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 ▶

P75152A

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 $(m^2)^3$

m^6

(1)

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

x^{13}

(1)

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

$4p^3 + 12p^2$

$4p^3 + 12p^2$

(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.

$0.68 \times 800 = 544$ people

$544 \times 2 = 1088$ cups

$1088 \times 10.6\text{g} = 11532.8\text{g}$

$\approx 11533\text{g}$

11533 g

(4)

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

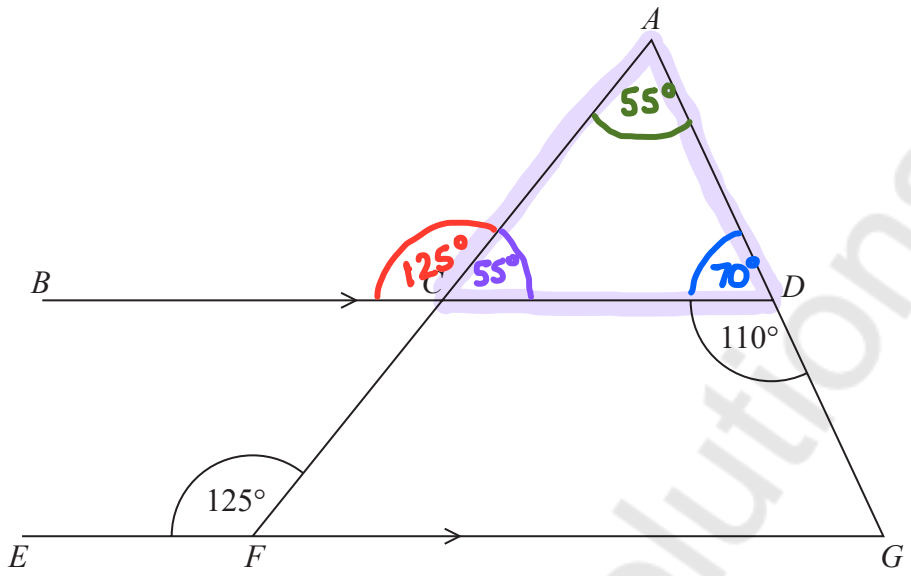
(b) How does this affect your answer to part (a)?

The amount of coffee needed increases.

(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.

$\angle ADC = 180° - 110°$
$= 70°$
Angles on a straight line sum to 180°

$\angle ACB = 125°$ Corresponding angles are equal

$\angle ACD = 55°$ Angles on a straight line sum to 180°

$\angle CAD = 180° - (55 + 70)$
$= 55°$

Triangle ACD has 2 equal angles ∴ 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?

÷5 (5 pumps = 14h) ×5

×4 (1 pump = 70h) ÷4

4 pumps = 17.5h

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.

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

$B = 3 \times 3 \times 7 \times 7$

$HCF = 3 \times 3 \times 7$

$= 63$

63

(1)

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

LCM = HCF x all other prime factors

$= 63 \times 2 \times 2 \times 3 \times 3 \times 7$

$= 15876$

15876

(2)

(Total for Question 5 is 3 marks)

6 Lava flows from a volcano at a constant rate of $11.9\,m^3/s$

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

$\frac{11.9\,m^3}{1\,s} \xrightarrow{\times 3600} \frac{42840\,m^3}{1\,h} \xrightarrow{\times 24} \frac{1028160\,m^3}{1\,day}$

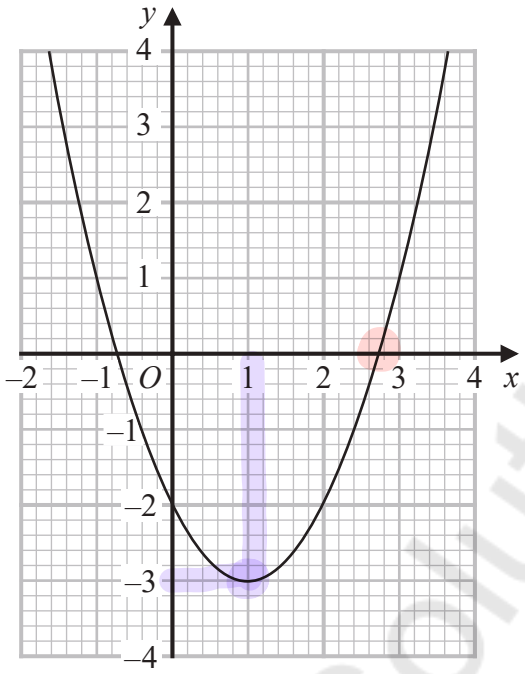
$67\,205\,600 \div 1028160 = 65.3649...$

≈ 65 days

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)

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.

m
D V

$m = D \times V$
$= 9 \times 72$
$= 648\text{g}$

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.

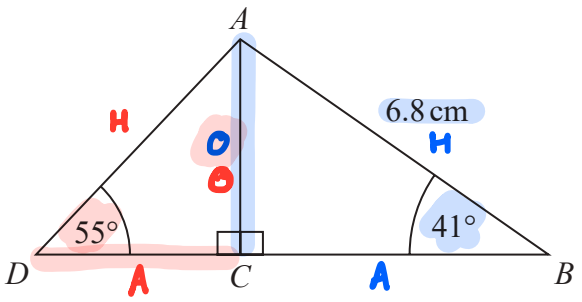
What percentage of the people asked said they wanted a television with a large screen?

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

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.

$\sin\theta = \frac{O}{H}$

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

$\times 6.8 \qquad \times 6.8$

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

$= 4.461201397 \text{ cm}$

$\tan\theta = \frac{O}{A}$

$\tan(55) = \frac{4.46\ldots}{DC}$

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

$= 3.12292562 \text{ cm}$

$\simeq 3.1$

3.1 cm

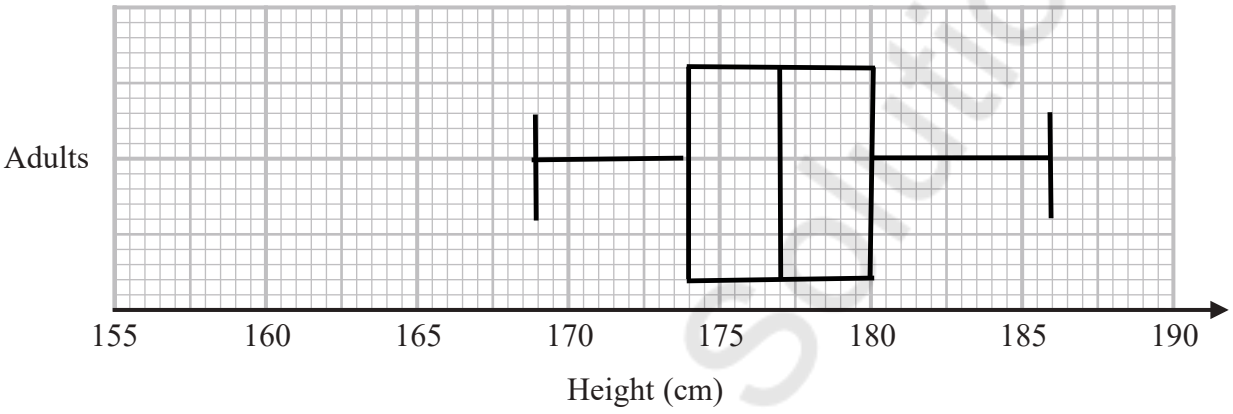
(Total for Question 10 is 3 marks)

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

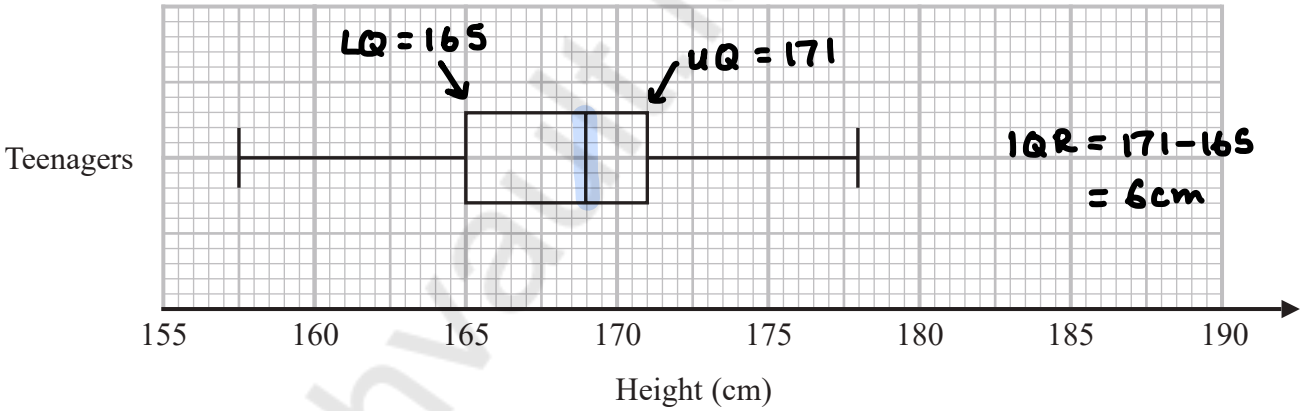
IQR = UQ − LQ
= 180 − 174
= 6cm

(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 than teenagers.
The interquartile range is the same for both 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	x	−1
x	x^2	−x
+3	+3x	−3

$= x^2 + 2x - 3$

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

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

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

(Total for Question 12 is 3 marks)

13 An expression for the nth 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.

$n \qquad n+1$

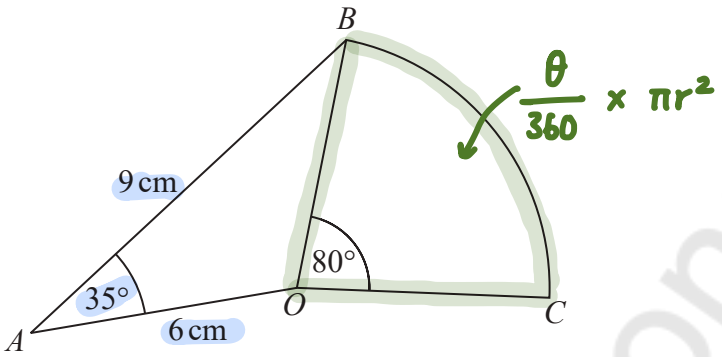
$\frac{n(n+1)}{2} + \frac{(n+1)(n+1+1)}{2}$

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

$n^2 + 2n + 2$

(Total for Question 13 is 3 marks)

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



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

Calculate the area of *OBC*.
Give your answer correct to 3 significant figures.

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

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

$OB^2 = 28.53157922$

$OB = 5.341495972$

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

$\frac{80}{360} \times \pi (5.34\ldots)^2$

$= 19.91879993$

$= 19.9 \text{ cm}^2$

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

(Total for Question 14 is 4 marks)

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

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

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

(1)

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

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

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

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

2^{20} = even

$2^{20}+1$ = odd

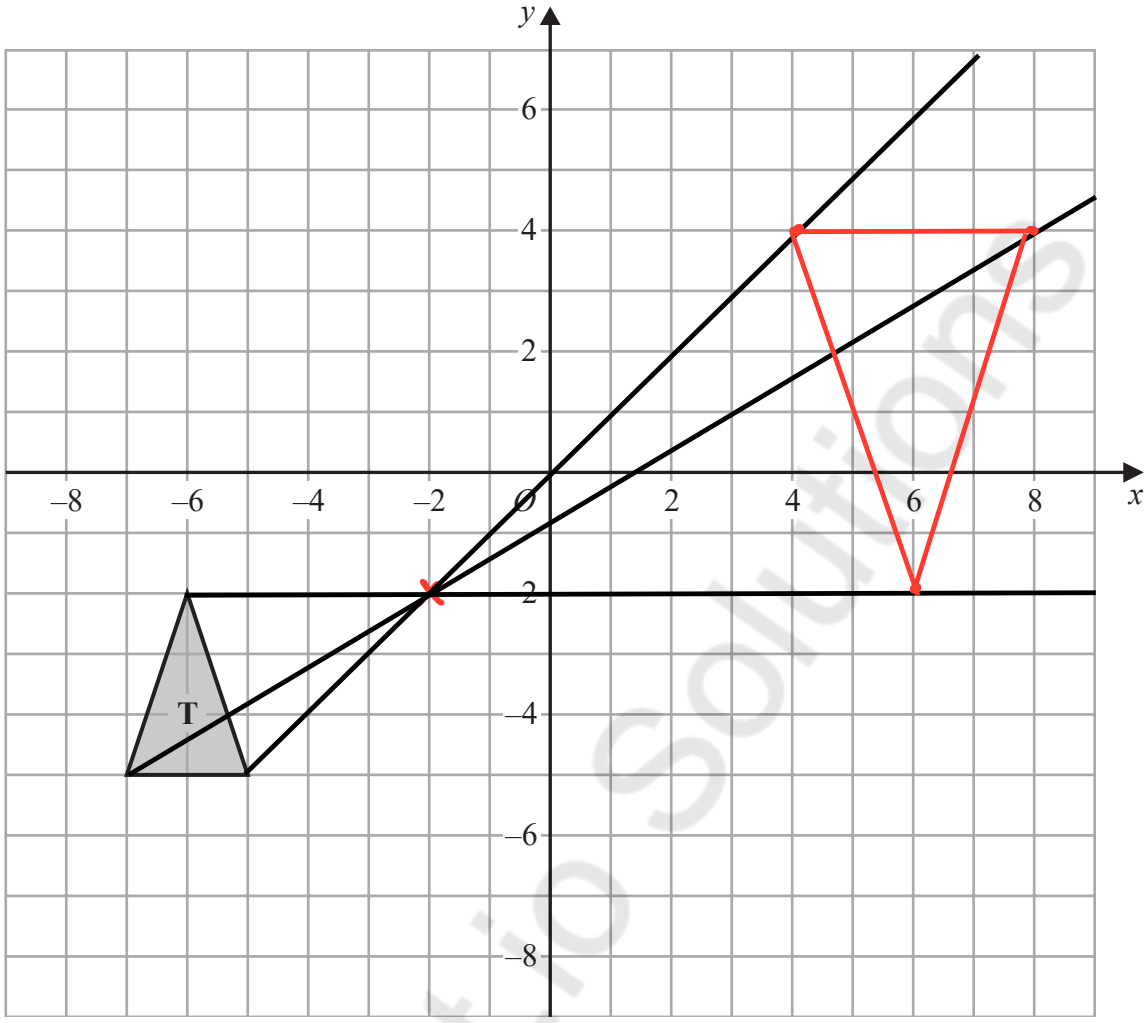
$2^{20}-1$ = odd

} 2 consecutive odd numbers

(2)

(Total for Question 15 is 3 marks)

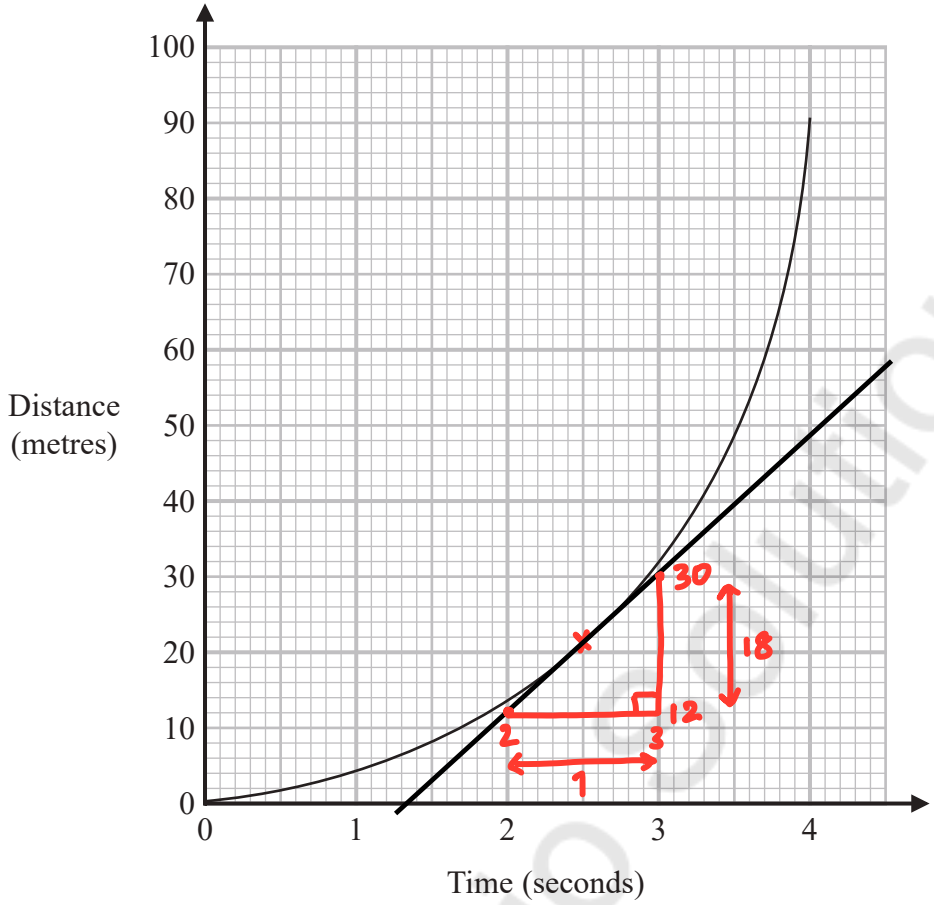
16



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.

$m = \frac{\text{change in } y}{\text{change in } x} = \frac{18}{1}$

$= 18$

18

(3)

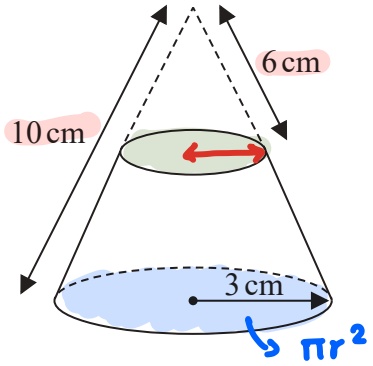
(b) What does the gradient of the graph represent?

Change in distance over time which is speed.

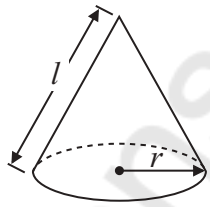
(1)

(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 = πrl



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.

S.A. of whole cone = $\pi rl + \pi r^2$ $r = 3$

$= \pi(3)(10) + \pi(3)^2$

$= 30\pi + 9\pi$

$= 39\pi \text{ cm}^2$

SF $= \frac{10}{6} = \frac{5}{3}$

Radius of small cone $= 3 \div \frac{5}{3}$

$= \frac{9}{5}$ cm

Curved S.A. $= \pi rl$ $r = \frac{9}{5}$ $l = 6$

$= \pi\left(\frac{9}{5}\right)(6)$

$= \frac{54}{5}\pi \text{ cm}^2$

$39\pi - \frac{54}{5}\pi = \frac{141}{5}\pi$

$\pi\left(\frac{9}{5}\right)^2 = \frac{81}{25}\pi$

$\frac{141}{5}\pi + \frac{81}{25}\pi$

$= 98.77167303$

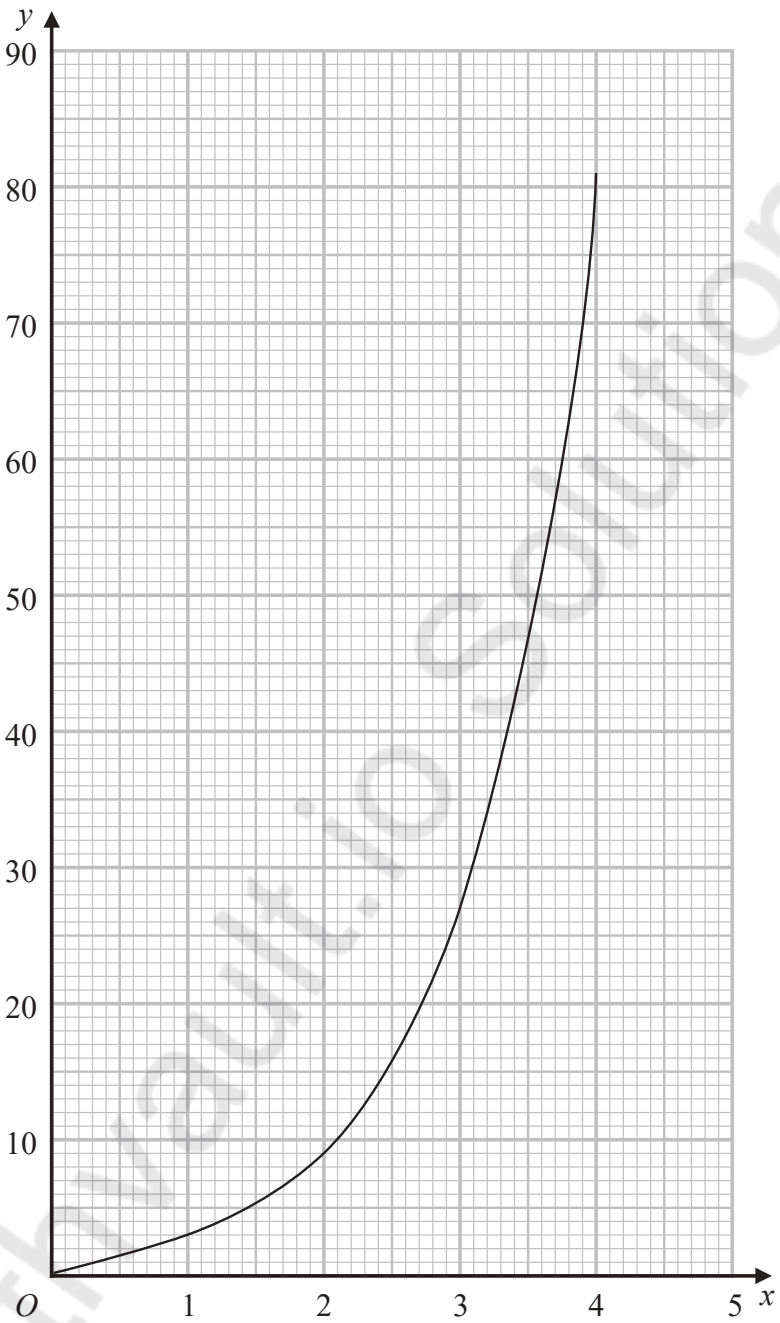
≈ 98.8

98.8 cm²

(Total for Question 18 is 5 marks)

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

She draws the graph shown on the grid.



$3^0 = 1$

Write down one thing Sana has done wrong.

$3^0 = 1$ so (0, 0) should be (0, 1)

(Total for Question 19 is 1 mark)

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

$x = 0.1\dot{2}\dot{3}$

$10x = 1.\dot{2}\dot{3}$

$100x = 12.\dot{3}\dot{2}$

$1000x = 123.\dot{2}\dot{3}$

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

$\div 990 \qquad \div 990$

$$x = \frac{122}{990} \begin{matrix} \div 2 \\ \div 2 \end{matrix} = \frac{61}{495}$$

(Total for Question 20 is 3 marks)

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

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

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

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

$$x(x+4)(2-2x) \qquad x(x+4)(2-2x)$$

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

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

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

$$2x^2 + 7x + 6 = 0 \qquad 2 \times 6 = 12 \quad (4, 3)$$

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

$$2x(x+2) + 3(x+2)$$

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

$$2x+3 = 0 \qquad x+2 = 0$$

$$-3 \quad -3 \qquad -2 \quad -2$$

$$2x = -3 \qquad x = -2$$

$$\div 2 \qquad \div 2$$

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

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

(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 $x\begin{pmatrix}13\\6\end{pmatrix}$

find an expression for b in terms of a.

$2a + 8b = 13x$ $\quad \div 13 \quad \div 13$

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

$6a + 2b = 6x$ $\quad \div 6 \quad \div 6$

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

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

$-\frac{2}{13}a \qquad -\frac{2}{13}a$

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

$-\frac{1}{3}b \qquad -\frac{1}{3}b$

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

$\times 39 \qquad \times 39$

$11b = 33a$

$\div 11 \qquad \div 11$

$b = 3a$

$b = 3a$

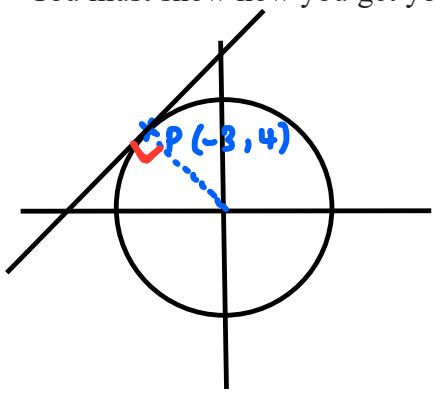
(Total for Question 22 is 3 marks)

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.



Gradient of radius $= \frac{y_2 - y_1}{x_2 - x_1}$

$(-3, 4)$
$(0, 0)$

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

$= -\frac{4}{3}$

Gradient of tangent $= \frac{3}{4}$

$y = mx + c \quad m = \frac{3}{4} \quad (-3, 4)$ $x \; y$

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

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

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

$+\frac{9}{4} \quad +\frac{9}{4}$

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

Equation of tangent: $y = \frac{3}{4}x + \frac{25}{4}$

$(-8, 0)$
$x \; y$

$0 = \frac{3}{4}(-8) + \frac{25}{4}$

$0 = \frac{-24}{4} + \frac{25}{4}$

$0 \neq \frac{1}{4}$

Alex is incorrect.

(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.

$x : y = 1 : 3$ (×3) → $x : 3x$; $y = 3x$; Total = $3x$

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.

$3x - 5 - x = 2x - 5$

$p(\text{pink}) = \frac{1}{3}$

$p(\text{blue}) = \frac{5}{3x}$

$p(\text{green}) = \frac{2x-5}{3x}$

$p(\text{two pink}) = \frac{1}{3} \times \frac{x-1}{3x-1} = \frac{x-1}{9x-3}$

$p(\text{two blue}) = \frac{5}{3x} \times \frac{4}{3x-1} = \frac{20}{9x^2-3x}$

$p(\text{two green}) = \frac{2x-5}{3x} \times \frac{2x-6}{3x-1} = \frac{(2x-5)(2x-6)}{9x^2-3x} = \frac{4x^2-22x+30}{9x^2-3x}$

$\frac{x-1}{9x-3}^{\times x} + \frac{20}{9x^2-3x} + \frac{4x^2-22x+30}{9x^2-3x}$

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

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

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

(Total for Question 24 is 5 marks)

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