

Total marks — 50
Attempt ALL questions

1. Dougie pays £460 for a new laptop.

It is expected that the value of the laptop will depreciate by 26% each year.

Calculate the expected value of Dougie's laptop after 3 years.

3

$$100 - 26 = 74\%$$

$$= 0.74$$

$$460 \times 0.74^3$$

$$= 186.40304$$

$$\therefore \underline{\underline{£186.40}}$$

2. An ant colony occupies an area of 250 hectares.

There is an average of 1.22×10^6 ants per hectare.

Calculate the number of ants in the colony.

Give your answer in scientific notation.

2

$$250 \times 1.22 \times 10^6$$

$$= 305000000$$

$$= \underline{\underline{3.05 \times 10^8 \text{ ants}}}$$

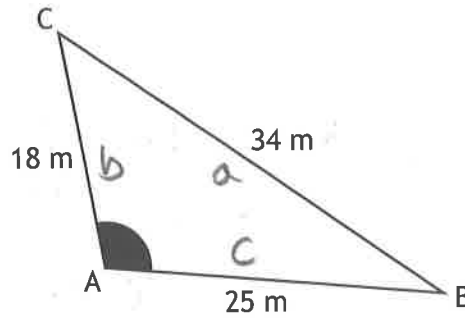
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3. In triangle ABC:

- AB = 25 metres
- AC = 18 metres
- BC = 34 metres.



Calculate the size of the shaded angle at A.

3

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

$$= \frac{18^2 + 25^2 - 34^2}{2(18)(25)}$$

$$= \frac{-207}{900}$$

$$A = \cos^{-1}\left(\frac{-207}{900}\right)$$

$$\underline{A = 103.3^\circ}$$



4. Solve, algebraically, the inequation

$$5(x-2)+4 < 7x+8.$$

3

$$\begin{aligned} 5x - 10 + 4 &< 7x + 8 \\ 5x - 6 &< 7x + 8 \\ 5x - 7x &< 8 + 6 \\ -2x &< 14 \\ \underline{\underline{x > -7}} \end{aligned}$$

5. This year the cost of Charley's car insurance is £278.40.

This is an increase of 16% on last year's cost.

Calculate the cost of Charley's insurance last year.

3

%	£
116	278.40
1	2.4
100	240

£240

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6. (a) Factorise $y^2 - 6y$.

$$y^2 - 6y = y(y - 6)$$

1

(b) Hence simplify $\frac{y^2 - 6y}{y^2 - 3y - 18}$.

2

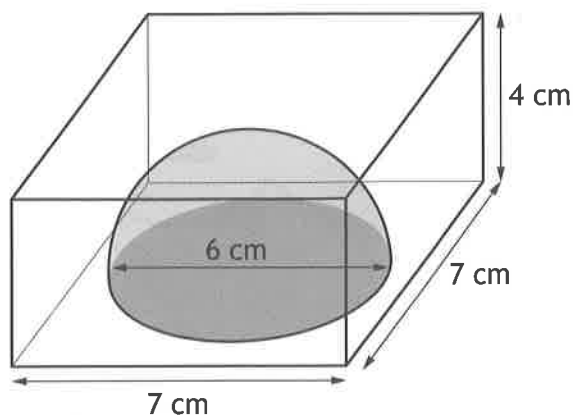
$$y^2 - 3y - 18 = (y + 6)(y - 3)$$

	y	+6
y	y ²	-6y
+3	+3y	-18

	18
1	18
2	9
+3	-6

$$\begin{aligned} \therefore \frac{y^2 - 6y}{y^2 - 3y - 18} &= \frac{y(y - 6)}{(y + 6)(y - 3)} \\ &= \frac{y}{y - 3} \end{aligned}$$

7. A paperweight is in the shape of a cuboid. It consists of a hemisphere of red glass surrounded by clear glass.



The cuboid has height 4 centimetres and a square base of length 7 centimetres.

The hemisphere has diameter 6 centimetres.

Calculate the volume of clear glass in the paperweight.

Give your answer correct to 2 significant figures.

4

HS
$$V = \frac{4}{3} \pi r^3 \div 2$$

$$= \frac{4}{3} \pi \times 3^3 \div 2$$

$$= 56.548\dots \text{cm}^3$$

CUBOID
$$V = LBH$$

$$= 7 \times 7 \times 4$$

$$= 196 \text{cm}^3$$

$$\therefore \text{glass} = 196 - 56.584\dots$$

$$= 139.415\dots$$

$$= \underline{140 \text{cm}^3} \text{ (2 sf)}$$

[Turn over



8. Solve the equation $3x^2 + 8x + 1 = 0$.
Give your answers correct to 2 decimal places.

3

$$a = 3$$

$$b = 8$$

$$c = 1$$

$$x = \frac{-8 \pm \sqrt{8^2 - 4(3)(1)}}{2(3)}$$

$$= \frac{-8 + \sqrt{52}}{6} \quad \text{OR} \quad \frac{-8 - \sqrt{52}}{6}$$

$$= -0.131\dots \quad \text{OR} \quad -2.535\dots$$

$$= -0.13 \quad \text{OR} \quad -2.54$$

9. Change the subject of the formula $f = \frac{2d+3}{e}$ to d .

3

$$\frac{2d+3}{e} = f$$

$$2d+3 = ef$$

$$2d = ef - 3$$

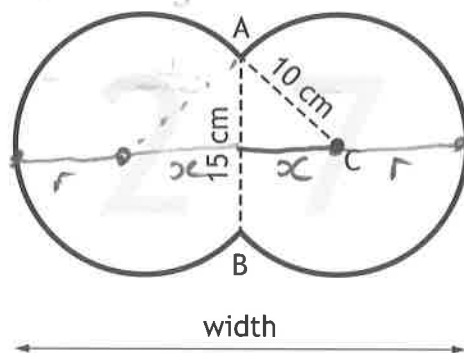
$$d = \frac{ef - 3}{2}$$



10. Karen buys a door-number sign for her house.
The sign consists of parts of two identical circles.



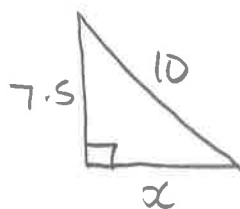
AB is a chord to both circles.



- AB has length 15 centimetres.
- The radius AC has length 10 centimetres.

Calculate the width of the sign.

4



$$x^2 = 10^2 - 7.5^2$$

$$= 43.75$$

$$x = \sqrt{43.75}$$

$$= \underline{6.61 \text{ cm}}$$

$$\begin{aligned} \text{width} &= 2x + 2 \times \text{radius} \\ &= 2 \times 6.61 + 2 \times 10 \\ &= \underline{\underline{33.22 \text{ cm}}} \end{aligned}$$

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11. Solve the equation $17 \sin x^\circ + 1 = 9$, for $0 \leq x < 360$.

$$17 \sin x + 1 = 9$$

$$17 \sin x = 8$$

$$\sin x = \frac{8}{17}$$

$$x = \sin^{-1}\left(\frac{8}{17}\right)$$

$$x = \underline{\underline{28^\circ, 152^\circ}}$$

$$\begin{array}{|c|c|} \hline (S) & (A) \\ \hline \cancel{X} & \cancel{X} \\ \hline \end{array}$$

$$180 - 28 = 152$$

12. Express

$$\frac{2}{x+5} + \frac{3}{x-4}, \quad x \neq -5, x \neq 4$$

as a single fraction in its simplest form.

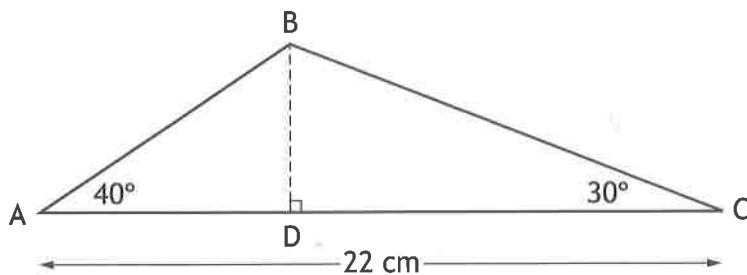
$$\frac{2}{x+5} + \frac{3}{x-4} = \frac{2(x-4) + 3(x+5)}{(x+5)(x-4)}$$

$$= \frac{2x - 8 + 3x + 15}{(x+5)(x-4)}$$

$$= \underline{\underline{\frac{5x + 7}{(x+5)(x-4)}}}$$



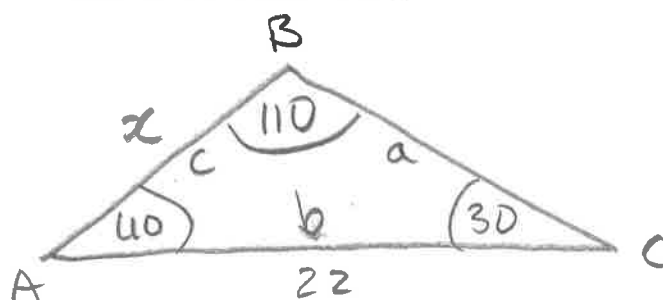
13. In triangle ABC:



- AC = 22 centimetres
- angle BAC = 40°
- angle BCA = 30°
- BD is perpendicular to AC.

Calculate the length of BD.

5

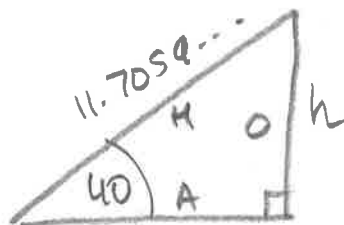


$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$\frac{x}{\sin 30} = \frac{22}{\sin 110}$$

$$x = \frac{22 \sin 30}{\sin 110}$$

$$x = 11.7059 \dots$$



SOH CAH TOA

$$\sin 40 = \frac{h}{11.70 \dots}$$

$$h = 11.7059 \dots \sin 40$$

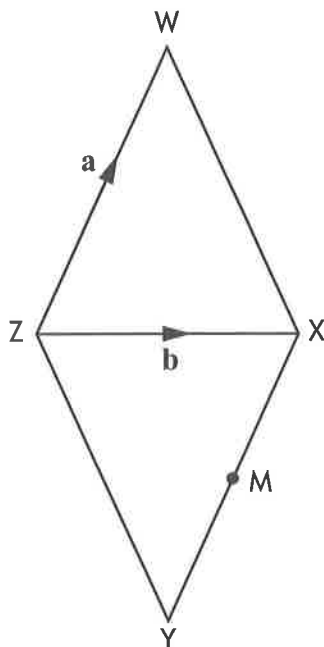
$$h = 7.5 \text{ cm}$$

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14. The diagram shows a rhombus WXYZ with a diagonal ZX drawn.



\vec{ZW} represents vector **a** and \vec{ZX} represents vector **b**.

(a) Express \vec{WX} in terms of **a** and **b**.

1

$$\begin{aligned} \vec{WX} &= \vec{WZ} + \vec{ZX} \\ &= \underline{-a} + \underline{b} \end{aligned}$$

M is the mid-point of XY.

(b) Express \vec{WM} in terms of **a** and **b**.

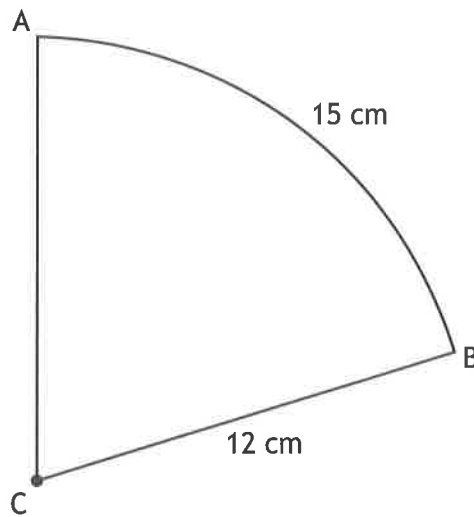
Give your answer in its simplest form.

2

$$\begin{aligned} \vec{WM} &= \vec{WX} + \vec{XM} \\ &= \underline{-a} + \underline{b} + \frac{1}{2} \vec{XY} \\ &= \underline{-a} + \underline{b} + \frac{1}{2} (-a) \\ &= \underline{b - \frac{3}{2}a} \end{aligned}$$



15. The diagram shows a sector of a circle, centre C.



The radius of the circle is 12 centimetres.

The length of arc AB is 15 centimetres.

Calculate the area of the sector.

3

$$\frac{\cancel{\pi}}{360} = \frac{\text{arc}}{\pi D} = \frac{\text{area}}{\pi r^2}$$

$$\therefore \frac{15}{\pi \times 24} = \frac{\text{area}}{\pi \times 12^2}$$

$$\frac{15 \times 144 \cancel{\pi}}{24 \cancel{\pi}} = \text{area}$$

$$\frac{2160}{24} = \text{area}$$

$$\underline{\underline{\text{area} = 90 \text{ cm}^2}}$$

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16. Express $3\cos^2 x^\circ - 1$ in the form $a + b\sin^2 x^\circ$.
Show your working.

$$\cos^2 x = 1 - \sin^2 x$$

$$\therefore 3(1 - \sin^2 x) - 1$$

$$= 3 - 3\sin^2 x - 1$$

$$= \underline{2 - 3\sin^2 x}$$

[END OF QUESTION PAPER]



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