

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname StemUp Model Solution

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE MATHEMATICS

H

Higher Tier

Paper 1 Non-Calculator

Tuesday 19 May 2020

Morning

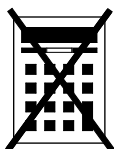
Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:

- mathematical instruments.

You must **not** use a calculator.



Instructions

- Use black ink or black ball-point pen. Draw diagrams in pencil.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80.
- You may ask for more answer paper, graph paper and tracing paper. These must be tagged securely to this answer book.

For Examiner's Use

Pages	Mark
2–3	
4–5	
6–7	
8–9	
10–11	
12–13	
14–15	
16–17	
18–19	
20–21	
22–23	
24–25	
TOTAL	

Advice

In all calculations, show clearly how you work out your answer.



J U N 2 0 8 3 0 0 1 H 0 1

Answer **all** questions in the spaces provided.

Do not write
outside the
box

- 1 Circle the fraction that is equivalent to 4.75

[1 mark]

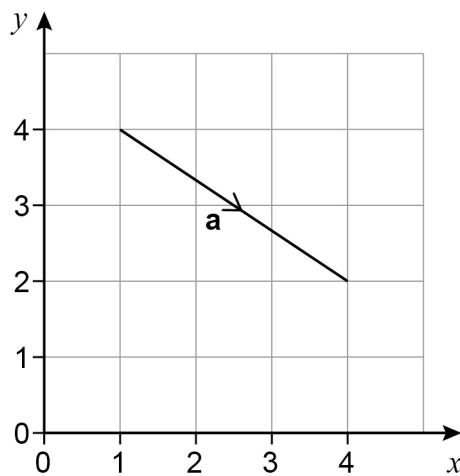
$$\frac{15}{4}$$

$$\frac{19}{4}$$

$$\frac{21}{4}$$

$$\frac{23}{4}$$

- 2 Here is vector **a**.



Circle the column vector that represents **a**.

[1 mark]

$$\begin{pmatrix} 3 \\ 2 \end{pmatrix}$$

$$\begin{pmatrix} -3 \\ 2 \end{pmatrix}$$

$$\begin{pmatrix} 3 \\ -2 \end{pmatrix}$$

$$\begin{pmatrix} -3 \\ -2 \end{pmatrix}$$

- 3 Which one of these is a square number **and** a cube number?
Circle your answer.

[1 mark]

100

1000

10 000

1 000 000



- 4 Circle the reciprocal of $\frac{5}{6}$

[1 mark]

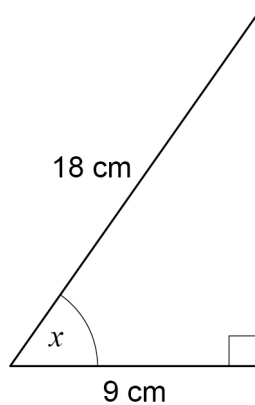
$$\left(\frac{6}{5} \right)$$

$$\frac{1}{6}$$

$$-\frac{1}{6}$$

$$-\frac{6}{5}$$

- 5 Use trigonometry to work out the size of angle x .

Not drawn
accurately

[2 marks]

$$\cos x = \frac{\text{adj}}{\text{hyp}} = \frac{9}{18} = \frac{1}{2}$$

$$x = \cos^{-1}(0.5)$$

$$x = 60^\circ$$

Answer 60 degrees

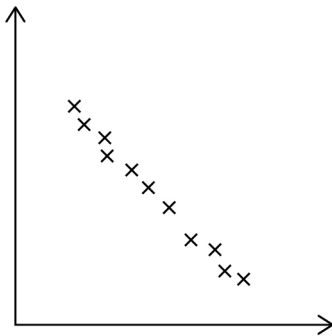
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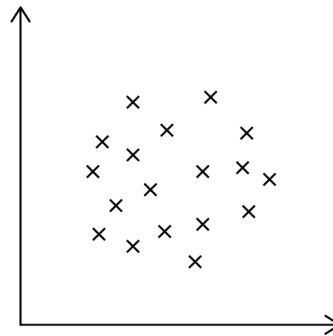
6

A and B are scatter graphs.

Graph A



Graph B



What type of correlation is shown by each graph?

Choose from

Weak positive
Strong positive
Weak negative
Strong negative
No correlation

[2 marks]Graph A Strong negativeGraph B No correlation

7

Here is some information about 80 people who play in bands.

12 are singers but not guitar players.

30% are neither a singer nor a guitar player.

$\frac{1}{4}$ of the guitar players are also singers.

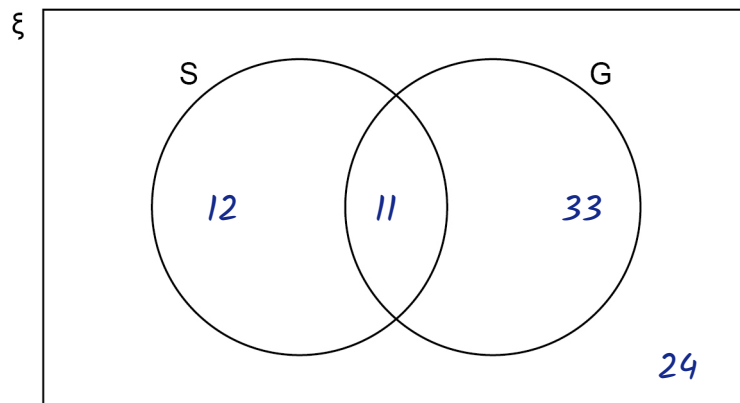
Complete this Venn diagram to represent the information.

[4 marks]

ξ = 80 people who play in bands

S = singers

G = guitar players



$$\text{Neither} = 30\% \text{ of } 80 = 0.3 \times 80 = 24$$

$$\text{Guitar players} = 80 - 24 - 12 = 44$$

$$\text{Both} = \frac{1}{4} \times 44 = 11$$

$$\text{Guitar only} = 44 - 11 = 33$$

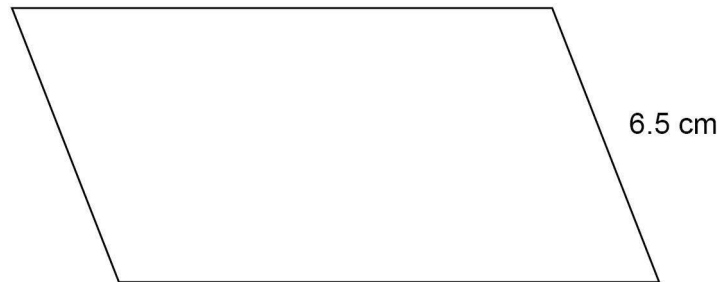
$$\text{Check: } 12 + 11 + 33 + 24 = 80$$



8

The shorter side of a parallelogram has length 6.5 cm

Not drawn
accurately



The length of the shorter side is $\frac{1}{9}$ of the perimeter.

Work out the length of the longer side.

[3 marks]

$$\text{Perimeter} = 6.5 \times 9 = 58.5 \text{ cm}$$

$$\text{Two shorter sides} = 2 \times 6.5 = 13 \text{ cm}$$

$$\text{Two longer sides} = 58.5 - 13 = 45.5 \text{ cm}$$

$$\text{Longer side} = 45.5 \div 2 = 22.75 \text{ cm}$$

Answer 22.75 cm



- 9 (a) All the terms of a **geometric** progression are positive.
The second and fourth terms are shown.

..... 4 16

Work out the first and third terms.

[2 marks]

$$4 \times r \times r = 16 \quad \text{so} \quad r^2 = 4, \quad r = 2 \quad (\text{terms positive})$$

$$\text{First term} = 4 \div 2 = 2$$

$$\text{Third term} = 4 \times 2 = 8$$

First term 2

Third term 8

- 9 (b) The first two terms of an **arithmetic** progression are shown.

p $5p$

The sum of the first three terms is 90

Work out the value of p .

[3 marks]

$$\text{Common difference} = 5p - p = 4p$$

$$\text{Third term} = 5p + 4p = 9p$$

$$p + 5p + 9p = 90 \quad \text{so} \quad 15p = 90$$

$$p = 90 \div 15 = 6$$

Answer 6



10

The cost of a holiday is £2400

Rana pays a deposit followed by monthly payments, in the ratio

deposit : total of the monthly payments = 3 : 5

She makes 6 equal monthly payments.

Work out her monthly payment.

[4 marks]

$$3 + 5 = 8 \text{ parts}$$

$$1 \text{ part} = 2400 \div 8 = £300$$

$$\text{Total of monthly payments} = 5 \times 300 = £1500$$

$$\text{Monthly payment} = 1500 \div 6 = £250$$

Answer £ 250



11 As a decimal $\frac{11}{40} = 0.275$

Work out $\frac{33}{400}$ as a decimal.

[2 marks]

$$\frac{33}{400} = \frac{11}{40} \times \frac{3}{10}$$

$$0.275 \times 3 = 0.825$$

$$0.825 \div 10 = 0.0825$$

Answer 0.0825

Turn over for the next question



12

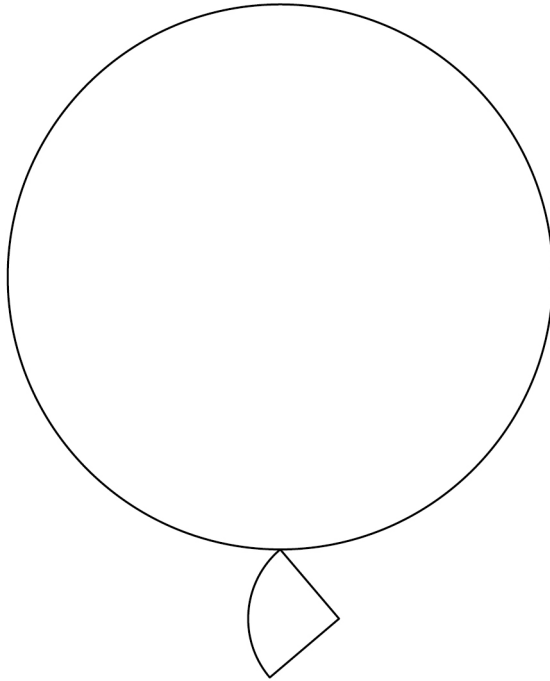
Two wire shapes make an earring.

The shapes are

a circle with radius 21 mm

and

a quarter circle.

Not drawn
accurately

radius of circle : radius of quarter circle = 7 : 2

12 (a) Show that the radius of the quarter circle is 6 mm

[1 mark]

$$21 \div 7 = 3 \quad \text{and} \quad 2 \times 3 = 6$$

so radius of quarter circle = 6 mm



12 (b) Work out the **total** length of the wire in the earring.

Give your answer in the form $a\pi + b$ where a and b are integers.

[4 marks]

$$\text{Circle: circumference} = 2 \times \pi \times 21 = 42\pi$$

$$\text{Quarter circle arc} = 2 \times \pi \times 6 \div 4 = 3\pi$$

$$\text{Two straight radii} = 2 \times 6 = 12$$

$$\text{Total} = 42\pi + 3\pi + 12$$

$$= 45\pi + 12$$

Answer $45\pi + 12$ mm

Turn over for the next question

Turn over ►



- 13 (a) s and t are **positive** integers.

$(x + s)(x - t)$ is expanded and simplified.

The answer is $x^2 + kx - 40$ where k is a positive integer.

Work out the **smallest** possible value of k .

[2 marks]

$$st = 40 \text{ and } k = s - t \text{ (} k \text{ positive, so } s > t \text{)}$$

$$\text{Factor pairs of 40: } 40, 1 \quad 20, 2 \quad 10, 4 \quad 8, 5$$

$$k = 39, 18, 6, 3 \text{ smallest is } 8 - 5 = 3$$

$$(x + 8)(x - 5) = x^2 + 3x - 40$$

Answer 3

- 13 (b) Faisal tries to solve $(x + 2)(x - 7) = 0$

Here is his working.

$$\begin{array}{l} (x + 2) = 0 \quad \text{or} \quad (x - 7) = 0 \\ \text{Answer} \quad x = 2 \quad \text{or} \quad x = 7 \end{array}$$

Give a reason why his answer is wrong.

[1 mark]

$$\text{If } x + 2 = 0 \text{ then } x = -2, \text{ not } x = 2$$

$$(x = 2 \text{ gives } (2 + 2)(2 - 7) = -20, \text{ not } 0)$$

$$\text{The answer should be } x = -2 \text{ or } x = 7$$



14 (a) $c = 2^{10} \times 3 \times 5^6$

Work out $18c$.

Give your answer as a product of prime factors in index form.

[2 marks]

$$18 = 2 \times 3^2$$

$$18c = 2 \times 3^2 \times 2^{10} \times 3 \times 5^6$$

$$= 2^{11} \times 3^3 \times 5^6$$

Answer $2^{11} \times 3^3 \times 5^6$

14 (b) Work out $\sqrt[3]{\frac{2^7 \times 11^3}{2}}$

Give your answer as an integer.

[2 marks]

$$\frac{2^7 \times 11^3}{2} = 2^6 \times 11^3$$

$$\sqrt[3]{(2^6 \times 11^3)} = 2^2 \times 11^1$$

$$= 4 \times 11 = 44$$

Answer 44



15

$$3x = \frac{1}{2}y$$

Circle the ratio $x : y$

[1 mark]

6 : 1

1 : 6

3 : 2

2 : 3

16

A sequence of numbers is formed by the iterative process

$$u_{n+1} = \frac{4}{u_n - 1} \quad u_1 = 9$$

Work out the values of u_2 and u_3

[2 marks]

$$u_2 = \frac{4}{9-1} = \frac{4}{8} = 0.5$$

$$u_3 = \frac{4}{0.5-1} = \frac{4}{-0.5} = -8$$

$$u_2 = \underline{\hspace{2cm} 0.5 \hspace{2cm}}$$

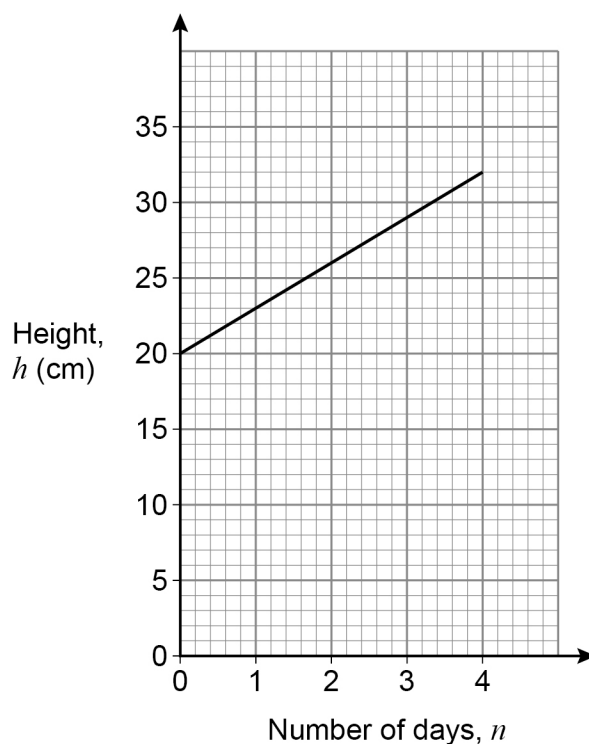
$$u_3 = \underline{\hspace{2cm} -8 \hspace{2cm}}$$



17

Jim buys a plant of height 20 cm

The graph shows how the height of the plant changes during the next 4 days.



Work out a formula for h in terms of n .

[3 marks]

Starts at 20 cm, so intercept = 20

$$\text{Gradient} = \frac{32 - 20}{4 - 0} = \frac{12}{4} = 3 \text{ cm per day}$$

$$h = 3n + 20$$

Answer $h = 3n + 20$

Turn over ►



18

Solve the simultaneous equations

$$2x + 4y = -9$$

$$2y = 4x - 7$$

[4 marks]

$$2y = 4x - 7 \quad \text{so} \quad 4y = 8x - 14$$

Substitute into $2x + 4y = -9$:

$$2x + 8x - 14 = -9$$

$$10x = 5$$

$$x = 0.5$$

$$2y = 4 \times 0.5 - 7 = 2 - 7 = -5$$

$$y = -2.5$$

$$\text{Check: } 2(0.5) + 4(-2.5) = 1 - 10 = -9 \quad \checkmark$$

$$x = \underline{\quad 0.5 \quad} \quad y = \underline{\quad -2.5 \quad}$$



- 19 Circle the expression that is equivalent to $\frac{x}{5} + \frac{x}{10}$ [1 mark]

$$\frac{3x}{10}$$

$$\frac{2x}{15}$$

$$\frac{x}{25}$$

$$\frac{x^2}{50}$$

- 20 (a) Write down the value of 7^0 [1 mark]

Answer 1

- 20 (b) Work out the value of $32^{-\frac{3}{5}}$ [2 marks]

$$32^{1/5} = {}^5\sqrt{32} = 2$$

$$32^{3/5} = 2^3 = 8$$

$$32^{-3/5} = \frac{1}{8}$$

Answer $\frac{1}{8}$

Turn over for the next question



21

Write these numbers in order of size.

15.6

 $3\sqrt{23}$ 2.1^4 $\frac{47}{3}$

Start with the smallest.

[2 marks]

$$3\sqrt{23} = \sqrt{(9 \times 23)} = \sqrt{207}, \quad 14^2 = 196, \quad 15^2 = 225$$

so $3\sqrt{23}$ is between 14 and 15 (about 14.4)

$$\frac{47}{3} = 15.666... \text{ which is more than } 15.6$$

$$2.1^2 = 4.41, \quad 2.1^4 = 4.41^2 = 19.4481$$

Smallest $3\sqrt{23}$

15.6

$\frac{47}{3}$

Largest 2.1^4



22 (a) y is directly proportional to x^3

$$y = 17 \quad \text{when} \quad x = 4$$

Work out an equation connecting y and x .

[3 marks]

$$y = kx^3$$

$$17 = k \times 4^3 \quad \text{so} \quad 17 = 64k$$

$$k = \frac{17}{64}$$

Answer $y = \frac{17}{64} x^3$

22 (b) m is inversely proportional to $\sqrt{r}$

The value of r is multiplied by 4

Circle what happens to the value of m .

[1 mark]

$\times 2$

$\times 16$

$\div 2$

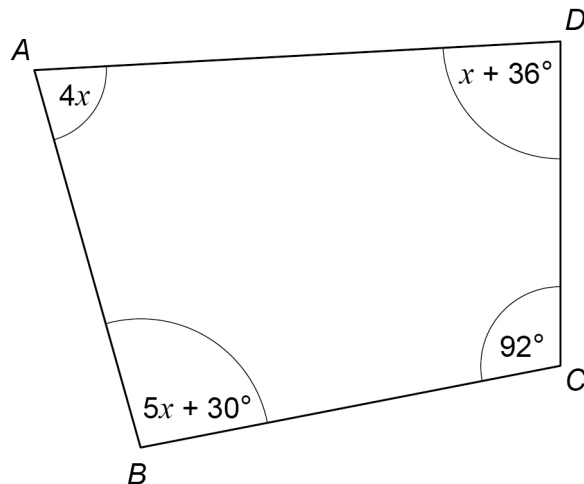
$\div 16$

Turn over for the next question

Turn over ►



23

 $ABCD$ is a quadrilateral.Not drawn
accuratelyProve that $ABCD$ is **not** a cyclic quadrilateral.

[4 marks]

Opposite angles of a cyclic quadrilateral add up to 180° .

If $ABCD$ were cyclic, angle $A + \text{angle } C = 180^\circ$:

$$4x + 92 = 180 \quad \text{so} \quad 4x = 88, \quad x = 22$$

and angle $B + \text{angle } D = 180^\circ$:

$$5x + 30 + x + 36 = 180 \quad \text{so} \quad 6x + 66 = 180$$

$$6x = 114, \quad x = 19$$

These give different values of x ($22 \neq 19$), but they

should be equal, so the opposite angles cannot both

add up to 180° . $\therefore ABCD$ is not a cyclic quadrilateral.



24

 y is an obtuse angle.

Which statement is true?

Tick **one** box.

[1 mark]

☐ $\sin y > 0$ and $\cos y > 0$ ☒ $\sin y > 0$ and $\cos y < 0$ ☐ $\sin y < 0$ and $\cos y > 0$ ☐ $\sin y < 0$ and $\cos y < 0$

Turn over for the next question

Turn over ►

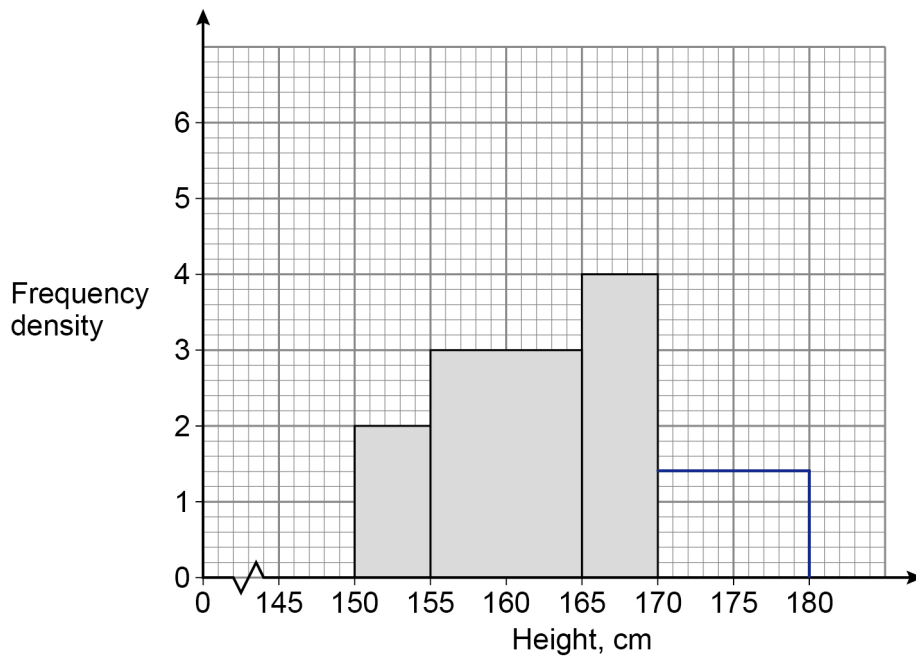


25

A histogram is drawn to represent the heights of a sample of women.

Three of the four bars are shown.

The bar for $170 \text{ cm} \leq \text{height} < 180 \text{ cm}$ is missing.



There are 74 women in the sample.

Complete the histogram.

[4 marks]

$$\text{Frequency} = \text{frequency density} \times \text{class width}$$

$$150-155: 2 \times 5 = 10, \quad 155-165: 3 \times 10 = 30$$

$$165-170: 4 \times 5 = 20$$

$$\text{Missing frequency} = 74 - 10 - 30 - 20 = 14$$

$$\text{Frequency density} = 14 \div 10 = 1.4$$



- 26 (a)** Show that $\frac{14}{\sqrt{7}}$ can be written in the form $a\sqrt{b}$ where a and b are integers.

[2 marks]

$$\frac{14}{\sqrt{7}} \times \frac{\sqrt{7}}{\sqrt{7}} = \frac{14\sqrt{7}}{7}$$

$$= 2\sqrt{7} \quad (a = 2, b = 7)$$

- 26 (b)** Work out $2\sqrt{10} \times \sqrt{80} \times \sqrt{18}$
Give your answer as an integer.

[3 marks]

$$\sqrt{80} = \sqrt{16 \times 5} = 4\sqrt{5}$$

$$\sqrt{18} = \sqrt{9 \times 2} = 3\sqrt{2}$$

$$2\sqrt{10} \times 4\sqrt{5} \times 3\sqrt{2} = 24 \times \sqrt{(10 \times 5 \times 2)}$$

$$= 24 \times \sqrt{100}$$

$$= 24 \times 10 = 240$$

Answer 240

Turn over for the next question

Turn over ►



27

A and B are similar solid cylinders.

base area of A : base area of B = 9 : 25
--

Complete these ratios.

[2 marks]

$$\text{curved surface area of A : curved surface area of B} = \underline{\quad 9 \quad} : \underline{\quad 25 \quad}$$

$$\text{height of A : height of B} = \underline{\quad 3 \quad} : \underline{\quad 5 \quad}$$

$$\text{length ratio} = \sqrt{9} : \sqrt{25} = 3 : 5$$

28

Factorise fully $144 - 4x^2$ **[2 marks]**

$$144 - 4x^2 = 4(36 - x^2)$$

$$= 4(6 + x)(6 - x)$$

$$\text{Answer } \underline{\quad 4(6 + x)(6 - x) \quad}$$



29

The graph of $y = x^3 + 6$ is translated 4 units to the right.

The translated graph has equation $y = f(x)$

Work out $f(x)$.

Give your answer in the form $x^3 + ax^2 + bx + c$ where a , b and c are integers.

[4 marks]

Translate 4 right: replace x with $x - 4$

$$f(x) = (x - 4)^3 + 6$$

$$(x - 4)^2 = x^2 - 4x - 4x + 16 = x^2 - 8x + 16$$

$$(x - 4)^3 = (x - 4)(x^2 - 8x + 16)$$

$$= x^3 - 8x^2 + 16x - 4x^2 + 32x - 64$$

$$= x^3 - 12x^2 + 48x - 64$$

$$f(x) = x^3 - 12x^2 + 48x - 64 + 6$$

$$= x^3 - 12x^2 + 48x - 58$$

Answer $x^3 - 12x^2 + 48x - 58$

END OF QUESTIONS



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outside the
box*

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ANSWER IN THE SPACES PROVIDED**



[illegible]

