

- 1 Write down a factor of 28 that is a prime number.

..... 7 or 2 [1]

- 2 Simplify.

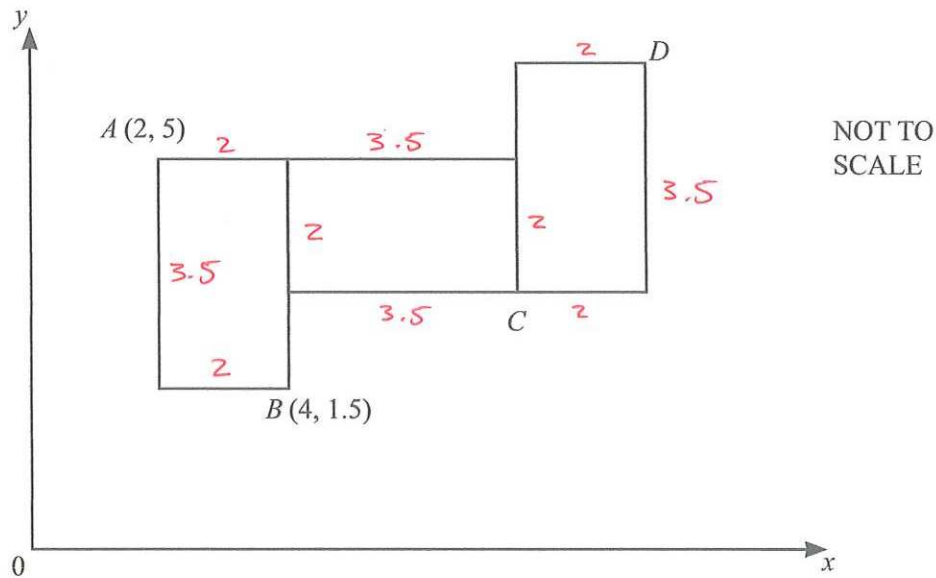
$$4y^2 + 3y - y^2 + 2y$$

..... $3y^2 + 5y$ [2]

- 3 Calculate $\frac{20.24 - \sqrt[3]{30}}{6.5}$.

Give your answer correct to 1 decimal place.

..... 2.6 [2]



A pattern is formed by 3 congruent rectangles.
 Each rectangle is a rotation of 90° around one vertex of the rectangle next to it.
 The point A has coordinates $(2, 5)$.
 The point B has coordinates $(4, 1.5)$.

Work out the coordinates of point C and point D .

$C (\underline{7.5} , \underline{3})$

$D (\underline{9.5} , \underline{6.5})$

[3]

- 5 Each week Nisha is paid \$12 per hour for the first 40 hours that she works.
 She is paid 30% more per hour for any extra hours that she works.
 One week Nisha works for 45.5 hours.

Calculate how much she is paid that week.

$$40 \times 12 = 480$$

$$5.5 \times 12 \times 1.3 = 85.8$$

\$ 565.80 [3]

- 6 Navin and Esther share some money in the ratio Navin : Esther = 5 : 7.

(a) Find Navin's share as a percentage of the total money.

$$\frac{5}{12} \times 100$$

..... ~~41.7~~ 41.7 % [1]

(b) Find Esther's share as a percentage of Navin's share.

$$\frac{7}{5} \times 100$$

..... 140 % [1]

(c) Navin's share is \$160.

Work out Esther's share.

$$\frac{160}{5} \times 7$$

\$ 224 [2]

- 7 Simplify.

$$\frac{5p^2 - 20p}{2p^2 - 32}$$

$$\frac{5p(p-4)}{2(p^2-16)}$$

$$= \frac{5p(\cancel{p-4})}{2(\cancel{p-4})(p+4)}$$

..... $\frac{5p}{2(p+4)}$ [3]

- 8 (a) Talia invests \$1500 in a savings account for 4 years.

The account pays simple interest at a rate of $2\frac{1}{6}\%$ per year.

Calculate the total interest she receives at the end of 4 years.

$$\left(1500 \times \frac{2\frac{1}{6}}{100}\right) \times 4 = 130$$

\$ 130 [2]

- (b) Kylian invests \$1500 in a different savings account.

The account pays compound interest at a rate of $r\%$ per year.

At the end of 5 years, the value of the investment is \$1825.

Calculate the value of r .

$$1825 = 1500(1+r)^5$$

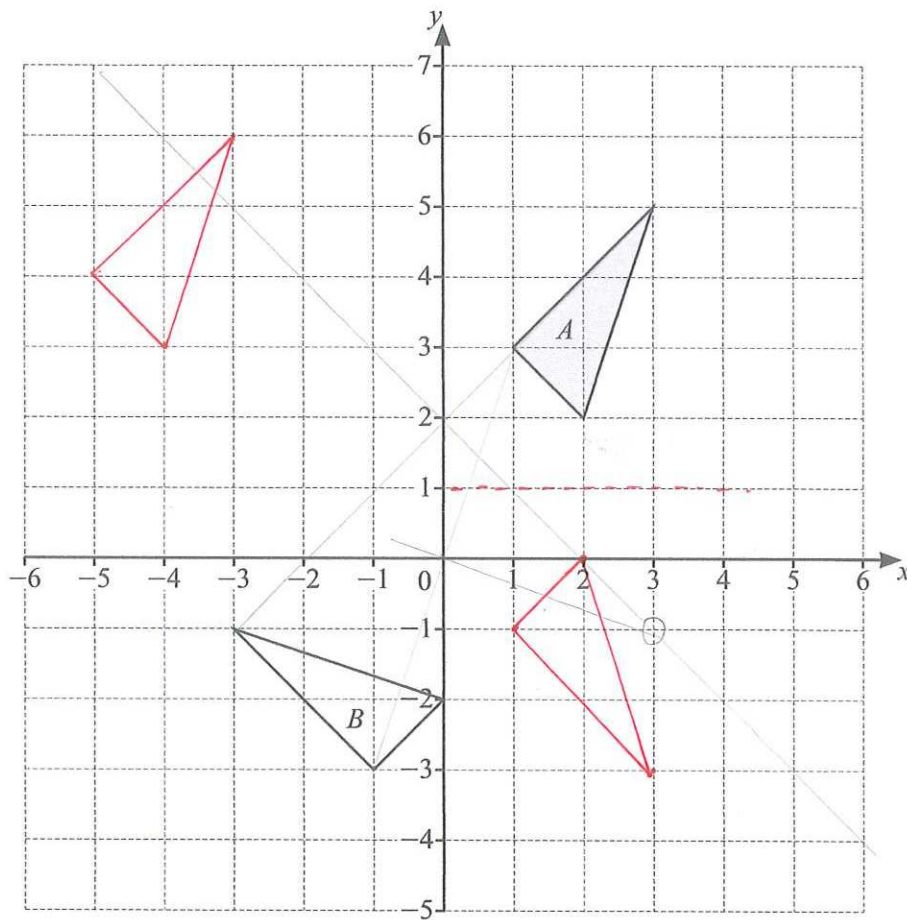
$$\sqrt[5]{\frac{1825}{1500}} = \sqrt[5]{(1+r)^5}$$

$$1.04... = 1+r$$

$$r = 0.04$$

$$r \text{ as } \% \quad 0.04 \times 100 = 4\%$$

$r =$ 4% [3]



(a) Draw the image of

(i) triangle A after a reflection in the line $y = 1$

[2]

(ii) triangle A after a translation by the vector $\begin{pmatrix} -6 \\ 1 \end{pmatrix}$.

[2]

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

Rotation 90° anti-clockwise around $(3, -1)$

[3]

- 10 The speed of each of 200 cars passing a building is measured.
The table shows the results.

	10	30	42.5	47.5	55	70
Speed (v km/h)	$0 < v \leq 20$	$20 < v \leq 40$	$40 < v \leq 45$	$45 < v \leq 50$	$50 < v \leq 60$	$60 < v \leq 80$
Frequency	16	34	62	58	26	4

- (a) Calculate an estimate of the mean.

$$\begin{aligned}
 10 \times 16 &= 160 \\
 30 \times 34 &= 1020 \\
 42.5 \times 62 &= 2635 \\
 47.5 \times 58 &= 2755 \\
 55 \times 26 &= 1430 \\
 70 \times 4 &= 280
 \end{aligned}$$

$$\frac{8280}{200}$$

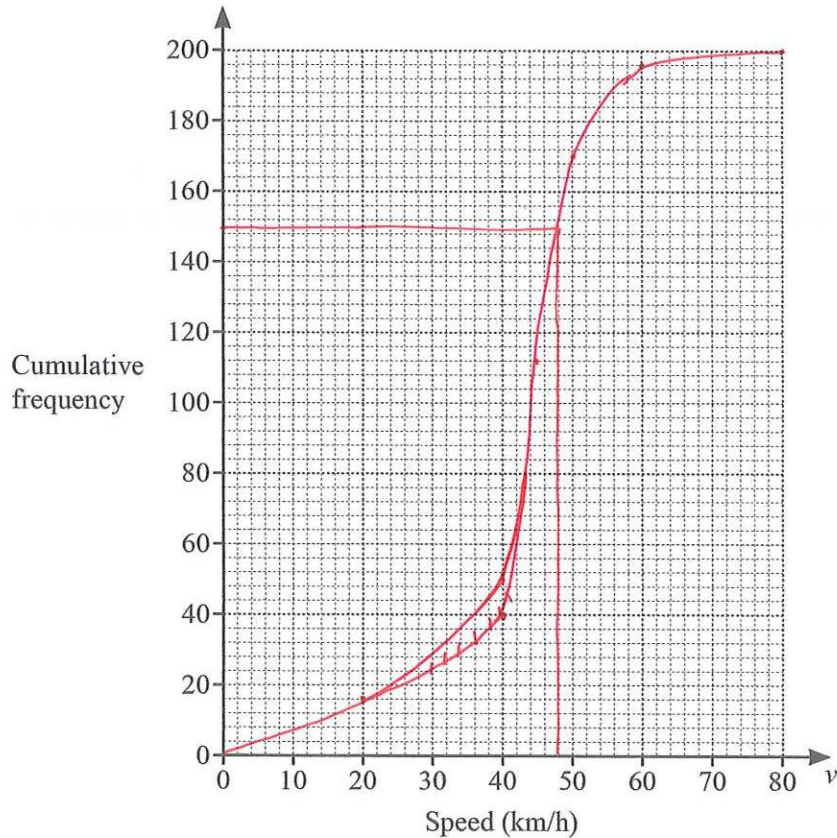
$$\dots\dots\dots 41.4 \dots\dots\dots \text{ km/h [4]}$$

- (b) (i) Use the frequency table to complete the cumulative frequency table.

Speed (v km/h)	$v \leq 20$	$v \leq 40$	$v \leq 45$	$v \leq 50$	$v \leq 60$	$v \leq 80$
Cumulative frequency	16	50	112	170	196	200

[1]

- (ii) On the grid, draw a cumulative frequency diagram.



[3]

- (iii) Use your diagram to find an estimate of the upper quartile.

$$\frac{3}{4} \times 200 =$$

..... 48 km/h [1]

- (c) Two of the 200 cars are chosen at random.

Find the probability that they both have a speed greater than 50 km/h.

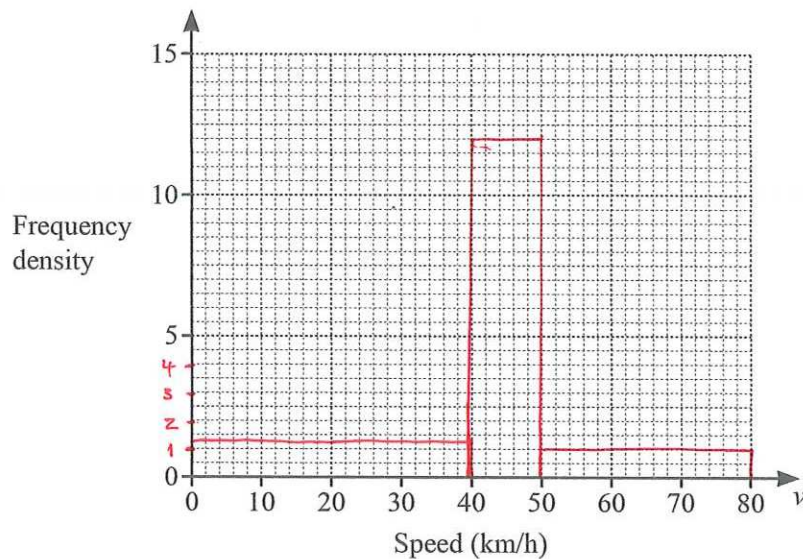
$$\frac{30}{200} \times \frac{29}{199} = \approx 2.2\%$$

..... $\frac{87}{3980}$ [2]

- (d) A new frequency table is made by combining intervals.

Speed (v km/h)	$0 < v \leq 40$	$40 < v \leq 50$	$50 < v \leq 80$
Frequency	50	120	30

On the grid, draw a histogram to show the information in this table.



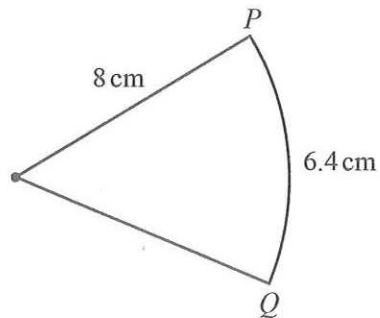
$$\frac{50}{40} = 1.25$$

$$\frac{120}{10} = 12$$

$$\frac{30}{30} = 1$$

[3]

11

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The diagram shows a sector of a circle of radius 8 cm.
The length of the arc PQ is 6.4 cm.

Find the area of the sector.

$$\frac{x}{360} \times 2\pi r = 6.4$$

$$\frac{x \times 2\pi(8)}{360} = 6.4$$

$$x \times 16\pi = 6.4 \times 360$$

$$x = \frac{6.4 \times 360}{16\pi}$$

$$x = 45.83662361\dots$$

$$\begin{aligned} \text{Area} &= \frac{45.8366\dots}{360} \times \pi(8)^2 \\ &= 25.6 \end{aligned}$$

$$\underline{\quad 25.6 \quad} \text{ cm}^2 [4]$$

12 The table shows the first 5 terms of sequences A , B and C .

	1st term	2nd term	3rd term	4th term	5th term	n th term
Sequence A	5	12	31	68	129	$n^3 + 4$
Sequence B	$\frac{10}{3}$	$\frac{9}{4}$	$\frac{8}{5}$	$\frac{7}{6}$	$\frac{6}{7}$	$\frac{-n+11}{n+2}$
Sequence C	4	8	16	32	64	$4(2)^{n-1}$

Complete the table to show the n th term of each sequence.

$$\begin{array}{cccccc}
 5 & 12 & 31 & 68 & 129 & \\
 \vee & & \vee & & \vee & \\
 7 & 19 & 37 & 61 & & \\
 & \vee & & \vee & & \\
 & 12 & 18 & 24 & & \\
 & & \vee & & \vee & \\
 & & 6 & & 6 &
 \end{array}$$

$$\begin{array}{cccc}
 6 \div 6 = 1 & n^3 & 1 & 8 & 27 \\
 & & 5 \downarrow & 12 \downarrow & 31 \downarrow \\
 & & +4 & +4 & +4
 \end{array}$$

$$\begin{array}{l}
 \text{or} \\
 a r^{n-1} \\
 a = 4 \\
 r = \frac{8}{4} = 2 \\
 \frac{16}{8} = 2 \\
 \frac{32}{16} = 2 \\
 \text{or} \\
 2^2 \cdot 2^{n-1} \\
 = 2^{n+1} \rightarrow
 \end{array}$$

[6]

13 $f(x) = 5 - 4x$

(a) Find $f(-3)$. $5 - 4(-3)$
 $= 5 + 12$

..... 17 [1]

(b) Find $f(3 - 2x)$.
 Give your answer in its simplest form.

$$\begin{array}{l}
 5 - 4(3 - 2x) \\
 = 5 - 12 + 8x \\
 = 8x - 7
 \end{array}$$

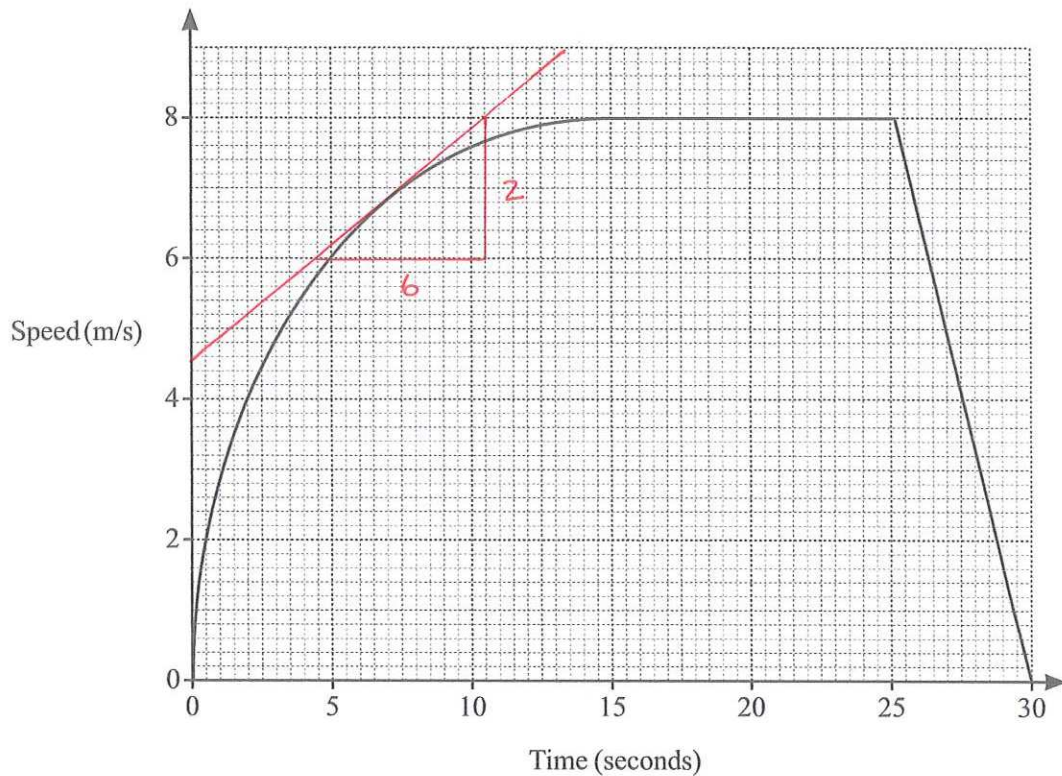
..... $8x - 7$ [2]

(c) Find $f^{-1}(x)$.

$$\begin{array}{l}
 y = 5 - 4x \\
 x = 5 - 4y \\
 \cancel{y} \\
 4y = 5 - x \\
 y = \frac{5 - x}{4}
 \end{array}$$

$$f^{-1}(x) = \frac{5 - x}{4} \dots\dots\dots [2]$$

- 14 The graph shows the speed of a cyclist during a journey of 30 seconds.



- (a) Write down the acceleration of the cyclist between 15 seconds and 25 seconds.

..... 0 m/s^2 [1]

- (b) By drawing a tangent, find an estimate for the acceleration of the cyclist at 7.5 seconds.

$$\frac{2}{6} = \frac{1}{3} \frac{\text{m/s}}{\text{s}}$$

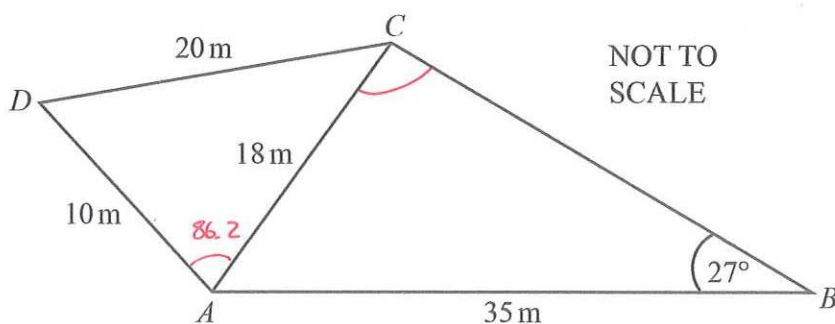
..... 0.33 m/s^2 [2]

- (c) Work out the average speed of the cyclist between 15 seconds and 30 seconds.

$$\begin{aligned} \text{speed} &= \frac{\text{distance}}{\text{time}} \\ &= \frac{(8 \times 10) + \frac{1}{2}(8 \times 5)}{15} \\ &= \frac{100}{15} \\ &= 6.6 \end{aligned}$$

..... 6.67 m/s [3]

15



The diagram shows the positions A , B , C and D on a football pitch.

(a) Show that angle $CAD = 86.2^\circ$, correct to 1 decimal place.

$$\begin{aligned}\cos A &= \frac{10^2 + 18^2 - 20^2}{2(10)(18)} \\ A &= \cos^{-1}\left(\frac{1}{18}\right) \\ &= 86.17744627 \\ &\approx 86.2 \quad (\text{correct to 1 d.p.})\end{aligned}$$

[4]

(b) Calculate the **obtuse** angle ACB .

$$\begin{aligned}\frac{\sin \hat{ACB}}{35} &= \frac{\sin 27}{18} \\ \sin \hat{ACB} &= 0.88275 \dots \\ \hat{ACB} &= 61.977\end{aligned}$$

$$\sin \theta = \sin (180 - \theta)$$

$$\sin 61.977 = 118$$

$$\dots\dots\dots 118^\circ \quad [4]$$

- 16 f is inversely proportional to the cube of g .
When $f = 0.5$, $g = 3$.

(a) Find f in terms of g .

$$f \propto \frac{1}{g^3} \quad k = 13.5$$

$$f = \frac{k}{g^3}$$

$$0.5 = \frac{k}{3^3}$$

$$f = \frac{13.5}{g^3} \dots\dots\dots [2]$$

(b) g is increased by 100%.

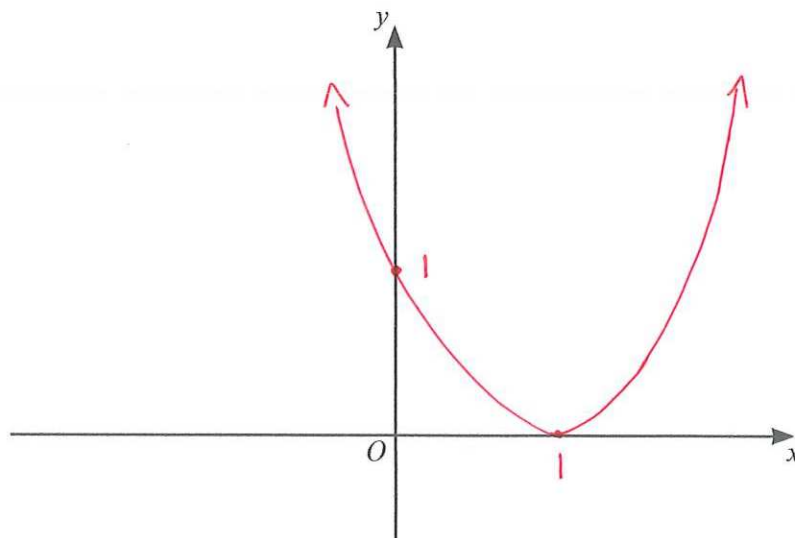
Find the percentage change in f .

$$\frac{13.5}{6^3} = 0.0625$$

$$\frac{0.5 - 0.0625}{0.5} \times 100$$

$$\dots\dots\dots 87.5 \% [3]$$

17



(a) On the diagram,

(i) sketch the graph of $y = (x - 1)^2$

[2]

$$x^2 - 2x + 1$$

- 18 A piece of metal has volume 1240 cm^3 , correct to the nearest 20 cm^3 .
The mass of the piece of metal is 7800 g , correct to the nearest 100 g .

Calculate the lower bound of the density of the metal.

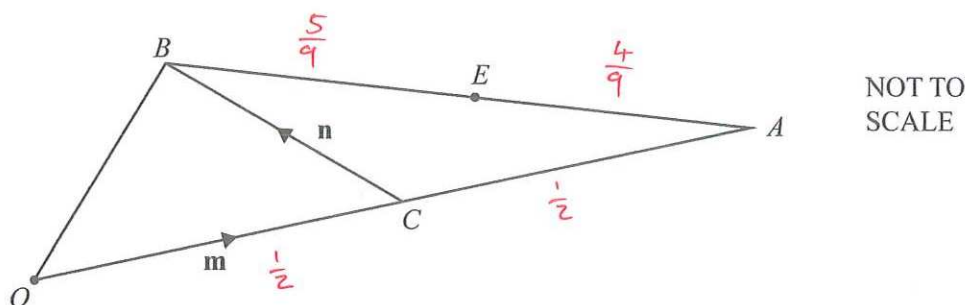
[Density = mass $\div$ volume.]

$$\begin{array}{l} \text{LB} \qquad \qquad \text{UB} \\ 1230 \leq \text{vol} < 1250 \\ 7750 \leq \text{mass} < 7850 \end{array}$$

$$\begin{aligned} \text{Density} &= \frac{\text{mass}}{\text{volume}} \\ &= \frac{7750}{1250} \\ &= 6.2 \end{aligned}$$

..... 6.2 g/cm^3 [3]

19



OAB is a triangle.

C is the midpoint of OA .

$\vec{OC} = \mathbf{m}$ and $\vec{CB} = \mathbf{n}$.

E lies on AB and $AE:EB = 4:5$.

Find, in terms of $\mathbf{m}$ and $\mathbf{n}$, the position vector of E .

Give your answer in its simplest form.

$$\begin{aligned} \vec{OE} &= \vec{OA} + \vec{AE} \\ &= 2\mathbf{m} + \frac{4}{9}(\vec{AB}) \\ &= 2\mathbf{m} + \frac{4}{9}(-\mathbf{m} + \mathbf{n}) \\ &= 2\mathbf{m} - \frac{4}{9}\mathbf{m} + \frac{4}{9}\mathbf{n} \\ &= 1\frac{5}{9}\mathbf{m} + \frac{4}{9}\mathbf{n} \end{aligned}$$

..... $1\frac{5}{9}\mathbf{m} + \frac{4}{9}\mathbf{n}$ [4]

- 20 The line $y = 4x + 12$ intersects the curve $y = 2x^2 - x - 3$ at point P and point Q .

Find the coordinates of P and Q .

You must show all your working and give your answers correct to 2 decimal places.

$$4x + 12 = 2x^2 - x - 3$$

$$0 = 2x^2 - 5x - 15$$

$$a = 2 \quad b = -5 \quad c = -15$$

$$x = \frac{-(-5) \pm \sqrt{(-5)^2 - 4(2)(-15)}}{2(2)}$$

$$= \frac{5 \pm \sqrt{145}}{4}$$

$$x = 4.26 \quad \text{or} \quad -1.76$$

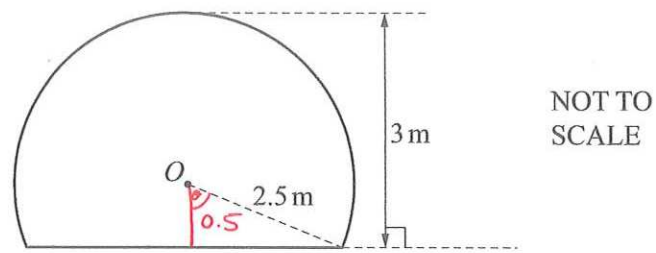
$$\begin{aligned} y &= 4(4.26) + 12 \\ &= 29.04 \end{aligned}$$

$$\begin{aligned} y &= 4(-1.76) + 12 \\ &= 4.958 \\ &\approx 4.96 \end{aligned}$$

$$(\underline{4.26}, \underline{29.0})$$

$$(\underline{-1.76}, \underline{4.96})$$

[6]



The diagram shows the major segment of a circle, centre O , radius 2.5 m.

The segment is the cross section of a tunnel with height 3 m.

The length of the tunnel is 800 m and it has the same cross section throughout its length.

Calculate the volume of the tunnel.

$$\cos \theta = \frac{0.5}{2.5} \quad \checkmark$$

$$\theta = \cos^{-1}\left(\frac{1}{5}\right)$$

$$= 78.4630... \quad \checkmark \quad (\times 2 \rightarrow 156.926^\circ)$$

$$\pi r^2 - \frac{156.9}{360} \times \pi r^2 + 2\left[\frac{1}{2}(0.5)(2.5)\sin(78.46...)\right] \quad \checkmark \quad \bigcirc - \triangle + \triangle \quad \checkmark$$

$$= \pi(2.5)^2 - 8.55899... + 1.224731...$$

$$= 19.634954... - 8.55899... + 1.224731...$$

$$= 12.30069...$$

$$\hookrightarrow \times 800 \quad \checkmark$$

$$= 9840.55606$$

$$\approx 9840 \quad (3sf)$$

$$\underline{9840} \quad \checkmark \quad \text{m}^3 [7]$$