



Model Answers

Please write clearly in block capitals.

Centre number

Candidate number

Surname _____

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.



JUN2083001H01

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

1 Circle the fraction that is equivalent to 4.75

[1 mark]

$$\begin{array}{r} 4.75 \\ 4 \overline{)1900} \\ \underline{16} \\ 30 \\ \underline{28} \\ 20 \\ \underline{20} \\ 0 \end{array}$$

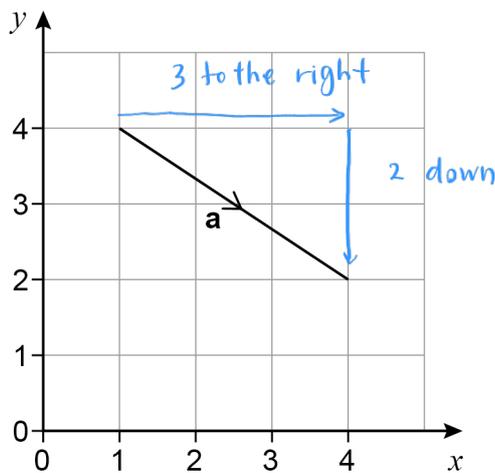
$$\frac{15}{4}$$

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

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

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

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

10000

1000000

square = 1000×1000

cube = $100 \times 100 \times 100$



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

invert the fraction



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

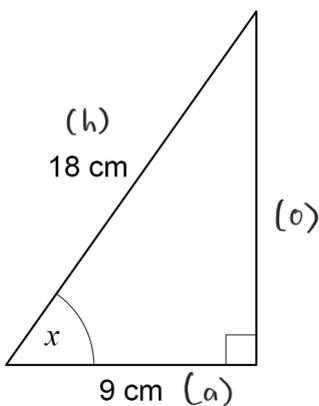
$$\frac{1}{6}$$

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

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

[1 mark]

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



Not drawn accurately

$$\cos = \frac{A}{H}$$

[2 marks]

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

$$x = 60^\circ$$

$$\cos x = 0.5$$

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

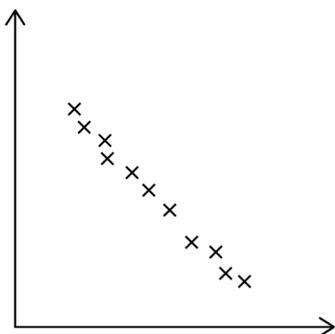
Answer 60° degrees



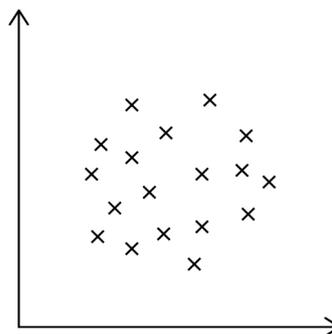
6

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 negative

Graph 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.

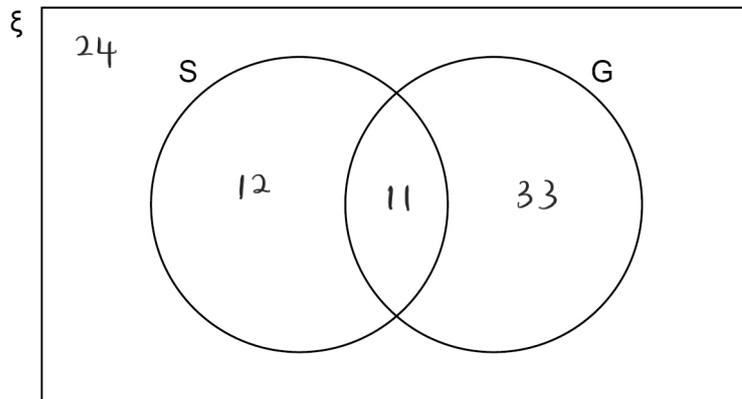
Complete this Venn diagram to represent the information.

[4 marks]

ξ = 80 people who play in bands

S = singers

G = guitar players



$\frac{30}{100} \times 80 = \text{neither a singer or a guitar player}$

$24 = \text{neither a singer or a guitar player}$

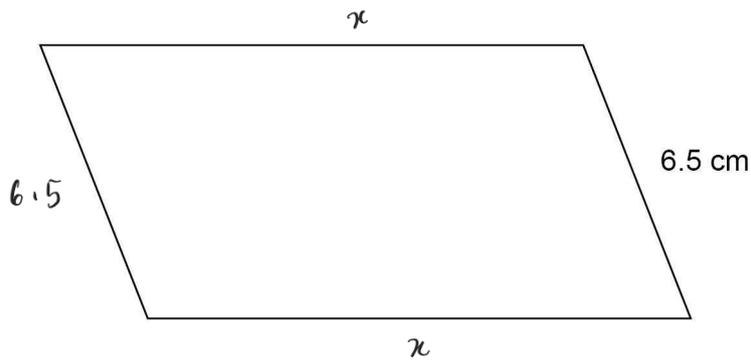
Guitar players = $80 - 24 - 12 = 44$

$\frac{1}{4} \times 44 = 11$ guitar players that are also singers.

$$\begin{array}{r} 780 \\ - 24 \\ \hline 56 \\ - 12 \\ \hline 44 \end{array}$$



8 The shorter side of a parallelogram has length 6.5 cm



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

Work out the length of the longer side.

[3 marks]

$$\begin{aligned} \text{perimeter} &= 6.5 + x + 6.5 + x \\ &= 13 + 2x \end{aligned}$$

$$\frac{1}{9} (13 + 2x) = 6.5$$

$$(13 + 2x) = 9 \times 6.5$$

$$13 + 2x = 58.5$$

$$2x = 58.5 - 13$$

$$2x = 45.5$$

$$x = 45.5 \div 2$$

$$x = 22.75$$

Answer 22.75 cm



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

$$\dots\dots\dots 4 \dots\dots\dots 16$$

$$(2^2) \qquad (2^4)$$

Work out the first and third terms.

[2 marks]

4 is also equal to 2^2 . 16 is equal to 2^4 .

This makes the first term : $2^1 = 2$

This makes the third term : $2^3 = 2 \times 2 \times 2 = 8$

First term _____ 2 _____

Third term _____ 8 _____

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

$$p \quad 5p \quad \dots\dots$$

The sum of the first three terms is 90

Work out the value of p .

[3 marks]

$$p + 5p + \text{third term} = 90$$

$$\text{third term} = 90 - 6p$$

$$5p - p = (90 - 6p) - 5p$$

$$4p = 90 - 11p$$

$$11p + 4p = 90$$

$$15p = 90$$

$$p = 6$$

difference between consecutive terms are the same

Answer _____ $p = 6$ _____



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]

Total ratio parts : $3 + 5 = 8$ parts

$£ 2400 \div 8 = £ 300$ (1 part = £ 300)

$\begin{matrix} \times 300 & \left(\begin{matrix} 3 & = & 5 \\ \downarrow & & \downarrow \end{matrix} \right) & \times 300 \\ & 900 & = & 1500 \end{matrix}$

$$\begin{array}{r} 250 \\ 6 \overline{)1500} \\ \underline{12} \\ 30 \\ \underline{30} \\ 0 \end{array}$$

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]

$$= \frac{11}{40} \xrightarrow{\times 3} \frac{33}{40} \xrightarrow{\div 10} \frac{33}{400} \qquad \begin{array}{r} 21 \\ 0.275 \\ \times \quad 3 \\ \hline 0.825 \end{array}$$

$$= 0.275 \xrightarrow{\times 3} 0.825 \xrightarrow{\div 10} 0.0825$$

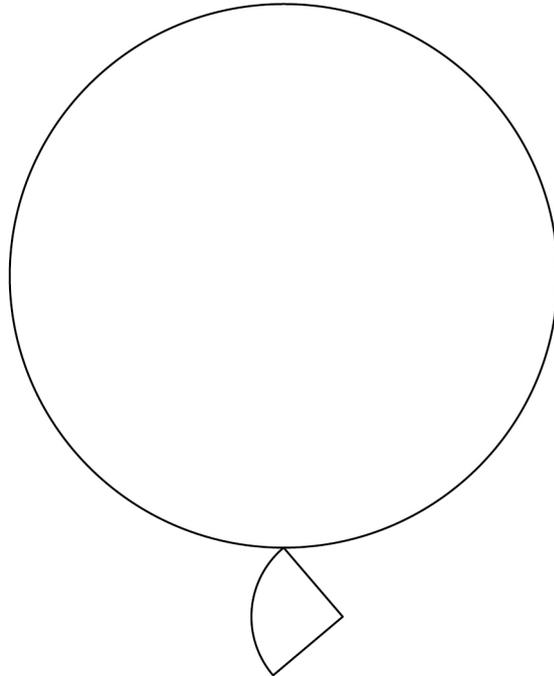
Answer 0.0825

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



$$\text{radius of circle} : \text{radius of quarter circle} = 7 : 2$$

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

[1 mark]

$$\begin{array}{l} \times 3 \quad 7 : 2 \quad \times 3 \\ \quad \quad \downarrow \quad \downarrow \\ \quad \quad 21 = 6 \end{array}$$

$$\text{Radius of quarter circle} = 6 \text{ mm}$$



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]

$$\text{Circumference of the circle} = 2\pi r$$

$$= 2\pi(21)$$

$$= 42\pi$$

$$\text{Perimeter of the quarter circle} = \frac{1}{4} \times 2\pi(6) + 6 + 6$$

$$= \frac{1}{4} \times \cancel{2}^3\pi + 12$$

$$= 3\pi + 12$$

$$\text{Total wires needed} = 42\pi + 3\pi + 12 = 45\pi + 12$$

Answer $45\pi + 12$ mm

Turn over for the next question



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]

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

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

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

$$= 2^{1+10} \times 3^{2+1} \times 5^6 = 2^{11} \times 3^3 \times 5^6$$

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]

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

$$= (2^6)^{1/3} \times (11^3)^{1/3}$$

$$= 2^2 \times 11$$

$$= 44$$

Answer 44



15 $3x = \frac{1}{2}y$

Circle the ratio $x : y$

[1 mark]

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

$6x = y$

$x = \frac{1}{6}y$

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]

$$u_2 = \frac{4}{u_1 - 1} = \frac{4}{9 - 1} = \frac{4}{8} = \frac{1}{2} = 0.5$$

$$u_3 = \frac{4}{u_2 - 1} = \frac{4}{0.5 - 1} = \frac{4}{-0.5} = -8$$

$u_2 =$ _____ 0.5

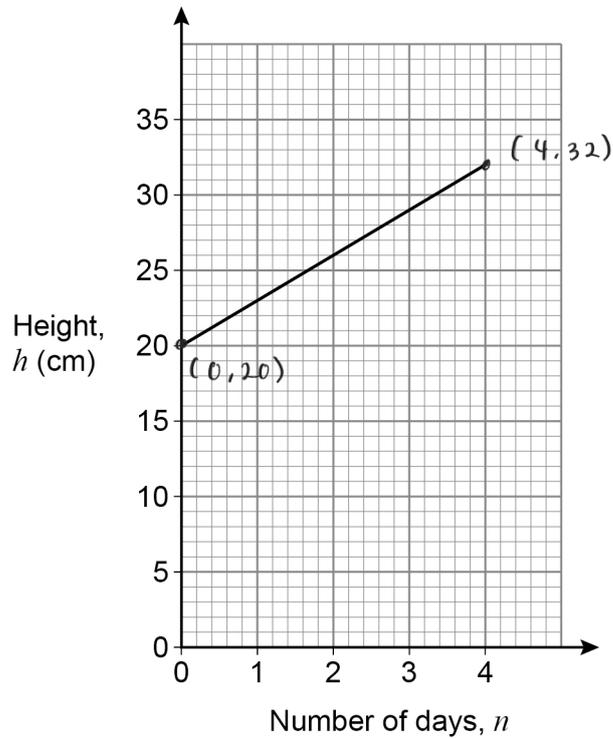
$u_3 =$ _____ -8



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]

$$y\text{-intercept, } c = 20$$

$$\text{gradient, } m = \frac{32 - 20}{4 - 0} = \frac{12}{4} = 3$$

$$y = mx + c \rightarrow h = 3n + 20$$

Answer $h = 3n + 20$



18 Solve the simultaneous equations

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

$$2y = 4x - 7$$

[4 marks]

$$2x + 4y = -9 \quad \text{--- (1)}$$

$$2y = 4x - 7 \quad \text{--- (2)}$$

$$y = \frac{4x - 7}{2} \quad \text{--- (3)}$$

Substitute (3) into (1)

substitute x into (3)

$$2x + 4 \left(\frac{4x - 7}{2} \right) = -9$$

$$y = \frac{4x - 7}{2}$$

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

$$= \frac{4(0.5) - 7}{2}$$

$$10x = -9 + 14$$

$$10x = 5$$

$$= \frac{2 - 7}{2} = -\frac{5}{2}$$

$$x = \frac{5}{10} = 0.5$$

$$y = -2.5$$

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



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]

$3\sqrt{23} = \text{less than } 15 \text{ (} 3\sqrt{25} = 15 \text{)}$

$2.1^4 = \text{more than } 16 \text{ (} 2^4 = 16 \text{)}$

$\frac{47}{3} = 15.666$

15.66 ...

$$\begin{array}{r} 3 \overline{)47.00} \\ \underline{3} \\ 17 \\ \underline{15} \\ 20 \\ \underline{18} \\ 20 \\ \underline{18} \end{array}$$

Smallest $3\sqrt{23}$

 15.6

 $\frac{47}{3}$

Largest 2.1^4



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

$y = 17$ when $x = 4$

Work out an equation connecting y and x .

[3 marks]

$$y = kx^3$$

$$17 = k(4)^3$$

$$17 = k(64)$$

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

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

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]

$\times 2$

$\times 16$

$\div 2$

$\div 16$

$$m = \frac{k}{\sqrt{r} \times 4}$$

$\sqrt{4} = 2$

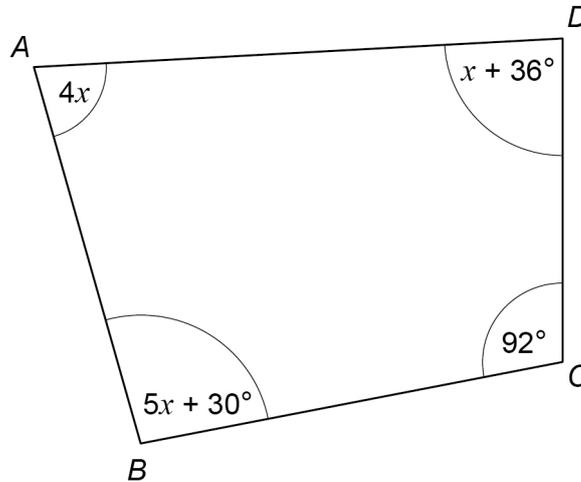
Turn over for the next question



23

$ABCD$ is a quadrilateral.

Not drawn
accurately



Prove that $ABCD$ is **not** a cyclic quadrilateral.

[4 marks]

If they are cyclic quadrilateral, the opposite angles should equate to 180°

$$4x + 5x + 30^\circ + 92^\circ + x + 36^\circ = 360^\circ$$

$$10x + 66^\circ + 92^\circ = 360^\circ$$

$$10x + 158^\circ = 360^\circ$$

$$10x = 360^\circ - 158^\circ$$

$$10x = 202^\circ$$

$$x = 20.2^\circ$$

$$= 4x + 92^\circ$$

$$= 4(20.2) + 92^\circ$$

$$= 80.8^\circ + 92^\circ$$

$$= 172.8^\circ$$

$$172.8^\circ \neq 180^\circ$$

The opposite angles do not equate to 180° . Hence, this is not a cyclic quadrilateral.



24

y is an obtuse angle.

Which statement is true?

Tick **one** box.

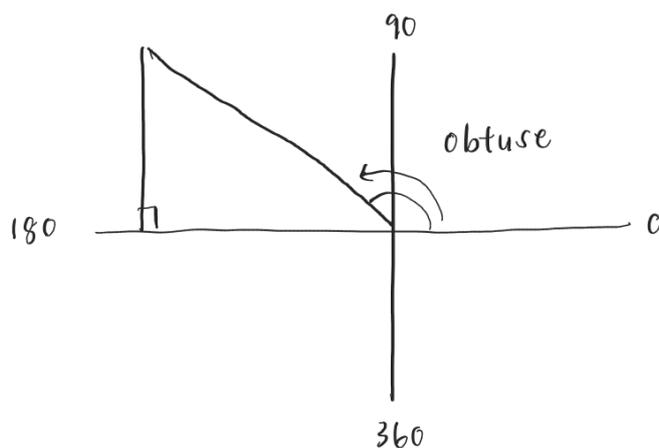
[1 mark]

$\sin y > 0$ and $\cos y > 0$

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

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

$\sin y < 0$ and $\cos y < 0$



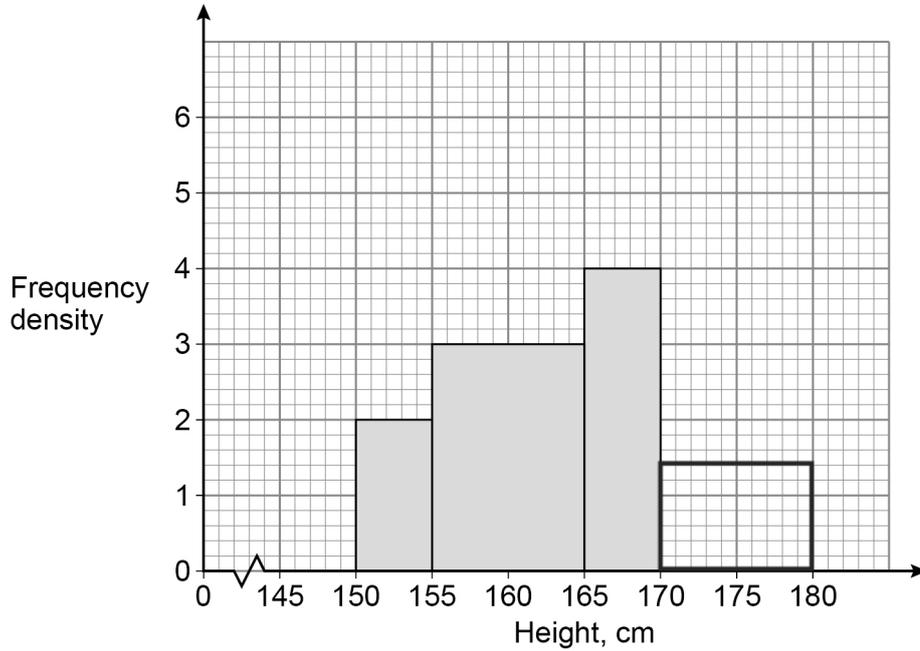
Turn over for the next question

5

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]

$$\text{Total frequency} = 74$$

$$\text{Frequency density}$$

$$\text{Frequency} :$$

$$\text{for } 170 - 180 :$$

$$150 - 155 = 5 \times 2 = 10$$

$$14 \div 10 = 1.4$$

$$155 - 165 = 10 \times 3 = 30$$

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

$$\text{Frequency for } 170 - 180 = 74 - 10 - 30 - 20$$

$$= 74 - 60$$

$$= 14$$



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]

$$\begin{aligned} \frac{14}{\sqrt{7}} &= \frac{2 \times 7}{7^{1/2}} \\ &= 2 \times 7^1 \times 7^{-1/2} \\ &= 2 \times 7^{(1-1/2)} = 2 \times 7^{1/2} & a = 2 \\ &= 2\sqrt{7} & b = 7 \end{aligned}$$

26 (b) Work out $2\sqrt{10} \times \sqrt{80} \times \sqrt{18}$

Give your answer as an integer.

[3 marks]

$$\begin{aligned} &= 2\sqrt{10} \times \sqrt{80} \times \sqrt{18} \\ &= 2\sqrt{2 \times 5} \times \sqrt{4 \times 4 \times 5} \times \sqrt{9 \times 2} \\ &= 2\sqrt{2} \times \sqrt{5} \times \sqrt{4} \times \sqrt{4} \times \sqrt{5} \times \sqrt{9} \times \sqrt{2} \\ &= 2 \times \sqrt{2} \times \sqrt{5} \times 2 \times 2 \times \sqrt{5} \times 3 \times \sqrt{2} \\ &= 2 \times 2 \times 2 \times 3 \times \sqrt{2} \times \sqrt{2} \times \sqrt{5} \times \sqrt{5} \quad (\text{Collect like terms}) \\ &= 24 \times 2 \times 5 \\ &= 240 \end{aligned}$$

Answer 240

Turn over for the next question



27 A and B are similar solid cylinders.

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

Complete these ratios.

since they are also areas, the ratio is the same

[2 marks]

curved surface area of A : curved surface area of B = 9 : 25

height of A : height of B = 3 : 5

✓ should be square root of the area ratio

height A = $\sqrt{9} = 3$

height B = $\sqrt{25} = 5$

28 Factorise fully $144 - 4x^2$

[2 marks]

$$\begin{aligned}
 &= 144 - 4x^2 && \begin{array}{r} 36 \\ 4\sqrt{144} \end{array} \\
 &= 4(36 - x^2) && \frac{12}{24} \\
 &= 4(6^2 - x^2) && \underline{24} \\
 &= 4(6-x)(6+x)
 \end{aligned}$$

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



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]

$$\begin{aligned}
 y &= x^3 + 6 && (x - 4) \rightarrow \text{translated 4} \\
 y &= (x - 4)^3 + 6 && \text{units to the right} \\
 &= (x - 4)(x - 4)(x - 4) + 6 \\
 &= (x^2 - 4x - 4x + 16)(x - 4) + 6 \\
 &= (x^2 - 8x + 16)(x - 4) + 6 && \begin{array}{r} \times 16 \\ 4 \end{array} \\
 &= x^3 - 8x^2 + 16x - 4x^2 + 32x + (16x - 4) + 6 && \underline{64} \\
 &= x^3 - 8x^2 + 16x - 4x^2 + 32x - 64 + 6 \\
 &= x^3 - 8x^2 - 4x^2 + 16x + 32x - 64 + 6 \quad (\text{collect like terms}) \\
 &= x^3 - 12x^2 + 48x - 58
 \end{aligned}$$

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

END OF QUESTIONS



There are no questions printed on this page

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outside the
box*

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ANSWER IN THE SPACES PROVIDED**



