Rewarding Learning

General Certificate of Secondary Education
2013

Additional Mathematics

Paper 1
Pure Mathematics

[G0301]

G0301

TUESDAY 21 MAY, AFTERNOON

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 **(i)** Using the axes and scales in **Fig. 1** in your Supplementary Answer Booklet, **sketch** the graph of $y = 2\cos x$ for $-180° \leqslant x \leqslant 180°$. [2]

(ii) Using the axes and scales in **Fig. 2** in your Supplementary Answer Booklet, **sketch** the graph of $y = \cos(2x)$ for $-180° \leqslant x \leqslant 180°$. [2]

2 **(i)** Solve the equation

$$\cos\theta = 0.3$$

for $0° \leqslant \theta < 360°$. [2]

(ii) **Hence** solve the equation

$$\cos\left(\tfrac{3}{4}x + 40°\right) = 0.3$$

for $0° \leqslant x < 360°$. [3]

3 **(i)** Find $\mathbf{A}^{-1}$ where $\mathbf{A} = \begin{bmatrix} -3 & -4 \\ 7 & 8 \end{bmatrix}$ [2]

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

$$-3x - 4y = 3$$

$$7x + 8y = -8$$ [4]

4 **(a)** Find $\frac{dy}{dx}$ if $y = \frac{1}{5}x^{10} - \frac{10}{x^5}$ [2]

(b) Find $\int \left(2x^3 + \frac{1}{3x^2} - 4 \right) dx$ [4]

5 A curve has the equation $y = 3x^2 + x - 4$

(i) Find the gradient of the tangent to this curve at the point $(-1, -2)$. [1]

(ii) Find the equation of the line l which passes through $(-1, -2)$ and is perpendicular to the tangent at $(-1, -2)$. [3]

(iii) Find the x-coordinate of the **other** point on the curve that the line l passes through. [3]

6 **(i)** Show that

$$\frac{3x-4}{2x-1} - \frac{5x-2}{5x+1}$$

can be written as

$$\frac{5x^2-8x-6}{10x^2-3x-1}$$ [4]

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

$$\frac{3x-4}{2x-1} - \frac{5x-2}{5x+1} = \frac{2}{3}$$ [4]

7 **(a)** Solve the equation

$$25^{\left(1-\frac{x}{2}\right)} = 6$$ [4]

(b) Solve the equation

$$\log_x 5 = 2$$ [1]

(c) If $\log_2 7 = a$ and $\log_2 5 = b$, express the following in terms of a and b

(i) $\log_2 35$ [1]

(ii) $\log_2 2.8$ [2]

8 A wildlife film crew were on board a stationary ship at a point O in the ocean, hoping to film a blue whale.

A spotter plane noticed a whale surfacing briefly at a point X, 3.75 km due south of the ship.

The ship remained stationary and 10 minutes later the plane noticed the whale surfacing again at a point Y, at a distance of 2.40 km and on a bearing of 116.10° from O, as shown in **Fig. 3**.

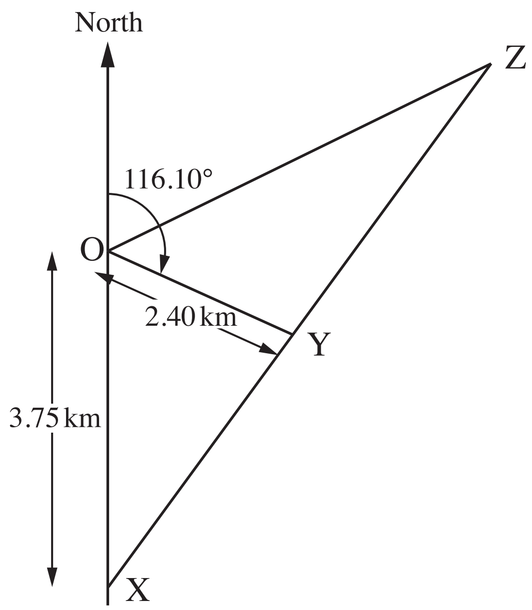

Fig. 3

(i) Calculate the distance XY travelled by the whale. [3]

(ii) Calculate the size of the **acute** angle $O\hat{Y}X$. [2]

The film crew made the assumption that the whale would continue to travel in a straight line at the same speed and resurface in another 10 minutes at the point Z.

They decided to head towards Z in the hope that they would be at the spot where the whale would next resurface.

(iii) Write down the distance YZ and the size of the angle $O\hat{Y}Z$. [1]

(iv) Calculate the distance OZ that the ship needs to travel. [2]

(v) Calculate the minimum speed in km/h at which the ship should travel in order to arrive at Z in time for the expected resurfacing of the whale. [1]

(vi) Calculate the bearing that the ship should take in order to reach Z. [3]

[Turn over

9 Lily is investigating the stopping distances of a new car for various speeds on a wet test track by measuring the lengths of the skid marks.

Table 1 below shows the initial speed S (miles per hour) at the beginning of each skid and the length L (feet) of the corresponding skid mark.

Table 1

Speed S (mph)	**Length** L (feet)
15	25
25	69
35	134
45	222
55	332

Lily believes that a relationship of the form

$$S = aL^b$$

exists between S and L, where a and b 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 a and b. Give your answers correct to 1 significant figure. [4]

(iii) Calculate the initial speed when the skid mark is 45 feet long. [1]

(iv) Calculate the length of the skid mark when the initial speed is 80 mph. **State any assumption which you make**. [3]

10 Joan regularly takes the train to visit friends in Oldtown, Newtown and Hightown.

In the first quarter of the year she made 10 journeys to Oldtown, 8 to Newtown and 6 to Hightown. The total cost of her train fares was £178

Let x, y and z represent the train fares in pounds to Oldtown, Newtown and Hightown respectively.

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

$$5x + 4y + 3z = 89$$ [1]

In the second quarter she made 9 journeys to Oldtown, 9 to Newtown and 15 to Hightown. The total cost of her fares was £219

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

$$3x + 3y + 5z = 73$$ [1]

In the third quarter of the year she made 7 journeys to Oldtown, 5 to Newtown and 6 to Hightown. The total cost of her fares was £130

(iii) Write down a third equation satisfied by x, y and z. [1]

(iv) Solve these equations, showing clearly each stage of your solution, to find the train fares to each of the towns. [8]

In the last quarter of the year Joan made an equal number of journeys to Oldtown and Newtown. She made one less journey to Hightown than she did to each of the other towns. The total cost of her fares was £163

Let n represent the number of journeys she made to Oldtown.

(v) Write down an equation satisfied by n. [1]

(vi) Solve this equation and hence determine the number of journeys she made to **each** of the three towns in the last quarter of the year. [2]

11 A curve is defined by the equation

$$y = x^3 - x^2 - 20x$$

(i) Find the coordinates of the points where this curve crosses the x-axis. [3]

(ii) Find the coordinates of the turning points of the curve. Give your answers correct to 2 decimal places. [6]

(iii) Identify each turning point as either a maximum or a minimum point. You **must** show working to justify your answers. [2]

(iv) Sketch the curve using **Fig. 5** in your Supplementary Answer Booklet. Your sketch must show where the curve crosses the x-axis and the turning points. [2]

(v) Find the area **enclosed** by the curve and the positive x-axis **to the left of** the straight line $x = 4$ [3]

Centre Number

71	

Candidate Number

Rewarding Learning

General Certificate of Secondary Education
2013

Additional Mathematics

Paper 1
Pure Mathematics

[G0301]

TUESDAY 21 MAY, AFTERNOON

G0301SAB

SUPPLEMENTARY ANSWER BOOKLET

1 **(i)** **Sketch** the graph of $y = 2\cos x$, for $-180° \leqslant x \leqslant 180°$, on the axes in **Fig. 1** below.

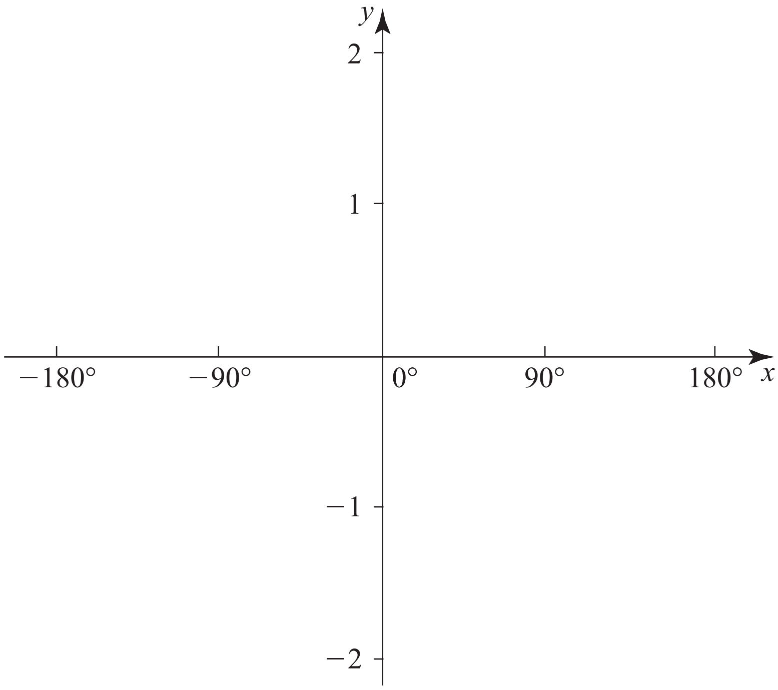

Fig. 1

(ii) **Sketch** the graph of $y = \cos(2x)$, for $-180° \leqslant x \leqslant 180°$, on the axes in **Fig. 2** below.

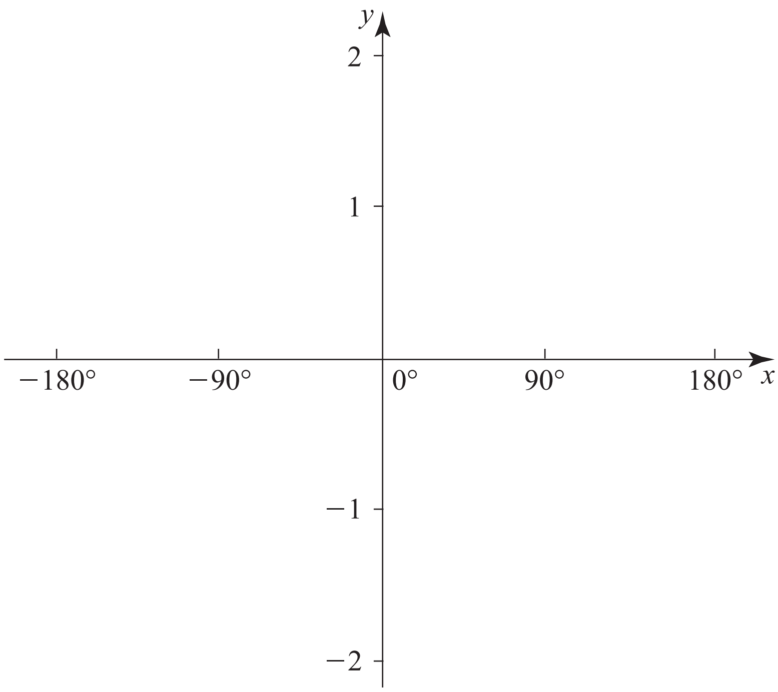

Fig. 2

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

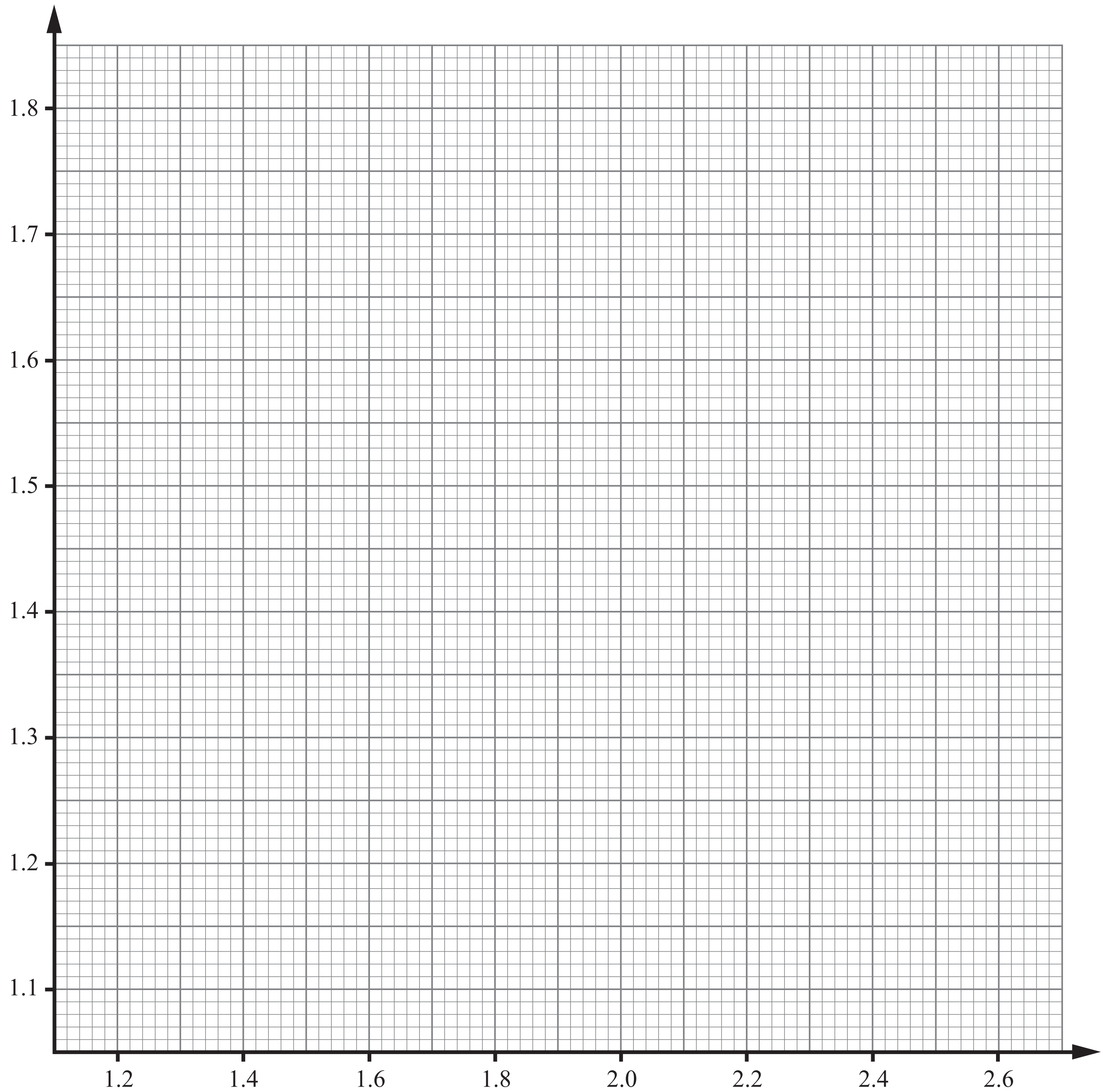

Fig. 4

11 **Sketch** the graph of $y = x^3 - x^2 - 20x$ in **Fig. 5** below.

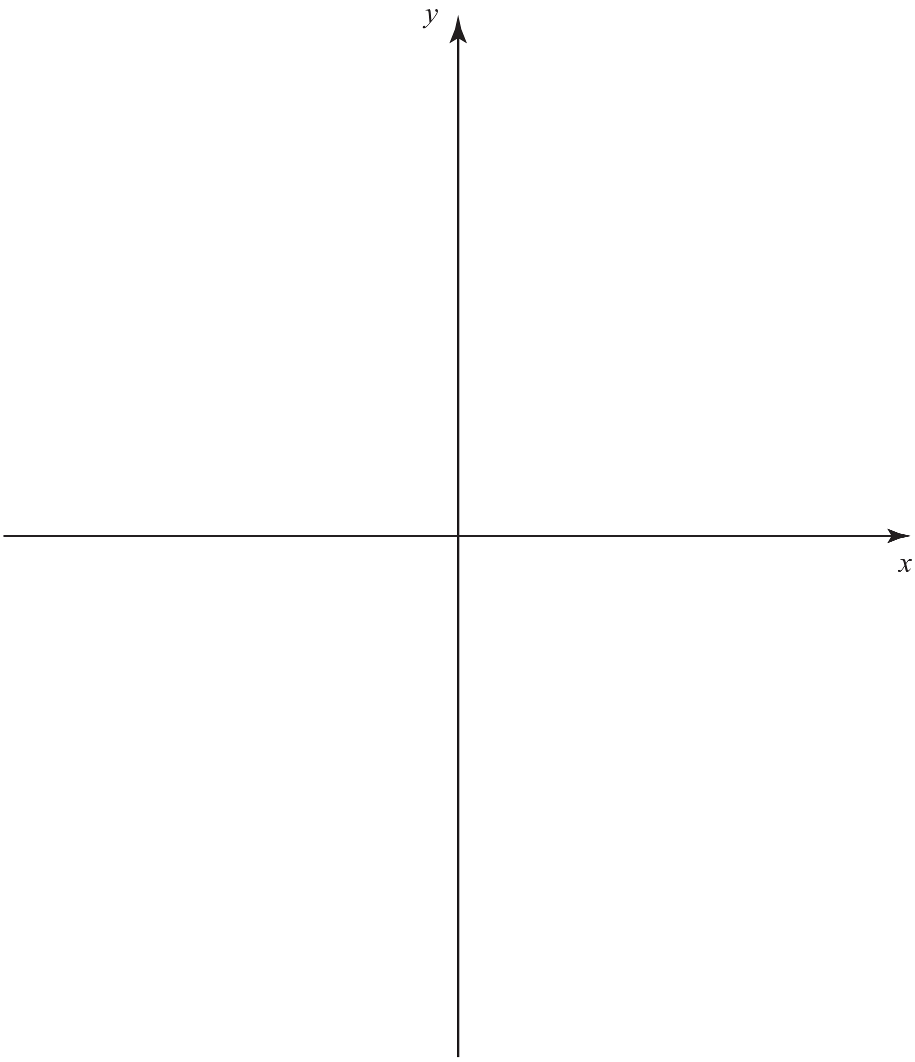

Fig. 5

113098