

General Certificate of Secondary Education
2014

Additional Mathematics

Paper 1
Pure Mathematics

[G0301]

MV18

MONDAY 9 JUNE, MORNING

TIME

2 hours, plus your additional time allowance.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number on the Answer Booklet and the Supplementary Answer Booklet provided.

Answer **all eleven** questions.

At the conclusion of this examination attach the Supplementary Answer Booklet to your Answer Booklet using the treasury tag supplied.

INFORMATION FOR CANDIDATES

The total mark for this paper is 100.

Figures in brackets printed at the end of each question indicate the marks awarded to each question or part question.

You may use a calculator.

A copy of the formulae list is provided.

Answer **all eleven** questions

1 (i) Using the axes and scales in **Fig. 1** in your Supplementary Answer Booklet, **sketch** the graph of $y = \sin\left(\frac{1}{2}x\right)$ for $-360^\circ \leq x \leq 360^\circ$. [2 marks]

(ii) **Hence**, using the axes and scales in **Fig. 2** in your Supplementary Answer Booklet, **sketch** the graph of $y = \sin\left(\frac{1}{2}x\right) + 1$ for $-360^\circ \leq x \leq 360^\circ$. [2 marks]

2 (i) Solve the equation

$$\tan \theta = 0.6$$

for $-180^\circ \leq \theta \leq 180^\circ$ [2 marks]

(ii) **Hence** solve the equation

$$\tan\left(\frac{1}{2}x - 60^\circ\right) = 0.6$$

for $-360^\circ \leq x \leq 360^\circ$ [3 marks]

3 (i) Find \mathbf{A}^{-1} where $\mathbf{A} = \begin{bmatrix} 4 & -3 \\ 2 & -9 \end{bmatrix}$ [2 marks]

(ii) **Hence**, using a matrix method, solve the following simultaneous equations for x and y . [4 marks]

$$4x - 3y = 6$$

$$2x - 9y = 8$$

4 (a) Find $\frac{dy}{dx}$ if $y = 4x^3 - \frac{3}{4}x^2 + \frac{4}{3x^2}$ [3 marks]

(b) Find $\int \left(4x - \frac{2}{x^3} \right) dx$ [3 marks]

5 A curve is defined by the equation $y = x^3 - 3x^2 - 18x$

(i) Show that the tangent to this curve at the point $(4, -56)$ is **parallel** to the straight line l with equation $y - 6x = 2$ [3 marks]

(ii) Find the coordinates of the **other** point on this curve at which the tangent is parallel to the straight line l . [4 marks]

6 (i) Show that

$$\frac{3x + 8}{x + 3} - \frac{6x}{2x + 1}$$

can be written as

$$\frac{x + 8}{2x^2 + 7x + 3} \quad [4 \text{ marks}]$$

(ii) **Hence**, or otherwise, solve the equation

$$\frac{3x + 8}{x + 3} - \frac{6x}{2x + 1} = -2 \quad [4 \text{ marks}]$$

7 (a) Solve the equation

$$3^{2-3x} = 4$$

giving your answer correct to 3 decimal places. [4 marks]

(b) Solve the equation

$$\log_{2x} 36 = 2 \quad [2 \text{ marks}]$$

(c) If $\log_3 4 = m$ and $\log_3 5 = n$, express the following in terms of m and n

(i) $\log_3 20$ [1 mark]

(ii) $\log_3 60$ [2 marks]

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(Questions continue overleaf)

- 8 A charity has organised a sponsored abseil from the roof **A** of the Majestic Hotel, **AB**. Fundraisers will abseil from the roof **A** to a balcony **X**, vertically below **A**.

An observer is at the point **D** on the roof of the Grand Hotel, **DE**, which is of height 25 m.

Another observer is at the point **C** on the horizontal ground, **BE**, 20 m from the point **E**.

The angles $\hat{A}CD$, $\hat{A}DX$ and $\hat{A}DC$ were measured as 84° , 34° and 71° respectively, as shown in **Fig. 3**.

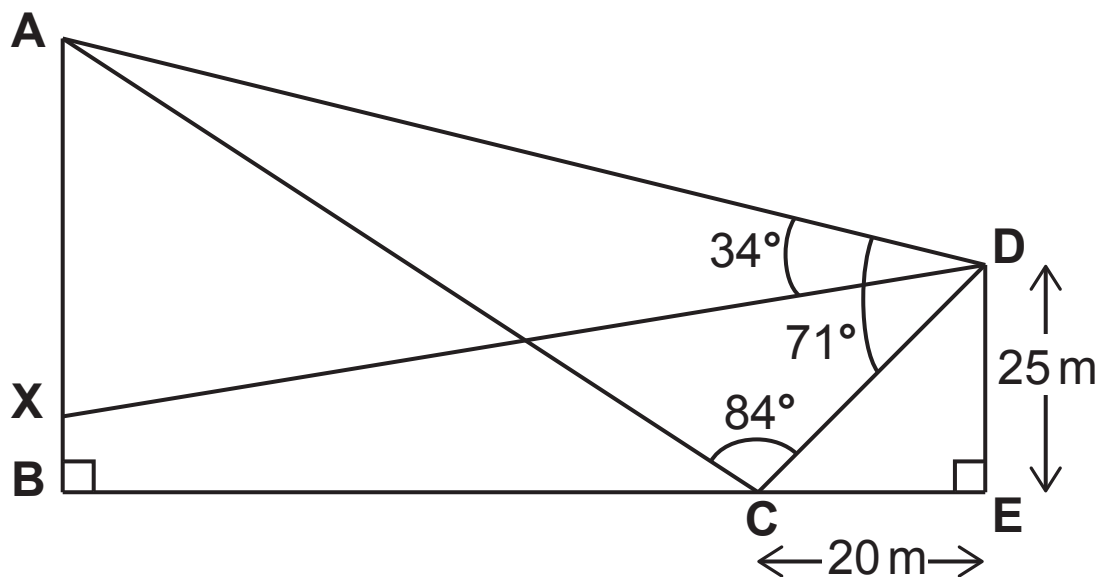


Fig. 3

(i) Find the size of the angle \hat{CAD} . [1 mark]

(ii) Calculate the distance CD . [2 marks]

(iii) Calculate the distance AD . [3 marks]

(iv) Given that the distance XD is 73.25 m, calculate the distance abseiled, AX . [3 marks]

The fastest abseiling time for a girl was two and a half minutes.

(v) Calculate her mean abseiling speed in metres per second. [2 marks]

- 9 Sarah measured the mass M (grams) and the height H (cm) of five plants of the same type. The results are given in **Table 1**.

Table 1

Height H (cm)	Mass M (g)
20	185
30	222
50	279
80	345
124	420

Sarah believes that a relationship of the form

$$M = pH^q$$

exists between M and H , where p and q are constants.

- (i) Using **Fig. 4** in your Supplementary Answer Booklet, verify this relationship by drawing a suitable straight line graph, using values correct to 3 decimal places. **Label the axes clearly.** [6 marks]
- (ii) Hence, or otherwise, obtain values for p and q . Give your answers to 2 significant figures. [4 marks]
- (iii) Use the formula $M = pH^q$ with the values you obtained for p and q to find the mass of a plant with a height of 64 cm. [1 mark]

(iv) Use the formula $M = pH^q$ with the values you obtained for p and q to find the height of a plant which has a mass of $\frac{1}{2}$ kg. **State any assumption which you make.**
[3 marks]

10 A wholesaler provides bags of coal, bags of logs and bags of peat briquettes, priced at $\pounds x$, $\pounds y$ and $\pounds z$ per bag respectively, to three local garages.

Garage A purchases 150 bags of coal, 100 bags of logs and 50 bags of peat briquettes at a total cost of $\pounds 2250$

(i) Show that x , y and z satisfy the equation

$$3x + 2y + z = 45 \quad [1 \text{ mark}]$$

Garage B purchases 195 bags of coal, 170 bags of logs and 75 bags of peat briquettes at a total cost of $\pounds 3195$

(ii) Show that x , y and z also satisfy the equation

$$39x + 34y + 15z = 639 \quad [1 \text{ mark}]$$

Garage C purchases 150 bags of coal, 75 bags of logs and 60 bags of peat briquettes at a total cost of $\pounds 2130$

(iii) Show that x , y and z also satisfy the equation

$$10x + 5y + 4z = 142 \quad [1 \text{ mark}]$$

(iv) Solve these equations, showing clearly each stage of your solution, to find the cost of a bag of coal, a bag of logs and a bag of peat briquettes. [8 marks]

As a special offer, the wholesaler is offering 25% off the price of a bag of coal and 25% off the price of a bag of logs.

Garage C puts in a **new** order to avail of the special offer. This order includes 75 bags of logs and 60 bags of peat briquettes. The wholesaler is asked to complete the order with bags of coal, so that the total cost is again £2130

(v) Calculate how many bags of coal are in the new order for garage C. [3 marks]

11 A curve is defined by the equation

$$y = x^3 - 5x^2 + 8x$$

- (i) Verify that the curve crosses the x -axis at the origin.
[1 mark]
- (ii) Show that there are no other points at which the curve crosses the x -axis. [2 marks]
- (iii) Find the coordinates of the turning points of the curve.
[5 marks]
- (iv) Identify each turning point as either a maximum or a minimum point. You **must** show working to justify your answers. [2 marks]
- (v) Using your answers from parts (i) to (iv) sketch the curve using **Fig. 5** in your Supplementary Answer Booklet. [2 marks]
- (vi) Find the area **enclosed** by the curve, the positive x -axis and the straight line $x = a$, where a is the x -coordinate of the **minimum** point. [4 marks]

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Centre Number

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Candidate Number

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**SUPPLEMENTARY
ANSWER BOOKLET**

- 1 (i) **Sketch** the graph of $y = \sin\left(\frac{1}{2}x\right)$ for $-360^\circ \leq x \leq 360^\circ$, on the axes in **Fig. 1** opposite.

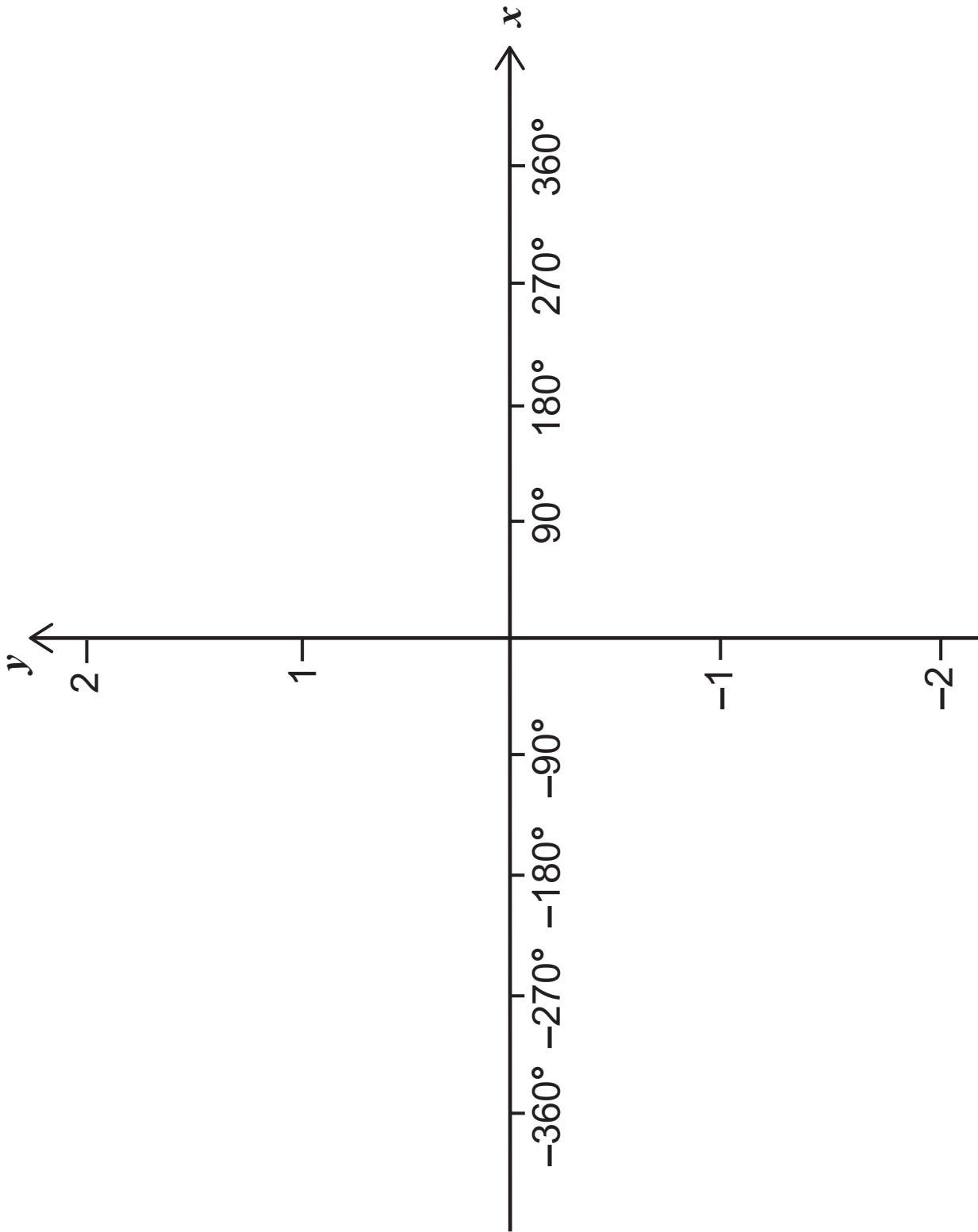


Fig. 1

(ii) **Sketch** the graph of
 $y = \sin\left(\frac{1}{2}x\right) + 1$ for $-360^\circ \leq x \leq 360^\circ$,
on the axes in **Fig. 2** opposite.

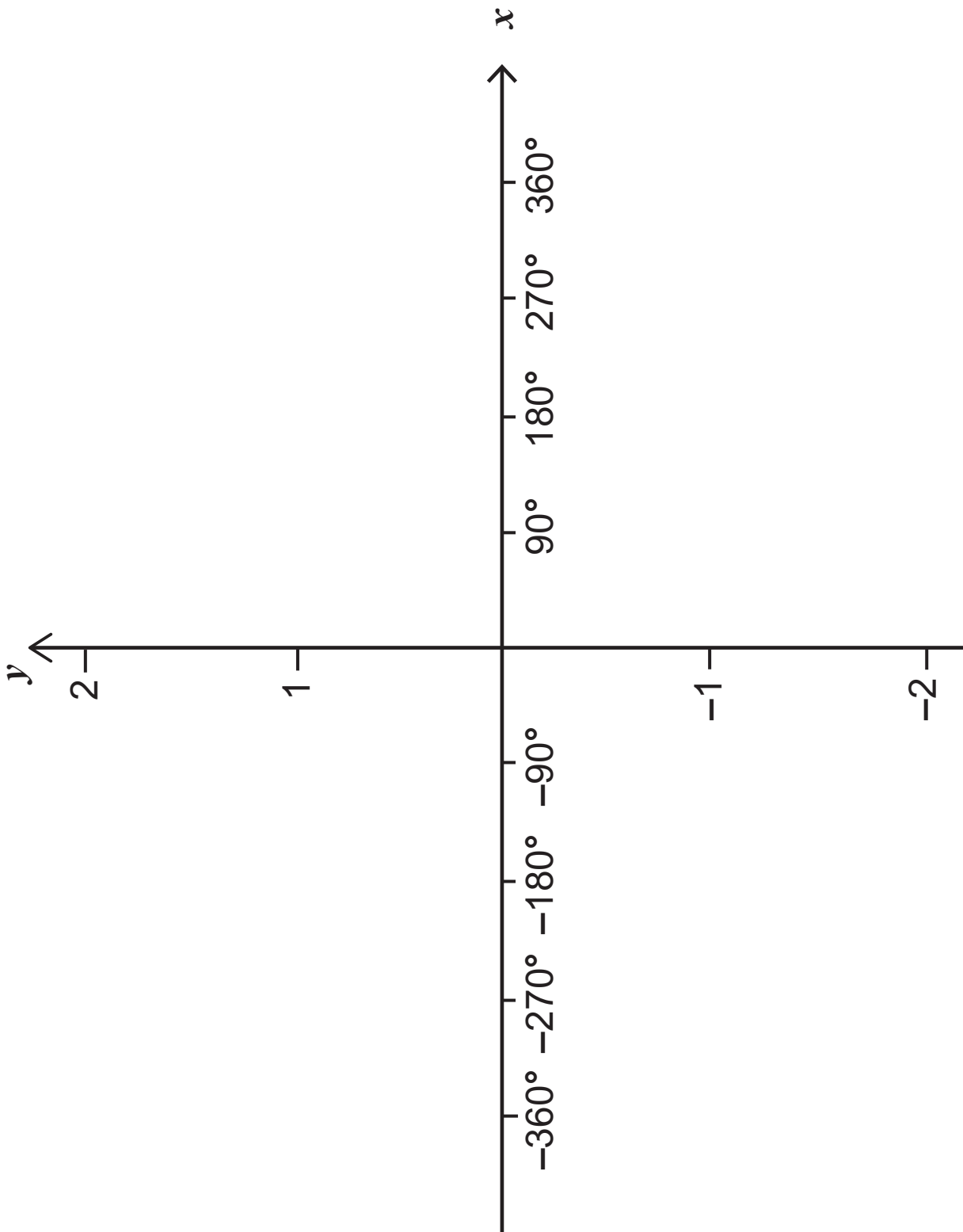


Fig. 2

- 9 Draw a suitable straight line graph using the axes and scales in **Fig. 4** below. **Label the axes.**

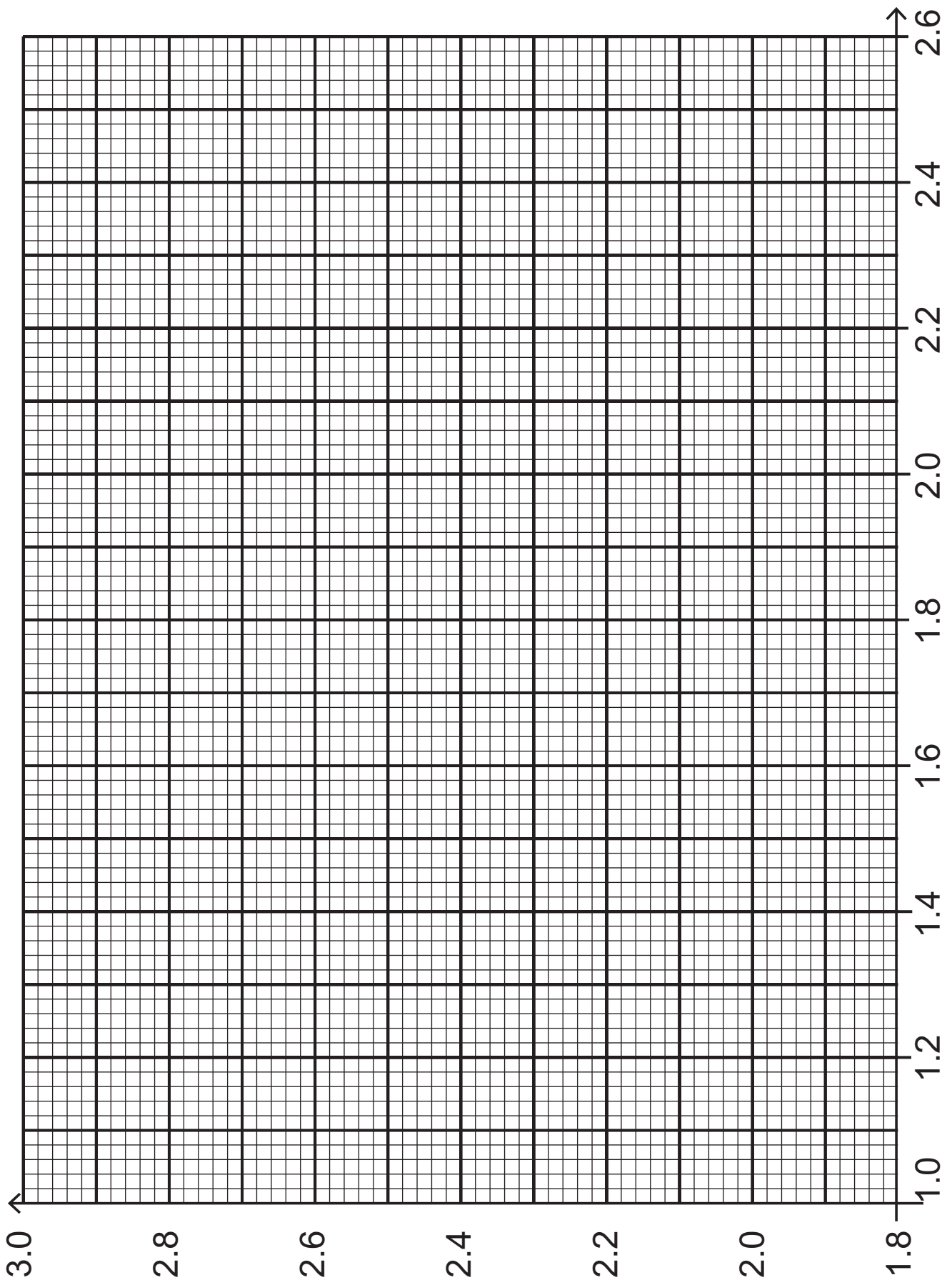


Fig. 4

11 Sketch the graph of $y = x^3 - 5x^2 - 8x$ in Fig. 5 below.



Fig. 5

