| Candidate surname | Other names |
|---|---|
| | |

Maths Planner

AQA

2024 Predicted Paper

# Mathematics

## PAPER 2 (Calculator)

## Higher Tier

**Time** 1 hour 30 minutes

Worked Written Solutions ✓

Total Marks

82

| Q | Topic(s) | Marks |
|---|---|---|
| 1 | Expand and Simplify | / 3 |
| 2 | Similar Shapes | / 2 |
| 3 | Primes, Cubes and Triangular Numbers | / 2 |
| 4 | Reverse Percentages | / 2 |
| 5 | Angles in Parallel Lines | / 2 |
| 6 | Ratio 1:n / Sharing | / 4 |
| 7 | Calculating with Speed | / 4 |
| 8 | Standard Form | / 3 |
| 9 | Combining Ratio / Fractions | / 3 |
| 10 | Types of Graphs | / 3 |
| 11 | Algebraic Fractions | / 1 |
| 12 | Angles in Polygons | / 3 |
| 13 | Product Rule for Counting | / 2 |

| Q | Topic(s) | Marks |
|---|---|---|
| 14 | Compound / Simple Interest | / 4 |
| 15 | Equation of a Straight Line | / 5 |
| 16 | Averages from a Table | / 4 |
| 17 | Trigonometry | / 4 |
| 18 | Quadratic Equations | / 5 |
| 19 | Iteration | / 4 |
| 20 | Volume / MDV / Bounds | / 4 |
| 21 | Direct / Inverse Proportion | / 5 |
| 22 | Histograms | / 3 |
| 23 | Non-Right Trigonometry | / 5 |
| 24 | Trig Graphs / Functions | / 5 |

Maths Planner

# Marking Codes

| Mark | What does it mean? |
|---|---|
| M1 | **Method mark**. This mark is generally given for an appropriate method in the context of the question. *This mark is given for showing your working and may be awarded even if working is incorrect.* |
| A1 | **Accuracy mark**. This mark is generally given for a correct answer following correct working. |
| B1 | **Working mark**. This mark is usually given when working and the answer cannot easily be separated. |
| C1 | **Communication mark.** This mark is given for explaining your answer or giving a conclusion in context supported by your working |
| P1 | **Process Mark.** This mark is generally given for setting up an appropriate process to find a solution in the context of the question |

# Student Warning

**The questions in this paper will not be in the exam**

These topics are **not guaranteed** to show up in your Paper 2 exam. Please make sure to revise **all topic areas**, especially since topics covered in Paper 1 can still come up.

These questions have been selected using analysis on previous official exam papers.

Answers all questions in the spaces provided.

*Do not write outside the box*

**1** Expand and simplify $3(2y + x) - 5(x - y)$

**[3 marks]**

$= 6y + 3x - 5x + 5y$ ✓ M1

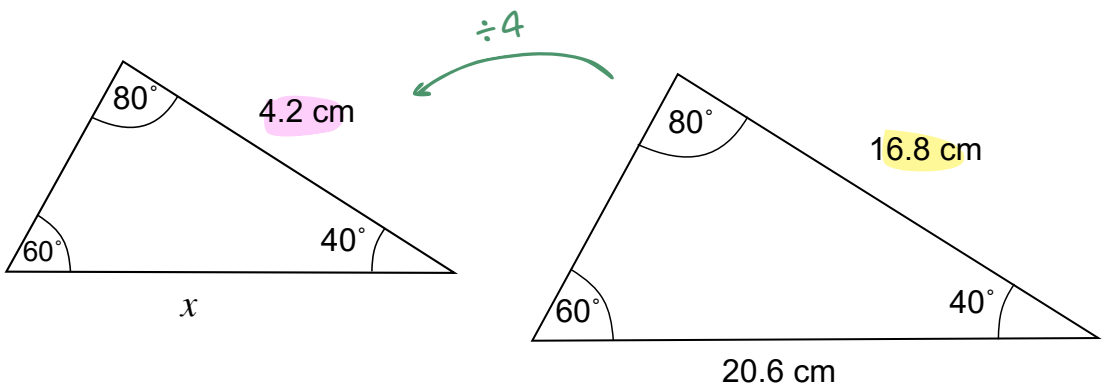
$= 11y - 2x$

✓ A1 (one correct term)
✓ A2 (two correct terms)

Answer $11y - 2x$

**2** Here are two scalene triangles.

Not drawn accurately




Work out the size of length $x$.

**[2 marks]**

💡 All angles are equal → Triangles are similar

Scale Factor = 16.8 ÷ 4.2 = 4 ✓ M1

$x = 20.6 \div 4 = 5.15$

Answer $x$ = 5.15 ✓ A1 cm

Do not write outside the box

**3** Sam is thinking of a single digit integer, which is **both** prime and triangular.

Work out the value of this integer cubed.

Integer: whole number

**[2 marks]**

Primes: 2, 3, 5, 7, ~~11~~, ...

Triangular: 1, 3, 6, ~~10~~, ... ✓ P1

$\therefore 3^3 = 27$

Answer 27 ✓ A1

**4** A gaming PC has a **discount** of 25%.
The discount price is **£2062.50**
Work out the original price before the sale.

Original = New ÷ Multiplier

**[2 marks]**

Multiplier: 100% - 25% = 75%

75 ÷ 100 = 0.75 ✓ B1 (finding correct multiplier)

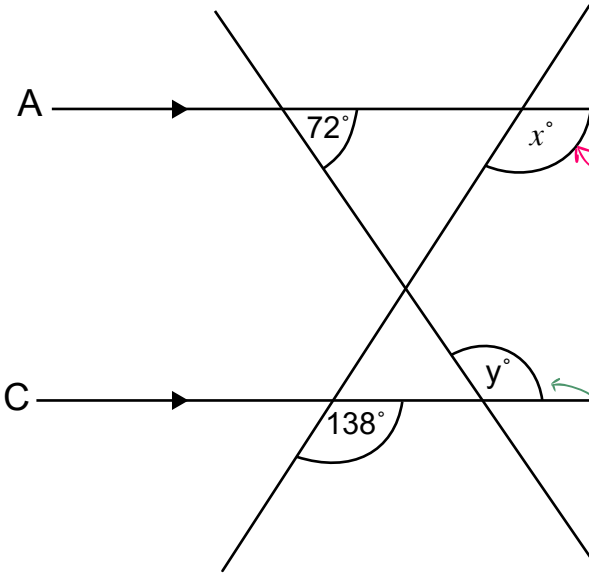
Original = 2062.50 ÷ 0.75

= 2750

Answer £ 2750 ✓ A1

Do not write outside the box

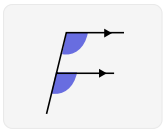
**5** AB and BC are parallel lines.




Not drawn accurately

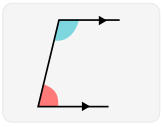
$x = 138°$

Corresponding angles are equal



$y = 180 - 72 = 108°$

Co-interior angles sum to 180°



**5 (a)** Work out the size of angle $x$.

**[1 mark]**

Answer 138 ✓ B1 °

**5 (b)** Work out the size of angle y.

**[1 mark]**

Answer 108 ✓ B1 °

Do not write outside the box

**6 (a)** Write 8 : 12 in the form 1 : *n*

**[1 mark]**

÷8 ↓ 8 : 12 ↓ ÷8

1 : $\frac{12}{8}$

Accept the forms:

✓ B1 ✓ B1 ✓ B1

Answer 1 : $\frac{12}{8}$ 1 : $\frac{3}{2}$ 1 : 1.5

**6 (b)** Tony and Sarah have money saved in the ratio 7 : 11

Sarah has saved £24 more than Tony.

Work out how much they have saved in total.

**[3 marks]**

÷4 ↓ 4 parts = £24 ✓ M1 ↓ ÷4

1 part = £6

+4 more parts

| T : S | Total |
|---|---|
| 7 : 11 | 18 ✓ M1 |
| 42 : 66 | 108 |

x6 ↓ x6

Answer £ 108 ✓ A1

Do not write outside the box

**7** Josh is competing in a 20 mile race.
He must **run the first half** and then cycle the remaining half.

After **24 minutes**, Josh looks at his fitness watch and reads he has ran **1.8 miles**.

He continues this pace until he reaches the half way point.

Work out exactly how long the first half of the race takes Josh to complete.
Give your answer in, hours, minutes and seconds.

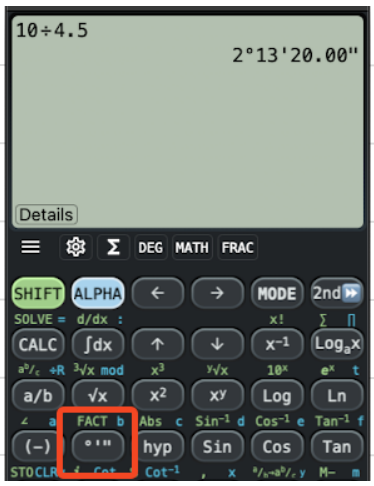
**[4 marks]**

20 miles ÷ 2 = 10 miles to run

24 minutes ÷ 60 = 0.4 hours

$S = \frac{D}{T} = \frac{1.8}{0.4} = 4.5$ mph ✓ M1

$T = \frac{D}{S} = \frac{10}{4.5} = 2.\dot{2}$ hours ✓ M1




pressing [° ′ ″] button will convert your answer into hours, minutes & seconds!

Answer 2 hrs hrs 13 mins mins 20 secs secs

✓ A1 (all three correct values)

Do not write outside the box

**8 (a)** Write $7.5 \times 10^{-6}$ as an ordinary number.

**[1 mark]**

0.000007.5

0.0000075

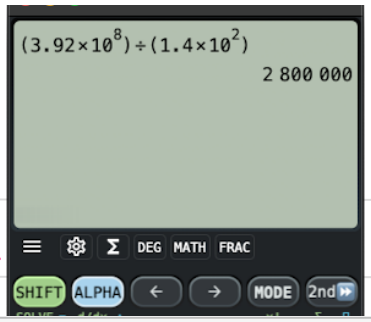
Answer 0.0000075 ✓ B1

**8 (b)** Work out $(3.92 \times 10^{8}) \div (1.4 \times 10^{2})$
Give your answer in standard form.

**[2 marks]**

2800000. ✓ P1

2.800000




You can input into your calculator

Answer $2.8 \times 10^{6}$ ✓ B1

**9** Given $x : y = 4 : 5$ and $\frac{x}{w} = \frac{7}{3}$

find the ratio $x : y : w$ in its simplest form.

**[3 marks]**

$x : y : w$

x7 $4 : 5$

✓ M1 $7 : \ : 3$ x4

28 : 35 : 12

They have '$x$', we can use this fact to link the two ratios!

4 x 7 = 28

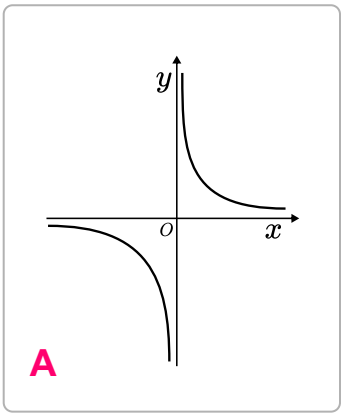
Answer 28 : 35 : 12

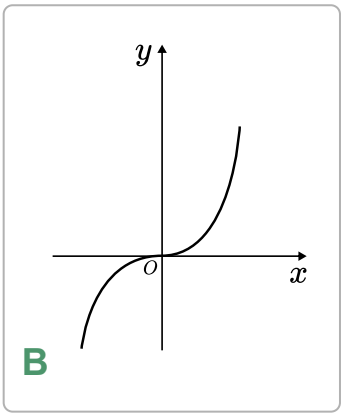
✓ A1 (at least 2 correct values)

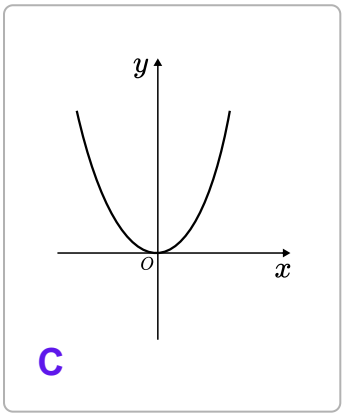
✓ A2 (all three values correct)

Do not write outside the box

**10** Here are some graphs.




Write down an equation for each graph.

**[3 marks]**

Answer

A $y = \frac{1}{x}$ ✓ B1 Accept any y=k/x

B $y = x^3$ ✓ B1 Accept any y=kx²

C $y = x^2$ ✓ B1 Accept any y=kx³

**11** Simplify $\dfrac{x^2 - 16}{x^2 - 4x - 32}$

DOTS: a²-b² = (a+b)(a-b)

$\dfrac{(x+4)(x-4)}{(x-8)(x+4)}$ -32 = -8x4

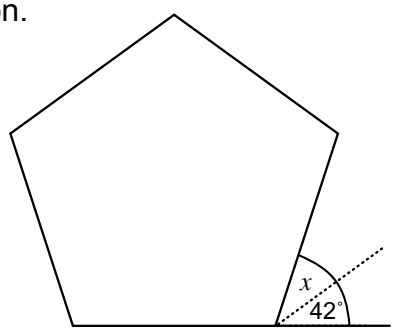
Circle the correct answer. **[1 mark]**

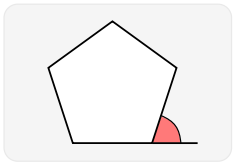
$-\dfrac{16}{4x + 32}$ $\dfrac{x - 4}{x - 8}$ $\dfrac{4}{x - 8}$ $\dfrac{x + 4}{x + 8}$

✓ C1

Do not write outside the box

**12** Here is a regular polygon.



Exterior Angle = $\frac{360}{N}$

Where N = number of sides

Work out the size of angle $x$.

**[3 marks]**

Exterior Angle = $\frac{360}{5}$ = 72° ✓ M1

∴ $x$ = 72 - 42 ✓ M1

$x$ = 30°

Answer 30 ✓ A1 °

**13** There are 21 teams in a youth football league.

During a season, each team will play each other **once**.

8 of the matches were cancelled.

Work out the total games that were played.

**[2 marks]**

💡 Since they only play each other once... we must divide total combo's by 2!

$\frac{21 \times 20}{2} = \frac{420}{2}$ = 210 matches ✓ M1

∴ 210 - 8 = 202

Answer 202 ✓ A1

Do not write outside the box

**14** Joanne wants to invest **£3800** into a high interest savings account.

These are the two banks she is considering.

| **Zupa Bank** | **Sterling Bank** |
|---|---|
| Compound Interest Rates: | Simple Interest Rates: |
| 6% for the **first** 6 months<br>3.2% thereafter | 3.8% per annum |

Work out the difference in interest Joanne would earn between the two banks after **4 years**.

**[4 marks]**

Compound Multipliers

$1 + \frac{6}{100} = 1.06$

$1 + \frac{3.2}{100} = 1.032$

Simple Multiplier

$3.8 \div 100 = 0.038$

**Zupa Bank**

$3800 \times 1.06^{0.5} \times 1.032^{3.5} = £4368.33$ ✓ M1

Interest earned = 4368.33 - 3800

= £568.33

**Sterling Bank**

$3800 \times 0.038 = £144.40$ ✓ M1

Interest earned = 4 x 144.40

= £577.60

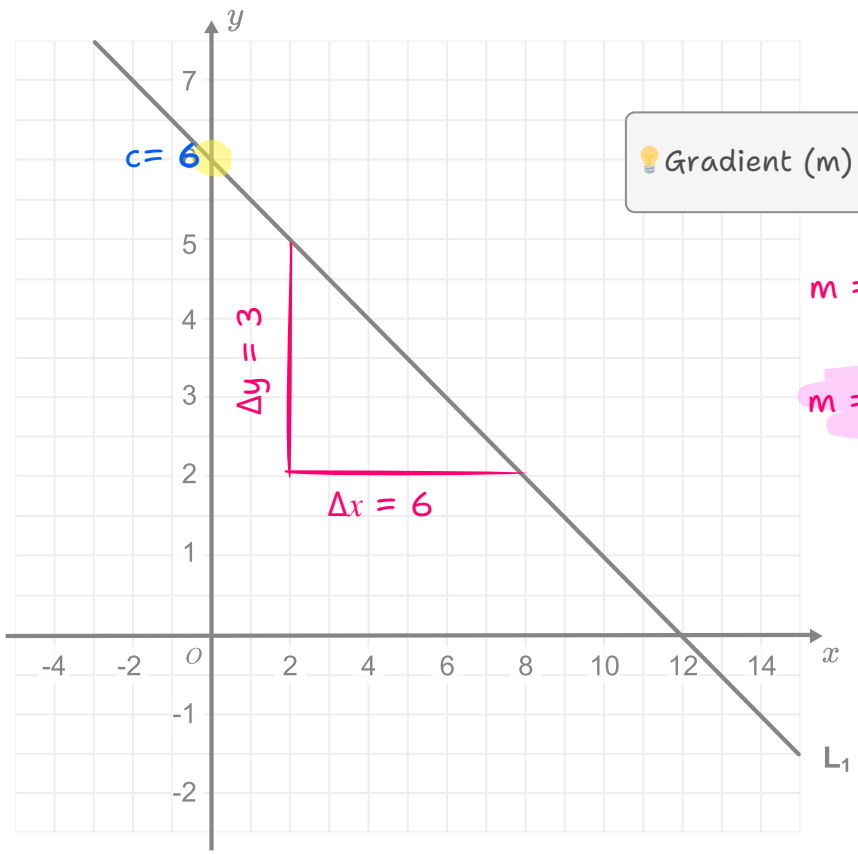
**Difference in interest** = 577.60 - 568.33 ✓ M1

= £9.27

Answer £ 9.27 ✓ A1

Do not write outside the box

**15** The line $L_1$ is shown on the grid.




**15 (a)** Write down the equation of the line $L_1$ in the form $y = mx + c$

**[2 marks]**

Answer $y = -\frac{1}{2}x + 6$ ✓A1 ✓A1 or $y = -0.5x + 6$ ✓A1 ✓A1

**15 (b)** The line $L_2$ is perpendicular to $L_1$, and passes through the point (0, -1)

Write down the equation for the line $L_2$ in the form $y = mx + c$

**[3 marks]**

Perpendicular Gradient: $m_1 \times m_2 = -1$

y-intercept: $(0, c)$

$-0.5 \times m_2 = -1$ ✓M1 $(0, -1) \rightarrow c=-1$ ✓P1 (to find c; sub in x,y values)

$\therefore$ $L_2$ gradient = 2

Answer $y = 2x - 1$ ✓A1

Do not write outside the box

**16** The frequency table gives information about the number of goals scored by a player.

| Number of goals (y) | Frequency (f) | fy |
|---|---|---|
| 0 | 13 | 0 |
| 1 | 17 | 17 |
| 2 | 6 | 12 |
| 3 | $x$ | $3x$ |
| 4 | 13 | 52 |
| $\Sigma$ | $x + 49$ | $3x + 81$ |

✓ M1

The **mean** number of goals scored is 2.

Work out the value of $x$

**[4 marks]**

✓ P1

$$\text{mean} = \frac{\Sigma fy}{\Sigma f} = \frac{3x + 81}{x + 49} \qquad \text{mean} = 2$$

$\therefore$ $\frac{3x + 81}{x + 49} = 2$ ✓ P1

$\times (x+49)$ ↓ ↓ $\times (x+49)$

$3x + 81 = 2(x + 49)$

$3x + 81 = 2x + 98$

$-x$ ↓ ↓ $-x$

$x + 81 = 98$

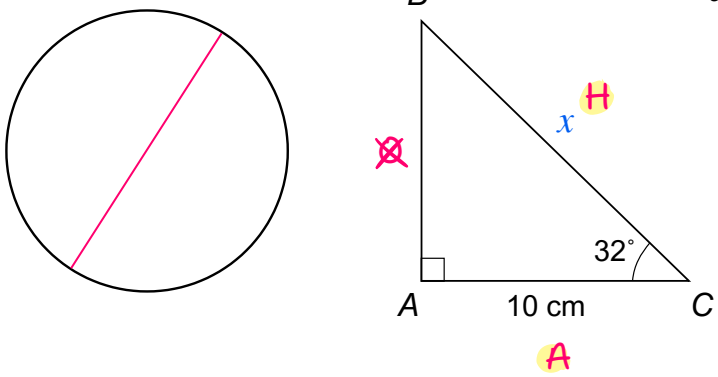
$-81$ ↓ ↓ $-81$

$x = 17$

Answer 17 ✓ A1

Do not write outside the box

**17** Here is a circle and right angled triangle *ABC*.




The **circumference** of the circle is $12\pi$ cm

Work out if the triangle will fit inside the circle.

You must show full workings and justify your answer.

**[4 marks]**

💡 We need to find out if the length of BC ($x$) is smaller than the diameter.

$C = \pi \times d$

SOH CAH TOA

$12\pi = \pi \times d$

$12 = d$ ✓ A1

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

$\cos(32) = \frac{10}{x}$ ✓ M1

$x = \frac{10}{\cos(32)}$

$x = 11.791784...$

$x = 11.8$ cm ✓ A1

∴ The triangle will fit since, 11.8 cm ≤ 12 cm ✓ C1

Do not write outside the box

**18** The equation of a quadratic curve is given by $2x^2 + 9 = 4x^2 - 4x$

**(a)** Work out the coordinates of the curves *y*–intercept.

**[2 marks]**

$ax^2 + bx + c = 0$, where c is the y-intercept

$0 = 4x^2 - 4x - 2x^2 - 9$ ✓ M1

$0 = 2x^2 - 4x - 9$

y-intercept: $(0, c)$

Answer $(0, -9)$ ✓ B1

**18** **(b)** Solve the quadratic equation.
Give your answers correct to 2 decimal places.

**[3 marks]**

From part (a):

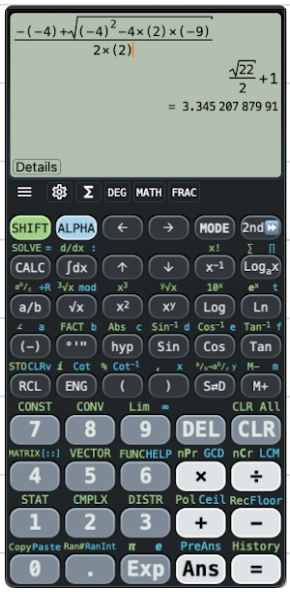
$2x^2 - 4x - 9 = 0$

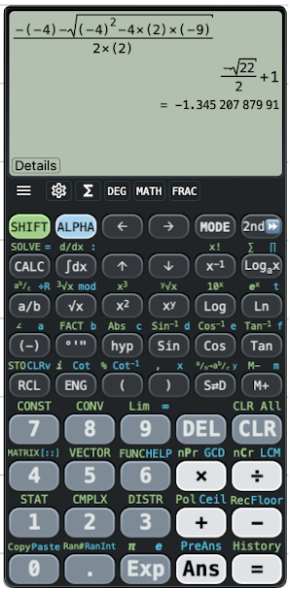
Clue to use Quadratic Formula!

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

✓ P1

$$x = \frac{-(-4) \pm \sqrt{(-4)^2-4\times(2)\times(-9)}}{2\times(2)}$$




$x^+ = 3.345207...$

$x^- = -1.345207...$

✓ A1 ✓ A1

Answer $x = -1.35$ , $x = 3.35$

Do not write outside the box

**19 (a)** Starting with $x_0 = 1$, use the iteration formula $x_{n+1} = \sqrt[3]{4x^2 + 8}$ to find the values of $x_1$, $x_2$ and $x_3$

**[3 marks]**

$x_1 = 2.289428485$

$x_2 = 3.071113247$

$x_3 = 3.575944199$

Accept any correct rounding

$x_1 =$ 2.2894 ✓ A1

$x_2 =$ 3.0711 ✓ A1

$x_3 =$ 3.5759 ✓ A1

**19 (b)** The values of $x_1$, $x_2$ and $x_3$ are solutions of an equation in the form $x^3 + ax + b = 0$ where *a* and *b* are integers.

Find the value of *a* and *b*.

**[1 mark]**

$x^3+ax^2+b = 0$ $\quad x = \sqrt[3]{4x^2+8}$

$x^3 = 4x^2+8$

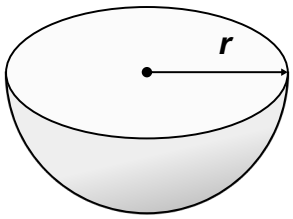
$x^3 - 4x^2 - 8 = 0$

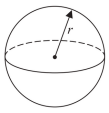
✓ A1 (both values)

*a* = -4 $\quad$ *b* = -8

Do not write outside the box

**20** Shown is a hemisphere.



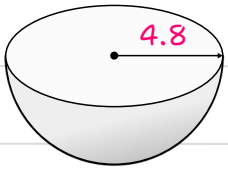

Volume of a sphere $= \frac{4}{3}\pi r^3$ 

***r*** = 4.8 cm correct to 2 signifiant figures.

The hemisphere has a mass of 8kg correct to the nearest kilogram.

Work out the hemisphere's **maximum** density, in grams per cubic centimetre.

**[4 marks]**




8kg = 8000g

✓ M1 (finding bounds)

Radius:

4.7 LB 4.8 UB 4.9

4.75 4.85

Mass:

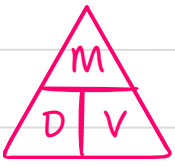
7 LB 8 UB 9

7.5 8.5

7500g 8500g

$V_{min} = \frac{\frac{4}{3} \times \pi \times (4.75)^3}{2}$ ✓ M1

$= 224.4602501\ cm^3$




$D = \frac{M}{V}$ $D_{max} = \frac{M_{max}}{V_{min}} = \frac{8500}{224.46...}$ ✓ M1

$= 37.86862037$

Answer 37.9 ✓ A1 g/cm³

Do not write outside the box

**21 (a)** **a** is inversely proportional to **b**.

Complete the table of values.

**[2 marks]**

$a \propto \frac{1}{b} \rightarrow a = \frac{k}{b}$ ← General Equation

$2 = \frac{k}{15}$ ✓ M1

$\therefore k = 30 \rightarrow a = \frac{30}{b}$ ← Specific Equation

$a = \frac{30}{4} = 7.5$

| | | | |
|---|---|---|---|
| **a** | 7.5 | 2 | 90 |
| **b** | 4 | 15 | $\frac{1}{3}$ |

✓ A1 (for both correct values) accept 0.3

$90 = \frac{30}{b}$

$b = \frac{30}{90}$

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

**21 (b)** **b** is directly proportional to the square root of **c**.

When **c = 16**, **b = 10**

Find a formula for **c** in terms of **a**.

**[3 marks]**

From part (a): $a = \frac{30}{b}$ (1)

💡 We used 'k' in part (a), so lets use 'p' for this constant of proportionality!

$b \propto \sqrt{c}$

$b = p\sqrt{c}$ General Equation

$10 = p\sqrt{16}$ ✓ M1

$10 = k \times 4$

$p = 2.5$

$\therefore b = 2.5\sqrt{c}$ (2)

Specific Equation

💡 To make 'c' in terms of 'a' we must connect equation (1) and (2)

(1) $a = \frac{30}{b} \rightarrow b = \frac{30}{a}$ (3)

(2) $b = 2.5\sqrt{c}$

💡 Lets sub (3) into (2)

$\therefore \frac{30}{a} = 2.5\sqrt{c}$ ✓ M1

÷2.5 ↓ $\frac{12}{a} = \sqrt{c}$ ↓ ÷2.5

$(\square)^2$ ↓ ↓ $(\square)^2$

$\frac{144}{a^2} = c$

Answer $c = \frac{144}{a^2}$ ✓ A1

Do not write outside the box

**22** The weights, in kilograms, of packages in a warehouse are shown in the table below.

f

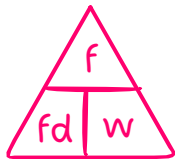
| Weight ($w$ kg) | Frequency |
|---|---|
| $20 < w \leqslant 30$ | 18 |
| $30 < w \leqslant 35$ | 23 |
| $35 < w \leqslant 50$ | 24 |
| $50 < w \leqslant 60$ | 8 |

fd = f÷w

| width | fd |
|---|---|
| 10 | 18÷10 = 1.8 |
| 5 | 23÷5 = 4.6 |
| 15 | 24÷15 = 1.6 |
| 10 | 8÷10 = 0.8 |

✓ M1

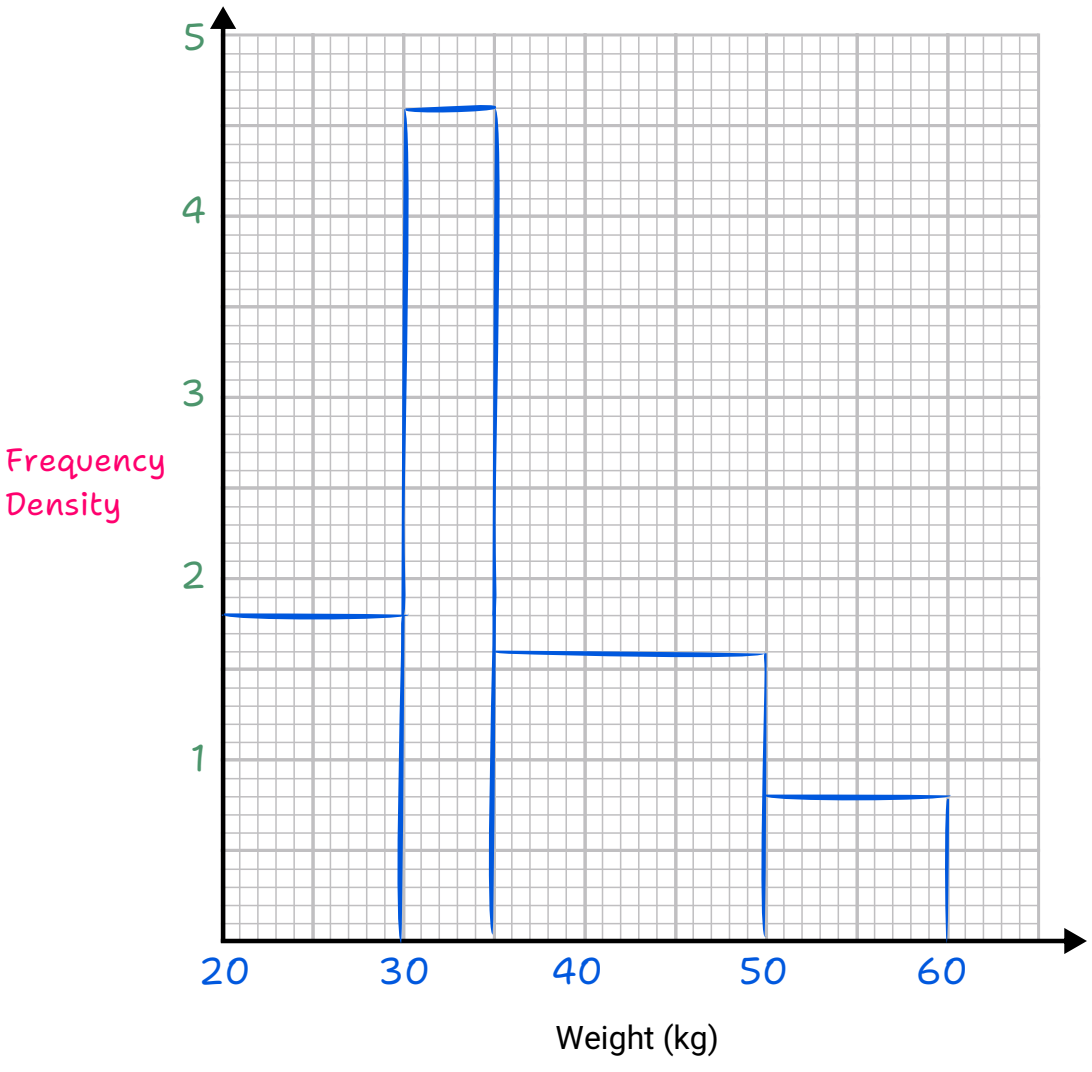
On the grid, draw a histogram for this information




✓ B3 (for fully correct histogram)

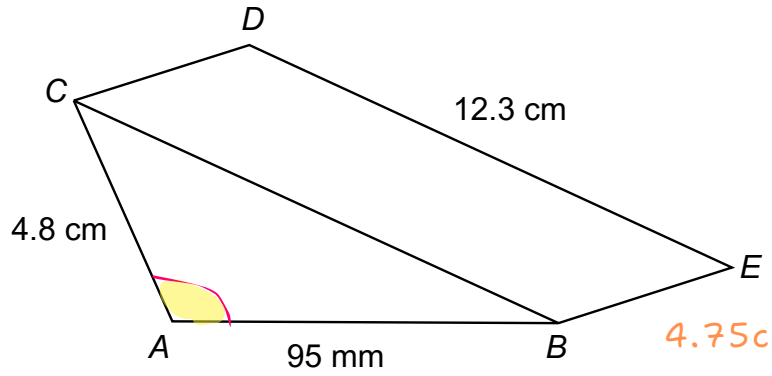
✓ B2 (for 3 correct blocks)

**[3 marks]**



Do not write outside the box

**23** The cross-section of this prism is a scalene triangle.




Not drawn accurately

4.75cm

9.5cm

AB : BE

x4.75 ( 2 : 1 ) x4.75

9.5 : 4.75

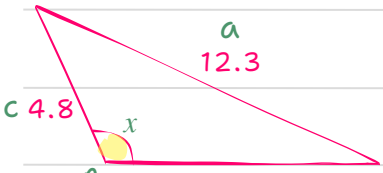
✓ A1

$AB : BE = 2 : 1$

Work out the **volume** of this prism.

Give your answer correct to 1 decimal place.

**[5 marks]**

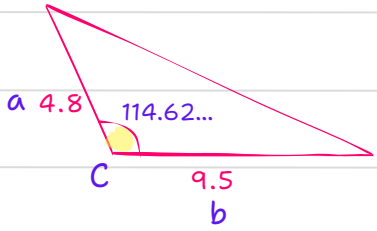



$\cos A = \frac{b^2+c^2-a^2}{2bc}$

$\cos(x) = \frac{9.5^2+4.8^2 - 12.3^2}{2x(9.5)x(4.8)}$

$x = \cos^{-1}(-\frac{5}{12})$ ✓ M1

$x = 114.6243184$




Area= ½absinC

Area = ½ x (4.8) x (9.5) x sin(114.62...)

= 20.72655302 ✓ M1

Volume = cross-section area x length

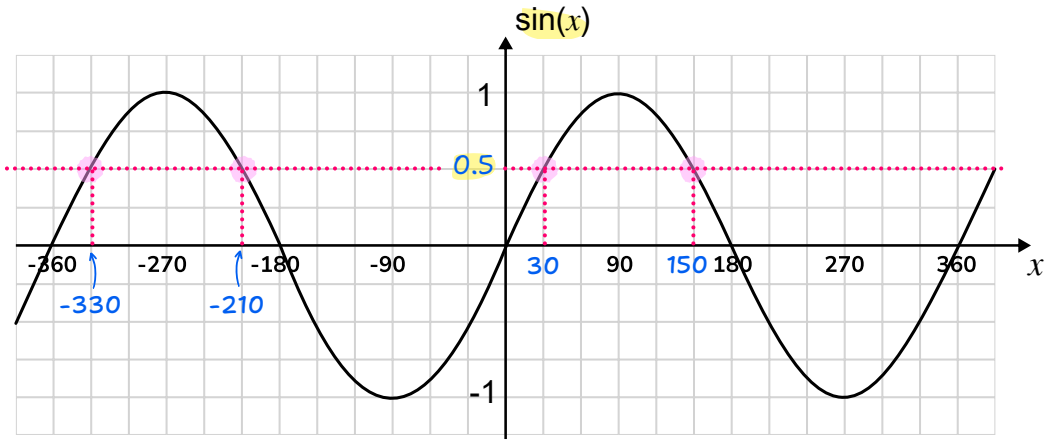
Volume = (20.726...) x 4.75 ✓ M1

= 98.45112683

Answer 98.5 ✓ A1 cm³

Do not write outside the box

**24** The function $f(x) = \sin(x)$ is shown on the graph below.




**24 (a)** Using the graph above

Solve the equation $\sin(x) = 0.5$ for all values of $x$ between $-360^\circ \leq x \leq 360^\circ$

$x = \sin^{-1}(0.5) = 30^\circ$

**[2 marks]**

Answer $-330^\circ,\ -210^\circ,\ 30^\circ,\ 150^\circ$

✓ B2 (for all correct values)

✓ B1 (for at least 3 correct values)

**24 (b)** $g(x) = \tan(x)$

Solve $f(45) = g^{-1}(x)$

Give your answer correct to 2 significant figures.

**[3 marks]**

$f(x) = \sin(x)$

$\therefore f(45) = \sin(45)$

$= \frac{\sqrt{2}}{2}$ ✓ M1

$g(x) = \tan(x)$

Let $y = \tan(x)$

$\tan^{-1}(y) = x$

$g^{-1}(x) = \tan^{-1}(x)$ ✓ M1

To find the inverse function, rearrange to make $x$ the subject!

$\therefore \frac{\sqrt{2}}{2} = \tan^{-1}(x) \rightarrow x = \tan\left(\frac{\sqrt{2}}{2}\right)$

$x = 0.0123419681$

Answer $x =$ 0.012 ✓ A1



**END OF QUESTIONS**