

Answer ALL TWENTY ONE questions.

Write your answers in the spaces provided.

You must write down all the stages in your working

1 (a) Factorise fully $4p + 6pq$

$$2p(2+3q)$$

(2)

(b) Expand and simplify $(e + 3)(e - 5)$

$$e^2 + 3e - 5e - 15$$
$$= e^2 - 2e - 15$$

(2)

(c) Solve $y = \frac{2y + 1}{5}$

Show clear algebraic working.

$$5y = 2y + 1$$

$$3y = 1$$

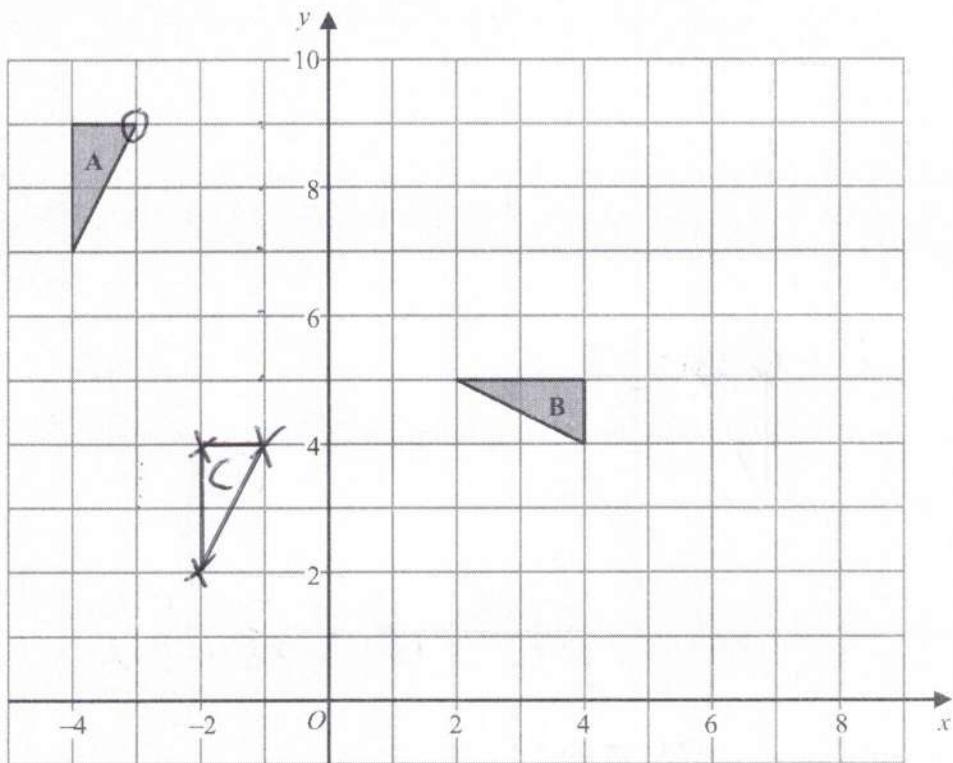
$$y = \frac{1}{3}$$

$$y = \frac{1}{3} (3)$$

(Total for Question 1 is 7 marks)



2



(a) Describe fully the single transformation that maps triangle A onto triangle B.

Rotation, 90° clockwise, centre $(-2, 3)$

(3)

(b) On the grid, translate triangle A by the vector $\begin{pmatrix} 2 \\ -5 \end{pmatrix}$

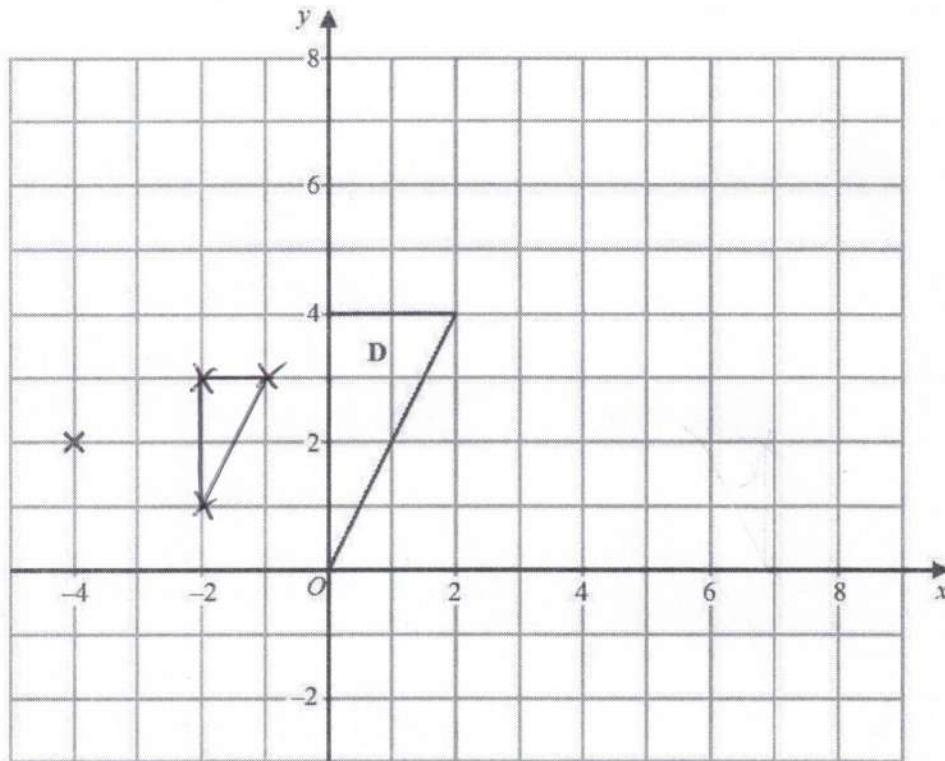
Label the new triangle C.

$\rightarrow 2$
 $\downarrow 5$

(1)



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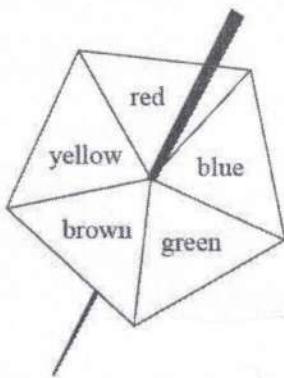
(c) On the grid, enlarge triangle D with scale factor $\frac{1}{2}$ and centre $(-4, 2)$

(2)

(Total for Question 2 is 6 marks)



3 Here is a biased 5-sided spinner.



When the spinner is spun, it can land on red, blue, green, brown or yellow.

The table gives the probabilities that the spinner lands on red or on blue or on green.

Colour	red	blue	green	brown	yellow
Probability	0.15	0.26	0.33	$x + 0.06$	x

When the spinner is spun once, the probability that the spinner lands on brown is 0.06 more than the probability that the spinner lands on yellow.

Jenine spins the spinner 150 times.

Work out an estimate for the number of times the spinner lands on yellow.

$$2x + 0.06 + 0.15 + 0.26 + 0.33 = 1$$

$$\begin{aligned}2x &= 0.2 \\x &= 0.1 \quad = \text{yellow}\end{aligned}$$

$$150 \times 0.1 = \underline{15}$$

(Total for Question 3 is 4 marks)



4 The table gives information about the price of gold.

	1st February 2016	1st March 2016
Price of one ounce of gold (dollars)	1126.50	1236.50

(a) Work out the percentage increase in the price of gold between 1st February 2016 and 1st March 2016

Give your answer correct to 3 significant figures.

$$\frac{1236.5 - 1126.5}{1126.5} \times 100 = 9.7647\ldots$$

9.76
(3) %

The price of one ounce of gold on 1st February 2016 was 1126.50 dollars.

The price of gold increased by 19% from 1st February 2016 to 1st July 2016

(b) Work out the price of one ounce of gold on 1st July 2016

Give your answer correct to the nearest dollar.

$$1126.5 \times 1.19 = 1340.535$$

1341
(3) dollars

(Total for Question 4 is 6 marks)



5

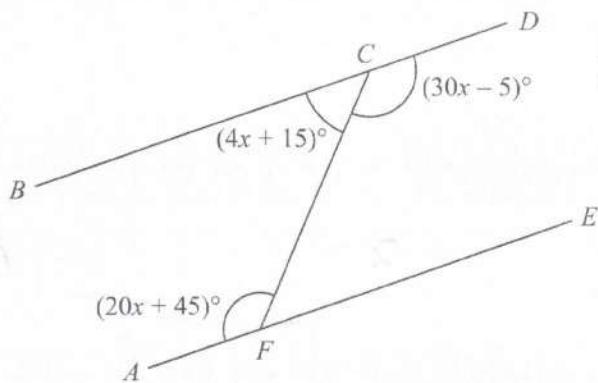


Diagram NOT
accurately drawn

BCD and AFE are straight lines.

Show that BCD is parallel to AFE .
Give reasons for your working.

Angles on straight line sum to 180

$$\text{so } 4x + 15 + 30x - 5 = 180$$

$$34x = 170$$

$$x = 5$$

$$\angle BCF = 4 \times 5 + 15 = 35$$

$$\angle AFC = 20 \times 5 + 45 = 145$$

Co-interior angles sum to 180

$\angle BCF + \angle AFC = 180$ hence BCD
is parallel to AFE

(Total for Question 5 is 5 marks)

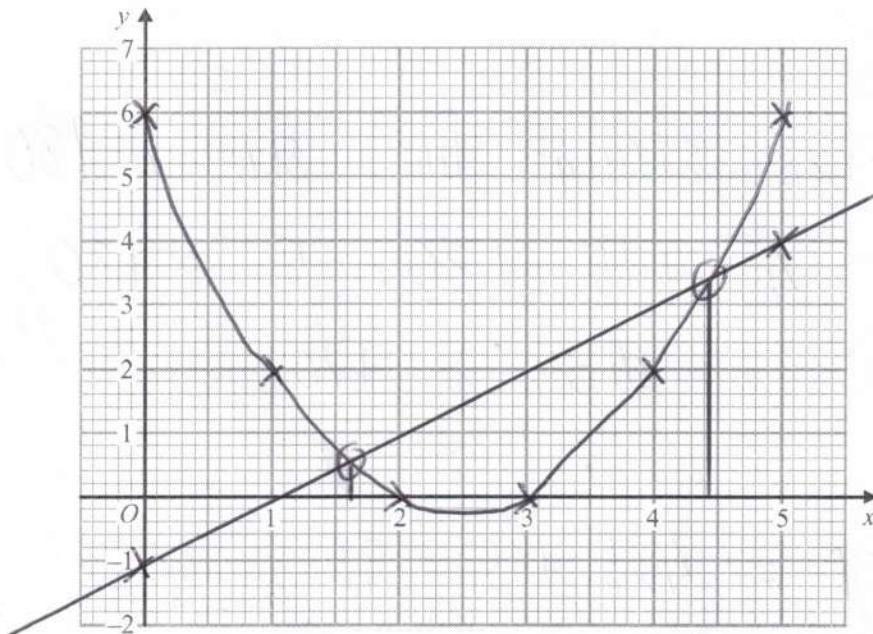


6 (a) Complete the table of values for $y = x^2 - 5x + 6$

x	0	1	2	3	4	5
y	6	2	0	0	2	6

(1)

(b) On the grid, draw the graph of $y = x^2 - 5x + 6$ for $0 \leq x \leq 5$



(2)

(c) By drawing a suitable straight line on the grid, find estimates for the solutions of the equation

$$x^2 - 5x + 6 = x - 1$$

$$x^2 - 5x + 6 = x - 1$$

x	0	5
y	-1	4

$$x = 4.4, x = 1.6$$

(3)

(Total for Question 6 is 6 marks)



7 The table shows the volumes, in km^3 , of four oceans.

Ocean	Volume (km^3)
Arctic Ocean	1.88×10^7
Atlantic Ocean	3.10×10^8
Indian Ocean	2.64×10^8
Southern Ocean	7.18×10^7

(a) Write 7.18×10^7 as an ordinary number.

71 800 000

(1)

(b) Calculate the total volume of these four oceans.

6.646×10^8

km^3

(2)

The volume of the South China Sea is 9 880 000 km^3

(c) Write 9 880 000 in standard form.

9.88×10^6

(1)

(Total for Question 7 is 4 marks)



8 The diagram shows an isosceles triangle.

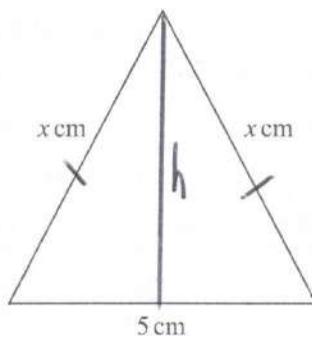


Diagram NOT
accurately drawn

The area of the triangle is 12 cm^2

$\leftarrow 2.5 \rightarrow$

Work out the perimeter of the triangle.

Give your answer correct to 3 significant figures.

$$A = \frac{1}{2}bh = 12 = \frac{1}{2} \times 5 \times h$$

$$h = 4.8$$

$$x = \sqrt{4.8^2 + 2.5^2} = 5.412\dots$$

$$\text{Per} = 5 + 2 \times 5.412 = 15.8$$

cm

(Total for Question 8 is 4 marks)



9 The table shows information about the speeds of 60 cycles.

Speed (s km/h)	Frequency
$0 < s \leq 10$	3
$10 < s \leq 20$	16
$20 < s \leq 30$	24
$30 < s \leq 40$	10
$40 < s \leq 50$	5
$50 < s \leq 60$	2

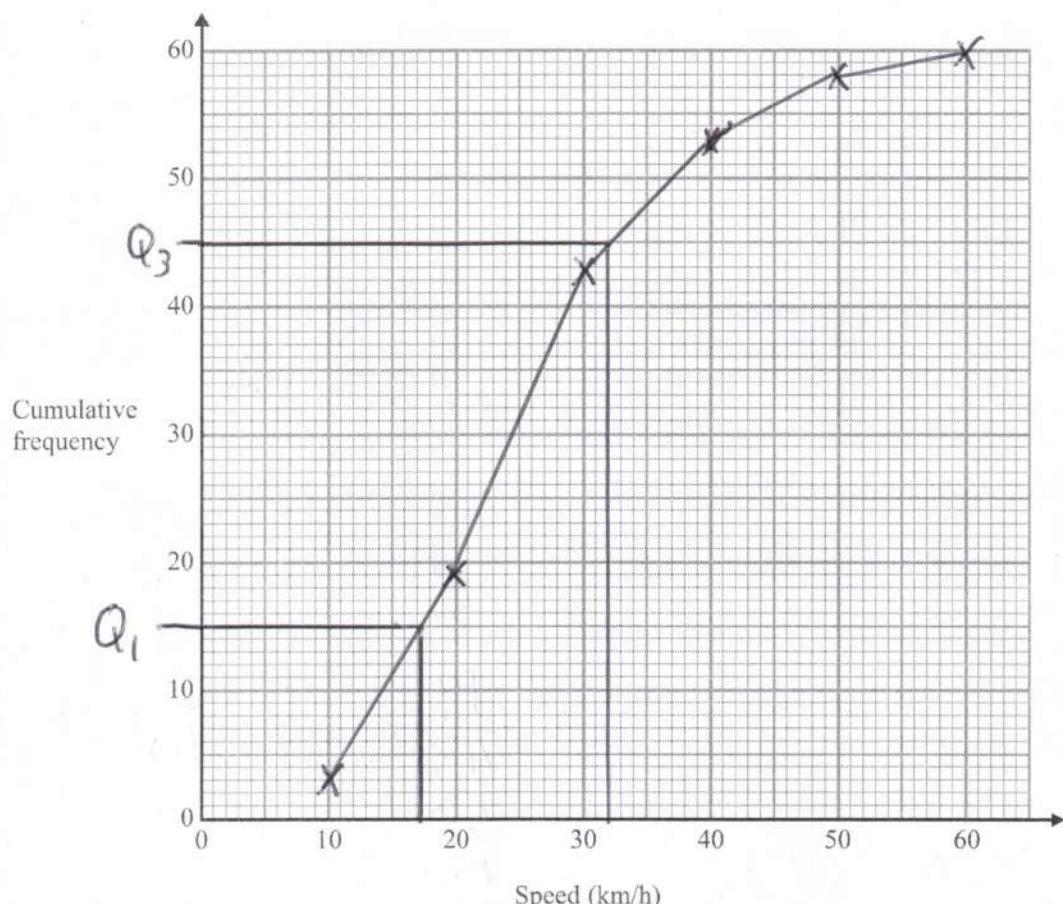
(a) Complete the cumulative frequency table.

Speed (s km/h)	Cumulative frequency
$0 < s \leq 10$	3
$0 < s \leq 20$	19
$0 < s \leq 30$	43
$0 < s \leq 40$	53
$0 < s \leq 50$	58
$0 < s \leq 60$	60

(1)



(b) On the grid, draw a cumulative frequency graph for your table.



(2)

(c) Use your graph to find an estimate for the interquartile range of the speeds.

$$32 - 17$$

$$[\text{ms: } 13 - 15]$$

$$15 \text{ km/h}$$

(Total for Question 9 is 5 marks)



10 Here is triangle ABD .

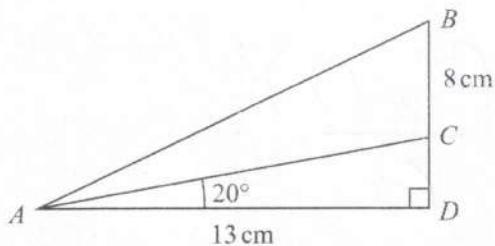


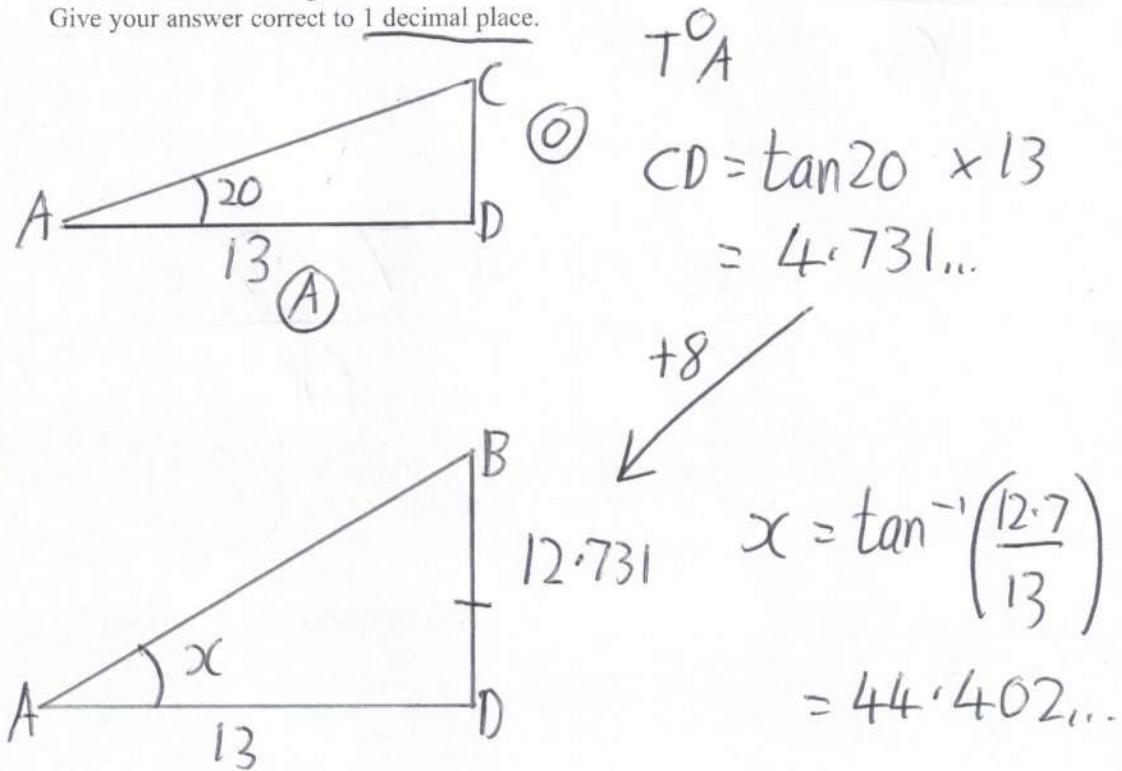
Diagram NOT
accurately drawn

The point C lies on BD .

$$AD = 13\text{ cm} \quad BC = 8\text{ cm} \quad \text{angle } ADB = 90^\circ \quad \text{angle } CAD = 20^\circ$$

Calculate the size of angle BAC .

Give your answer correct to 1 decimal place.



$$\begin{aligned} \text{so } \angle BAC &= 44.4 - 20 \\ &= \underline{\underline{24.4^\circ}} \end{aligned}$$

(Total for Question 10 is 5 marks)



P 5 9 0 1 7 A 0 1 4 2 8

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11 Express $\frac{5}{3} - \frac{x+2}{2x}$ as a single fraction in its simplest terms.

$$\frac{10x}{6x} - \frac{(3x+6)}{6x}$$

$$\frac{10x - (3x+6)}{6x}$$

$$= \frac{7x-6}{6x}$$

(Total for Question 11 is 3 marks)



12 The curve C has equation $y = \frac{1}{3}x^3 - 9x + 1$

(a) Find $\frac{dy}{dx}$

$$3x \frac{1}{3}x^2 - 9$$

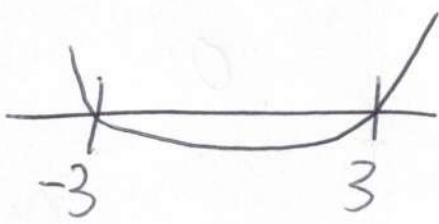
$$\frac{dy}{dx} = x^2 - 9 \quad (2)$$

(b) Find the range of values of x for which C has a negative gradient.

$$\frac{dy}{dx} < 0$$

$$x^2 - 9 < 0$$

$$(x - 3)(x + 3) < 0$$



$$-3 < x < 3$$

(3)

(Total for Question 12 is 5 marks)



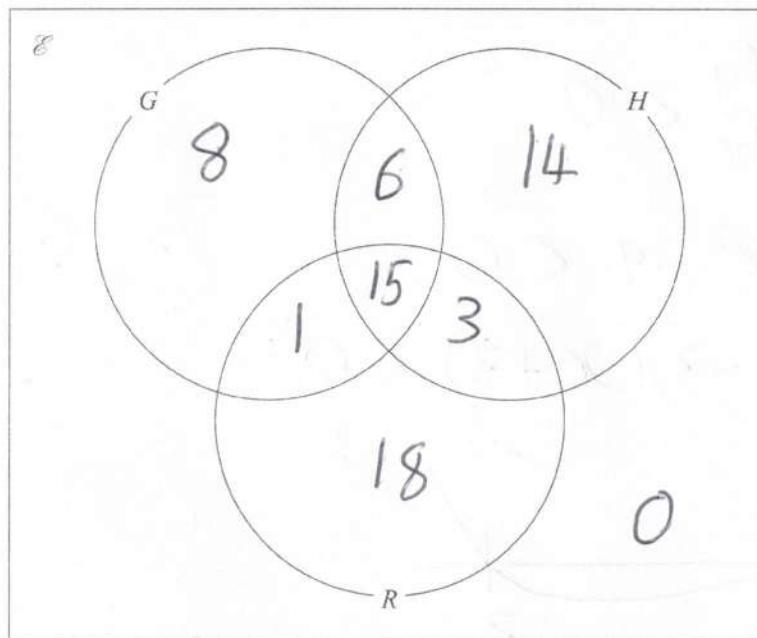
13 All the students in Year 11 at a school must study at least one of Geography (G), History (H) and Religious Studies (R).

In Year 11 there are 65 students.

Of these students

- 15 study Geography, History and Religious Studies
- 21 study Geography and History
- 16 study Geography and Religious Studies
- 30 study Geography
- 18 study only Religious Studies
- 37 study Religious Studies

(a) Using this information, complete the Venn diagram to show the number of students in each region of the Venn diagram.



(3)

A student in Year 11 who studies both History and Religious Studies is chosen at random.

(b) Work out the probability that this student does **not** study Geography.

$$\frac{3}{18} = \frac{1}{6}$$

(2)

(Total for Question 13 is 5 marks)



14 T is directly proportional to the cube of r

$$T = 21.76 \text{ when } r = 4$$

(a) Find a formula for T in terms of r

$$T = K \times r^3$$

$$21.76 = K \times 4^3$$

$$K = \frac{17}{50}$$

$$T = \frac{17r^3}{50}$$

(3)

(b) Work out the value of T when $r = 6$

$$T = \frac{17 \times 6^3}{50} = 73.44$$

(1)

(Total for Question 14 is 4 marks)



15 The total surface area of a solid hemisphere is equal to the curved surface area of a cylinder.

The radius of the hemisphere is r cm.

The radius of the cylinder is twice the radius of the hemisphere.

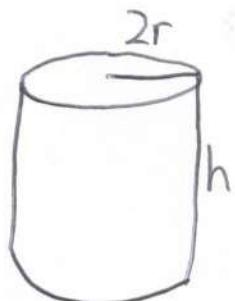
Given that

$$\text{volume of hemisphere : volume of cylinder} = 1 : m$$

find the value of m .



$$\begin{aligned} &= 4\pi r^2 \div 2 + \pi r^2 \\ &= 3\pi r^2 \end{aligned}$$



$$= 2\pi(2r)h = 4\pi rh$$

$$\text{so } 3\pi r^2 = 4\pi rh$$

$$r = \frac{4}{3}h \quad \text{or} \quad h = \frac{3}{4}r$$

$$\text{Vol } \textcircled{A} = \frac{4}{3} \times \pi r^3 \div 2 = \frac{2}{3} \pi r^3$$

$$\text{Vol } \textcircled{B} = \pi (2r)^2 \times h = \pi \times 4r^2 \left(\frac{3}{4}r \right)$$

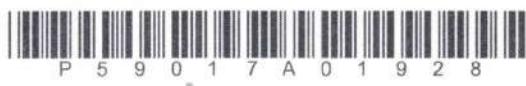
$$\frac{2}{3} \pi r^3 : 3\pi r^3$$

$$2 : 9$$

$$1 : 4.5$$

$$m = 4.5$$

(Total for Question 15 is 4 marks)



16 (a) Rationalise the denominator of $\frac{a + \sqrt{4b}}{a - \sqrt{4b}}$ where a is an integer and b is a prime number.

Simplify your answer.

$$\frac{(a + \sqrt{4b})}{(a - \sqrt{4b})} \times \frac{(a + \sqrt{4b})}{(a + \sqrt{4b})} = \frac{a^2 + 4b + 2a\sqrt{4b}}{a^2 - 4b}$$

$$= \frac{a^2 + 4b + 4a\sqrt{b}}{a^2 - 4b}$$

(3)

(b) Given that $\left(\sqrt{\frac{y}{x}}\right)^{-5} = \frac{x^m}{y^m}$ where $x \neq y$

find the value of m .

$$\left(\left(\frac{x}{y}\right)^{\frac{1}{2}}\right)^5$$

$$m = \frac{5}{2} \text{ or } 2.5 \quad (1)$$

(Total for Question 16 is 4 marks)



17 Here is triangle ABC.

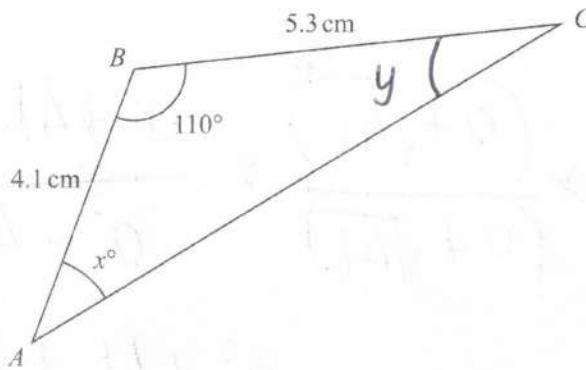


Diagram NOT
accurately drawn

Calculate the value of x .
Give your answer correct to 3 significant figures.

$$AC^2 = 4.1^2 + 5.3^2 - 2 \times 4.1 \times 5.3 \times \cos 110$$

$$AC = \sqrt{59.7\dots} = 7.730\dots$$

$$\frac{\sin x}{5.3} = \frac{\sin 110}{7.73}$$

$$x = \sin^{-1}(0.644\dots) = 40.1125\dots$$

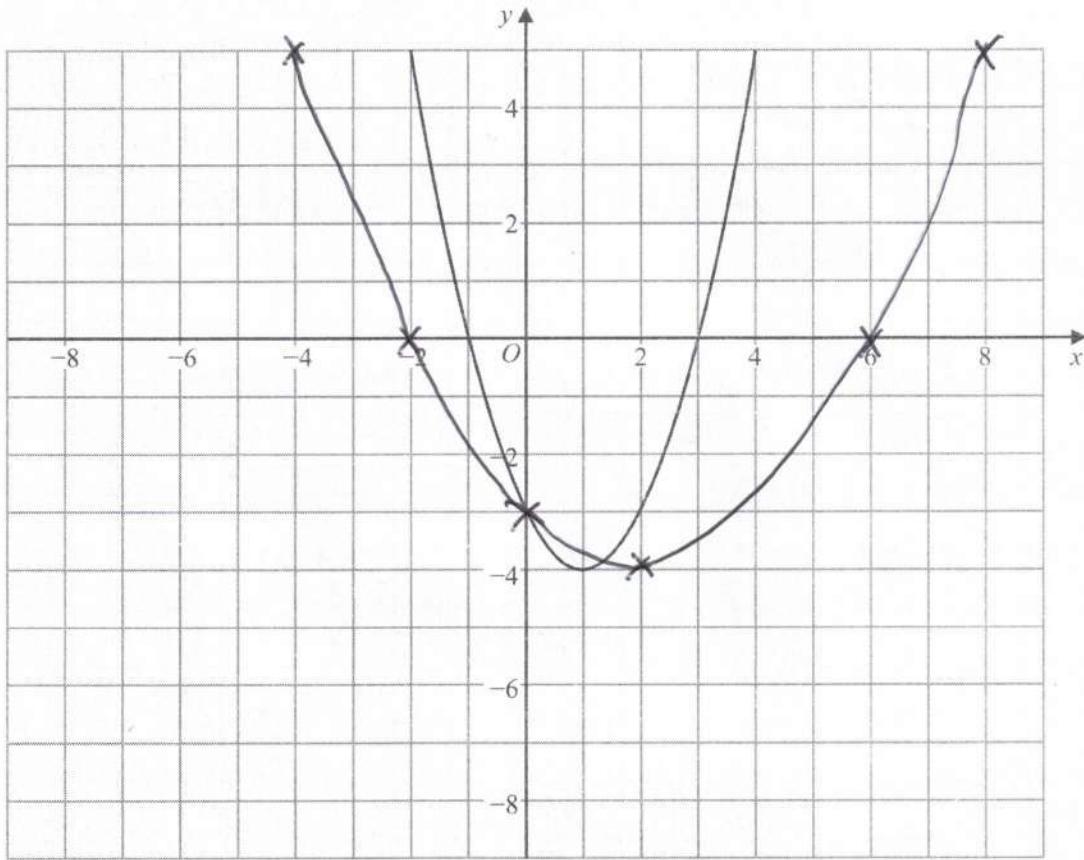
$$= 40.1 \text{ cm}$$

(Total for Question 17 is 5 marks)



18 The graph of $y = f(x)$ is shown on the grid.

a bit wobbly!



(a) On the grid above, sketch the graph of $y = f\left(\frac{1}{2}x\right)$

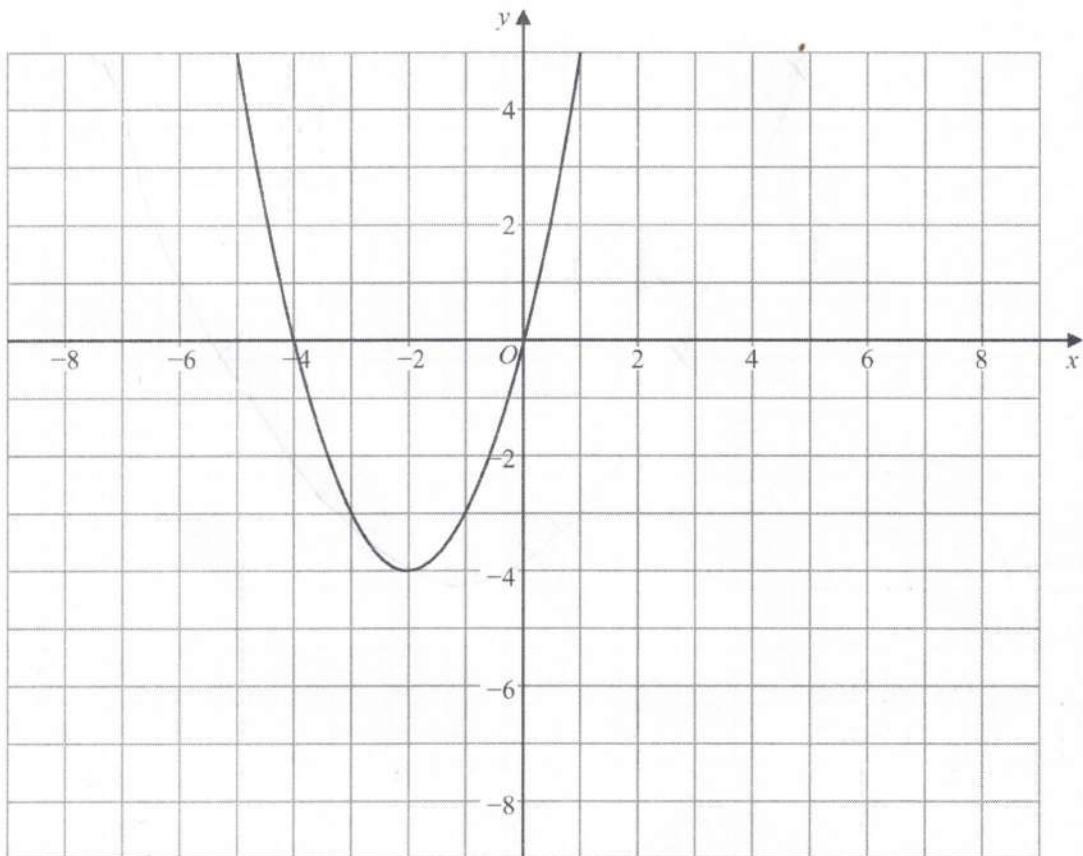
(2)

← →
stretch
 $sf = 2$



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The graph of $y = f(x + k)$ is shown on the grid below.



(b) Write down the value of k

←
3

$K = 3$

(1)

(Total for Question 18 is 3 marks)



19 g is the function with domain $x \geq -3$ such that $g(x) = x^2 + 6x$

(a) Write down the range of g^{-1}

Domain of function = range of
inverse function

$$y \geq -3$$

(1)

(b) Express the inverse function g^{-1} in the form $g^{-1}: x \mapsto \dots$

$$y = (x+3)^2 - 9$$
$$y + 9 = (x+3)^2$$
$$\pm\sqrt{y+9} = x+3$$

$$x = -3 + \sqrt{y+9}$$

$$x = -3 - \sqrt{y+9}$$

reject as < -3

$$g^{-1}: x \mapsto -3 + \sqrt{y+9}$$

(4)

(Total for Question 19 is 5 marks)



20 A bowl contains n pieces of fruit.
Of these, 4 are oranges and the rest are apples.

Two pieces of fruit are going to be taken at random from the bowl.

The probability that the bowl will then contain $(n - 6)$ apples is $\frac{1}{3}$

Work out the value of n

Show your working clearly.

$$\begin{array}{cc} O & A \\ 4 & n-4 \end{array}$$

$$P(AA) = \frac{1}{3} = \frac{n-4}{n} \times \frac{n-5}{n-1}$$

$$n^2 - n = 3n^2 - 27n + 60$$

$$0 = 2n^2 - 26n + 60$$

$$0 = n^2 - 13n + 30$$

$$0 = (n - 10)(n - 3)$$

$$\underline{\underline{n \neq 3}}$$

$$\text{so } n = 10$$

(Total for Question 20 is 6 marks)



21 $(2x + 23)$, $(8x + 2)$ and $(20x - 52)$ are three consecutive terms of an arithmetic sequence.

Prove that the common difference of the sequence is 12

$$(20x - 52) - (8x + 2) = (8x + 2) - (2x + 23)$$

$$12x - 54 = 6x - 21$$

$$6x = 33$$

$$x = 5.5$$

$$t_1 = 2x5.5 + 23 = 34$$

$$t_2 = 8x5.5 + 2 = 46$$

$$t_3 = 20x5.5 - 52 = 58$$

$\rightarrow +12$

$\rightarrow +12$

$$\text{so } d = 12$$

(Total for Question 21 is 4 marks)

TOTAL FOR PAPER IS 100 MARKS

