

Please check the examination details below before entering your candidate information

Candidate surname		Other names	
Centre Number		Candidate Number	

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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N/A/17/1/1/1/1



Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

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

$$2 \times 3$$

$$m^6$$

(1)

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

$$5 + 8$$

$$x^{13}$$

(1)

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

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

(2)

(Total for Question 1 is 4 marks)



- 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.

$$800 \times 2 \times 10.6 \times 0.68$$

11533

(4)

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

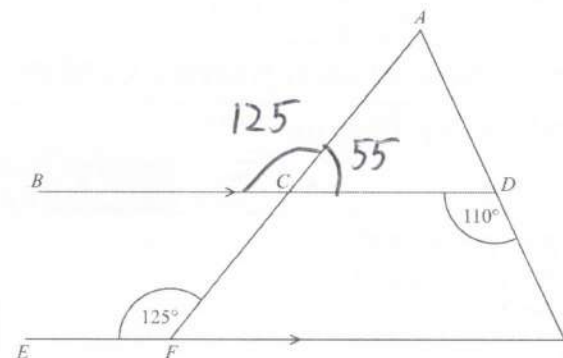
- (b) How does this affect your answer to part (a)?

It will increase

(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.

$$\widehat{BCA} = 125^\circ \text{ (corresponding angles are equal)}$$

$$\widehat{ACD} = 55^\circ \text{ (straight line} = 180)$$

$$\widehat{ADC} = 70^\circ \text{ (" " ")}$$

$$\widehat{CAD} = 55^\circ \text{ (} 180 - 70 - 55 \text{ as angles in a } \triangle = 180)$$

Two angles the same hence 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?

$$14 \times 5 = 70$$

$$70 \div 4$$

$$17.5 \text{ hours}$$

(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 .

$$\text{HCF} = 3 \times 3 \times 7$$

$$= 63$$

(1)

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

$$\begin{aligned} \text{LCM} &= \text{HCF} \times \text{"Leftovers"} \\ &= 63 \times 2^2 \times 3^2 \times 7 \end{aligned}$$

$$15876$$

(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 $67\,205\,600 \text{ m}^3$ of lava to flow from the volcano?
Give your answer correct to the nearest day.

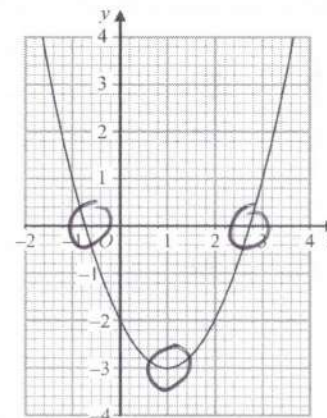
$$\frac{67\,205\,600}{11.9} = \text{seconds}$$

then $\div 3600$ and $\div 24$
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 $x^2 - 2x - 2 = 0$

-0.8 to -0.6
or 2.6 to 2.8
(1)

(Total for Question 7 is 2 marks)

- 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.

$$\begin{matrix} \textcircled{M} \\ D \times V \end{matrix}$$

$$\begin{aligned} M &= D \times V \\ &= 9 \times 72 \end{aligned}$$

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.

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?

70% Yes $\times$ Large 80%

$$\frac{70}{100} \times \frac{80}{100} = 0.56$$

56

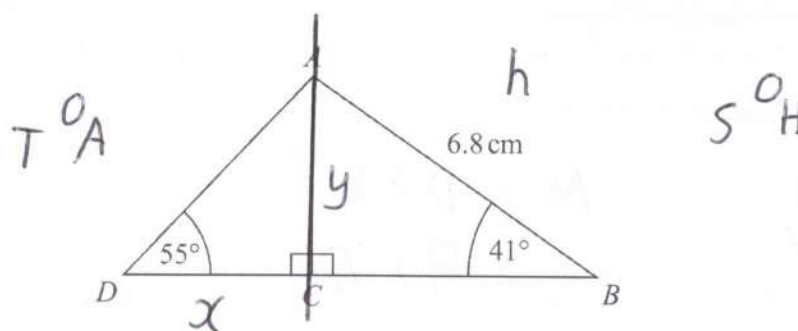
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(Total for Question 9 is 2 marks)



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.

$$y = \sin 41 \times 6.8 = 4.461...$$

$$x = \frac{4.461}{\tan 55} = 3.123...$$

3.1

cm

(Total for Question 10 is 3 marks)



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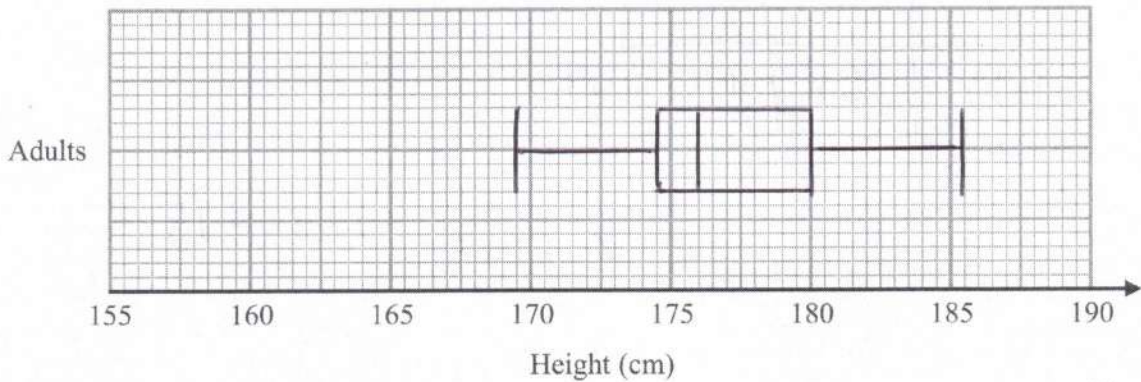
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11 The table shows some information about the heights of a group of adults.

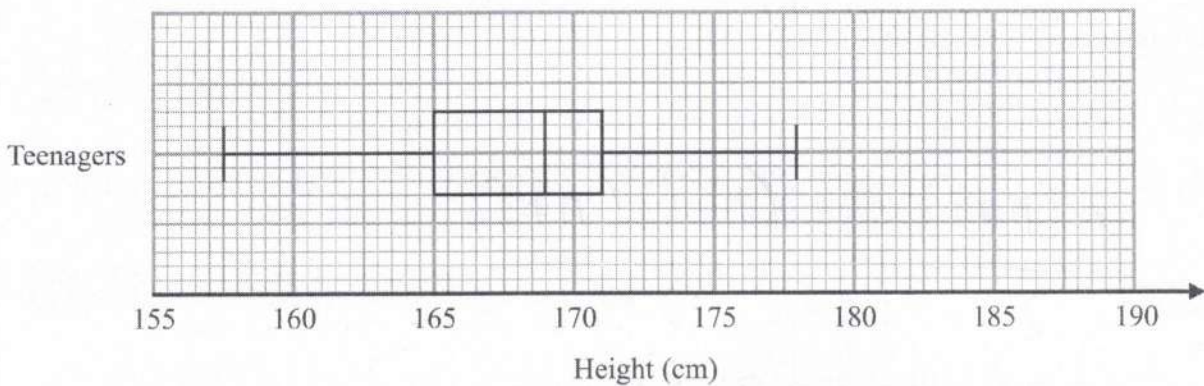
least height	169 cm
greatest height	186 cm
median	177 cm
lower quartile	174 cm
upper quartile	180 cm

(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.

Adult median > teen median

Both have IQR of 6 (OR) Teen range > adult
(20.5) (17)

(2)

(Total for Question 11 is 5 marks)



P 7 5 1 5 2 A 0 1 1 2 4

- 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.

$$x^2 + 3x - 1x - 3$$

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

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

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

(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.

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

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

$$= \frac{2n^2 + 4n + 2}{2} = n^2 + 2n + 1$$

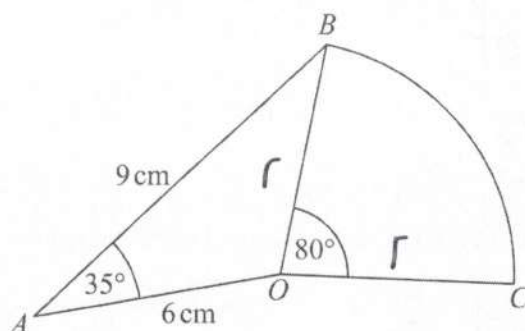
$$= (n+1)^2$$

(Total for Question 13 is 3 marks)



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

Cosine
rule



$$\pi r^2 \times \frac{80}{360}$$

Calculate the area of OBC .

Give your answer correct to 3 significant figures.

$$\begin{aligned} r^2 &= 9^2 + 6^2 - 2 \times 9 \times 6 \times \cos 35 \\ &= 117 - 118 \cos 35 \\ &= 28.5315... \\ r &= 5.341 \end{aligned}$$

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

19.9 cm²

(Total for Question 14 is 4 marks)



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

difference of
2 squares

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

(1)

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

$$\left[\begin{array}{l} \text{note: } \sqrt{2^{40}} = 2^{40 \times \frac{1}{2}} \\ = 2^{20} \end{array} \right]$$

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

$$= (\text{Even} + 1)(\text{Even} - 1)$$

↑ ↑
Same
even number

hence consecutive odds

(2)

(Total for Question 15 is 3 marks)

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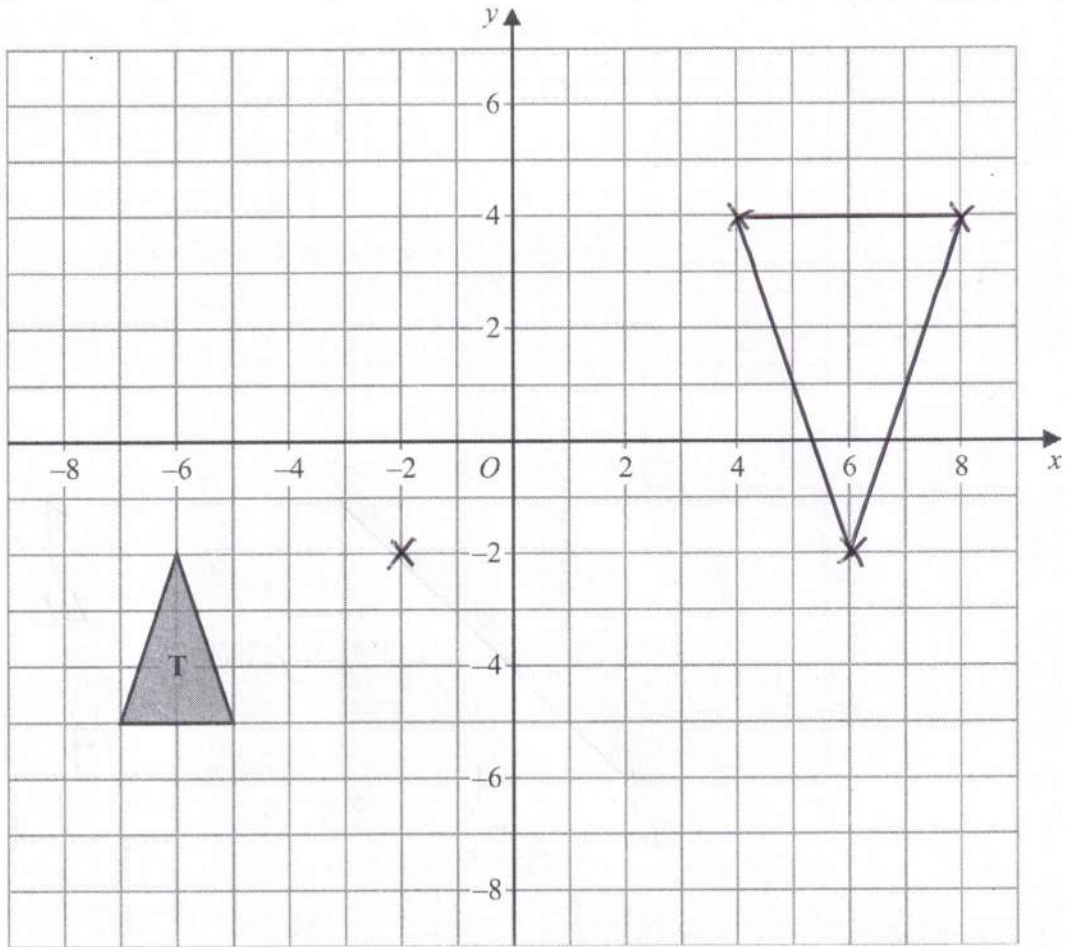


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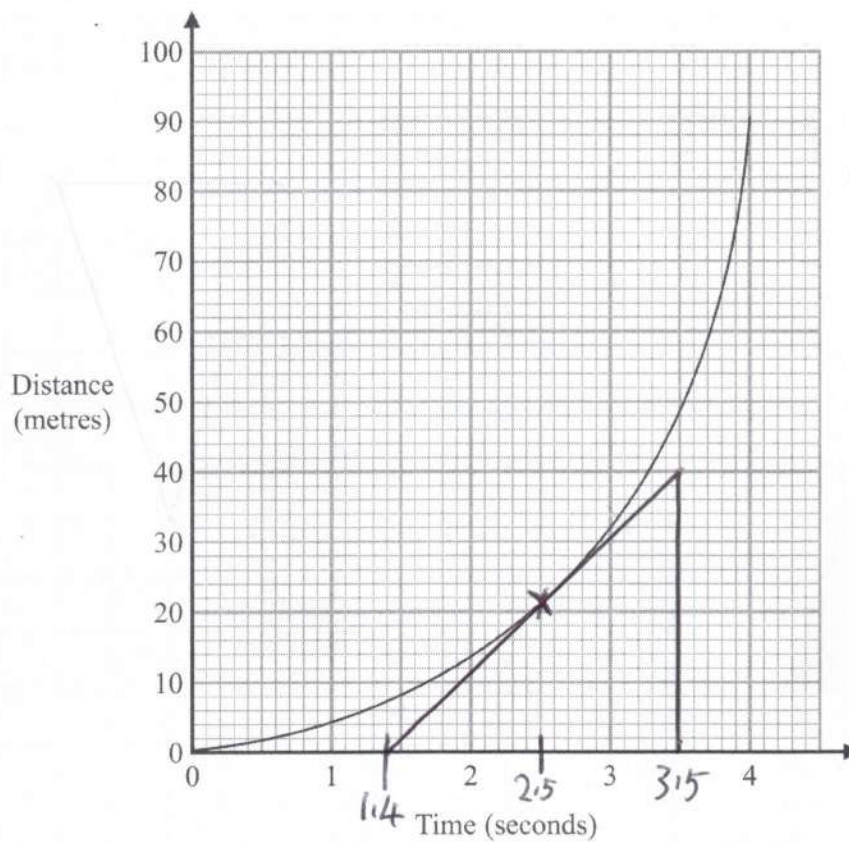


On the grid, enlarge triangle T by scale factor -2 with centre of enlargement $(-2, -2)$

(Total for Question 16 is 2 marks)



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.

$$40 \div 2.1 = 19.04...$$

19

(3)

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

speed/velocity

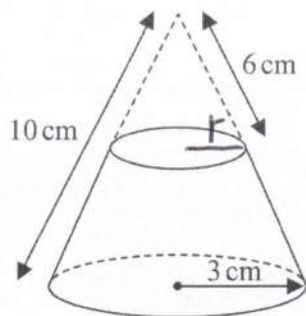
(1)

(Total for Question 17 is 4 marks)



F

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

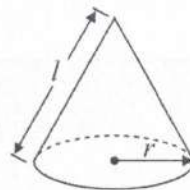


The slant height of the small cone is 6 cm.
 The slant height of the large cone is 10 cm.
 The radius of the base of the large cone is 3 cm.

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

CSA

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



$$6 \div 10 = 0.6$$

so

$$\begin{aligned} \text{small radius} &= 0.6 \times 3 \\ &= 1.8 \end{aligned}$$

$$\begin{aligned} \text{Total SA} &= \text{Top O} + \text{Bot O} + \text{CSA of F} \\ &= \pi \times 1.8^2 + \pi \times 3^2 + (\pi \times 3 \times 10) - (\pi \times 1.8 \times 6) \\ &= 98.757... \end{aligned}$$

98.8

cm²

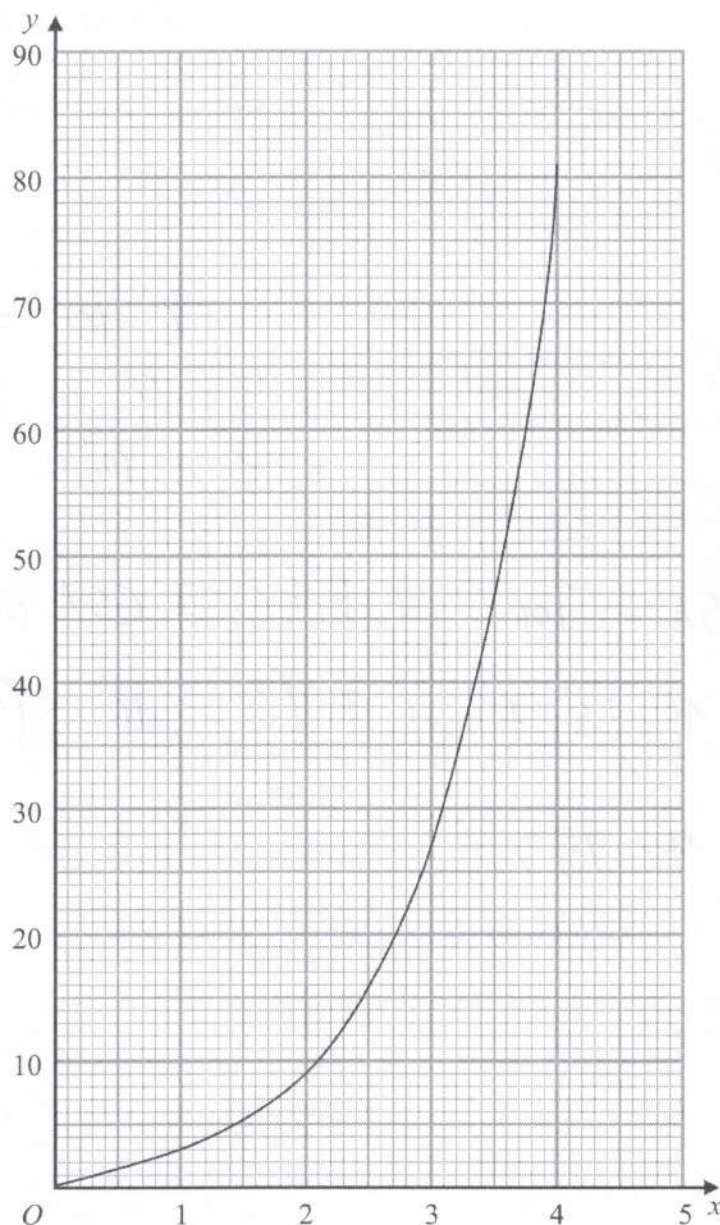
(Total for Question 18 is 5 marks)



P 7 5 1 5 2 A 0 1 7 2 4

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.

Should start at $(0, 1)$ not $(0, 0)$

(Total for Question 19 is 1 mark)

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

$$\begin{array}{r} x = 0.\dot{1}\dot{2}\dot{3} \\ - \quad 10x = 1.\dot{2}\dot{3} \\ \quad 1000x = 123.\dot{2}\dot{3} \\ \hline 990x = 122 \end{array}$$

$$x = \frac{122}{990} = \frac{61}{495} \quad \text{as req'd}$$

(Total for Question 20 is 3 marks)



P 7 5 1 5 2 A 0 1 9 2 4

21 Solve

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

$$1(2-2x) + 3(x+4) = 1(x+4)(2-2x)$$

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

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

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

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

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

(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 $\begin{pmatrix} 13 \\ 6 \end{pmatrix} = K\begin{bmatrix} 13 \\ 6 \end{bmatrix}$

find an expression for b in terms of a .

$$\begin{array}{lcl} 2a + 8b = 13K & (\times 6) \Rightarrow & 12a + 48b = 78K \\ 6a + 2b = 6K & (\times 13) \Rightarrow & 78a + 26b = 78K \\ \hline & & -66a + 22b = 0 \\ \hline \end{array}$$

$$22b = 66a$$

$$b = 3a$$

(Total for Question 22 is 3 marks)



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

$$C(0,0) \quad r = 5$$

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.

$$m_{\text{radius}} = -\frac{4}{3}$$

$$m_{\perp} = \frac{3}{4}$$

$$\text{Tangent: } y = \frac{3}{4}x + c$$

$$\left. \begin{array}{l} x = -3 \\ y = 4 \end{array} \right\} 4 = \frac{3}{4}(-3) + c$$

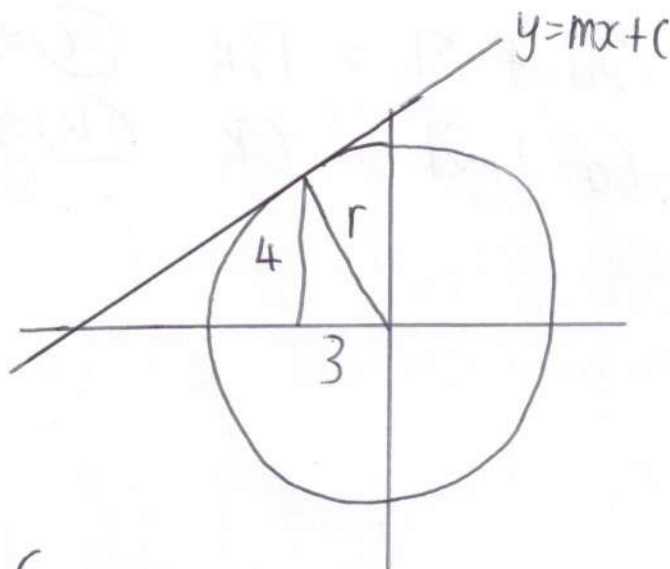
$$c = \frac{25}{4}$$

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

hits x -axis at $y = 0$

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

$$x = -\frac{25}{4} \div \frac{3}{4} = -\frac{25}{3}, \text{ not } -8$$



(Total for Question 23 is 4 marks)

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- 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.

$$x:y = 1:3 \rightarrow$$

so

$$y = 3x$$

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.

P
 x

B
5

G

$$P(P, P) = \frac{x}{y} \times \frac{x-1}{y-1} \Rightarrow \frac{x^2 - x}{3x(3x-1)}$$

+

$$P(B, B) = \frac{5}{y} \times \frac{4}{y-1} \Rightarrow \frac{20}{3x(3x-1)}$$

+

$$P(G, G) = \frac{y-x-5}{y} \times \frac{y-x-6}{y-1} \Rightarrow \frac{(2x-5)(2x-6)}{3x(3x-1)}$$

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

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

(Total for Question 24 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS

