CLASS	INDEX NUMBER	NAME

BUKIT MERAH SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2025
SECONDARY 4 EXPRESS/ 5 NORMAL (ACADEMIC)

MATHEMATICS
Paper 1

4052/01

Candidates answer on the Question Paper.

22 August 2025
2 hours 15 minutes

READ THESE INSTRUCTIONS FIRST

Write your class, index number and name in the spaces at the top of this page.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Answer **all** the questions.
The number of marks is given in brackets [ ] at the end of each question or part question.

If working is needed for any question it must be shown with the answer.
Omission of essential working will result in loss of marks.
The total of the marks for this paper is **90**.

The use of an approved scientific calculator is expected, where appropriate.
If the degree of accuracy is not specified in the question and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.
For π, use either your calculator value or 3.142.

Calculator Model

For Examiner's Use

This document consists of **21** printed pages and 1 blank page.

[Turn over

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Mathematical Formulae

Compound interest

$$\text{Total amount} = P\left(1 + \frac{r}{100}\right)^n$$

Mensuration

$$\text{Curved surface area of a cone} = \pi rl$$

$$\text{Surface area of a sphere} = 4\pi r^2$$

$$\text{Volume of a cone} = \frac{1}{3}\pi r^2 h$$

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

$$\text{Area of triangle } ABC = \frac{1}{2}ab\sin C$$

$$\text{Arc length} = r\theta, \text{ where } \theta \text{ is in radians}$$

$$\text{Sector area} = \frac{1}{2}r^2\theta, \text{ where } \theta \text{ is in radians}$$

Trigonometry

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

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

Statistics

$$\text{Mean} = \frac{\Sigma fx}{\Sigma f}$$

$$\text{Standard deviation} = \sqrt{\frac{\Sigma fx^2}{\Sigma f} - \left(\frac{\Sigma fx}{\Sigma f}\right)^2}$$

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TURN OVER FOR QUESTION 1

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Answer **all** the questions.

1 Express as a single fraction in its simplest form $\frac{21xy}{12} \div \frac{5x}{4y}$.

Answer ..... [1]

---

2 Write the following numbers in order of size, starting with the **smallest**.

$$0.75, \quad \frac{5}{6}, \quad \left(\frac{5}{6}\right)^2, \quad \frac{4}{5}$$

Answer ....., ..., ..., ... [1]

---

3 Factorise $16x^2 - 9y^2$.

Answer ..... [1]

---

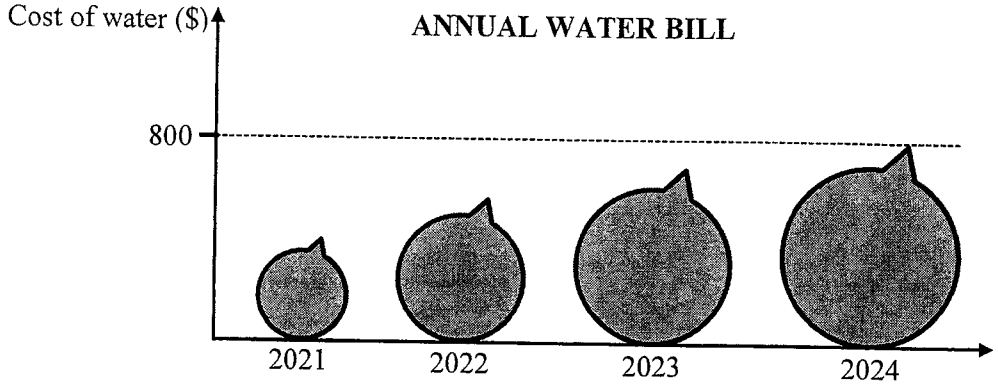
4 Calculate $\frac{15.7^3}{8.64 - 2.76}$.

Write down the first six digits of your answer.

Answer ..... [1]

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5 Alice draws this graph to show her annual water bill for each of the last four years.



State one aspect of the graph that may be misleading and explain how this may lead to a misinterpretation of the graph.

.....

.....

..... [2]

---

6 $$40 \times 7^4 + 9 \times 49^2 = 7^k$$

Use the laws of indices to find the value of k. Show your working clearly.

Answer k =..... [2]

---

7 The distance from the earth to the moon is approximately 384 megametres.
1 megametre $= 1 \times 10^6$ metres

(a) Write down the distance from the earth to the moon in metres, giving your answer in standard form.

Answer ..... m [1]

(b) A spacecraft took 102.75 hours to travel from earth to the moon.
Find the speed of the spacecraft in metres per second.

Answer ..... m/s [1]

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8 Brandon invests \$15 000 in a bank that pays compound interest at the rate of 2.45 % per year. Find the total amount of interest Brandon will earn after 6 years.

Answer \$ ..... [2]

---

9 A map is drawn to a scale of 1 : 35000.

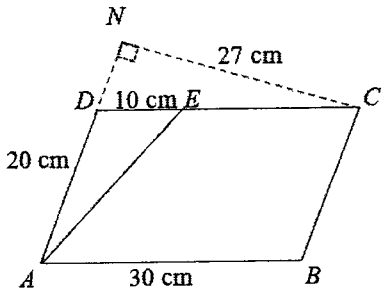
(a) This scale can be expressed as 1 cm represents n km. Find the value of n.

Answer n = ... [1]

(b) A lake has an actual area 2.5 km^2. Find the area, in square cm, of the lake on the map.

Answer ..... cm^2 [2]

10



In the figure, $ABCD$ is a parallelogram, AB = 30 cm, AD = 20 cm, DE = 10 cm and CN = 27 cm.

(a) Find the area of the parallelogram $ABCD$.

Answer ..... cm^2 [1]

(b) Find the area of the trapezium $ABCE$.

Answer ..... cm^2 [2]

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11 A factory mixes lime cordial with water in a barrel in the ratio of 2: 5.
50 litres of lime cordial was accidentally added to the barrel and the ratio of lime cordial to water in the mixture changed to 12: 25.
Water was then added to the mixture to restore the original ratio.
Find the amount of water added to restore the original ratio.

Answer ..... litres [3]

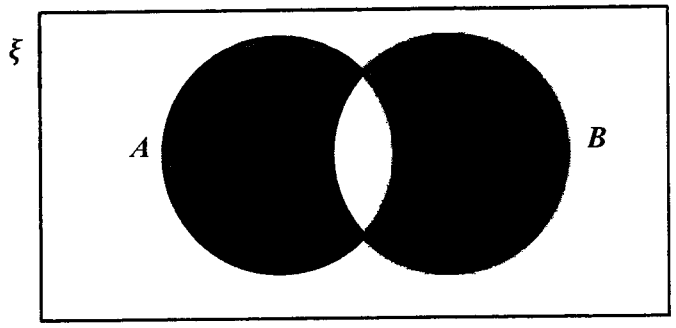
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12 Solve the equation $x^2 - 12x + 25 = 0$ by completing the square.

Answer $x =$ ..... or $x =$ ..... [3]

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13 (a) Use set notation to describe the shaded region.



Answer ..... [1]

(b)

$\xi = \{x: x \text{ is an integer and } 1 \leq x \leq 10\}$
$A = \{x: x \text{ is a factor of } 10\}$
$B = \{x: x \text{ is a prime number}\}$

(i) List the elements contained in the set $A \cap B$.

Answer ..... [1]

(ii) Find the value of $n(A \cup B')$.

Answer ..... [1]

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14 The data set consists of the ages of seven staff in a company.

$$25,\quad 21,\quad 18,\quad p,\quad 17,\quad 12,\quad 15$$

The mean age of the staff is 18.

(a) Find the value of p.

Answer $p =$ ..... [1]

(b) Find the standard deviation of the ages of the staff.

Answer ..... [1]

(c) Explain how the mean and standard deviation of the ages of the staff will change after three years.

.....

.....

..... [1]

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15 Cathy runs a dog-walking service. She charges \$36 to walk a group of dogs and \$20 to walk one dog.

In a particular year, Cathy's income from the dog-walking service was \$5760.
Cathy carried out x group walks and y indivdual walks. The group walks earned Cathy \$1800 more than the individual walks.

Form and solve two simultaneous equations, and find the total number of dog walks that Cathy carried out in that year.

Answer ..... [4]

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16 The stem-and-leaf diagram shows the marks of a Mathematics test obtained by 14 pupils.

Stem	Leaf
1	2 3
2	1 6 9
3	2 4 6 8 8
4	1 7 8
5	0

Key : 4|1 means 41 marks.

(a) Find the modal mark.

Answer ..... [1]

(b) Find the median mark.

Answer ..... [1]

(c) Find the interquartile range of the marks.

Answer ..... [2]

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17 P is the point $(4, 5)$ and Q is the point $(-2, 3)$.

(a) Write down the column vector $\overrightarrow{PQ}$.

Answer $\overrightarrow{PQ}$ = ... [1]

(b) Find the magnitude of vector $\overrightarrow{PQ}$.

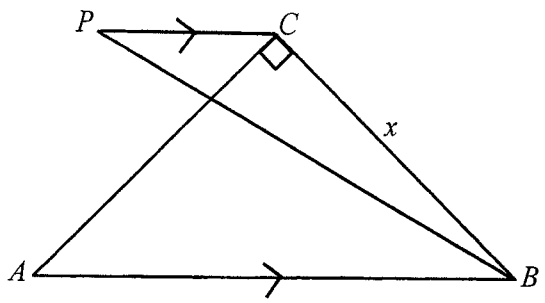
Answer ..... [1]

(c) Find the equation of the line PQ.

Answer ..... [2]

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18 $AC = BC = x$ cm, $PC // AB$ and angle $ACB = 90°$.



(a) Show that $AB = \sqrt{2}x$ cm.

Answer

[2]

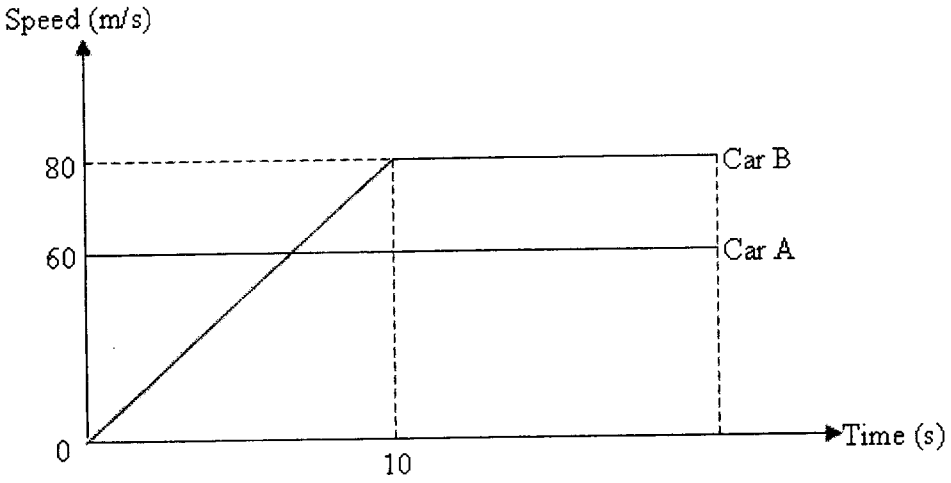
(b) It is given that $x = 6\sqrt{2}$.

Find the shortest distance from C to AB in cm. Show your working clearly.

Answer ..... cm [3]

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19 The diagram below shows Car *A* travelling at a uniform speed of 60 m/s.
Car *B* accelerated uniformly from rest to reach a speed of 80 m/s in 10s and continued travelling at the same speed thereafter.



(a) Find the acceleration of Car *B* from 0 to 10s.

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

(b) Find the time when both cars were travelling at the same speed.

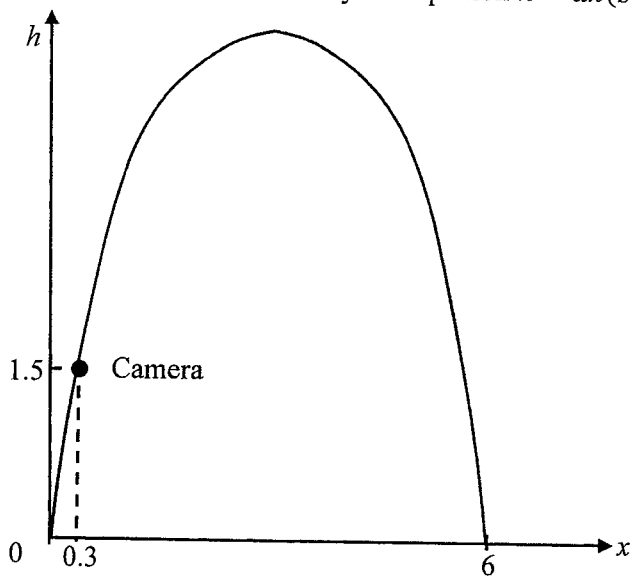
Answer ..... s [2]

(c) Find the time when Car *B* overtook Car *A*.

Answer ..... s [2]

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20 The entrance to a stadium is a parabolic arch, 6 metres wide at the base.
A camera is mounted on one side of the arch as shown.
The height of the arch, h metres, can be modelled by the equation $h = ax(b - x)$.



(a) Find the value of a and of b.

Answer $a =$ .....

$b =$ ..... [3]

(b) Find the maximum height of the arch, giving your answer correct to one decimal place.

Answer ..... m [2]

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21 (a) In a regular polygon, the ratio of interior angle: exterior angle = 13 : 2.
Calculate the number of sides of the polygon.

Answer ..... [3]

(b) When the height of a cuboid is reduced by 4.5 cm, its surface area is reduced by 162 cm^2.
The resulting object is a cube. Find the volume of the original cuboid.

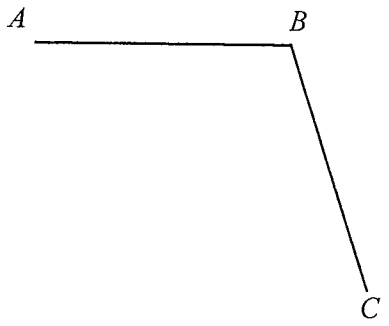
Answer ..... cm^3 [2]

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22 The diagram shows part of a kite $ABCD$ in which $AB = BC$, $AD = CD$ and $BD = 8$ cm. AB and BC have already been drawn.

(a) Construct and complete the kite $ABCD$.

Answer



[2]

(b) Measure and write down the length of AD.

Answer $AD =$ ..... cm [1]

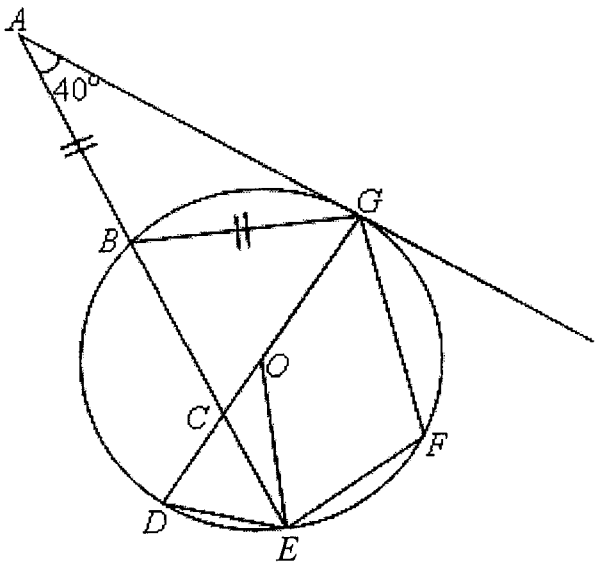
(c) Construct the perpendicular bisector of AD. [1]

(d) Mark a possible point which is inside the kite, equidistant from A and D, and is nearer to AB than BC. Label this point P.

[1]

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23



In the diagram, O is the centre of the circle and AG is a tangent to the circle at point G. $\angle BAG = 40°$ and $AB = BG$. The points B, D, E, F and G are on the circle.

(a) Show whether triangle BCG is isosceles. State your reasons clearly.
Answer

[3]

(b) Stating your reasons clearly, calculate

(i) angle GFE,

Answer Angle GFE = ... [1]

(ii) angle DOE.

Answer Angle DOE = ... [1]

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24 In a pharmacy, skin lotion is stored in a cylindrical container that has a base radius of 5 cm and height of 8 cm, as shown in Figure I.

The pharmacy decides to use a new container to store the skin lotion. The bottom part of the new container's inner space resembles a hemisphere, as shown in Figure II.

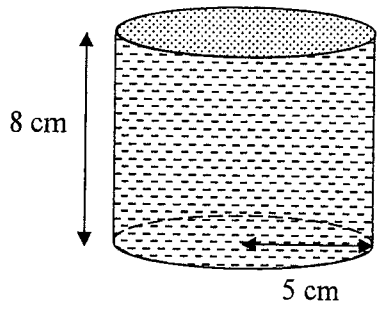


Figure I

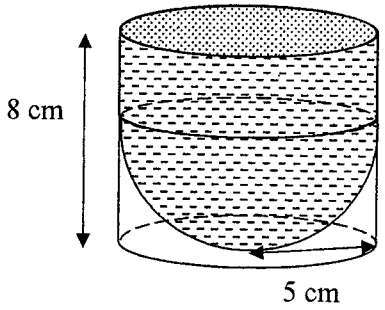


Figure II

(a) Calculate the volume of lotion that will fill the container in Figure I to the brim.

Answer ..... cm^3 [1]

(b) Calculate the volume of lotion that will fill the container in Figure II to the brim.

Answer ..... cm^3 [3]

(c) The lotion in the original container in Figure I is priced at \$40.
The lotion in the new container in Figure II is priced at \$36.99.
Which lotion (in Figure I or Figure II) offers good value to a consumer?

The lotion in Figure ..... because .....

.....

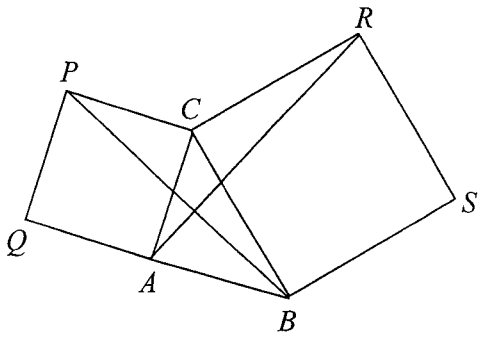
.....

..... [2]

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25 (a) In the diagram, $ACPQ$ and $BCRS$ are squares.
Show that ΔBPC and ΔRAC are congruent.
Give a reason for each statement you make.

Answer



[3]

(b) There are three jugs, X, Y and Z.
The jugs X and Y are geometrically similar.
The volume of jug X and jug Y are 216 cm^3 and 512 cm^3 respectively.

(i) Find the ratio of the surface area of jug X to the surface area of jug Y.

Answer ..... : ..... [2]

(ii) Both jugs X and Z are cylindrical containers that have the same vertical height.
The radius of the circular base of jug Z is twice the radius of the circular base of jug X.
Find the volume of jug Z.

Answer ..... cm^3 [1]

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26 (a) Find the prime factors of 2600, giving your answer in index form.

Answer ..... [2]

(b) Two integers, A and B, can be written as products of prime factors.

$$A = p \times q^{r+2} \times 13 \quad B = p^2 \times q^r \times 13$$

The lowest common multiple of A and B is 2600.

(i) Find the value of p and of q.

Answer $p =$ .....

$q =$ ..... [2]

(ii) A charity group plans to distribute rice and oil that it has to senior citizens.

The number of packets of rice that the charity group has is A, where $A = p \times q^{r+2} \times 13$.

The number of bottles of oil that the charity group has is B, where $B = p^2 \times q^r \times 13$.

The charity group plans to distribute A packets of rice and B bottles of oil equally and benefit the greatest possible number of senior citizens. Each senior citizen will receive the same number of packets of rice and the same number of bottles of oil.

Find the number of packets of rice and bottles of oil each senior citizen will get.

Answer ..... packets of rice

..... bottles of oil [2]

End of Paper

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BUKIT MERAH SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2025
SECONDARY 4 EXPRESS/ 5 NORMAL (ACADEMIC)

MATHEMATICS
Paper 2

4052/02

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26 August 2025
2 hours 15 minutes

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TURN OVER FOR QUESTION 1

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Answer **all** the questions.

1 **(a)** Solve $7 - 8x = 6(1 - 2x)$.

Answer $x =$ ..... [2]

(b) Find the largest integer value of y that satisfies the inequality $-3y > 25$.

Answer ..... [1]

(c)

$$Aq = \pi p(2p + q)$$

Rearrange the formula to make q the subject.

Answer $q =$ ..... [3]

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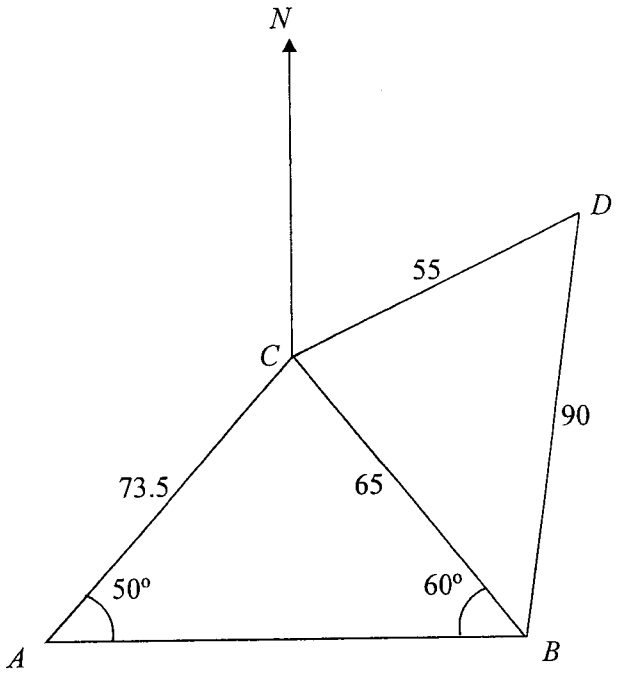
(d) Solve the equation

$$\frac{x}{x+3} - \frac{4x+1}{x+1} = 2.$$

Answer $x =$ ..... or $x =$ ..... [4]

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2



In the diagram, each of the points A, B, C and D represents the foot of a building on horizontal ground. B is due east of A.

$AC = 73.5$ m, $BC = 65$ m, $BD = 90$ m and $CD = 55$ m. Angle $CAB = 50°$ and angle $CBA = 60°$.

(a) (i) Find the bearing of A from C.

Answer ..... [1]

(ii) Calculate the area of triangle ABC.

Answer ..... m^2 [2]

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(iii) Calculate angle CBD.

Answer Angle CBD = ... [3]

(b) Calculate the shortest distance from C to AB.

Answer ..... m [2]

(c) The building at B is 37 m high.

The angle of depression of the top of the building at B from the top of the building at C is 2.7°.

Find the height of the building at C.

Answer ..... m [2]

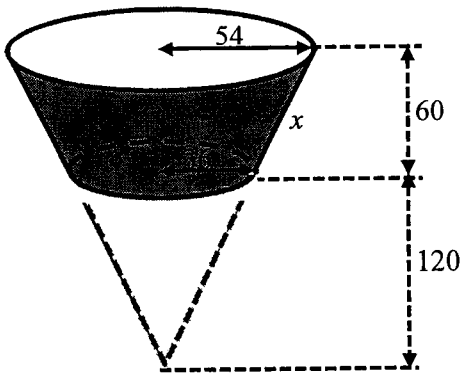
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3 **(a)** The quantity of paint needed to cover the outside of a container is proportional to the square of the depth of the container.
When the depth is 60 cm, the quantity of paint needed is 180 ml.

Calculate the quantity of paint needed when the depth is 90 cm.

Answer ..... ml [2]

(b) The diagram shows a pot which is part of a right circular cone of vertical height 180 cm.
The open end of the pot is a circle of radius 54 cm.
The base of the pot is a circle of radius 36 cm.
The vertical height of the pot is 60 cm.
The slant height of the pot is x cm.
[You may ignore any holes in the base of the pot.]



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(i) Show that $x = 62.642$, correct to 5 significant figures.

Answer

[2]

(ii) Calculate the total surface area of the outside of the pot.

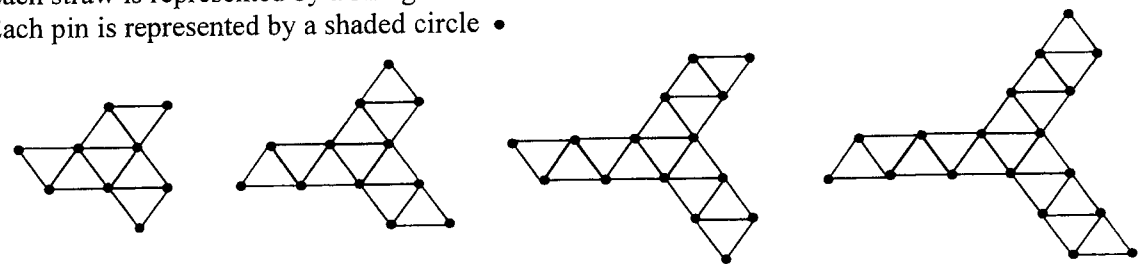
Answer ..... cm^2 [4]

(iii) Another pot is to be made with a volume twice the volume of this pot.
Given that the two pots are geometrically similar, find the vertical height of the larger pot.

Answer ..... cm [2]

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4 The diagram shows part of a pattern of triangles that are made from straws and pins.
Each straw is represented by a straight line ——
Each pin is represented by a shaded circle •



$n = 1$ $n = 2$ $n = 3$ $n = 4$

(a) Draw the pattern for $n = 5$.

[1]

(b) The table shows the information for the pattern of triangles.

n	Number of Triangles (T_n)	Number of Straws (S_n)	Number of Pins (P_n)
1	7	15	9
2	10	21	12
3	13	27	15
4	16	33	18
5	19	a	b

(i) Consider the last row of the above table and write down the value of a and of b.

Answer $a =$ .....

$b =$ ..... [2]

(ii) Express, in terms of n, the number of triangles, T_n.
Simplify your answer.

Answer $T_n =$ ..... [2]

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(iii) Explain why it is not possible to have a pattern containing 159 triangles.

.....

..... [1]

(iv) Show that the number of straws, S_n, is an odd number for every integer n.

Answer

[2]

(c) S straws and P pins are used to form a patten containing T triangles.

Write down an equation relating S and P.

Answer ..... [2]

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5 Henry and John have time deposit in Australian dollars (AUD), New Zealand dollars (NZD) and American dollars (USD) with a bank. Their amounts deposited are shown in the matrix **M**.

$$\mathbf{M} = \begin{matrix} \\ \text{Henry} \\ \text{John} \end{matrix} \begin{matrix} \begin{matrix} \text{AUD} & \text{NZD} & \text{USD} \end{matrix} \\ \begin{pmatrix} 100000 & 150000 & 200000 \\ 120000 & 180000 & 150000 \end{pmatrix} \end{matrix}$$

(a) The exchange rates of these currency wtih Singapore dollars (SGD) are as follows.

1 AUD = 0.83 SGD

1 NZD = 0.77 SGD

1 USD = 1.28 SGD

Write a 3×1 matrix **E** to represent these exchange rates.

Answer **E** = [1]

(b) Evaluate the matrix **D** = **ME**.

Answer **D** = [2]

(c) Explain what the elements in **D** represent.

.....

..... [1]

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(d) The annual interest rates for three deposits are as follows.

AUD: 1.18%, NZD: 2.74%, USD: 0.375%

(i) Evaluate

$$\mathbf{A} = \mathbf{M}\begin{pmatrix} 1.18\% & 0 & 0 \\ 0 & 2.74\% & 0 \\ 0 & 0 & 0.375\% \end{pmatrix}$$

Answer $\mathbf{A} =$ [2]

(ii) Explain what the elements in **A** represent.

.....

..... [1]

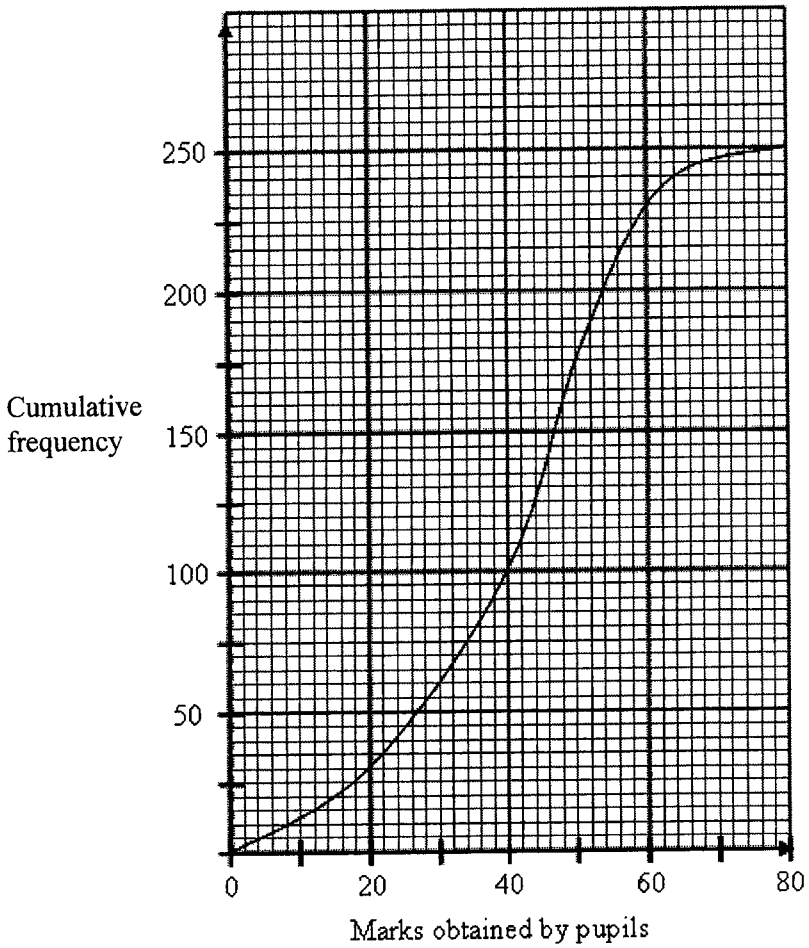
(iii) Using matrix multiplication of the result in part **d(i)** and matrix **E**, find the total annual interest in Singapore dollars that Henry and John each earned.

Answer Henry $ .....

John $ .....[3]

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6 The cumulative frequency curve shows the distribution of marks obtained by pupils in school A in a Science test. The maximum mark is 80.



(a) Find the 80th percentile.

Answer ..... [1]

(b) Given that $\frac{7}{10}$ of the pupils passed the test, find the pass mark.

Answer ..... [1]

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(c) The cumulative frequency curve can be represented in the following frequency table.

Marks obtained by pupils, x	$0 \leq x < 20$	$20 \leq x < 40$	$40 \leq x < 60$	$60 \leq x < 80$
Number of pupils	30	p	q	20

(i) Find the value of p and of q.

Answer $p =$ .....

$q =$ ..... [2]

(ii) Calculate the mean and standard deviation.

Answer Mean = ...

Standard deviation = ... [2]

(iii) Two of the pupils are selected at random.
Find, as a fraction in its lowest terms, the probability that one student scored under 20 marks and the other student scored 60 marks or more.

Answer ..... [2]

(iv) The mean and standard deviation of the marks obtained by pupils of school B in the same Science test are 44.8 and 12.1 respectively.

Make two comparisons between the performance of both schools in the Science test. Use figures to support your answer.

1. .....

.....

2. .....

.....

[2]

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7 The variables x and y are connected by the equation $y = 3 - \frac{x}{5} - \frac{1}{2x^3}$.

Some corresponding values of x and y are given in the table below.

x	0.4	0.5	1	1.5	2	3	4	5	6
y	−4.9	−1.1	2.3	2.6	2.5	2.4	2.2	2.0	p

(a) Find the value of p, giving your answer correct to 1 decimal place.

Answer p = ... [1]

(b) On the grid opposite, draw the graph of $y = 3 - \frac{x}{5} - \frac{1}{2x^3}$ for $0.4 \leq x \leq 6$. [3]

(c) By drawing a tangent, find the gradient of the curve at (1, 2.3).

Answer ..... [2]

(d) **(i)** On the same axes, draw the line with gradient 1.5 that passes through the point with coordinates $(2, -1)$. [1]

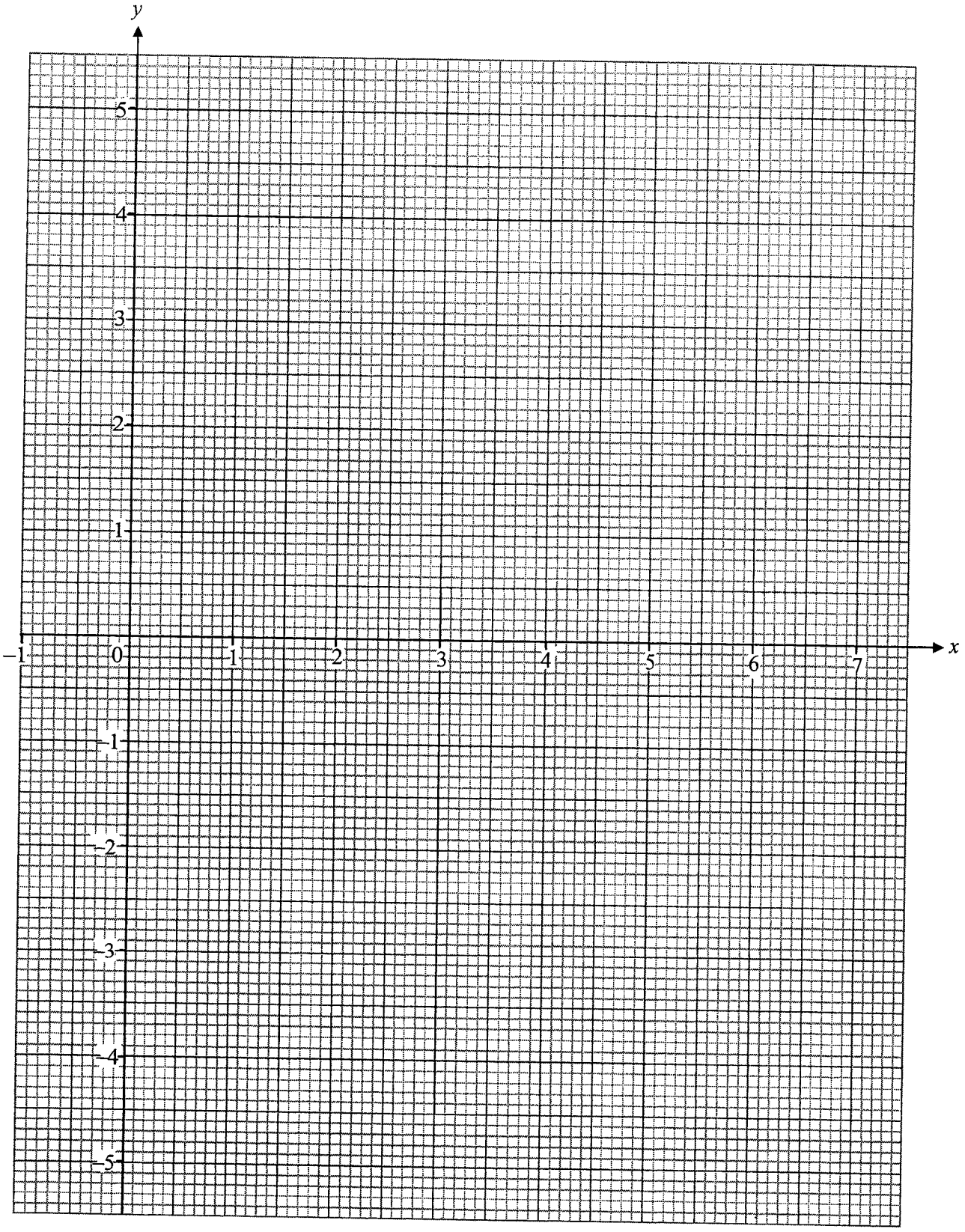
(ii) Write down the equation of this line.

Answer ..... [1]

(iii) Write down the x-coordinates of the points where the line intersects the curve.

Answer x = ... or x = ... [2]

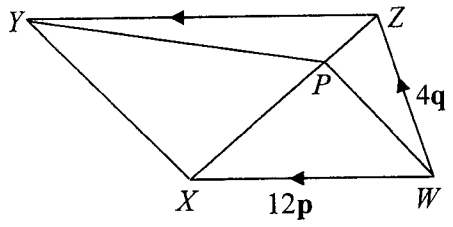
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8 In the diagram, $WXYZ$ is a trapezium. WX and ZY are parallel. $\overrightarrow{WX} = 12\mathbf{p}$ and $\overrightarrow{WZ} = 4\mathbf{q}$.

The point P on XZ is such that $ZP : ZX = 1 : 4$ and $4WX = 3ZY$.



(a) Find $\overrightarrow{ZX}$ in terms of **p** and **q**.

Answer $\overrightarrow{ZX}$ = ... [1]

(b) Find $\overrightarrow{WP}$, as simply as possible, in terms of **p** and **q**.

Answer $\overrightarrow{WP}$ = ... [2]

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(c) Show that the line XY is parallel to the line WP.

Answer

[3]

(d) **(i)** Find the value of $\frac{\text{area of } \Delta WPX}{\text{area of } \Delta XYP}$.

Answer ..... [1]

(ii) Find the value of $\frac{\text{area of } \Delta WZP}{\text{area of } \Delta WXZ}$.

Answer ..... [1]

(iii) Find the value of $\frac{\text{area of } \Delta WZP}{\text{area of } \Delta XYZ}$.

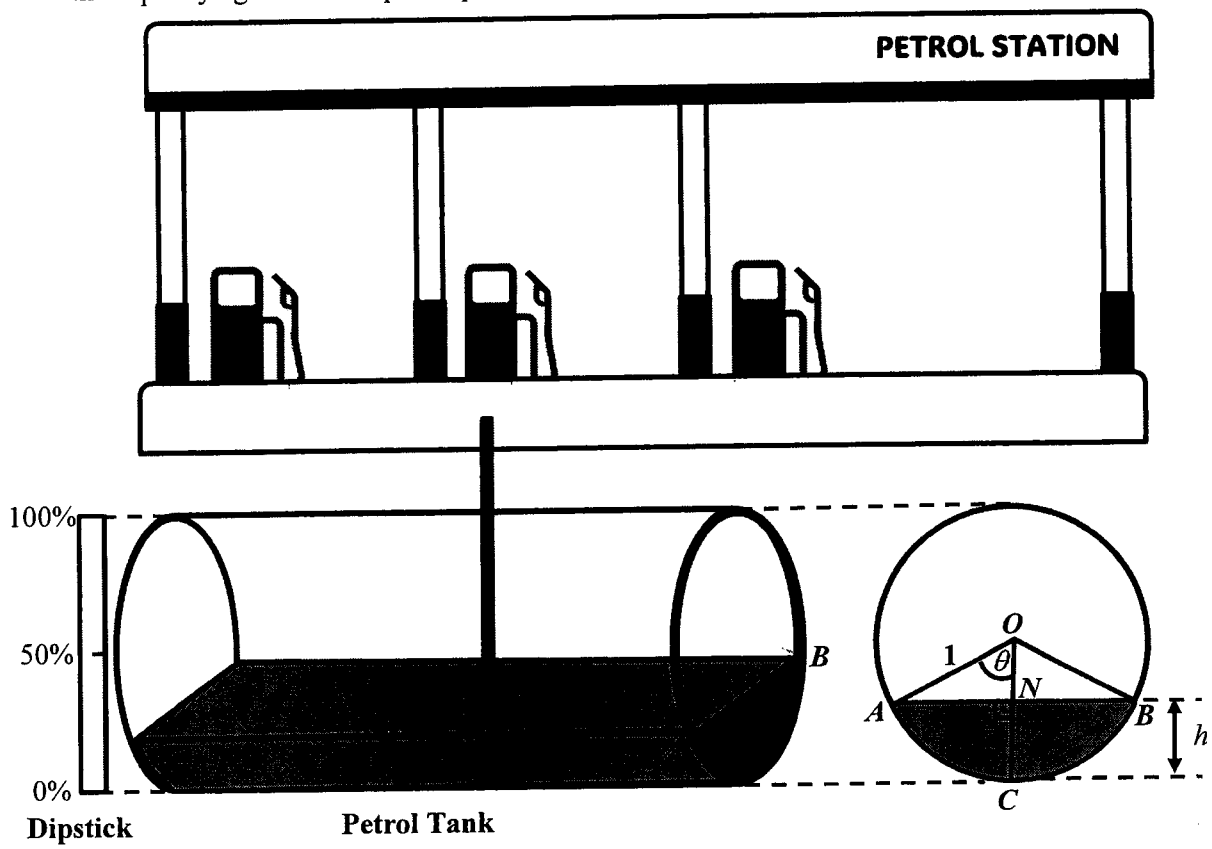
Answer ..... [2]

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9 The diagram shows a petrol station and its underground petrol tank.

The petrol tank is a horizontal cylindrical tank whose cross-section is a circle of radius 1 metre. The volume of petrol in the tank is proportional to the cross-sectional area of petrol in the tank.

The amount of petrol in the petrol tank is monitored using a dipstick, which is placed along the vertical diameter at one end of the tank. The calibration on the dipstick marks 0%, 50%, 100% of the capacity against the depth of petrol.



The diagram also shows the circular end of the tank with centre O and petrol surface AB, $\angle AOC = \theta$ radians and the depth of petrol $NC = h$ metres.

(a) Find h in terms of θ.

Answer $h =$ ..... m [1]

(b) Find, in terms of θ, the shaded cross-sectional area of petrol in the tank.

Answer ..... m^2 [2]

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(c) The current dipstick reading indicates that the tank is $\frac{3}{8}$ full of petrol.

The amount of petrol is $y\%$ of the capacity of the tank.

By finding the values of y corresponding to $h = 0.80$ and $h = 0.81$,

suggest a suitable depth of petrol that indicates that the tank is $\frac{3}{8}$ full of petrol.

Show your calculations clearly.

.....

..... [7]

End of paper

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