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## **MATHEMATICS**

**0580/43**

Paper 4 (Extended)

**May/June 2023**

**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  $\pi$ , 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.

1 (a) Tomas sells a computer, a bike and a phone.

The amounts he receives are in the ratio computer : bike : phone = 14 : 17 : 9.

(i) Calculate the amount he receives for the phone as a percentage of the total.

..... % [2]

(ii) The total amount he receives is \$560.

Calculate how much he receives for the bike.

\$ ..... [2]

(iii) Tomas originally bought the bike for \$195.

He wanted to make a profit of at least 25% when he sold it.

Does Tomas make a profit of at least 25%?

You must show all your working to support your decision.

[3]

(b) Ulla invests \$725 for 6 years in an account paying simple interest at a rate of 1.3% per year.

Calculate the total interest earned at the end of 6 years.

\$ ..... [2]

(c) In a sale, all prices are reduced by 24%.  
Victor pays \$36.86 for a pair of shoes in the sale.

Calculate the original price of the shoes.

\$ ..... [2]

2 (a) Anna records the number of text messages she receives for 14 days.

17	15	31	38	31	22	13
18	21	27	28	21	31	29

(i) Complete the stem-and-leaf diagram.

1	
2	
3	

Key: .....

[3]

(ii) Find the median.

..... [1]

(iii) Find the mode.

..... [1]

(iv) Find the range.

..... [1]

(b) In a shop, there are 4 red and 8 grey phones.  
Anna and Pete each pick one of these phones at random.

Work out the probability that they both pick a grey phone.

..... [2]

3 (a) The scale drawing shows two sides,  $AB$  and  $BC$ , of a field. The scale is 5 centimetres represents 200 metres.



Scale: 5 cm to 200 m

(i) Measure angle  $ABC$ .

Angle  $ABC$  = ..... [1]

(ii)  $X$  is a point on  $BC$ .  
 $BX = 332$  m.

Mark the point  $X$  on the diagram. [2]

(iii) Find the scale in the form  $1 : n$ .

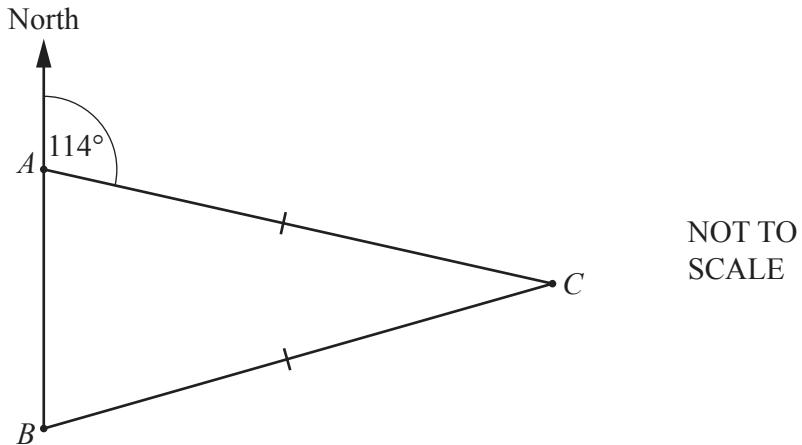
1: ..... [2]

(b) A bronze statue is 4.5 m high and has a mass of 195 200 kg.  
The density of bronze is  $8000 \text{ kg/m}^3$ .  
The volume of a mathematically similar model of the statue is  $0.385 \text{ m}^3$ .

Calculate the height of the model.  
[Density = Mass  $\div$  Volume]

..... m [5]

4 (a)

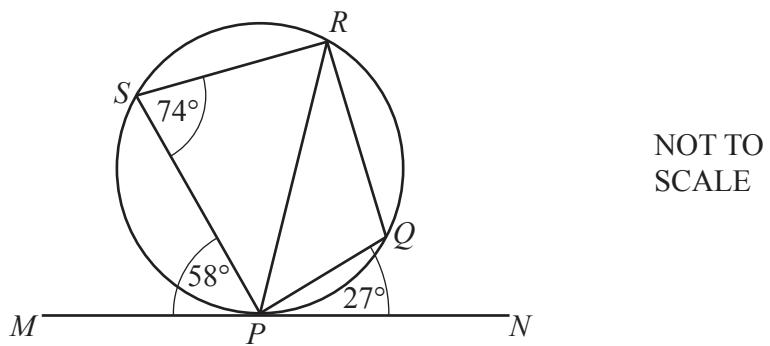


$A, B$  and  $C$  are three towns and the bearing of  $C$  from  $A$  is  $114^\circ$ .  
 $B$  is due south of  $A$  and  $AC = BC$ .

Calculate the bearing of  $B$  from  $C$ .

..... [3]

(b)



$P, Q, R$  and  $S$  lie on a circle.

$MN$  is a tangent to the circle at  $P$ .

Angle  $MPS = 58^\circ$ , angle  $PSR = 74^\circ$  and angle  $QPN = 27^\circ$ .

(i) Find angle  $PRS$ .

Angle  $PRS =$  ..... [1]

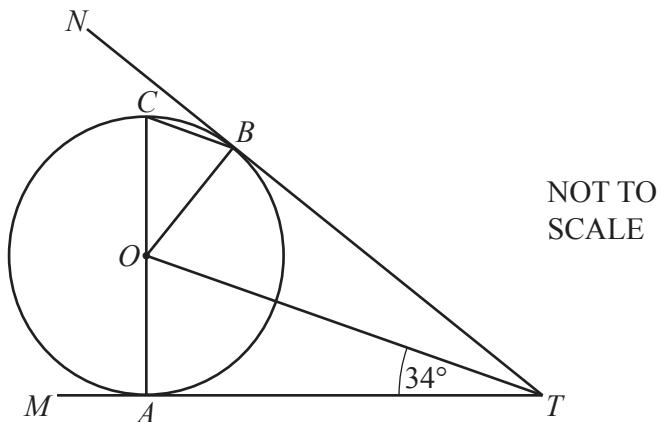
(ii) Find angle  $PQR$ .

Angle  $PQR =$  ..... [1]

(iii) Find angle  $RPQ$ .

Angle  $RPQ =$  ..... [2]

(c)



$A, B$  and  $C$  lie on a circle, centre  $O$ , with diameter  $AC$ .  
 $TAM$  and  $TBN$  are tangents to the circle and angle  $ATO = 34^\circ$ .

Using values and geometrical reasons, complete these statements to show that  $CB$  is parallel to  $OT$ .

In triangles  $AOT$  and  $BOT$ ,  $OT$  is common.  
Angle  $OAT =$  angle  $OBT = 90^\circ$  because .....

.....

$AT = BT$  because .....

.....

Triangle  $AOT$  is congruent to triangle  $BOT$  because of congruence criterion .....

Angle  $AOT =$  angle  $BOT = 56^\circ$  because angles in a triangle add up to  $180^\circ$ .

Angle  $BOC = \dots^\circ$  because .....

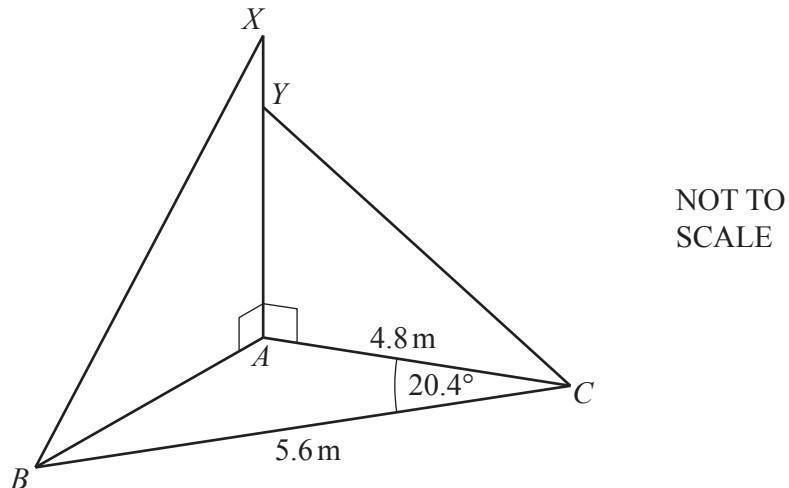
Angle  $OBC = \dots^\circ$  because .....

.....

$CB$  is parallel to  $OT$  because .....

[6]

5 (a)



$ABC$  is a scalene triangle on horizontal ground.

$AYX$  is a straight vertical post, held in place by two straight wires  $XB$  and  $YC$ .  
 $AC = 4.8$  m,  $BC = 5.6$  m and angle  $ACB = 20.4^\circ$ .

(i) Calculate  $AB$ .

$$AB = \dots \text{ m} \quad [3]$$

(ii) Angle  $XBA = 64^\circ$ .

Calculate  $AX$ .

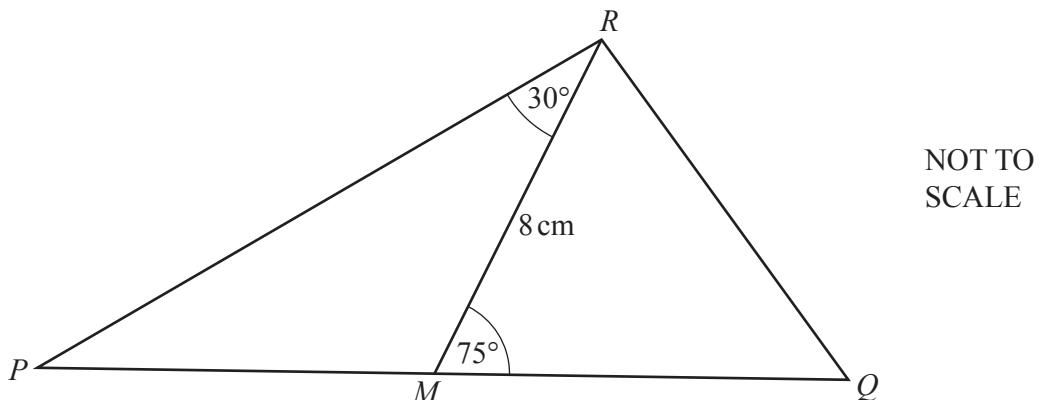
$$AX = \dots \text{ m} \quad [2]$$

(iii)  $AY = 2.9$  m.

Calculate the area of triangle  $YAC$ .

$$\dots \text{ m}^2 \quad [2]$$

(b)



In triangle  $PQR$ ,  $M$  is the midpoint of  $PQ$ .  
 $RM = 8\text{ cm}$ , angle  $PRM = 30^\circ$  and angle  $RMQ = 75^\circ$ .

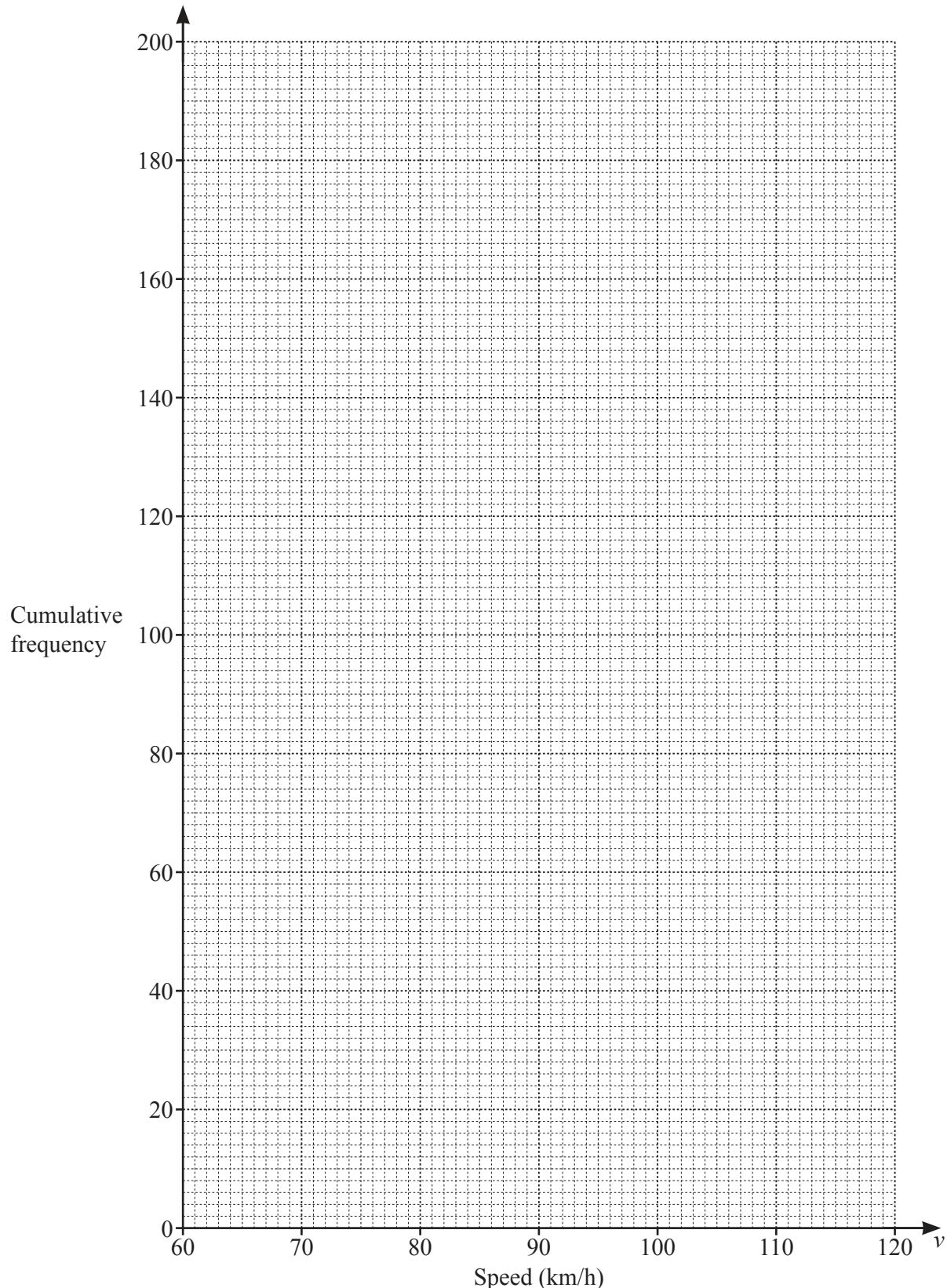
Calculate  $PQ$ .

$$PQ = \dots \text{ cm} \quad [5]$$

6 (a) The cumulative frequency table shows information about the speed of each of 200 cars as they pass a speed camera.

Speed ( $v$ km/h)	$v \leq 70$	$v \leq 80$	$v \leq 90$	$v \leq 95$	$v \leq 100$	$v \leq 120$
Cumulative frequency	12	46	115	155	177	200

(i) On the grid, draw the cumulative frequency diagram.



[3]

(ii) Use your cumulative frequency diagram to find an estimate of

(a) the median

..... km/h [1]

(b) the interquartile range

..... km/h [2]

(c) the number of cars with a speed greater than 110 km/h.

..... [2]

(b) The frequency table shows information about the mass of each of 50 trucks.

Mass ( $m$ kg)	$2000 < m \leq 2600$	$2600 < m \leq 3500$	$3500 < m \leq 5000$	$5000 < m \leq 5700$
Frequency	12	15	16	7

(i) Calculate an estimate for the mean mass of the trucks.

..... kg [4]

(ii) In a histogram showing this information, the height of the first block is 6 cm.

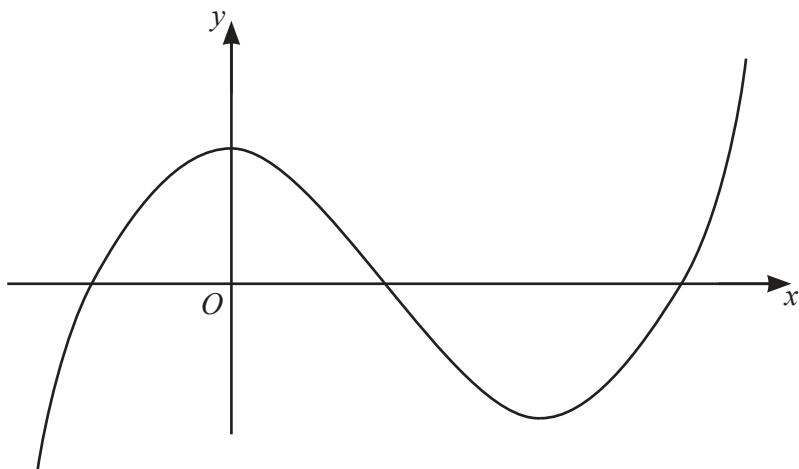
Calculate the heights of the remaining three blocks.

Height of block for  $2600 < m \leq 3500$  ..... cm

Height of block for  $3500 < m \leq 5000$  ..... cm

Height of block for  $5000 < m \leq 5700$  ..... cm [3]

7 (a) The diagram shows the graph of a function.



Put a ring around the word which correctly identifies the type of function.

reciprocal

quadratic

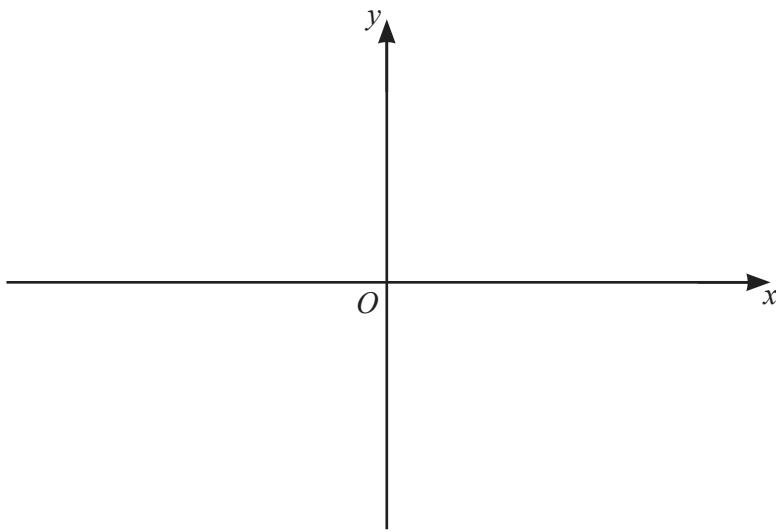
cubic

exponential

linear

[1]

(b) (i)



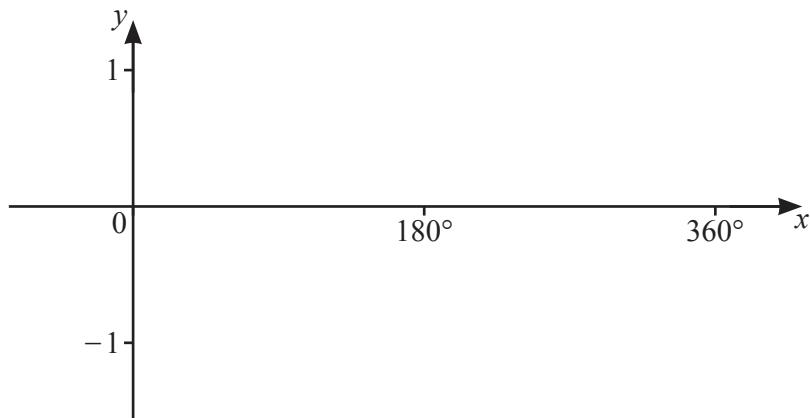
On the diagram, sketch the graph of  $y = \frac{1}{2x}$ ,  $x \neq 0$ .

[2]

(ii) Solve the equation  $\frac{1}{2x} = 2x$ .

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

(c) (i)



On the diagram, sketch the graph of  $y = \sin x$  for  $0^\circ \leq x \leq 360^\circ$ .

[2]

(ii) Solve the equation  $3 \sin x + 1 = 0$  for  $0^\circ \leq x \leq 360^\circ$ .

$x = \dots$  and  $x = \dots$  [3]

8 (a) A shop sells shirts for  $\$x$  and jackets for  $\$(x + 27)$ .  
The shop sells 4 shirts and 3 jackets for a total of  $\$194.75$ .

Write down and solve an equation to find the cost of one shirt.

\$ ..... [3]

(b) Solve the simultaneous equations.  
You must show all your working.

$$\begin{aligned}x^2 + 4y &= 37 \\ 5x + y &= -8\end{aligned}$$

$$x = \dots, y = \dots$$

$$x = \dots, y = \dots [5]$$

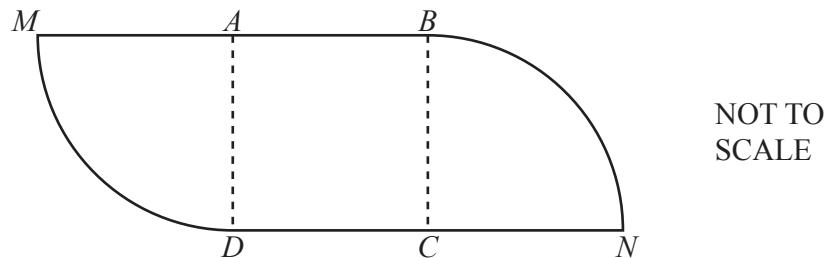
(c) A solid cylinder has radius  $x$  and height  $6x$ .  
A sphere of radius  $r$  has the same surface area as the total surface area of the cylinder.

Show that  $r^2 = \frac{7}{2}x^2$ .

[The surface area,  $A$ , of a sphere with radius  $r$  is  $A = 4\pi r^2$ .]

[4]

9 (a)



The diagram shows a shape made from a square  $ABCD$  and two equal sectors of a circle.

The square has side 11 cm.

$MAB$  and  $DCN$  are straight lines.

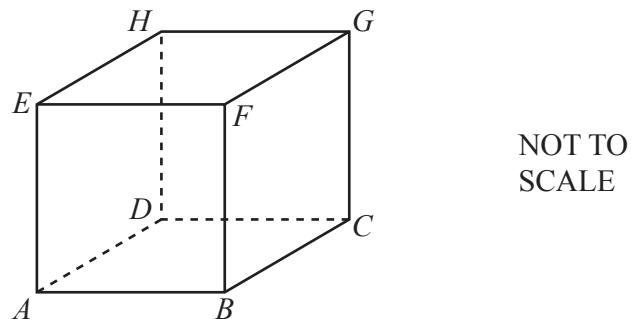
(i) Calculate the area of the shape.

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

(ii) Calculate the perimeter of the shape.

.....  $\text{cm}$  [3]

(b)



The diagram shows a cube  $ABCDEFGH$  of edge 7 cm.

Calculate the angle between  $AG$  and the base of the cube.

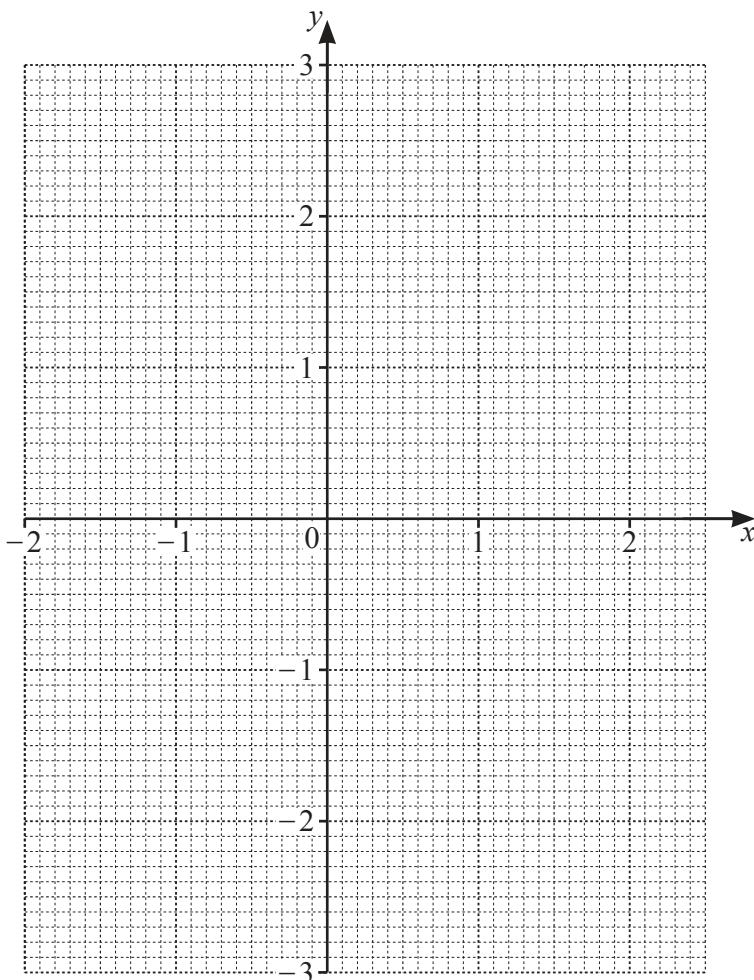
..... [4]

10 The table shows some values for  $y = 2^x - 3$ .

$x$	-2	-1	0	0.5	1	1.5	2	2.5
$y$	-2.75			-1.58		-0.17	1	2.66

(a) Complete the table. [3]

(b) On the grid, draw the graph of  $y = 2^x - 3$  for  $-2 \leq x \leq 2.5$ .



[4]

(c) Use your graph to solve the equation  $2^x - 3 = 2$ .

$x = \dots$  [1]

(d) By drawing a suitable straight line, solve the equation  $2^x - x - 1.5 = 0$ .

$x = \dots$  or  $x = \dots$  [4]

11  $M$  has coordinates  $(4, 1)$  and  $N$  has coordinates  $(-2, -7)$ .

(a) Find the length of  $MN$ .

..... [3]

(b) Find the gradient of  $MN$ .

..... [2]

(c) Find the equation of the perpendicular bisector of  $MN$ .

..... [4]

**Question 12 is printed on the next page.**

12 The equation of a curve is  $y = x^4 - 8x^2 + 5$ .

(a) Find the derivative,  $\left(\frac{dy}{dx}\right)$ , of  $y = x^4 - 8x^2 + 5$ .

..... [2]

(b) Find the coordinates of the three turning points.  
You must show all your working.

(....., ..... ) and (....., ..... ) and (....., ..... ) [4]

(c) Determine which one of these turning points is a maximum.  
Justify your answer.

[2]

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