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MATHEMATICS

1521/42

Paper 4 (Extended)

May/June 2021

2 hours 30 minutes

You must answer on the question paper.

You will need: Geometrical instruments

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You should use a calculator where appropriate.
- You may use tracing paper.
- You must show all necessary working clearly.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.
- For π , use either your calculator value or 3.142.

INFORMATION

- The total mark for this paper is 130.
- The number of marks for each question or part question is shown in brackets [].

This document has **20** pages. Any blank pages are indicated.

1 Fred is a gardener.

(a) Every week, he works 8 hours for Dr Shah, 8 hours for Mrs Tarek and the rest of his time for Mr Umbert.

(i) Fred works for a total of 20 hours every week.
Mr Umbert pays him \$37 each week.

Work out how much Mr Umbert pays him for each hour.

\$ [2]

(ii) Dr Shah pays him \$6 for each hour.
Mrs Tarek pays him \$24 for the first 3 hours and then \$3 for each further hour.

Show that Fred is paid a total of \$124 each week.

[3]

(iii) Fred is saving this money to buy a mower costing \$800.

Calculate the number of weeks Fred must work before he can buy the mower.

..... [2]

(b) Fred uses compost in each of the gardens in the ratio Dr Shah : Mrs Tarek : Mr Umbert = 5 : 4 : 6.
He uses a total of 345 litres of compost.

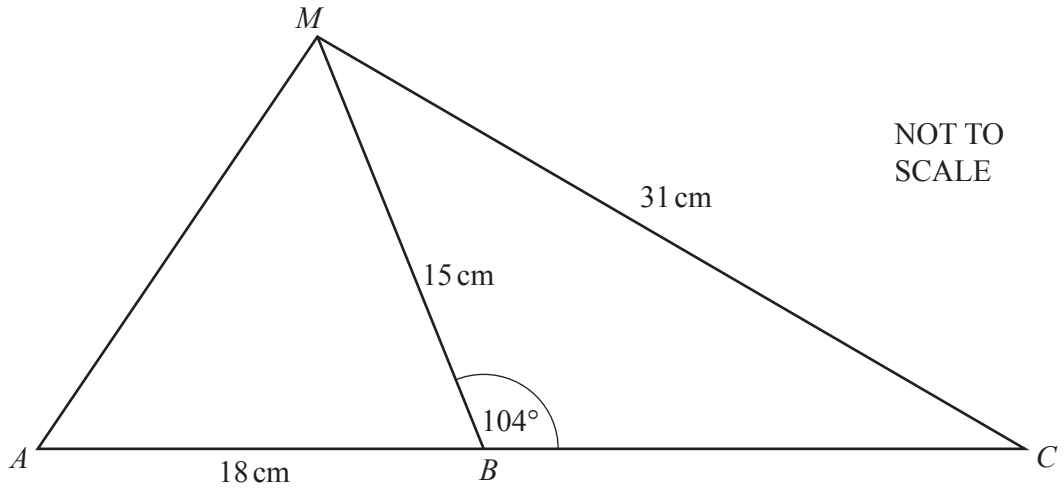
Find the number of litres of compost Fred uses in Mr Umbert's garden.

..... litres [2]

(c) Fred buys two different boxes of grass seed.
One box of grass seed has a mass of 350 g and the other box of grass seed has a mass of 240 g, both correct to the nearest 10 grams.

Calculate the upper bound of the difference between the masses of the two boxes of grass seed.

..... g [2]



ABC is a straight line.
 $AB = 18\text{ cm}$, $MB = 15\text{ cm}$, $MC = 31\text{ cm}$ and angle $MBC = 104^\circ$.

Calculate

(a) angle MCB ,

Angle $MCB = \dots\dots\dots [3]$

(b) AM ,

$AM = \dots\dots\dots\text{ cm} [4]$

(c) the area of triangle MAC .

$\dots\dots\dots\text{ cm}^2 [3]$

- 3 (a) A is the point $(-1, 4)$ and B is the point $(7, -8)$.

Find

- (i) the coordinates of the midpoint of AB ,

(..... ,) [2]

- (ii) the length of AB ,

..... [3]

- (iii) the equation of the line that is perpendicular to AB and passes through the point $(9, 4)$.

..... [4]

- (b) Point P has position vector \mathbf{s} and point Q has position vector \mathbf{t} .
 PQ is extended to point X such that $PX : QX = 7 : 3$.

Find the position vector of X .

..... [3]

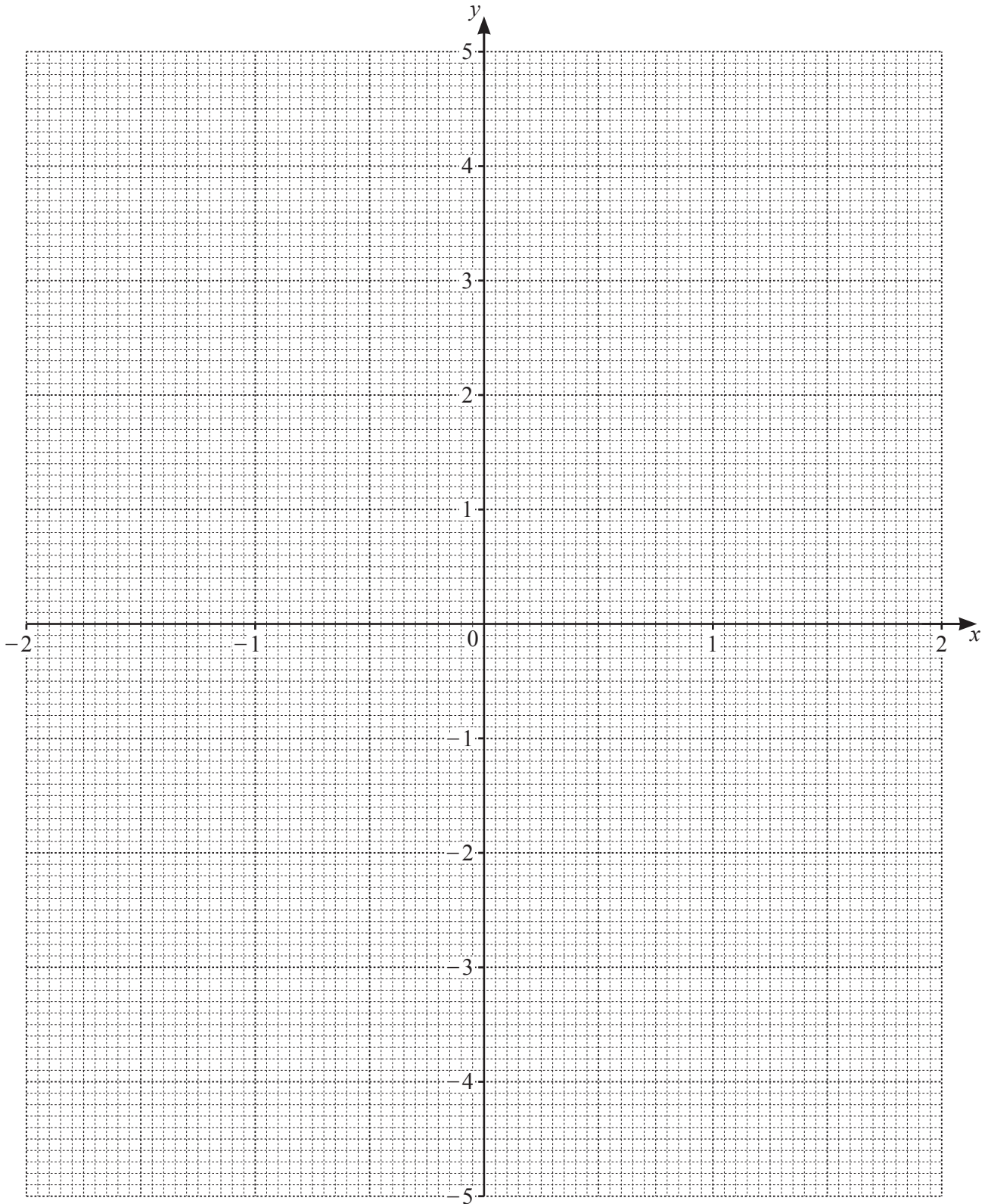
- 4 The table shows some values for $y = \frac{x}{2} - \frac{1}{x}$, $x \neq 0$.

x	-2	-1.5	-1	-0.5	-0.2		0.2	0.5	1	1.5	2
y	-0.5	-0.08		1.75				-1.75		0.08	0.5

(a) Complete the table.

[3]

(b) Draw the graph of $y = \frac{x}{2} - \frac{1}{x}$ for $-2 \leq x \leq -0.2$ and $0.2 \leq x \leq 2$.



(c) Use your graph to solve the equation $\frac{x}{2} - \frac{1}{x} = -3.5$.

$x = \dots\dots\dots$ [1]

(d) (i) On the grid, draw the line $5x + 3y = 0$.

[2]

(ii) Write down the x -coordinate of each point where the line $5x + 3y = 0$ crosses the graph of $y = \frac{x}{2} - \frac{1}{x}$.

$x = \dots\dots\dots$ and $x = \dots\dots\dots$ [2]

(iii) Make y the subject of the equation $5x + 3y = 0$.

$y = \dots\dots\dots$ [2]

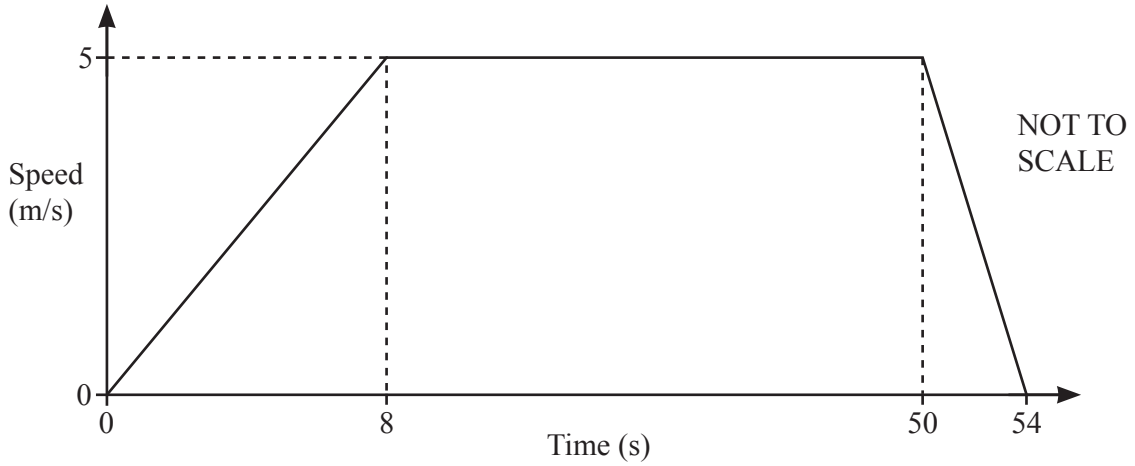
(iv) The answers to **part (d)(ii)** are the solutions to $kx^2 = 6$, where k is integer.

Find the value of k , showing all of your working.

$k = \dots\dots\dots$ [3]

5 Abel and Benny ride their bicycles from school to the park.

(a) The speed-time graph below shows information about Abel's journey.



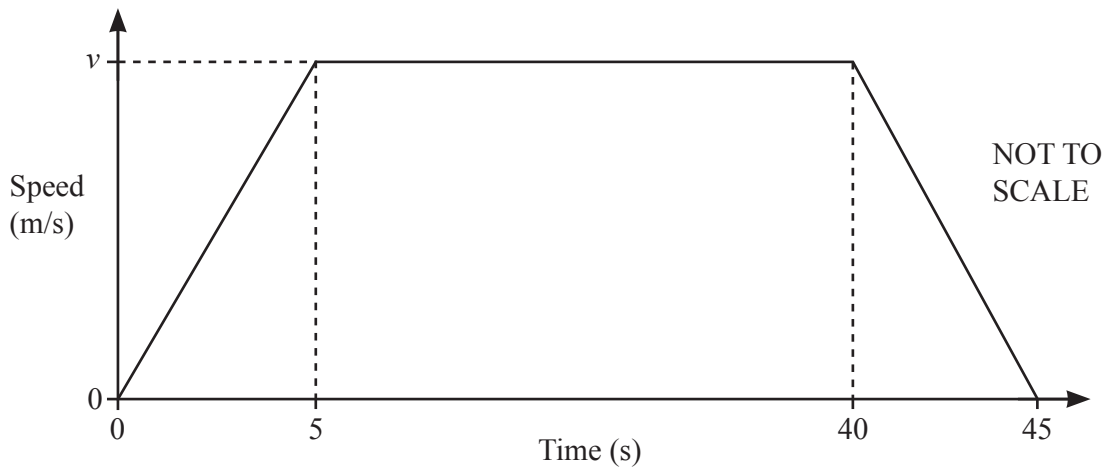
(i) Find his acceleration during the first 8 seconds.

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

(ii) Find the total distance that Abel cycles from school to the park.

..... m [3]

(b) The speed-time graph below shows information about Benny's journey along the same route from the school to the park.



Find the value of v .

$v =$ [4]

- 6 (a) In Aytown the number of people without a computer is decreasing exponentially at a rate of 18% per year.
Today, there are 25 000 people in Aytown without a computer.

(i) Calculate the number of people without a computer in 11 years time.

..... [2]

- (ii) Find how many complete years from today it will be until there are fewer than 1000 people without a computer.

..... [2]

- (b) Johann and Katya each buy a computer.
Johann pays 469 euros and Katya pays \$538.

Calculate the difference in price when the exchange rate is $\$1 = 0.9046$ euros.
Give your answer in dollars, correct to the nearest cent.

\$ [3]

- (c) In a sale, the price of another computer is reduced by 16% to \$273.

Calculate the price of this computer before the sale.

\$ [3]

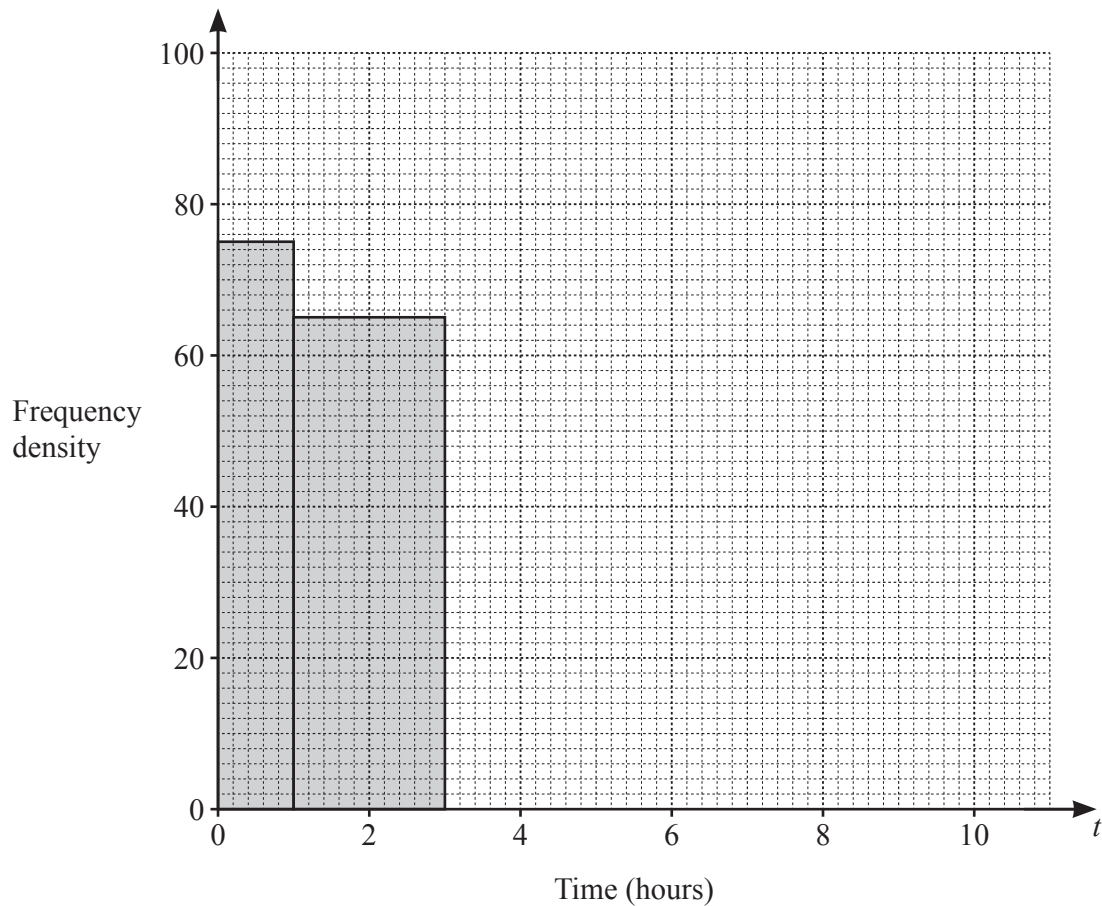
- 7 (a) 800 employees of a company were each asked how many hours it took them to travel to and from work in a week.
The frequency table shows this information.

Time (t hours)	$0 < t \leq 1$	$1 < t \leq 3$	$3 < t \leq 5$	$5 < t \leq 8$	$8 < t \leq 10$
Frequency	75	130	166	291	138

- (i) Calculate an estimate of the mean.

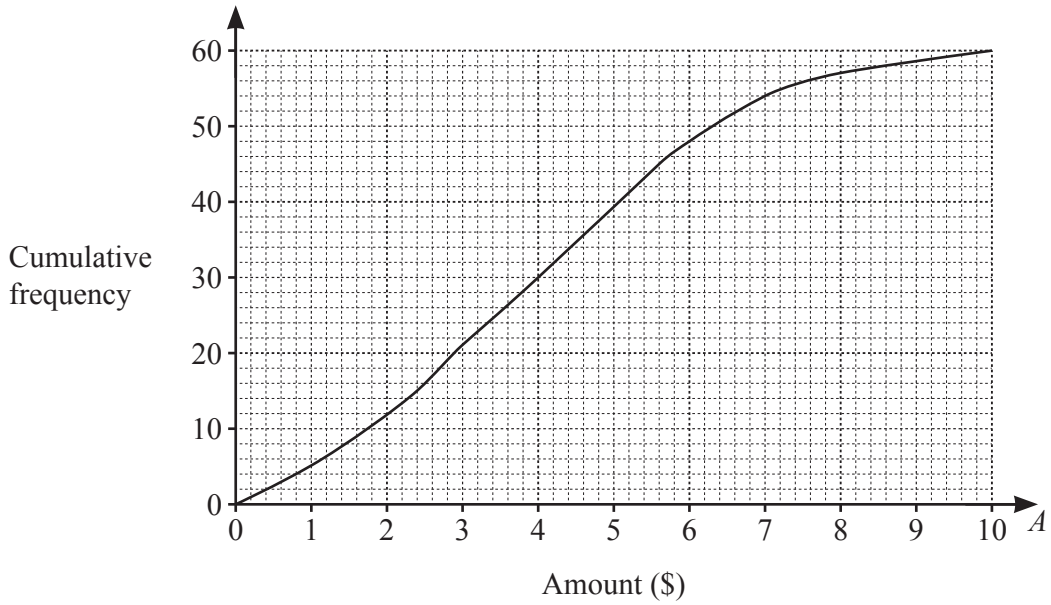
..... h [4]

- (ii) Complete the histogram to show the information in the table.



[3]

- (b) The cumulative frequency diagram shows information about the amount (\$ A) that each of 60 people spend in a café.



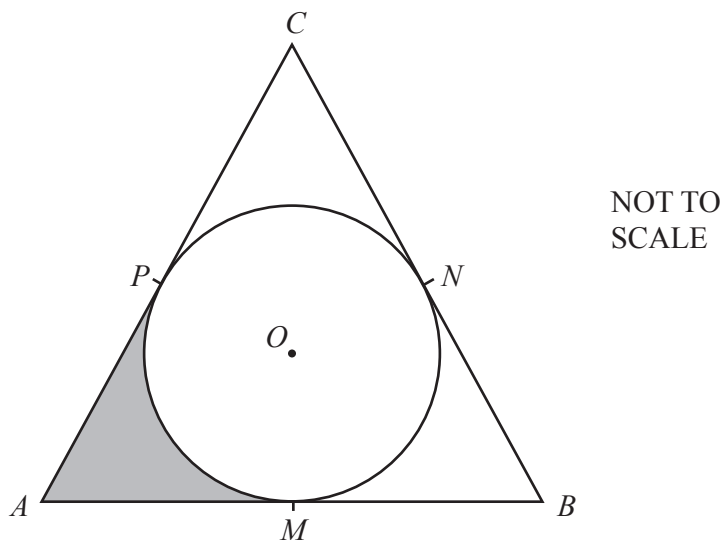
- (i) Use the cumulative frequency diagram to find an estimate of
- (a) the median, \$ [1]
 - (b) the interquartile range, \$ [2]
 - (c) the number of people who spend more than \$7. [2]
- (ii) (a) Use the information in the cumulative frequency diagram in **part (b)** to complete the frequency table.

Amount (\$ A)	$0 < A \leq 1$	$1 < A \leq 3$	$3 < A \leq 6$	$6 < A \leq 8$	$8 < A \leq 10$
Frequency	5				

[2]

- (b) Two people are chosen at random from those who spend more than \$1.
Find the probability that these people each spend more than \$6.

..... [3]



ABC is an equilateral triangle.
 The sides of the triangle are tangents to the circle, centre O , at M , N and P .
 The radius of the circle is 5 cm.

(a) (i) Write down the reason why angle OMA is a right angle.

(ii) Find angle OAM .

Angle $OAM = \dots\dots\dots$ [1]

(b) Calculate AM .

$AM = \dots\dots\dots$ cm [3]

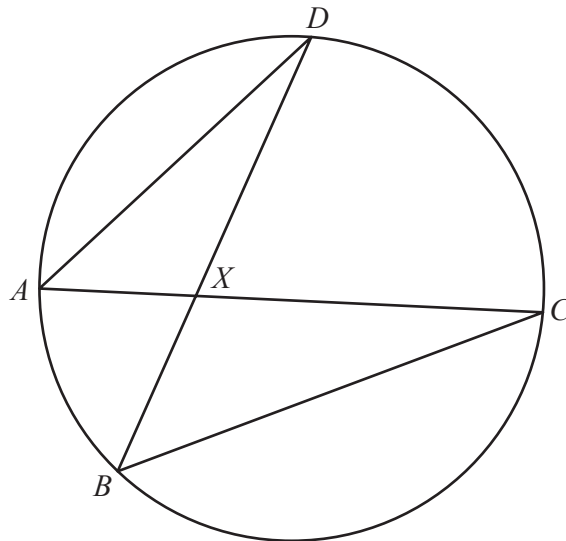
(c) Calculate the area of the shaded part of the diagram.

..... cm^2 [4]

(d) Calculate the perimeter of the shaded part of the diagram.

..... cm [3]

9 (a)



NOT TO SCALE

A, B, C and D are points on the circumference of a circle.
 AC and BD intersect at X .

- (i) Write down the angle that is equal to angle AXD , giving a reason for your answer.

Angle because
 [2]

- (ii) Write down the angle that is equal to angle DAX , giving a reason for your answer.

Angle because
 [2]

- (iii) Complete the statement.

Triangle BXC is to triangle AXD . [1]

- (iv) $AX = 1.6$ cm, $DX = 4.6$ cm and $BX = 2.4$ cm.

Calculate CX .

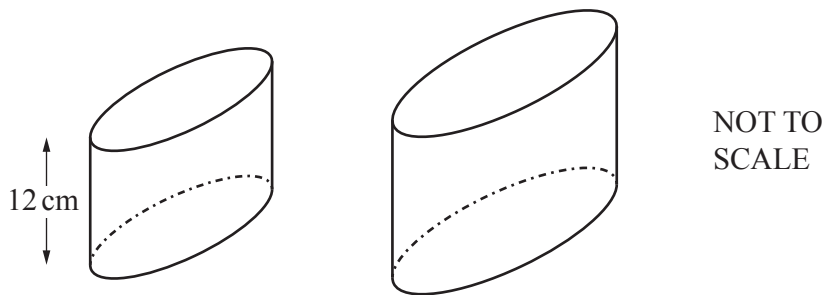
$CX =$ cm [2]

(v) The area of triangle BXC is 7.2 cm^2 .

Calculate the area of triangle AXD .

..... cm^2 [2]

(b)

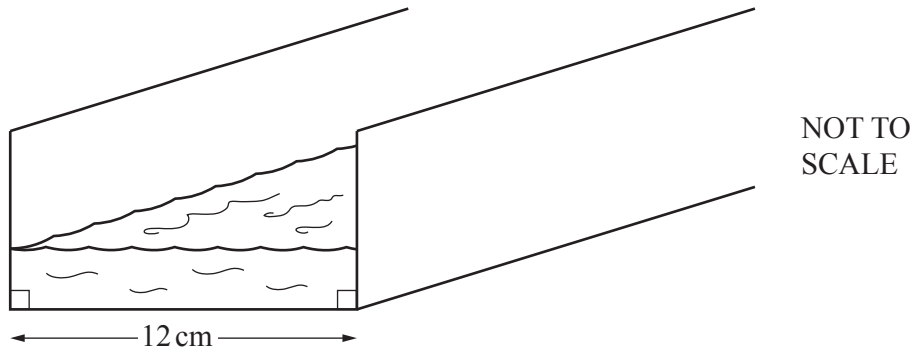


The two containers are mathematically similar.
 The volume of the smaller container is 189 cm^3 and its height is 12 cm.
 The volume of the larger container is 448 cm^3 .

Calculate the height of the larger container.

..... cm [3]

10



The diagram shows a rectangular channel that carries water to a storage tank. The width of the channel is 12 cm.

- (a) In summer, the water in the channel is 3 cm deep and flows at a rate of 4 cm/s.

Show that $518\,400\text{ cm}^3$ of water flows into the storage tank in 1 hour.

[2]

- (b) In winter, the water in the channel is 5 cm deep and flows at a rate of 18 cm/s.

Calculate the percentage increase, from the summer to the winter, in the volume of water that flows into the storage tank in 1 hour.

..... % [4]

- (c) The storage tank is a vertical cylinder with radius r .
When $518\,400\text{ cm}^3$ of water flows into the storage tank, the depth of the water increases by 4 mm.

Calculate the radius r .
Give your answer in metres.

$r =$ m [4]

11 A curve has equation $y = \frac{1}{4}x^4 - 3x^3 + 9x^2$.

(a) Find the coordinates of the three stationary points on this curve.

(.....,), (.....,) and (.....,) [6]

(b) Determine whether each of the stationary points is a maximum or a minimum.
Give reasons for your answers.

[4]

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