



National
Qualifications
2018

X847/75/01

**Mathematics
Paper 1 (Non-Calculator)**

FRIDAY, 4 MAY

INSTRUCTIONS TO CANDIDATES

Candidates should enter their surname, forename(s), date of birth, Scottish candidate number and the name and Level of the subject at the top of their first answer sheet.

Total marks — 50

Attempt ALL questions.

You may NOT use a calculator.

To earn full marks you must show your working in your answers.

State the units for your answer where appropriate.

Write your answers clearly on your answer sheet.

Questions marked with an asterisk differ in some respects from those in the printed paper.

Marks are shown in square brackets at the end of each question or part question.

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FORMULAE LIST

The roots of $ax^2 + bx + c = 0$ are $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

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

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

Area of a triangle: $A = \frac{1}{2}ab \sin C$

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

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

Volume of a pyramid: $V = \frac{1}{3}Ah$

Standard deviation: $s = \sqrt{\frac{\sum(x - \bar{x})^2}{n - 1}}$

or $s = \sqrt{\frac{\sum x^2 - \frac{(\sum x)^2}{n}}{n - 1}}$, where n is the sample size.

Total marks — 50
Attempt ALL questions

1. Evaluate $2\frac{1}{3} + \frac{4}{5}$. [2 marks]

2. Expand and simplify $(3x+1)(x-1) + 2(x^2 - 5)$. [3 marks]

3. Solve, algebraically, the system of equations

$$4x + 5y = -3$$

$$6x - 2y = 5. \text{ [3 marks]}$$

4. Two vectors are given by $\mathbf{u} = \begin{pmatrix} 1 \\ 5 \\ 1 \end{pmatrix}$ and $\mathbf{u} + \mathbf{v} = \begin{pmatrix} 6 \\ -4 \\ 3 \end{pmatrix}$.

Find vector \mathbf{v} .

Express your answer in component form. [2 marks]

5. Solve

$$x^2 - 11x + 24 = 0. \text{ [2 marks]}$$

* 6. Refer to the diagram for Question 6. It shows part of the graph of $y = a \cos bx^\circ$.
State the values of a and b . [2 marks]

- * 7. Refer to the diagram for Question 7. It shows a graph. The cost of a journey with Tom's Taxis depends on the distance travelled.

The graph shows the cost, P pounds, of a journey with Tom's Taxis against the distance travelled, d miles.

Point A represents a journey of 8 miles which costs £14.

Point B represents a journey of 12 miles which costs £20.

- (a) Find the equation of the line in terms of P and d .
Give the equation in its simplest form. [3 marks]
- (b) Calculate the cost of a journey of 5 miles. [1 mark]

8. Determine the nature of the roots of the function $f(x) = 2x^2 + 4x + 5$. [2 marks]

- * 9. Refer to the diagram for Question 9. It shows ABCDEFGHJK, a regular decagon.

- Angle KLJ is 17° .
- AKL is a straight line.

Calculate the size of angle KJL. [2 marks]

- *10. Refer to the diagram for Question 10. In triangle XYZ:

- $XZ = 10$ centimetres
- $YZ = 8$ centimetres
- $\cos Z = \frac{1}{8}$.

Calculate the length of XY. [3 marks]

11. Express $\frac{9}{\sqrt{6}}$ with a rational denominator.

Give your answer in its simplest form. [2 marks]

12. Given that $\cos 60^\circ = 0.5$, state the value of $\cos 240^\circ$. [1 mark]

- *13. A triangular prism, ABCDEF, is relative to the coordinate axes. A is the point (4, 0, 5), at the top of the front of the prism. E is the point (2, 0, 0), at the front left of the base of the prism. D is the point at the front right of the base of the prism. AED form a triangle. AD = AE. EDCF form a rectangle. DC = 8 units. Edges EF, DC and AB are parallel to the y -axis.

Write down the coordinates of B and C. [2 marks]

14. Change the subject of the formula $y = g\sqrt{x} + h$ to x . [3 marks]

15. Remove the brackets and simplify $\left(\frac{2}{3}p^4\right)^2$. [2 marks]

- *16. Describe the graph of $y = (x - 6)(x + 4)$, stating:

(a) the shape of the graph

(b) the coordinates of the points of intersection with the x -axis and the y -axis

(c) the coordinates of the turning point. [3 marks]

- *17. In a square based pyramid, the square base has length 6 centimetres.

The volume is 138 cubic centimetres.

Calculate the height of the pyramid. [3 marks]

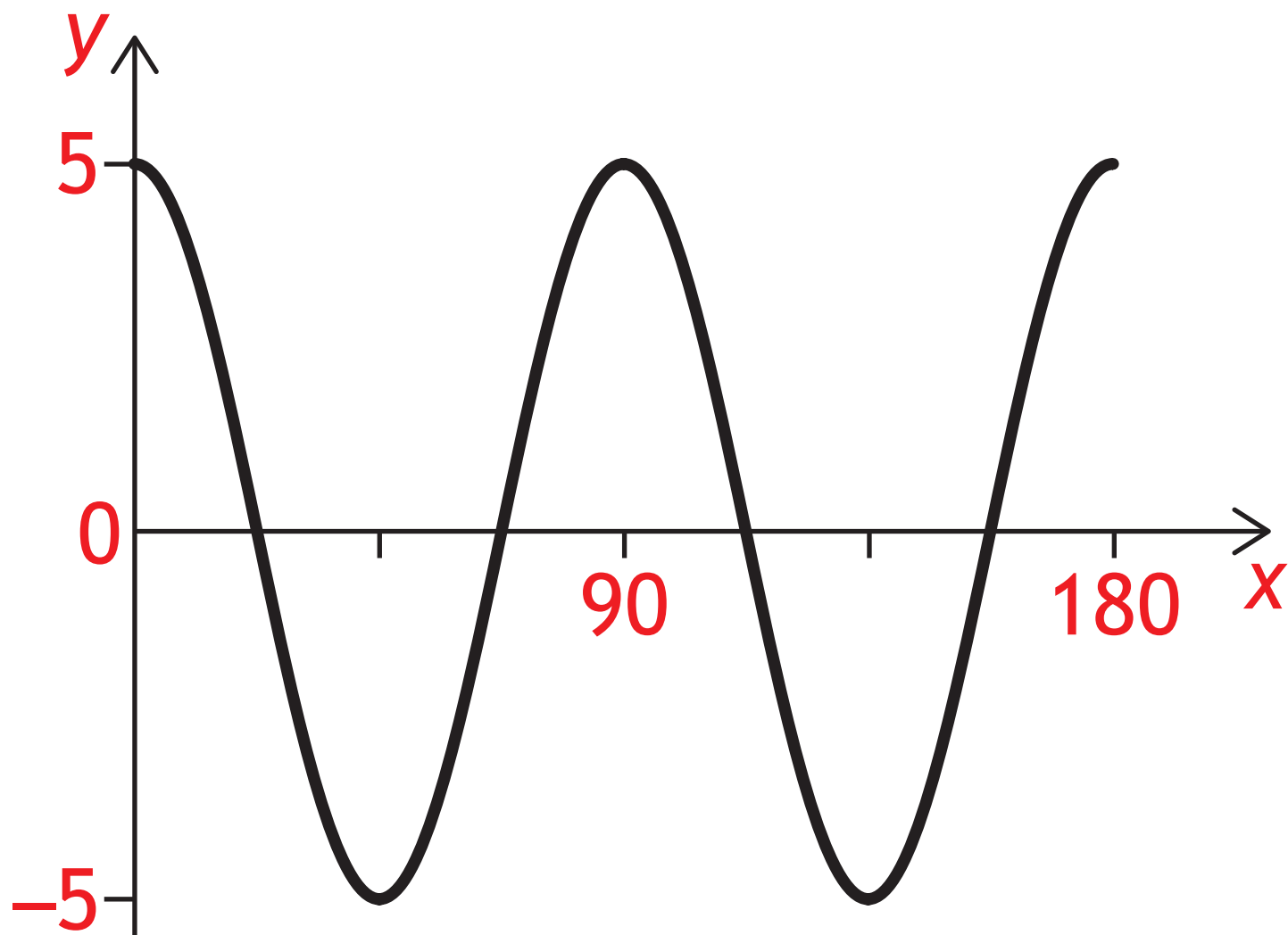
18. Express $\sin x^\circ \cos x^\circ \tan x^\circ$ in its simplest form.

Show your working. [2 marks]

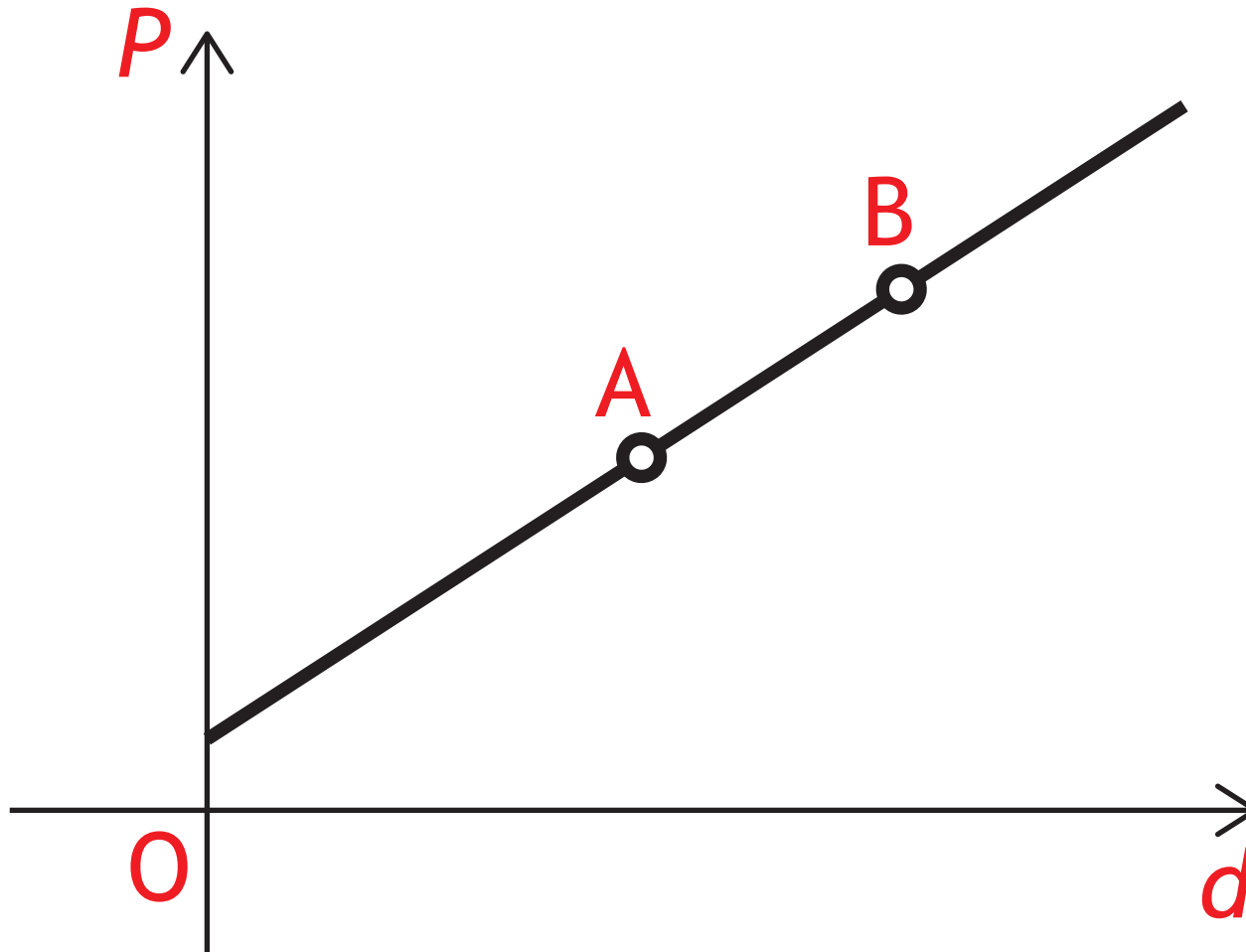
19. (a) (i) Express $x^2 - 6x - 81$ in the form $(x - p)^2 + q$. [2 marks]
- (ii) Hence state the equation of the axis of symmetry of the graph of $y = x^2 - 6x - 81$. [1 mark]
- (b) The roots of the equation $x^2 - 6x - 81 = 0$ can be expressed in the form $x = d \pm d\sqrt{e}$. Find, algebraically, the values of d and e . [4 marks]

[END OF QUESTION PAPER]

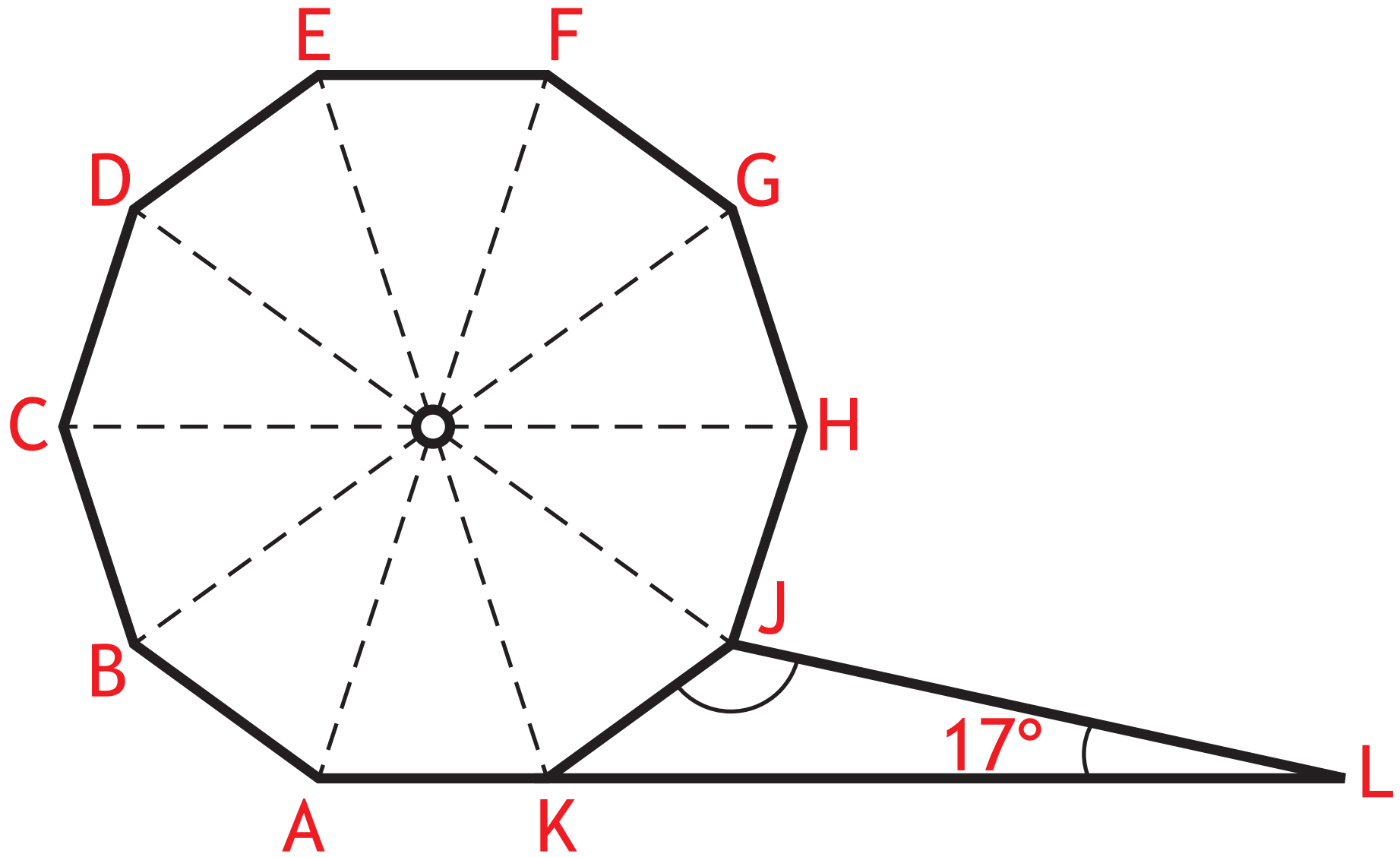
Q6



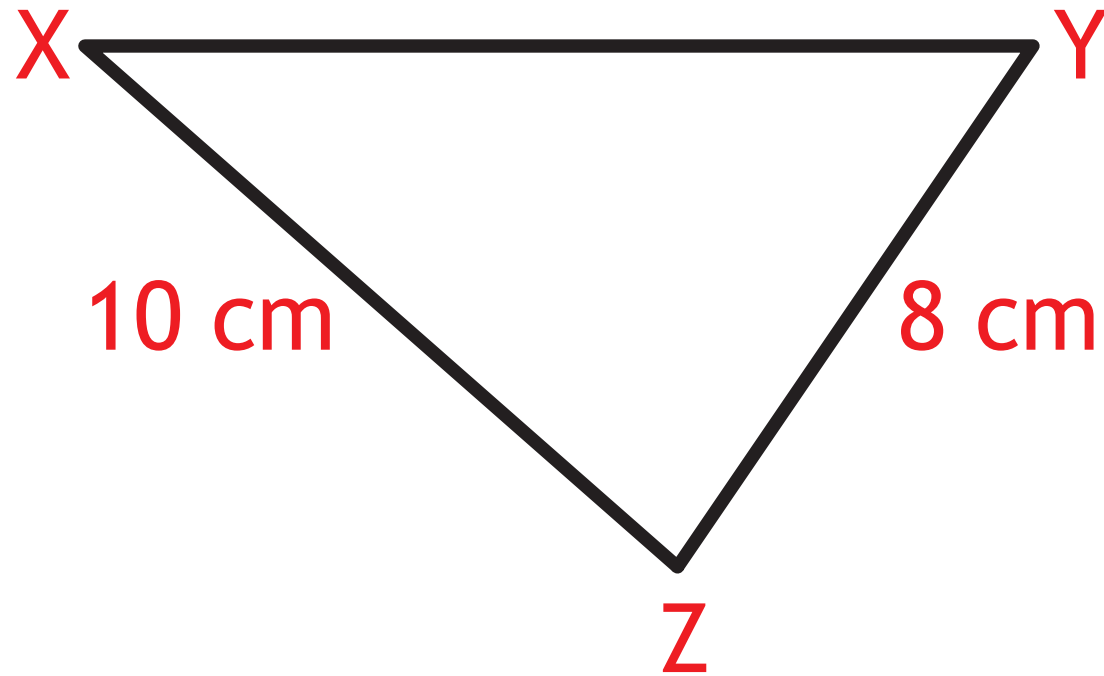
Q7



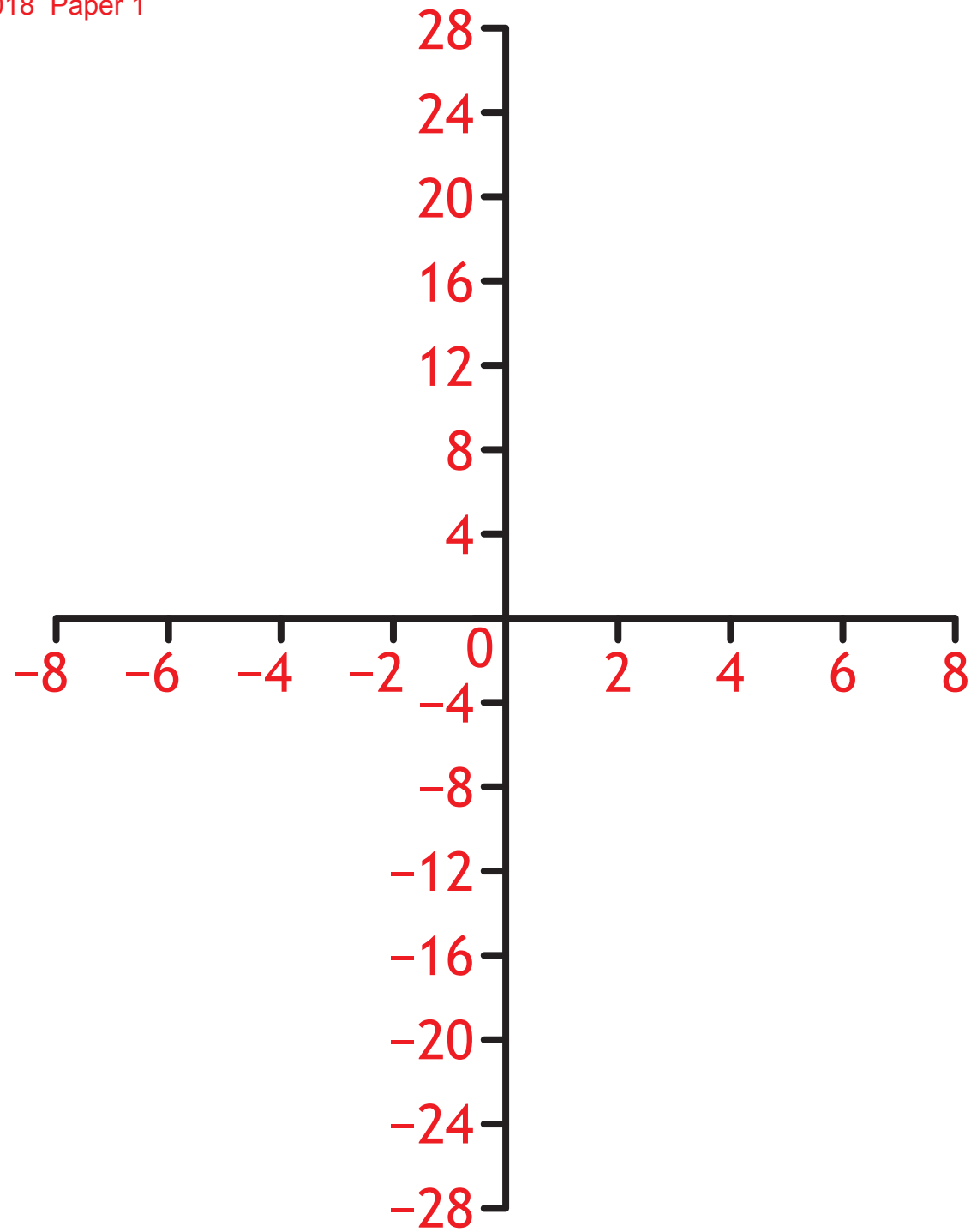
Q9



Q10



Q16





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**Mathematics
Paper 2**

FRIDAY, 4 MAY

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Total marks — 60

Attempt ALL questions

1. Households in a city produced a total of 125 000 tonnes of waste in 2017. The total amount of waste is expected to fall by 2% each year. Calculate the total amount of waste these households are expected to produce in 2020. [3 marks]

- * 2. Refer to the diagram for Question 2. It shows a sector of a circle, centre C.
The radius of the circle is 7.4 centimetres. Calculate the length of the major arc AB. [3 marks]

3. Find $|\mathbf{r}|$, the magnitude of vector $\mathbf{r} = \begin{pmatrix} 24 \\ -12 \\ 8 \end{pmatrix}$. [2 marks]

4. Solve, algebraically, the inequation $3x < 6(x-1) - 12$. [3 marks]

5. A farmers' market took place one weekend.
Stallholders were asked to record the number of customers who visited their stall.
The number of customers who visited six of the stalls on Saturday were as follows:
120 126 125 131 130 124
 - (a) Calculate the mean and standard deviation of the number of customers. [4 marks]
 - (b) The mean number of customers who visited these six stalls on Sunday was 117 and the standard deviation was 6.2. Make two valid comments comparing the number of customers who visited these stalls on Saturday and Sunday. [2 marks]

6. A function is defined as $f(x) = 5 + 4x$.
Given that $f(a) = 73$, calculate a . [2 marks]

- * 7. A toy company makes juggling balls in the shape of a sphere with a diameter of 6.4 centimetres. Calculate the volume of one juggling ball.

Give your answer correct to 2 significant figures. [3 marks]

8. Solve the equation $7 \sin x^\circ + 2 = 3$, for $0 \leq x < 360$. [3 marks]

- * 9. Refer to the diagram for Question 9. In the diagram:

- angle $ABD = 75^\circ$
- angle $BDC = 37^\circ$
- $BC = 20$ centimetres.

Calculate the length of DC . [3 marks]

- *10. Refer to the diagram for Question 10. \vec{AB} and \vec{EA} represent the vectors \mathbf{u} and \mathbf{w} respectively.

- $\vec{ED} = 2\vec{AB}$
- $\vec{EA} = 2\vec{DC}$

Express \vec{BC} in terms of \mathbf{u} and \mathbf{w} .

Give your answer in its simplest form. [2 marks]

- *11. Venus and Earth are two planets within our solar system.

The volume of Venus is approximately 9.3×10^{11} cubic kilometres.

This is 85% of the volume of Earth.

Calculate the volume of Earth. [3 marks]

- *12. Refer to the diagram for Question 12. It shows a shape which is part of a circle, centre O .

The circle has radius 13 centimetres.

AB is a chord of length 20 centimetres.

Calculate the width of the shape. [4 marks]

- *13.** Refer to the diagram for Question 13. A ferry and a trawler receive a request for help from a stranded yacht.

On the diagram the points F, T and Y show the positions of the ferry, the trawler and the yacht respectively.

- FY is 7.2 kilometres.
- TY is 5.6 kilometres.
- FT is 10.3 kilometres.
- F is on a bearing of 240° from T.

Calculate the bearing of the yacht from the trawler. **[4 marks]**

- 14.** A straight line has equation $2x - 5y = 20$.

Find the coordinates of the point where this line crosses the y -axis. **[2 marks]**

- 15.** Express

$$\frac{n}{n^2 - 4} \div \frac{3}{n - 2}, \quad n \neq -2, n \neq 2$$

as a single fraction in its simplest form. **[3 marks]**

- *16.** Chris wants to store his umbrella in a locker. The locker is a cuboid with internal dimensions of length 40 centimetres, breadth 40 centimetres and height 70 centimetres.

The umbrella is 85 centimetres long.

He thinks it will fit into the locker from corner P, at the top left and back of the locker, to corner M, at the bottom right and front of the locker.

Is he correct?

Justify your answer. [4 marks]

- *17.** Refer to the diagram for Question 17. AOD is a sector of a circle, with centre O, and BOC is a triangle.

In sector AOD:

- radius = 30 centimetres
- angle AOD = 75° .

In triangle OBC:

- OB = 38 centimetres
- OC = 55 centimetres.

Calculate the area of the shaded region, ABCD. **[5 marks]**

- *18.** A cinema sells popcorn in two different sized cartons.

The small carton is 16 centimetres deep and has a volume of 576 cubic centimetres.

The large carton is 24 centimetres deep and has a volume of 1125 cubic centimetres.

(a) Show that the two cartons are **not** mathematically similar. **[3 marks]**

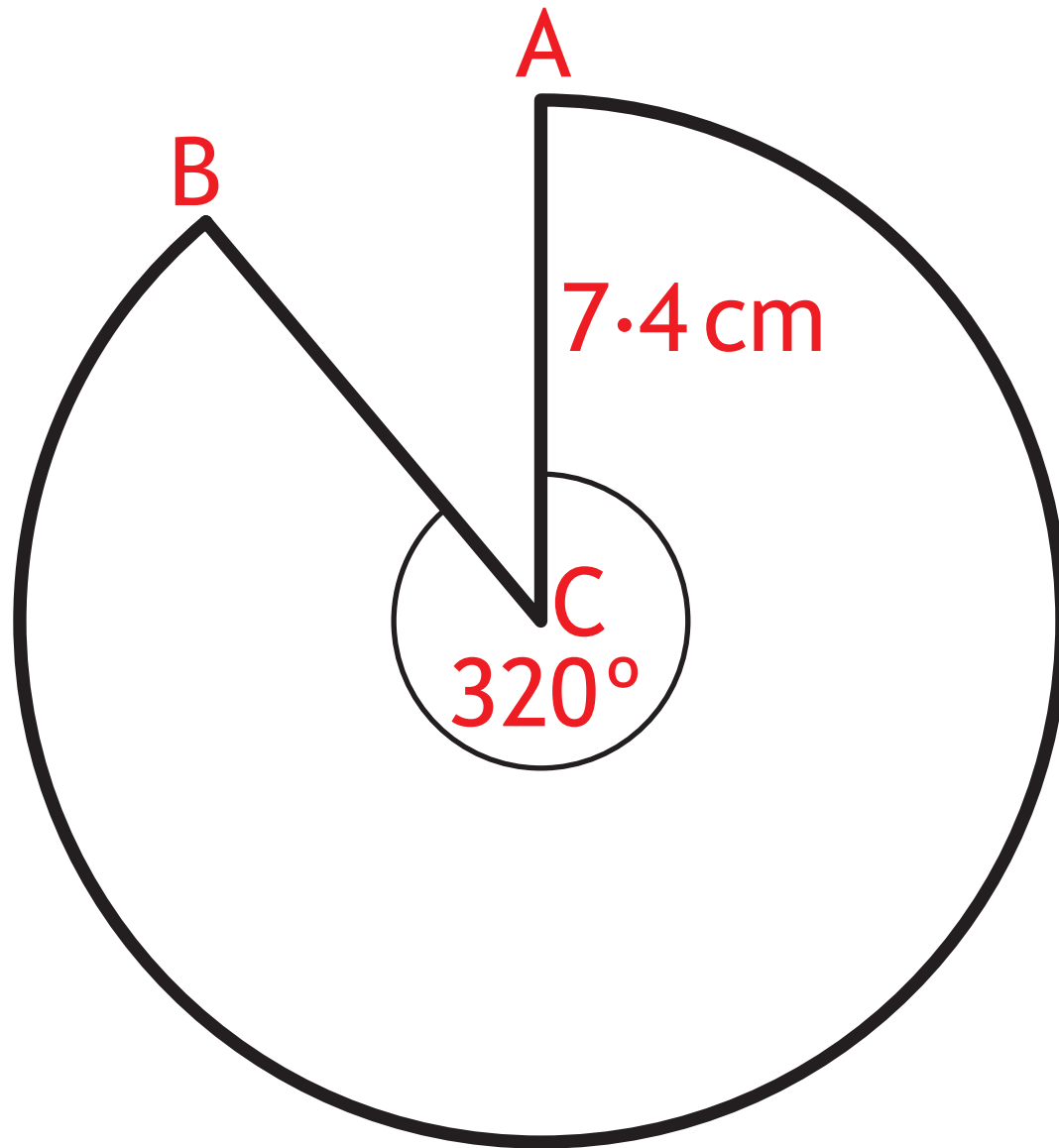
(b) The large carton is redesigned so that the two cartons are **now** mathematically similar.

The volume of the redesigned large carton is 1500 cubic centimetres.

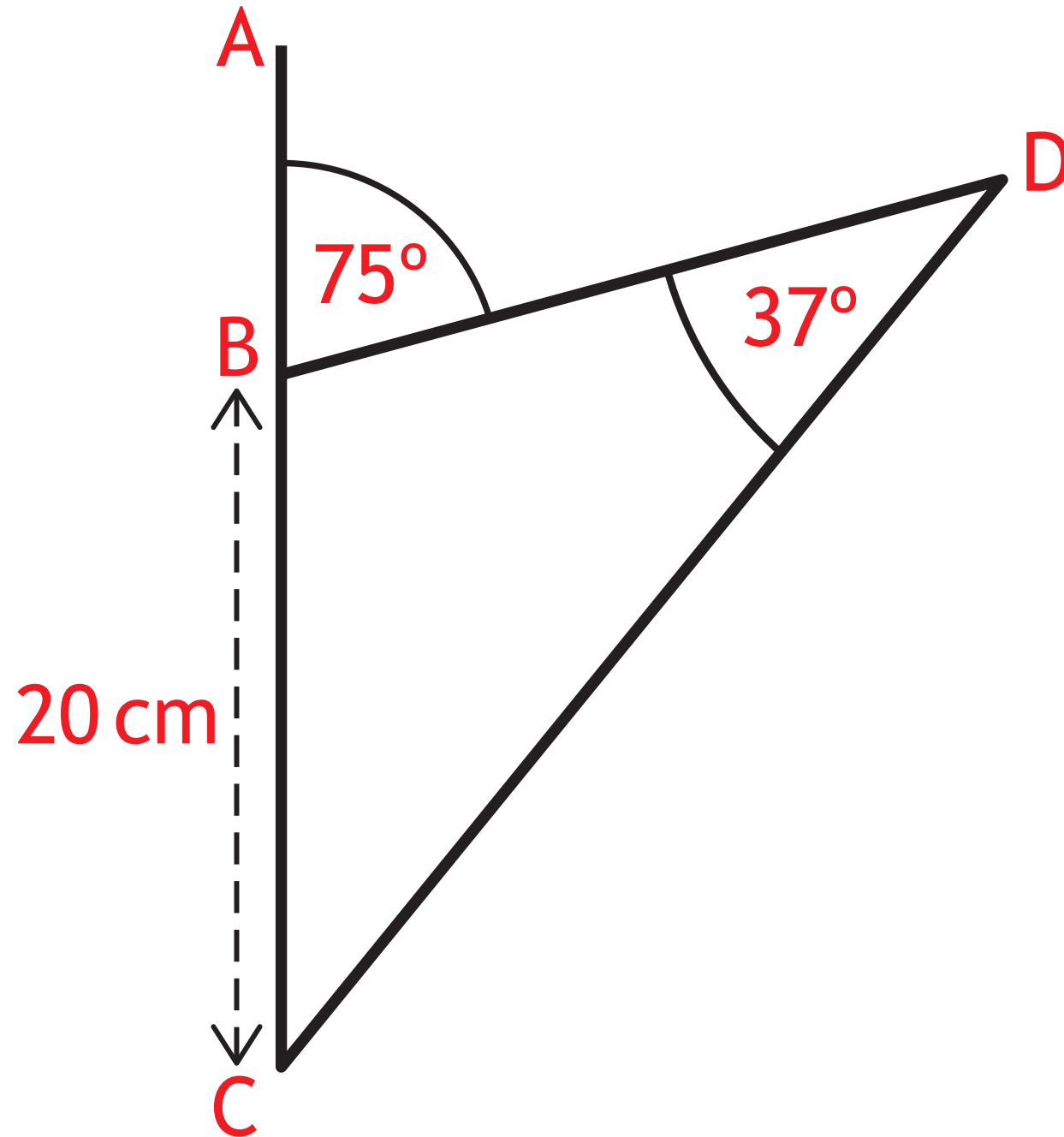
Calculate the depth of the redesigned large carton. **[2 marks]**

[END OF QUESTION PAPER]

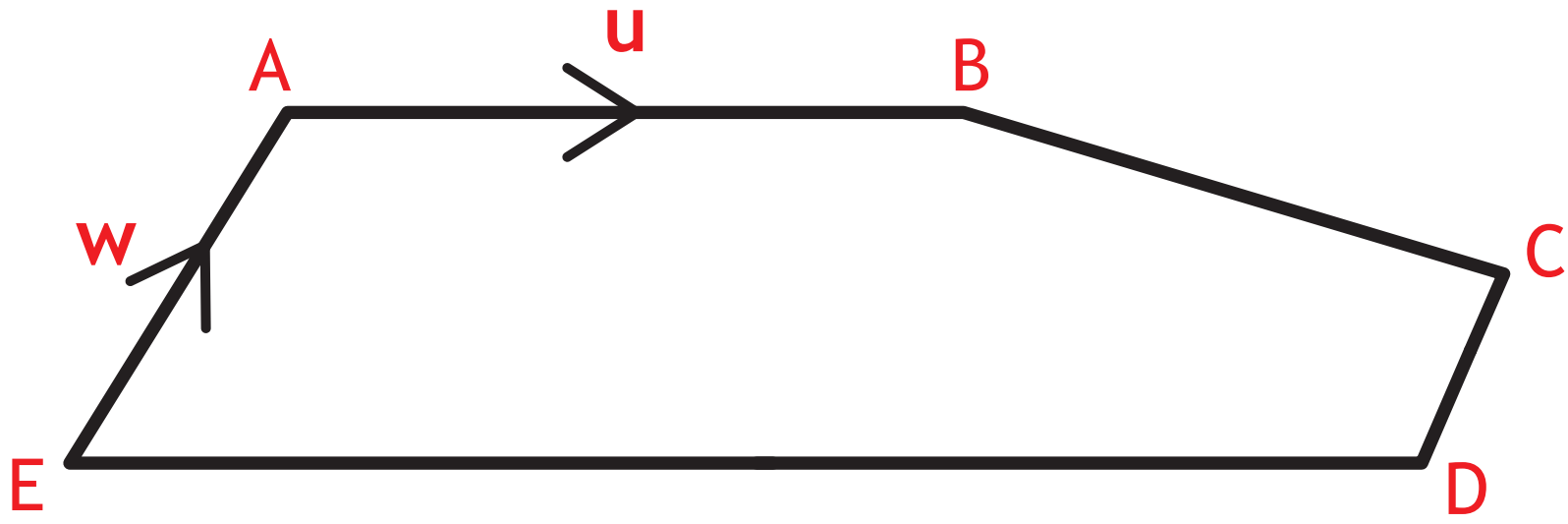
Q2

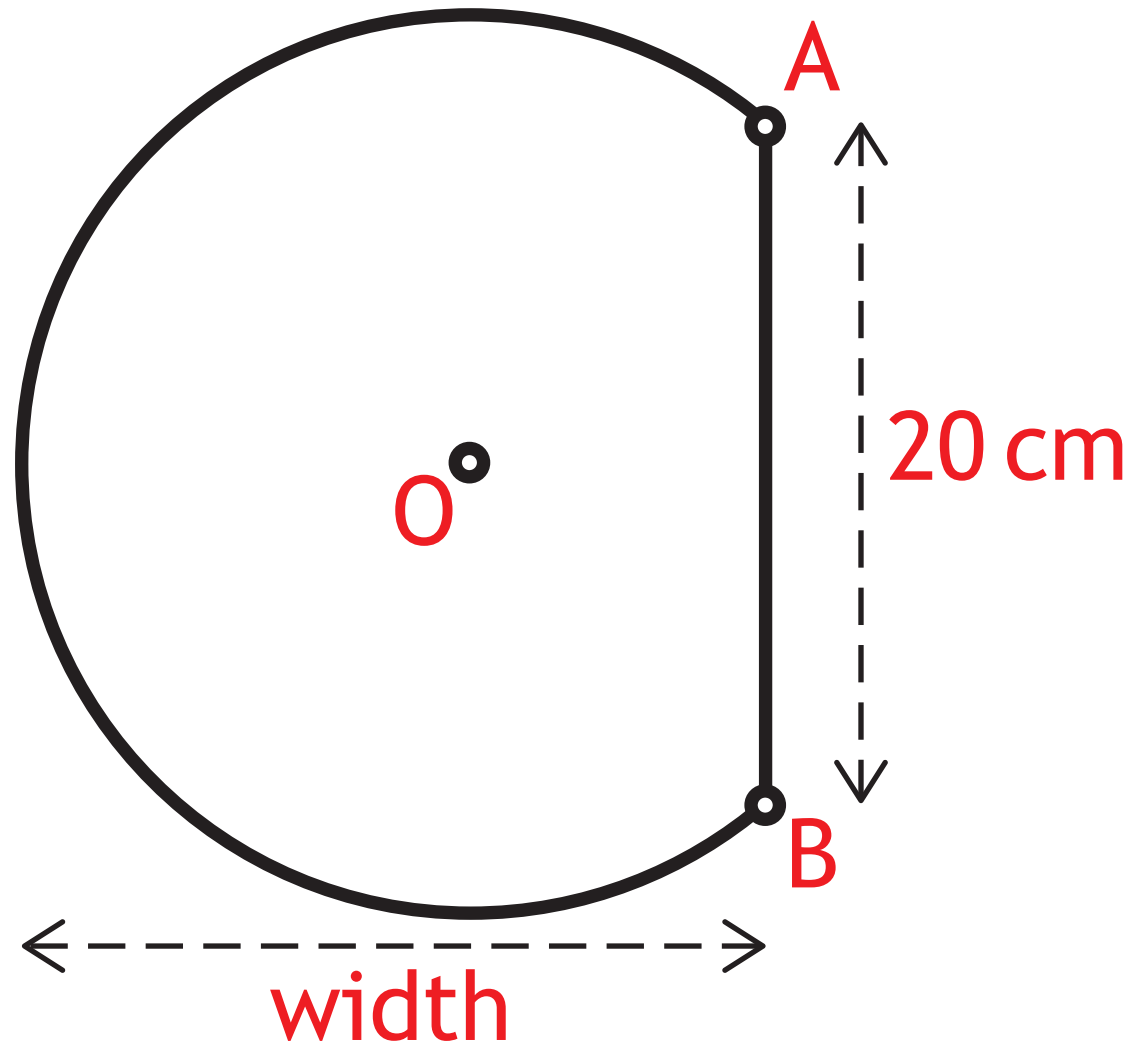


Q9



Q10





Q13

