

General Certificate of Secondary Education
2011

Additional Mathematics

Paper 1
Pure Mathematics

[G0301]



TUESDAY 17 MAY, MORNING

TIME

2 hours.

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 down the right-hand side of pages 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 Using the axes and scales in **Fig. 1** in your Supplementary Answer Booklet, **sketch** the graph of $y = \sin\left(\frac{1}{3}x\right)$ for $-360^\circ \leq x \leq 360^\circ$. [4]

- 2 (i) Solve the equation

$$\cos \theta = 0.1$$

for $0^\circ \leq \theta < 360^\circ$. [2]

- (ii) Hence solve the equation

$$\cos\left(\frac{4}{5}x + 30^\circ\right) = 0.1$$

for $0^\circ \leq x < 360^\circ$. [3]

- 3 (i) Find \mathbf{A}^{-1} where $\mathbf{A} = \begin{bmatrix} 2 & 3 \\ 1 & -6 \end{bmatrix}$ [2]

- (ii) Hence, using a matrix method, solve the following simultaneous equations for x and y .

$$2x + 3y = 7$$

$$x - 6y = 6$$
 [4]

4 (a) Find $\frac{dy}{dx}$ when $y = ax^3 - \frac{2}{x}$ where a is a constant. [2]

(b) Find $\int \left(2x^5 + \frac{3}{4x^4} - 6 \right) dx$ [4]

5 Fig. 2 shows a sketch of the graph of the curve $y = \frac{12}{x^2}$ for $x > 0$

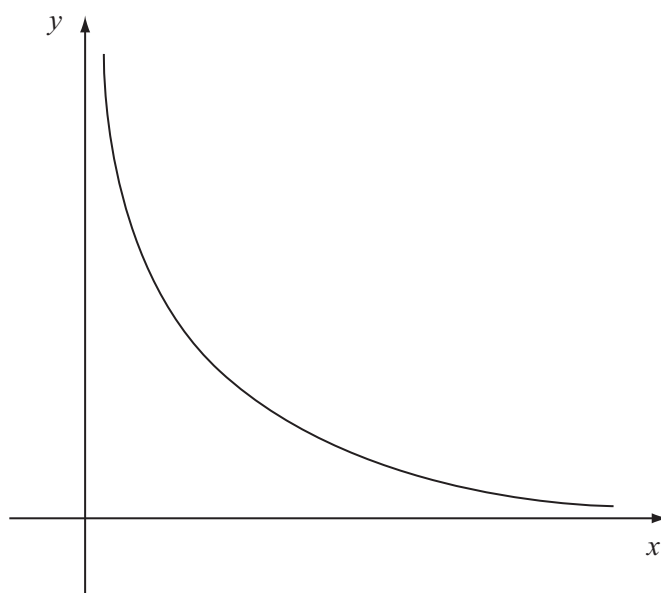


Fig. 2

(i) Find the equation of the tangent to this curve at the point P with x -coordinate 2 [4]

This tangent cuts the x -axis at A and cuts the y -axis at B.

(ii) Find the coordinates of A and B. [2]

(iii) Find the area of the triangle AOB. [1]

6 (i) Show that

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

can be written as

$$\frac{3x^2 + 2x - 3}{2x^2 - 3x + 1} \quad [4]$$

(ii) Hence, or otherwise, solve the equation

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

7 (a) Solve the equation

$$8^{(2-\frac{x}{3})} - 5 = 0 \quad [4]$$

(b) Calculate the value of

$$\log_5 25 + \log_2 8 \quad [2]$$

(c) Find the value of a if $\log_a 4 = \frac{1}{3}$ [2]

- 8 A lough of uniform width has a straight northern shoreline MN and a straight southern shoreline PQ. A ship is anchored in the lough and its length BS is **parallel** to the shorelines, as shown in **Fig. 3**.

Alan and Chrissie live at points A and C respectively, 1000 m apart, on the southern shoreline.

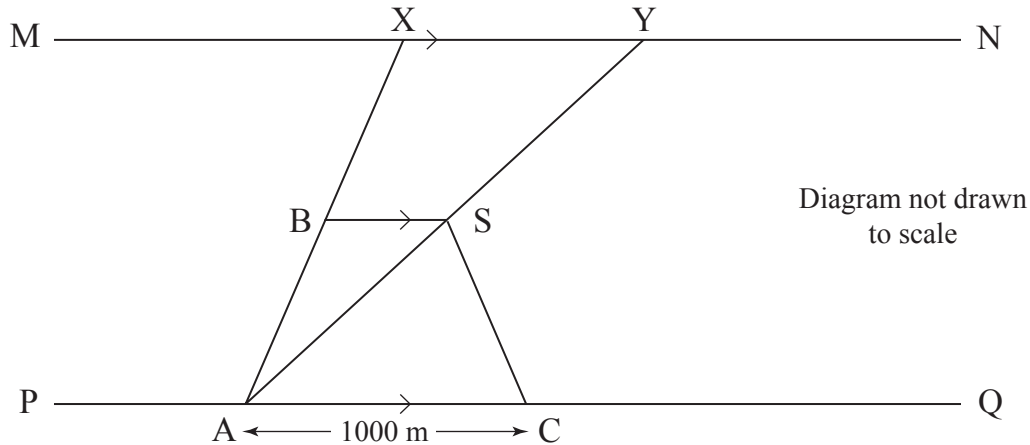


Fig. 3

Alan noticed that the bow B and stern S of the ship were directly in line with landmarks X and Y respectively on the northern shoreline. From a map he measured the distances AX, AY and XY as 3045 m, 3115 m and 310 m respectively.

- (i) Calculate the size of the angle \hat{XYA} . [3]

- (ii) Write down the size of the angle \hat{SAC} . [1]

Chrissie measured the size of the angle \hat{ACS} as 48.50° .

- (iii) Calculate the size of the angle \hat{ASC} . [1]

- (iv) Calculate the distance AS. [2]

Alan will be able to see the full length of the ship in his binoculars if the angle \hat{XAY} is less than 5° .

- (v) Determine whether or not he is able to see the full length of the ship in his binoculars. [3]

- (vi) Using the fact that triangles ASB and AYX are similar, or otherwise, find the length BS of the ship. [2]

- 9 The secretary of a local football club recorded the attendance A and the profit $\text{£}P$ made at five football matches. The results are given in **Table 1**.

Table 1

Profit $\text{£}P$	Attendance A
1217	2640
962	2272
887	2157
536	1563
477	1450

She believes that a relationship of the form

$$A = kP^n$$

exists between A and P , where k and n 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]
- (ii) Hence, or otherwise, obtain values for k and n . Give your answers correct to 2 decimal places. [4]
- (iii) Use the formula $A = kP^n$ with the values you obtained for k and n to calculate the attendance when a profit of $\text{£}508$ was made. [1]
- (iv) Use the formula $A = kP^n$ with the values you obtained for k and n to calculate the profit made when the attendance was 2190. [2]
- (v) The maximum attendance is 2640. At a cup match the attendance was $\frac{3}{4}$ of the maximum attendance. John says that the profit should be $\frac{3}{4}$ of $\text{£}1217$.
Without doing any calculations explain why John is wrong. [1]

- 10 Callum takes either Cornflakes or Porridge or Crispies for breakfast. The number of grams of carbohydrate, protein and fibre in each 100 g portion of these breakfasts is given in **Table 2**.

Table 2

	Cornflakes	Porridge	Crispies
Carbohydrate	84	60	68
Protein	7	11	6
Fibre	3	9	1

Callum found that in a month his breakfasts gave him a total of 824 g of carbohydrate, 100 g of protein and 58 g of fibre.

Let x , y and z represent the amounts, in hundreds of grams, of Cornflakes, Porridge and Crispies that he ate in the month.

- (i) By considering the amounts of carbohydrate in each breakfast show that x , y and z satisfy the equation

$$21x + 15y + 17z = 206 \quad [2]$$

- (ii) By considering the amounts of protein and fibre in each breakfast write down two more equations satisfied by x , y and z . [2]

- (iii) Solve these equations, showing clearly each stage of your solution, to find the **amounts, in grams**, of Cornflakes, Porridge and Crispies that Callum ate in the month. [8]

David takes either Weetabicks or Shredded Weet for his breakfast. The number of grams of protein and fibre in each 100 g portion of these breakfasts is given in **Table 3**.

Table 3

	Weetabicks	Shredded Weet
Protein	12	9
Fibre	10	7.5

David found that during the month his breakfasts gave him a total of 120 g of protein and 100 g of fibre.

Let p and q represent the amounts, in hundreds of grams, of Weetabicks and Shredded Weet that David ate in the month.

- (iv) Write down two equations satisfied by p and q and explain why it is not possible to determine from these equations the amounts of Weetabicks and Shredded Weet that David ate. [2]

11 A curve is defined by the equation

$$y = -2x(3x + 1)(2x - 3)$$

- (i) Find the coordinates of the points where this curve crosses the x -axis. [2]
- (ii) Find the coordinates of the turning points of this curve. Give your answers to 2 decimal places. [7]
- (iii) Identify each turning point as either a maximum or a minimum point. You **must** show working to justify your answers. [2]
- (iv) Using your answers from parts (i) to (iii) **sketch** this curve using **Fig. 5** in your Supplementary Answer Booklet. [2]
- (v) Find the area enclosed between the curve and the positive x -axis. [3]

THIS IS THE END OF THE QUESTION PAPER



Rewarding Learning

Centre Number

71

Candidate Number

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**SUPPLEMENTARY
ANSWER BOOKLET**

1 Sketch the graph of $y = \sin\left(\frac{1}{3}x\right)$ on the axes in **Fig. 1** below.

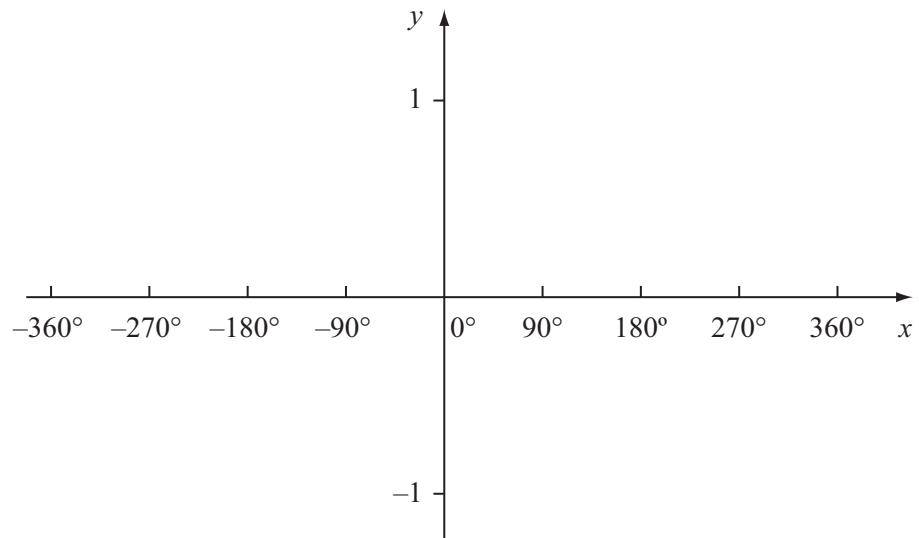


Fig. 1

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

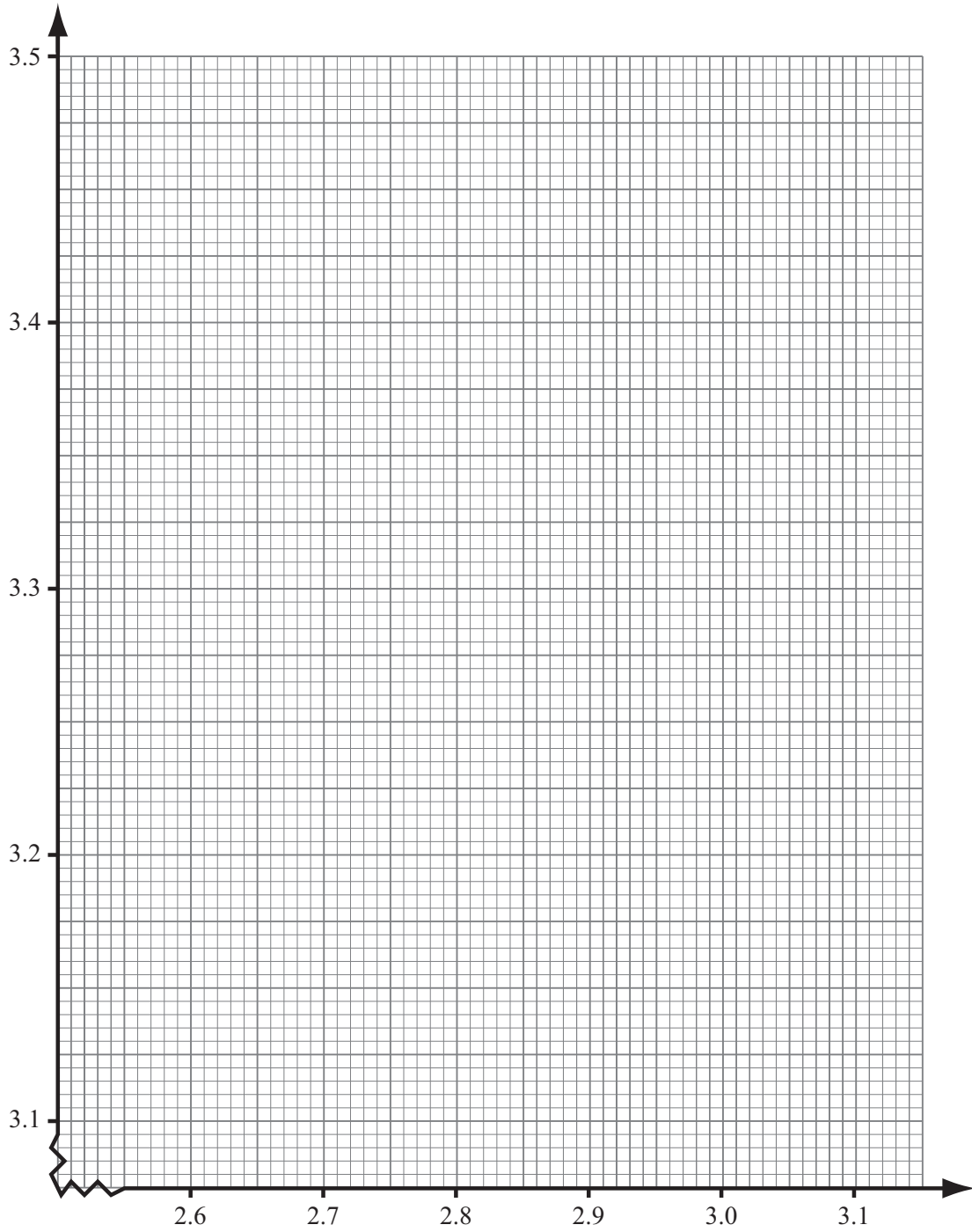


Fig. 4

11 Sketch the graph of $y = -2x(3x + 1)(2x - 3)$ in Fig. 5 below.

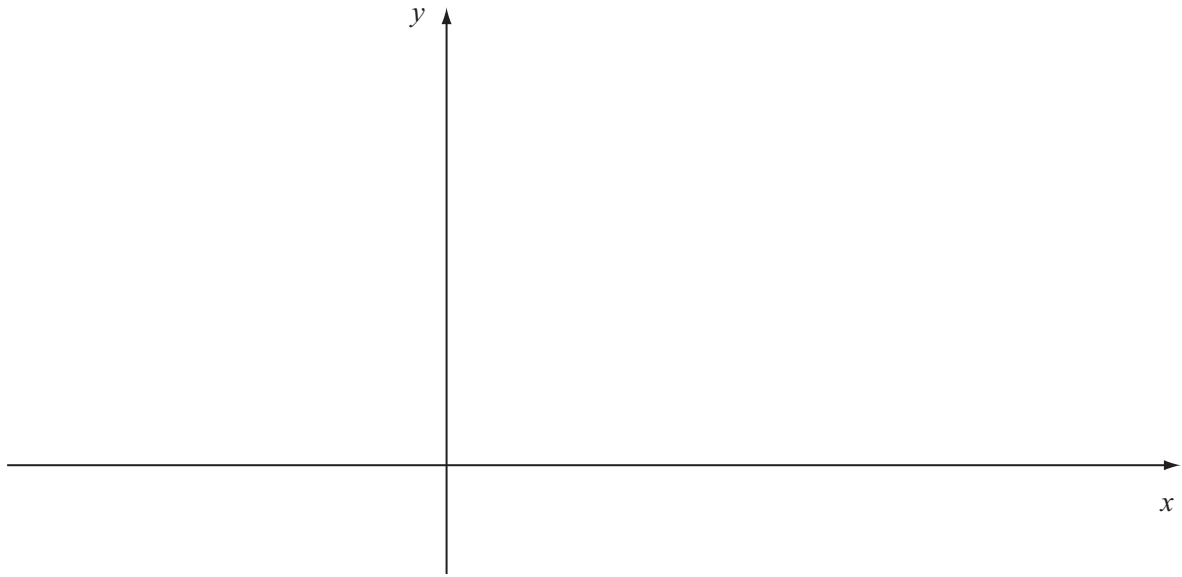


Fig. 5