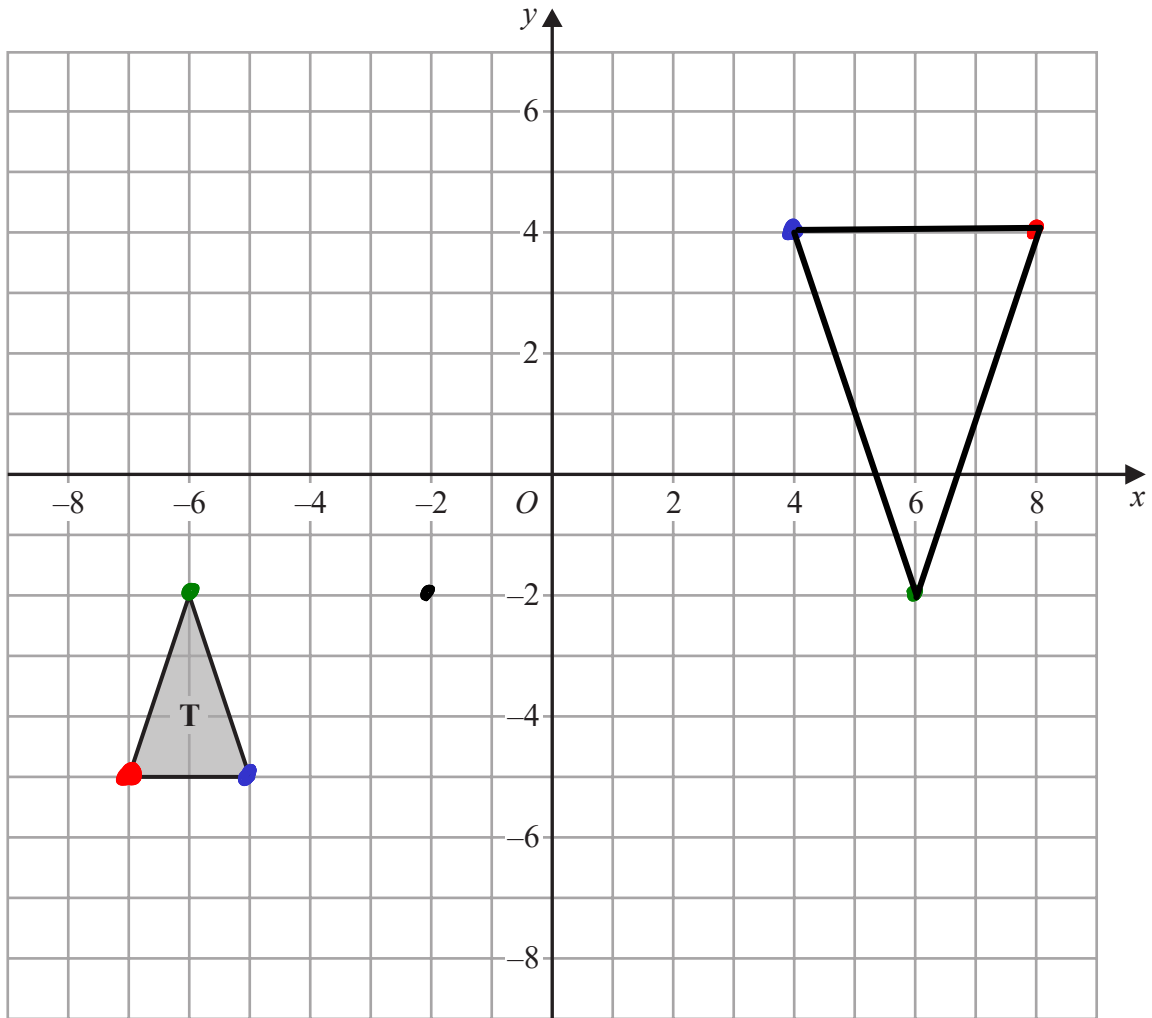
(Total for Question 15 is 3 marks)

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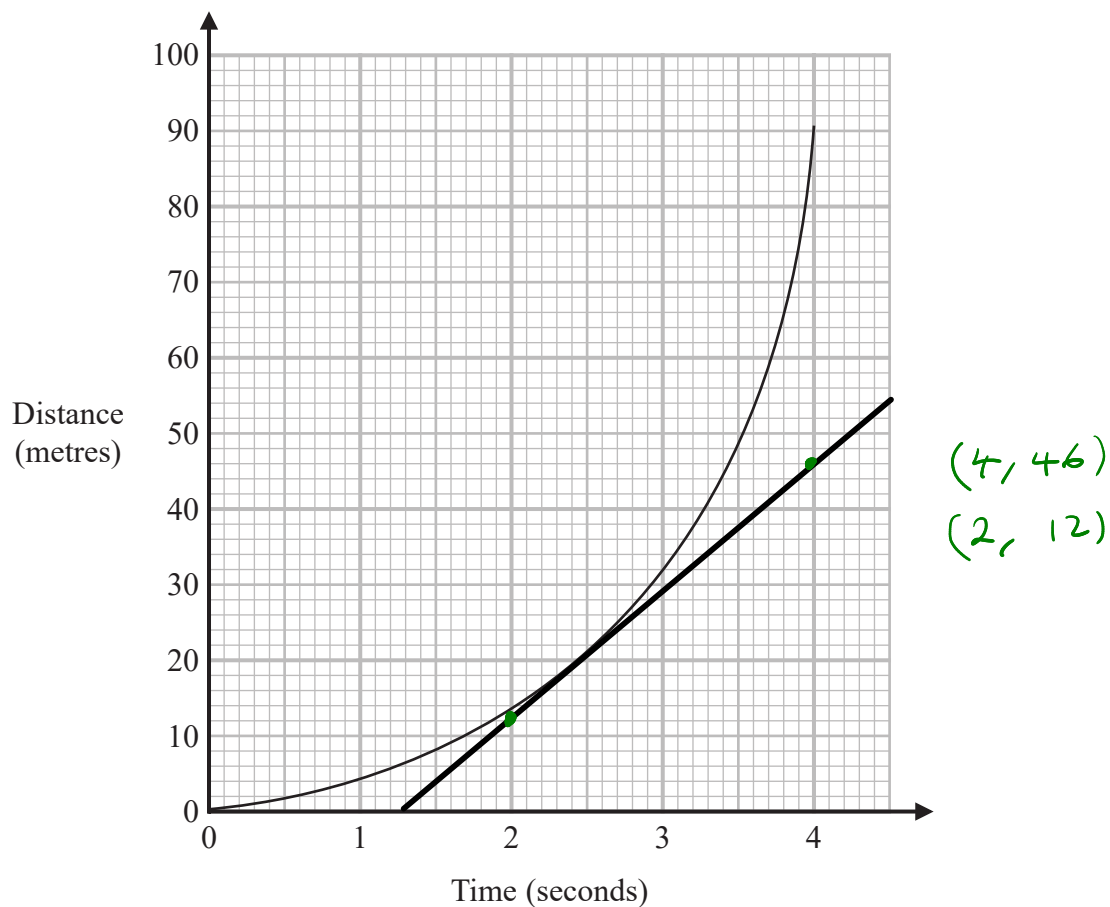
On the grid, enlarge triangle T by scale factor  $-2$  with centre of enlargement  $(-2, -2)$

(Total for Question 16 is 2 marks)

$$\begin{pmatrix} -4 \\ 0 \end{pmatrix} \times -2 = \begin{pmatrix} 8 \\ 0 \end{pmatrix} \quad \begin{pmatrix} -3 \\ -3 \end{pmatrix} \times -2 = \begin{pmatrix} 6 \\ 6 \end{pmatrix}$$

$$\begin{pmatrix} -5 \\ -3 \end{pmatrix} \times -2 = \begin{pmatrix} 10 \\ 6 \end{pmatrix}$$

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.

$$\begin{aligned} \text{gradient} &= \frac{\text{change in } y}{\text{change in } x} \\ &= \frac{46 - 12}{4 - 2} \\ &= \frac{34}{2} = \underline{\underline{17}} \end{aligned}$$

$$\frac{17}{(3)} \\ (16.5 \text{ to } 19.5)$$

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

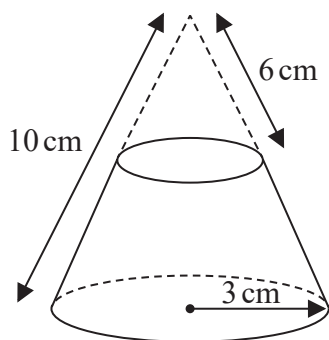
The speed.

(1)

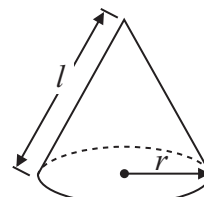
(Total for Question 17 is 4 marks)



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

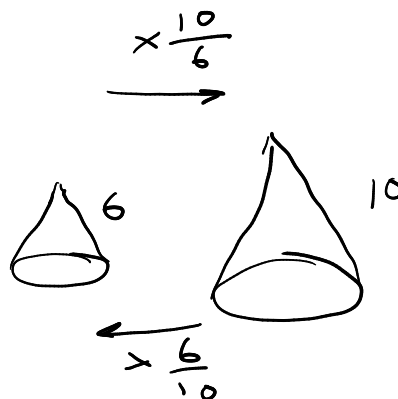


Curved surface area of cone =  $\pi r l$



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.



$$\text{radius of top} = \frac{6}{10} \times 3 = \underline{1.8 \text{ cm}}$$

$$\begin{aligned} \text{Curved s.a. of big cone} &= \pi (3)(10) \\ &= 30\pi \end{aligned}$$

$$\begin{aligned} \text{Curved s.a. of small cone} &= \pi (1.8)(6) \\ &= \frac{54}{5}\pi \end{aligned}$$

$$\begin{aligned} \text{Curved s.a. of frustum} &= 30\pi - \frac{54}{5}\pi \\ &= \underline{\underline{\frac{96}{5}\pi}} \end{aligned}$$

$$\begin{aligned} \text{Area of base} &= \pi (3)^2 \\ &= \underline{9\pi} \end{aligned}$$

$$\begin{aligned} \text{Area of top} &= \pi (1.8)^2 \\ &= \underline{\underline{\frac{81}{25}\pi}} \end{aligned}$$

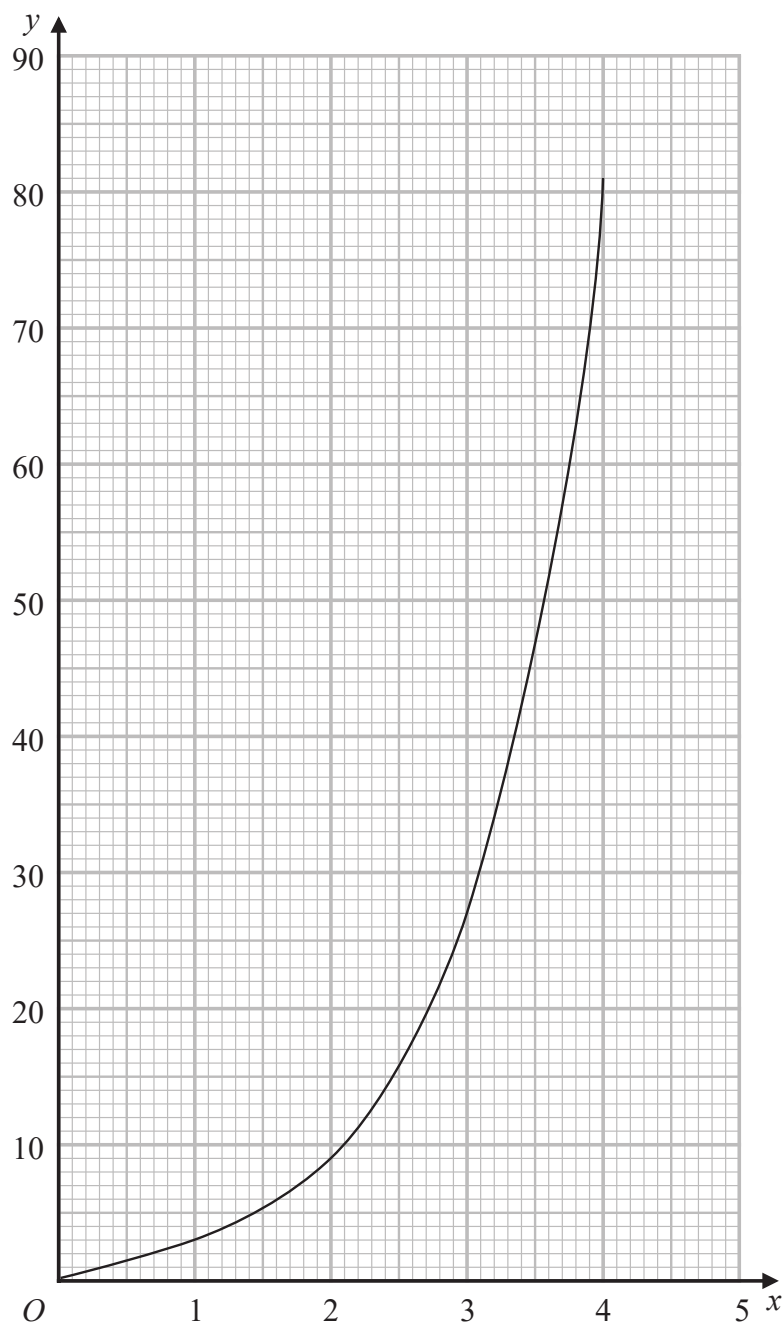
$$\begin{aligned} &\frac{96}{5}\pi + 9\pi + \frac{81}{25}\pi \\ &= \underline{\underline{98.8 \text{ cm}^2}} \\ &\dots\dots\dots 98.8 \dots\dots\dots \text{cm}^2 \end{aligned}$$

(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.

The graph should go through  $(0,1)$  not  $(0,0)$ .

(Total for Question 19 is 1 mark)



20 Prove algebraically that  $0.\dot{1}\dot{2}\dot{3}$  can be written as  $\frac{61}{495}$

$$\begin{aligned}0.\dot{1}\dot{2}\dot{3} &= x \\1.\dot{2}\dot{3} &= 10x \\123.\dot{2}\dot{3} &= 1000x \\122 &= 990x \\x &= \frac{122}{990} \\&= \frac{61}{495}\end{aligned}$$

(Total for Question 20 is 3 marks)



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

$$\frac{1(2-2x)}{(x+4)(2-2x)} + \frac{3(x+4)}{(x+4)(2-2x)} = 1$$

$$\frac{2-2x}{(x+4)(2-2x)} + \frac{3x+12}{(x+4)(2-2x)} = 1$$

$$\frac{2-2x+3x+12}{(x+4)(2-2x)} = 1$$

$$\frac{14+x}{(x+4)(2-2x)} = 1$$

$$14+x = (x+4)(2-2x)$$

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

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

$$2x^2 + 4x + 3x + 6 = 0$$

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

$$\underline{\underline{x = -1.5}} \quad \underline{\underline{x = -2}}$$

$$\underline{\underline{x = -1.5, x = -2}}$$

(Total for Question 21 is 4 marks)



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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  $a$ .

$$2a + 8b = 13x$$

$$6a + 2b = 6x$$

$$\frac{2}{13}a + \frac{8}{13}b = x$$

$$a + \frac{1}{3}b = x$$

$$\frac{2}{13}a + \frac{8}{13}b = a + \frac{1}{3}b$$

$$\frac{8}{13}b = \frac{11}{13}a + \frac{1}{3}b$$

$$\frac{11}{39}b = \frac{11}{13}a$$

$$\underline{\underline{b = 3a}}$$

$$b = 3a$$

(Total for Question 22 is 3 marks)



23 A circle has equation  $x^2 + y^2 = 25$

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

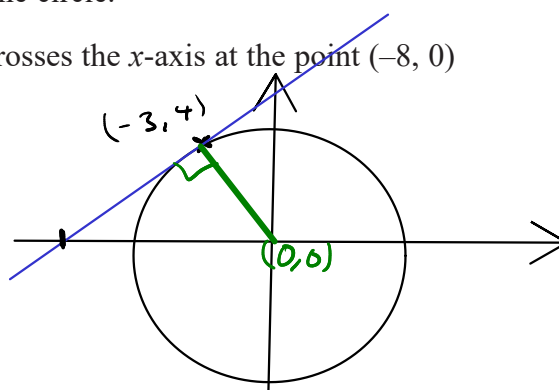
Alex says that the tangent to the circle at  $P$  crosses the  $x$ -axis at the point  $(-8, 0)$

Is Alex correct?

You must show how you get your answer.

$$\text{gradient} = \frac{\text{change in } y}{\text{change in } x}$$

$$\text{gradient of } r = \frac{4}{-3}$$



$$\therefore \text{gradient of tangent} = \frac{3}{4}$$

$$\text{equation: } y = \frac{3}{4}x + c \quad \begin{matrix} x & y \\ (-3, & 4) \end{matrix}$$

$$4 = \frac{3}{4}(-3) + c$$

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

$$c = 6.25 \text{ or } \frac{25}{4}$$

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



Crosses  $x$  when  $y=0$

$$0 = \frac{3}{4}x + \frac{25}{4}$$

$$0 = 3x + 25$$

$$\frac{-25}{3} = x$$

$$x = -8.\bar{3}$$

$(-8.\bar{3}, 0)$  not  $(-8, 0)$  No.

(Total for Question 23 is 4 marks)



24 There is a total of  $y$  counters in a box.

There are  $x$  pink counters and 5 blue counters in the box.  
The rest of the counters are green.

$$x:y = 1:3 \quad \frac{1}{3} \text{ pink, } 5 \text{ blue, the rest green}$$

Freda takes at random two counters from the box.

Find, in terms of  $x$ , an expression for the probability that Freda takes two counters of the same colour.

Give your answer as a fraction in the form  $\frac{ax^2 + bx + c}{dx^2 + ex}$  where  $a, b, c, d$  and  $e$  are integers.

$$y = 3x \quad \text{total} = 3x$$

$$P(2 \text{ pink}) = \frac{1}{3} \times \frac{x-1}{3x-1}$$

$$P(2 \text{ blue}) = \frac{5}{3x} \times \frac{4}{3x-1}$$

$$P(2 \text{ green}) = \frac{2x-5}{3x} \times \frac{2x-6}{3x-1}$$

$$\frac{1}{3} \times \frac{x-1}{3x-1} + \frac{5}{3x} \times \frac{4}{3x-1} + \frac{(2x-5)(2x-6)}{3x(3x-1)}$$

$$\frac{x-1}{3(3x-1)} + \frac{20}{3x(3x-1)} + \frac{(2x-5)(2x-6)}{3x(3x-1)}$$

$$\frac{x-1}{9x-3} + \frac{20}{9x^2-3x} + \frac{4x^2-12x-10x+30}{9x^2-3x}$$

$$\frac{x^2-x}{9x^2-3x} + \frac{20}{9x^2-3x} + \frac{4x^2-22x+30}{9x^2-3x}$$

$$\frac{5x^2-23x+50}{9x^2-3x}$$

$$\frac{5x^2-23x+50}{9x^2-3x}$$

(Total for Question 24 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS



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