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

Pearson

Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

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

$m^{2 \times 3} = m^6$

m^6 ①

(1)

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

$x^5 \times x^8 = x^{5+8}$

$= x^{13}$

x^{13} ①

(1)

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

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

$= 4p \times p^2 + 4p \times 3p$

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

$4p^3 + 12p^2$ ②

(2)

(Total for Question 1 is 4 marks)

P 7 5 1 5 2 A 0 2 2 4

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.

Finding the number of people assumed to drink coffee:

$$\frac{68}{100} \times \overset{8}{800} = 544 \ \text{①}$$

Finding the amount of coffee for each person:

$$10.6 \, g \times 2 = 21.2 \, g \ \text{①}$$

Finding the total amount of coffee Jonny needs:

$$21.2 \, g \times 544 = 11532.8 \, g \ \text{①}$$

$$\approx 11533 \, g \ (\text{to the nearest gram}) \ \text{①}$$

11533

.... g

(4)

Jonny's assumption is wrong.
72% of the people will drink coffee.
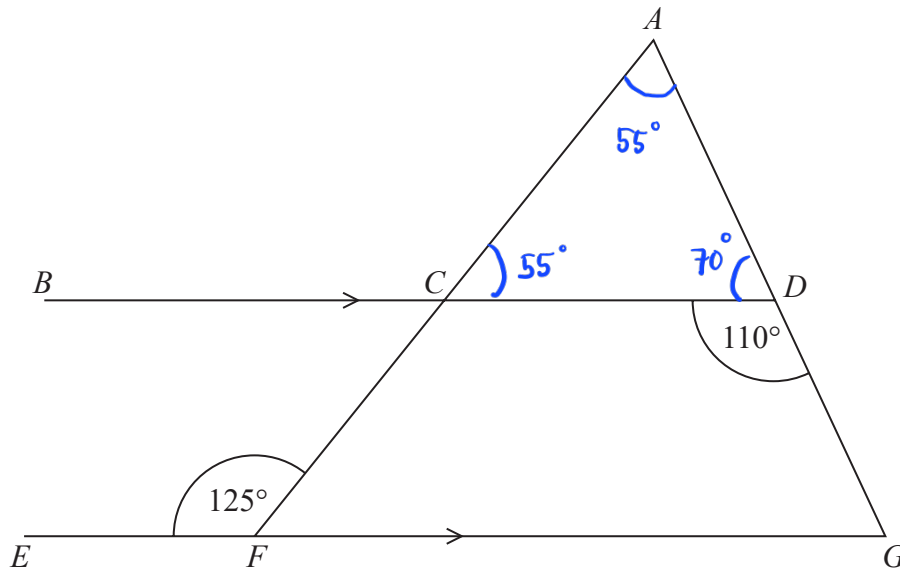
(b) How does this affect your answer to part (a)?

Jonny will need more amount of coffee. ①

(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.

A

55°

B ———→ *C*) 55° 70° (*D*

110°

125°

E *F* ———→ *G*

Show that triangle *ACD* is isosceles. — two base angles are equal
Give a reason for each stage of your working.

$\angle ADC = 180° - 110° = 70°$ ①
(because angles on a straight line add up to 180°) ①

$a + b = 180°$

$\angle ACD = \angle BCF$ (because opposite angles are equal to each other)

$x = y$

$\angle BCF = 180° - \angle EFC$

$= 180° - 125° = 55°$ ①

(because co-interior angles add up to 180°) ①

$m + n = 180°$

$\angle CAD = 180° - \angle ADC - \angle ACD$ (because angles in triangle adds up to 180°)

$= 180° - 70° - 55°$

$= 55°$

$a + b + c = 180°$

$\angle ACD = \angle CAD = 55°$ ①

∴ triangle *ACD* is an 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?

Finding total time for 1 pump to fill the tank:

14 hours × 5 = 70 hours ①

Finding the time if 4 pumps are used:

$$\frac{70 \text{ hours}}{4} = 17.5 \quad ①$$

..........**17.5**.......... hours

(Total for Question 4 is 2 marks)

P 7 5 1 5 2 A 0 5 2 4

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*.

List all the factors of A and B :

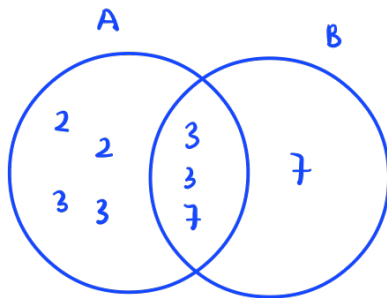A : 2 × 2 × ③ × ③ × 3 × 3 × ⑦

B : ③ × ③ × ⑦ × 7

Circle all common factors of A and B.

Multiply all the common factors to get HCF :

3 × 3 × 7 = 63

63 ①

(1)

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

LCM = 2 × 2 × 3 × 3 × 3 × 3 × 7 × 7

$$= 2^2 \times 3^4 \times 7^2$$ ①

= 15 876 ①

15 876

(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.

[Handwritten annotation showing conversion diagram: day →×24→ hour →×60→ minute →×60→ second, with ÷24, ÷60, ÷60 going back]

Finding total time it takes in seconds:

$$\frac{67\,205\,600 \text{ m}^3}{11.9 \frac{\text{m}^3}{\text{s}}} = 564\,7529.412 \text{ s} \quad ①$$
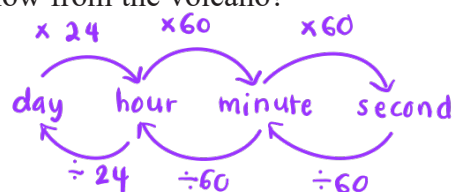
Converting time from seconds to days:

$$= 564\,7529.412 \text{ s} \times \frac{1 \text{ day}}{(24 \times 60 \times 60)\text{s}}$$

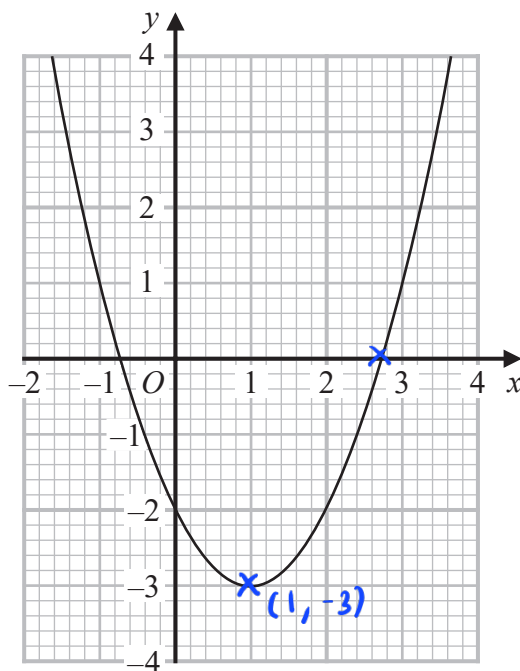$$= \frac{564\,7529.412}{86400} \quad ① = 65.3 \text{ days}$$

$$= 65 \text{ days (nearest day)} \quad ①$$

.... 65 .... days

(Total for Question 6 is 3 marks)

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......, ...-3......)

(1)

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

x-intercepts (found on graph)

2.7

(1)

(Total for Question 7 is 2 marks)

8 A solid cuboid is made of metal.

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

Work out the mass of the cuboid.

$$density = \frac{mass}{volume}$$

mass = density × volume

= 9 gcm^{-3} × 72 cm^3 ①

= 648 g ①

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?

Finding percentage of people who wants tv with large screens :-

80% of 70%

: 0.8 × 0.7 = 0.56 × 100% ①

= 56% ①

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*.

A

6.8 cm

55°   41°

D C B
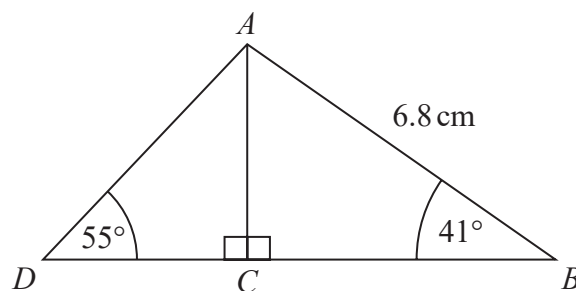
Work out the length of *DC*.
Give your answer correct to 1 decimal place.

Finding length AC ;

$$\sin 41° = \frac{AC}{6.8 \text{ cm}}$$

$$AC = 6.8 \sin 41° \quad ①$$

$$= 4.46 \text{ cm}$$

Finding length DC :

$$\tan 55° = \frac{AC}{DC}$$

$$DC = \frac{AC}{\tan 55°}$$

$$= \frac{4.46}{\tan 55°} \quad ①$$

$$= 3.12$$

$$= 3.1 \text{ (one decimal place)}$$

$$①$$

3.1

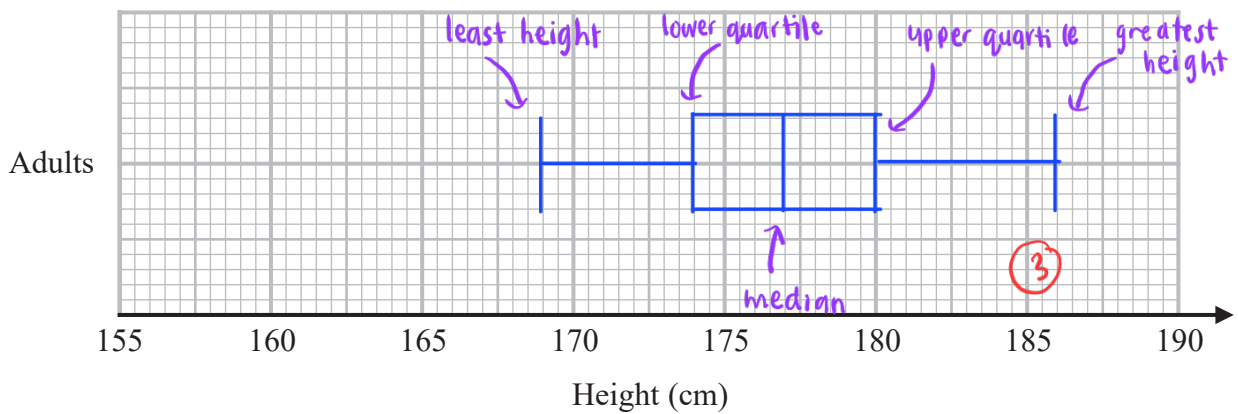... cm

(Total for Question 10 is 3 marks)

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

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

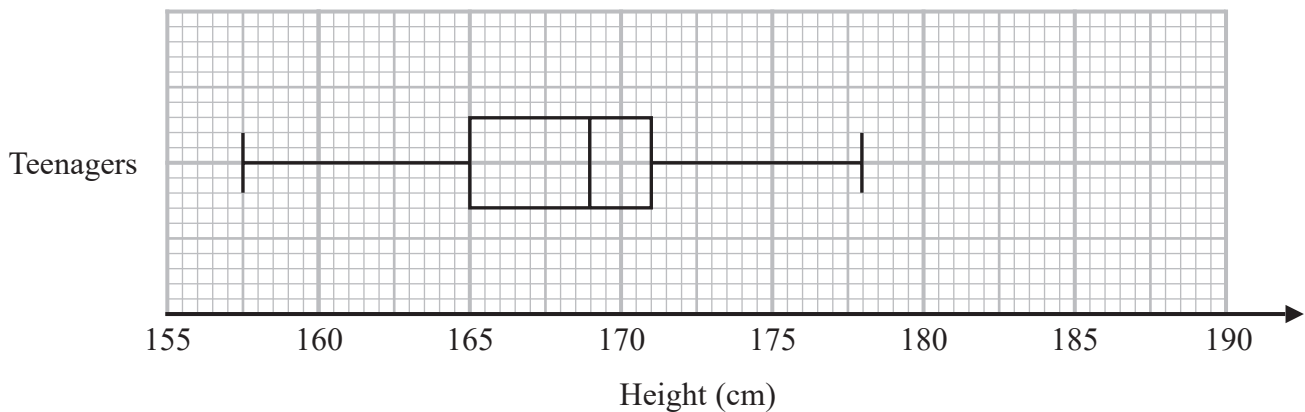| least height	169 cm
greatest height	186 cm
median	177 cm
lower quartile	174 cm
upper quartile	180 cm

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

Adults

Height (cm)

(3)

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

Teenagers

Height (cm)

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

○ Adults have higher median compared to teenagers which means average adults have a greater height than teenagers. ①

○ Interquartile range of adults is the same as teenagers. But teenagers have large range than adult. ①

(2)

(Total for Question 11 is 5 marks)

DO NOT WRITE IN THIS AREA

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.

Finding products of $(x-1)$ and $(x+3)$ first :

$$(x-1)(x+3) = x^2 + 3x - x - 3 \quad ①$$
$$= x^2 + 2x - 3$$

Finding products of $(x^2 + 2x - 3)$ and $(x-5)$:

$$(x^2 + 2x - 3)(x-5) = x^3 - 5x^2 + 2x^2 - 10x - 3x + 15 \quad ①$$
$$= x^3 - 3x^2 - 13x + 15 \quad ①$$

(Total for Question 12 is 3 marks)

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

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

$$n\text{th term} = \frac{n(n+1)}{2} \qquad n\text{th}-1 \text{ term} = \frac{n(n-1)}{2} \quad ①$$

Finding sum of nth and nth-1 term :

$$\frac{n(n+1)}{2} + \frac{n(n-1)}{2} \quad ① \; = \; \frac{n^2 + n + n^2 - n}{2}$$

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

$$= n^2 \quad ①$$

(Total for Question 13 is 3 marks)

14 *OAB* is a triangle.
OBC is a sector of a circle, centre *O*.
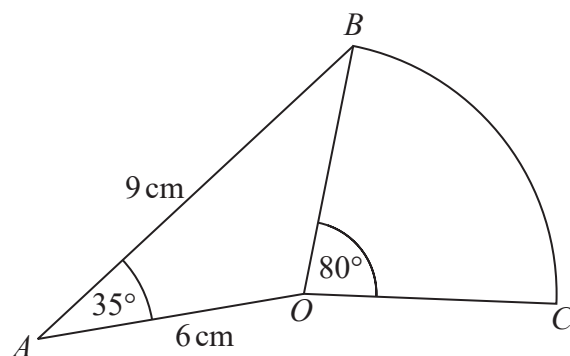
Calculate the area of *OBC*.
Give your answer correct to 3 significant figures.

by using cosine rule

Area of sector of = $\pi \times r^2 \times \dfrac{\theta}{360}$
a circle

cosine rule = $a^2 = b^2 + c^2 - 2bc \cos \theta$

Finding length OB :

$OB^2 = 9^2 + 6^2 - 2(9)(6) \cos 35°$ ①

$OB = \sqrt{28.532 \ cm^2}$ ①

$OB = 5.34 \ cm$

Finding area of OBC :

$\dfrac{80}{360} \times \pi \times 5.34^2$ ①

$= 19.9 \ cm^2$ ①

.... 19.9 cm²

(Total for Question 14 is 4 marks)

Turn over ▶

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

$(a-b)(a+b)$ ①

(1)

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

Let $a^2 = 2^{40}$, $b^2 = 1$
$a = 2^{20}$ $b = 1$

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

$2^{20} =$ even number, so $(2^{20} - 1)$ is odd.
$(2^{20} + 1)$ is also odd ①

∴ Hence, $(2^{20} - 1)(2^{20} + 1)$ is product of two consecutive
odd numbers
$(2^{20} - 1)$ and $(2^{20} + 1)$ are consecutive because they are 2 apart.
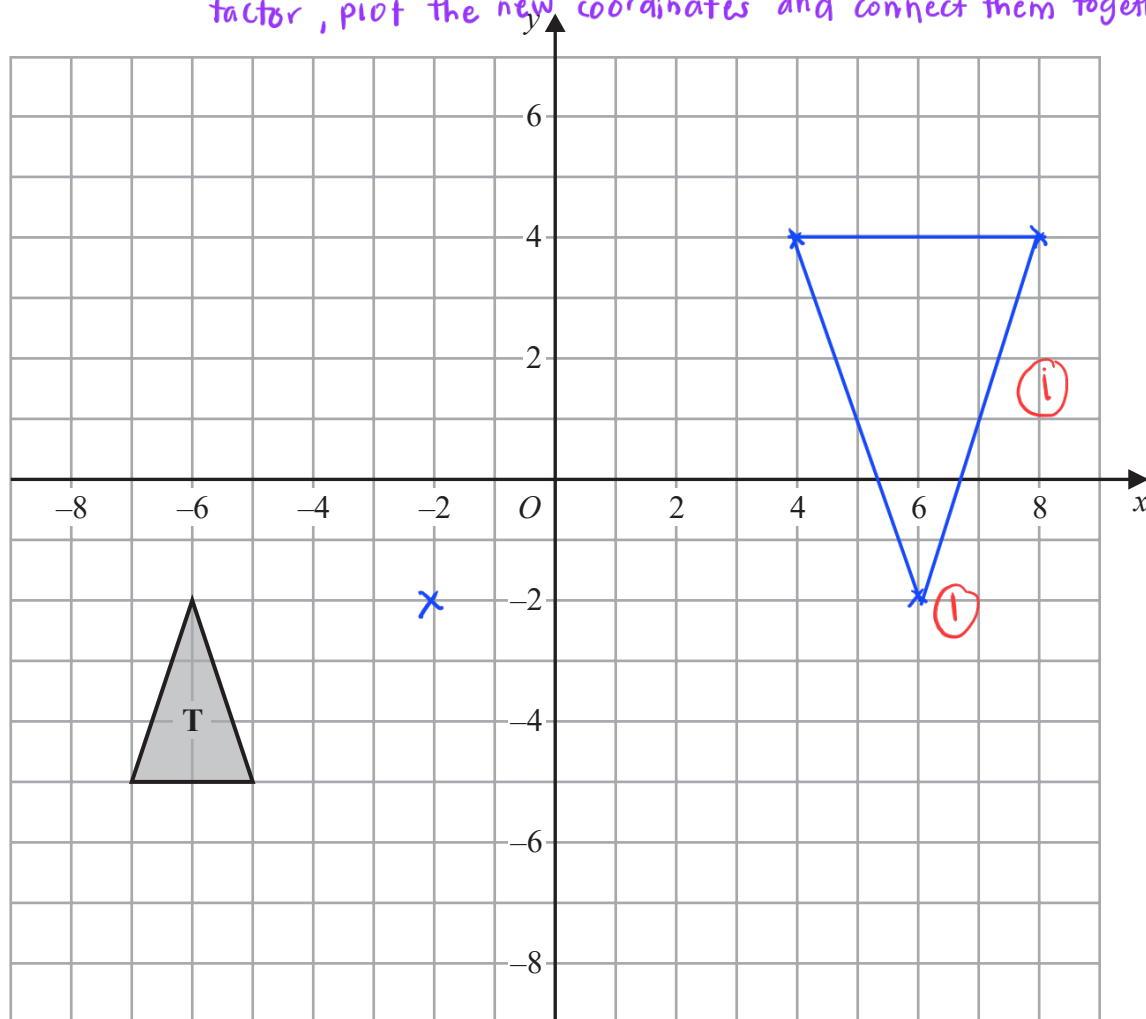
(2)

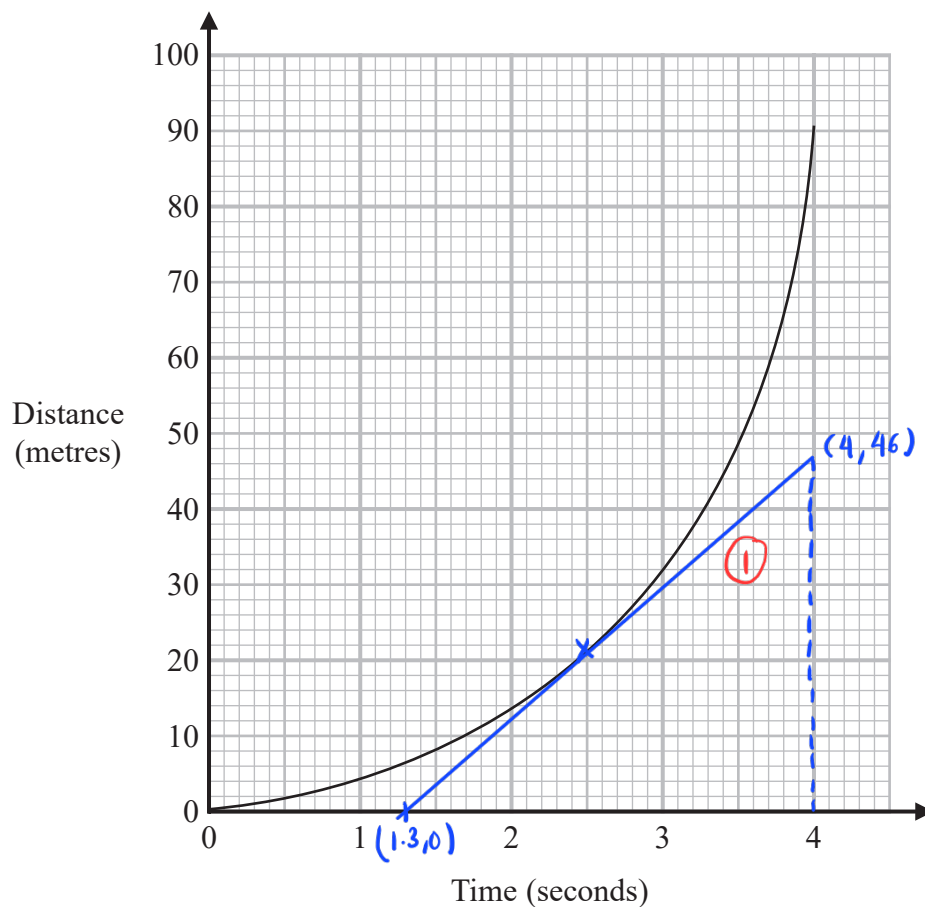**(Total for Question 15 is 3 marks)**

16

Tips: Multiply the coordinates of the original shape by the scale factor, plot the new coordinates and connect them together.

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.

Finding gradient of tangent at 2.5 s :

$$m = \frac{46-0}{4-1.3} \,① = 17.03$$

$$= 17.0 \,①$$

17.0

(3)

(b) What does the gradient of the graph represent?
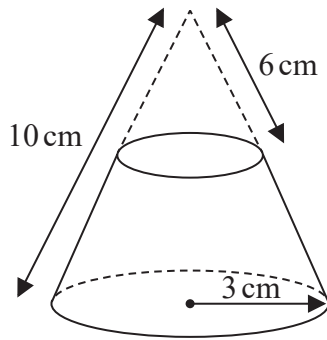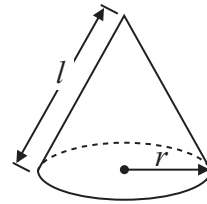
Speed because $\frac{distance}{time}$ = Speed. ①

(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.

6 cm

10 cm

3 cm

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.

Finding scale factor of small cone to large cone:

$$\frac{6}{10} = 0.6$$

Finding radius of small cone:

$$0.6 \times 3 \, cm = 1.8 \, cm \quad ①$$

Finding surface area of whole cone:

$$\pi r^2 + \pi r l = \pi (3)^2 + \pi (3)(10) = 39 \, \pi \, cm^2$$
$$① \qquad ①$$

Finding surface area of small cone (curved):

$$\pi r l = \pi (1.8)(6) = 10.8 \, \pi \, cm^2$$

Finding surface area of small cone (base):

$$\pi r^2 = \pi (1.8)^2 = 3.24 \, \pi \, cm^2$$

Finding total surface area of frustrum:

$$39 \, \pi - 10.8 \, \pi + 3.24 \, \pi \quad ①$$

$$= 31.44 \, \pi = 98.8 \, cm^2 \quad ①$$

.............98.8.............. cm²

(Total for Question 18 is 5 marks)

Turn over ▶

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.
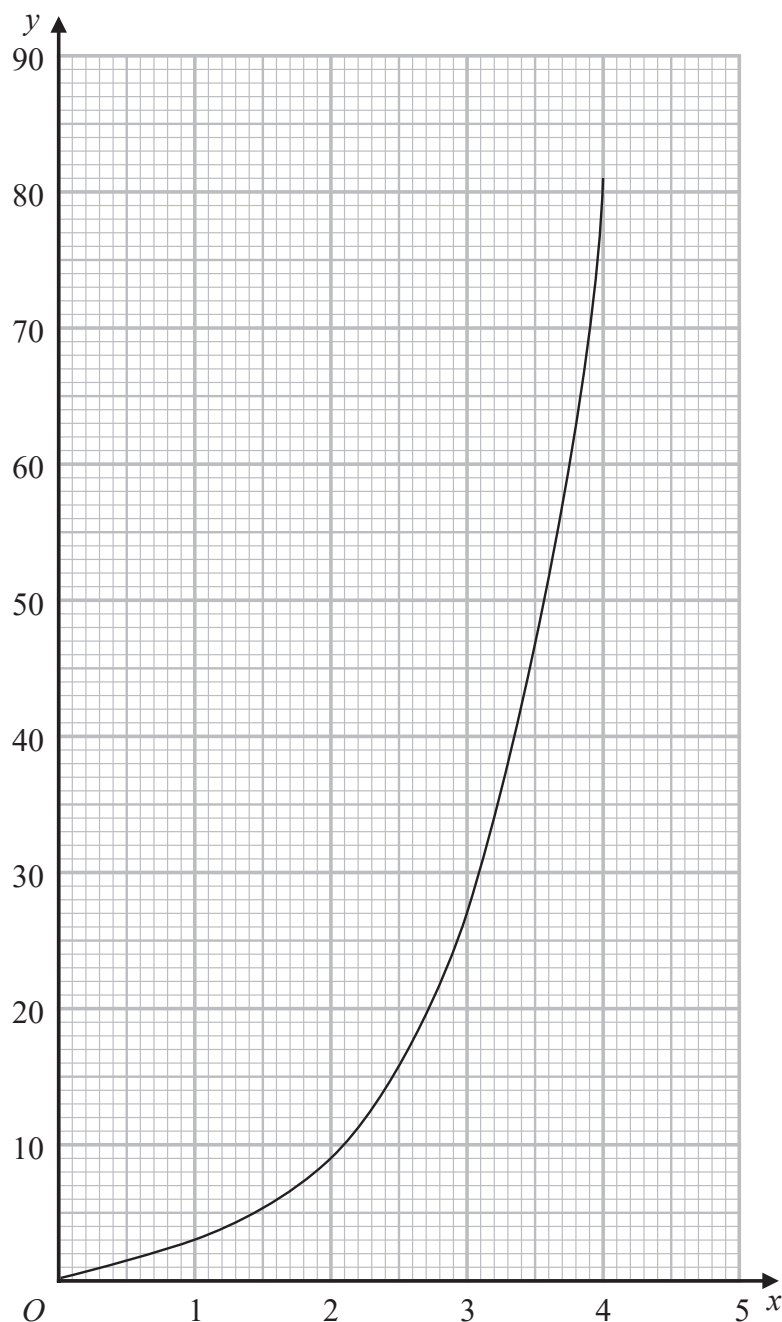
Write down one thing Sana has done wrong.

The graph should start at $(0,1)$. Because y value cannot be
0 since $3^0 = 1$ -

①

(Total for Question 19 is 1 mark)

20 Prove algebraically that $0.12\dot{3}$ can be written as $\dfrac{61}{495}$

Let $x = 0.12323\ldots$

$10\ x = 10\ (0.12323\ldots)$
$\qquad = 1.2323\ldots$ ①

$100\ x = 100\ (0.12323\ldots)$
$\qquad = 12.323\ldots$

$100\ x - x = 12.323\ldots - 0.1232\ldots$ ①

$99\ x = 12.2$

$x = \dfrac{12.2}{99}$

$\qquad = \dfrac{61}{495}$ ①

(Total for Question 20 is 3 marks)

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

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

Eliminate the fractions by multiplying by $(x+4)(2-x)$:

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

$2-2x + 3(x+4) = (x+4)(2-2x)$ ①

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

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

$2x^2 + 7x + 6 = 0$ ①

substituting into formula :

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

$= \dfrac{-7 \pm \sqrt{7^2 - 4(2)(6)}}{2(2)}$ ①

$= \dfrac{-7 \pm \sqrt{1}}{4}$

$= \dfrac{-7+1}{4}$ and $\dfrac{-7-1}{4}$

$x = -\dfrac{3}{2}$ and -2 ①

$x = -2$ and $x = \dfrac{-3}{2}$

....

(Total for Question 21 is 4 marks)

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

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.

Method in finding linear equations with term a and b :

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

$(2a + 8b = 13k) \times 6 \longrightarrow 12a + 48b = 78k$

$(6a + 2b = 6k) \times 13 \longrightarrow 78a + 26b = 78k$ ①

making the RHS
of both equations the
same to eliminate k

$-66a + 22b = 0$

$66a = 22b$

$b = 3a$ ①

$b = 3a$

(Total for Question 22 is 3 marks)

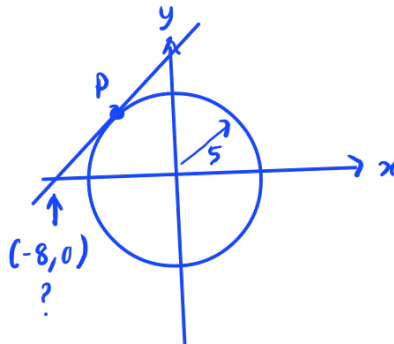*Turn over* ▶

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

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.

Finding the gradient of normal to the tangent :

$$m = \frac{4-0}{-3-0} = -\frac{4}{3} \quad ①$$

Finding gradient of tangent :

$$M_{tangent} = \frac{-1}{M_{normal}} = \frac{-1}{-\frac{4}{3}} = \frac{3}{4} \quad ①$$

Finding equation of the tangent line :

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

$$c = 4 + \frac{9}{4} = \frac{25}{4}$$

Tangent line equation : $\quad y = \frac{3}{4}x + \frac{25}{4} \quad ①$

Check if point $(-8,0)$ is a part of the line by substituting
the x or y value into the equation :

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

when $x = -8$, $\quad y = \frac{3}{4}(-8) + \frac{25}{4} \quad ①$

$$= \frac{1}{4} \quad (\text{not } 0) \qquad \therefore \text{ No, Alex is not correct.}$$

(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.

$$x:y = 1:3$$

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 $\dfrac{ax^2 + bx + c}{dx^2 + ex}$ where a, b, c, d and e are integers.

Finding probability in x and y term:

$$y = 3x \quad ①$$

First Pick

$$P(P) = \frac{x}{y}$$

$$P(B) = \frac{5}{y}$$

$$P(G) = \frac{y-x-5}{y}$$

Second Pick of same colour

$$P(P) = \frac{x-1}{y-1}$$

$$P(B) = \frac{4}{y-1} \quad ①$$

$$P(G) = \frac{y-x-6}{y-1}$$

A: $P(P) \times P(P) = \dfrac{x}{y} \times \dfrac{x-1}{y-1} = \dfrac{x^2-x}{y^2-y} = \dfrac{x^2-x}{9x^2-3x}$

B: $P(B) \times P(B) = \dfrac{5}{y} \times \dfrac{4}{y-1} ① = \dfrac{20}{y^2-y} = \dfrac{20}{9x^2-3x}$

C: $P(G) \times P(G) = \dfrac{y-x-5}{y} \times \dfrac{y-x-6}{y-1} = \dfrac{3x-x-5}{3x} \times \dfrac{3x-x-6}{3x-1} = \dfrac{4x^2-22x+30}{9x^2-3x}$

A or B or C : A + B + C

$$= \frac{x^2-x+20+4x^2-22x+30}{9x^2-3x} \quad ① = \frac{5x^2-23x+50}{9x^2-3x} \quad ①$$

(Total for Question 24 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS

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