Rewarding Learning

General Certificate of Secondary Education
2007

Additional Mathematics

Paper 1
Pure Mathematics

[G0301]

G0301

TUESDAY 15 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 Using the axes and scales in **Fig. 1** in your Supplementary Answer Booklet, **sketch** the graph of $y = 2 \cos x$ for $0° \leqslant x \leqslant 360°$. [4]

2 **(i)** Solve the equation

$$\cos \theta = 0.1$$

for $-180° < \theta \leqslant 180°$. Give your answers correct to 2 decimal places. [2]

(ii) **Hence** solve the equation

$$\cos (2x - 10°) = 0.1$$

for $-90° < x \leqslant 90°$. Give your answers correct to 2 decimal places. [2]

3 **(i)** Find $\mathbf{A}^{-1}$ where $\mathbf{A} = \begin{bmatrix} -3 & 2 \\ 5 & 1 \end{bmatrix}$ [2]

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

$$\begin{aligned} -3x + 2y &= 16 \\ 5x + y &= -5 \end{aligned}$$ [4]

4 **(a)** Find $\dfrac{dy}{dx}$ when $y = 3x^2 + \dfrac{2}{x}$ [2]

(b) Find $\int (x^5 - \dfrac{1}{x^2} + 2)\, dx$. [4]

5 **Fig. 2** shows a sketch of the graph of $y = 4 - \frac{8}{x}$ for $x > 0$

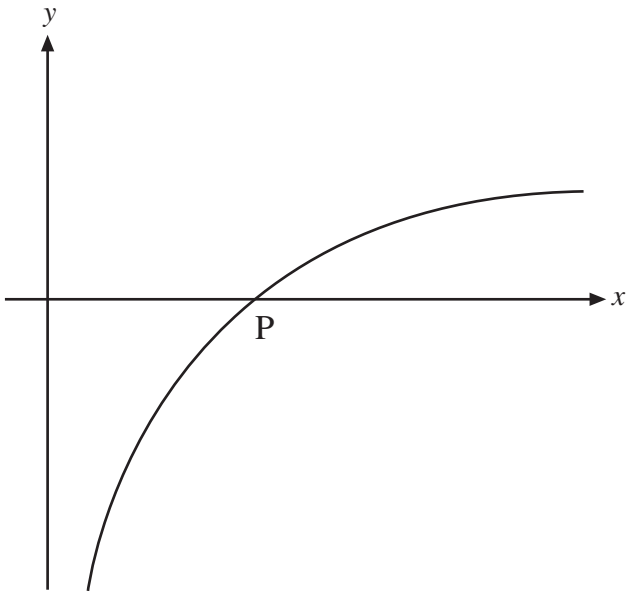

Fig. 2

(i) Find the coordinates of the point P where the curve cuts the x-axis. [1]

(ii) Find the equation of the tangent to the curve at P. [2]

(iii) Find the coordinates of the point Q on the above curve where the gradient of the tangent is $\frac{1}{2}$. [2]

(iv) Verify that the tangent to the curve at Q passes through the origin. [2]

6 **(i)** Show that

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

can be written as

$$\frac{-5x^2 - 4x + 10}{2x^2 - 5x - 25}$$

[4]

(ii) Hence, or otherwise, solve the equation

$$\frac{1-2x}{x-5} - \frac{x+1}{2x+5} = -2$$

[4]

7 **(a)** Solve the equation

$$4^{(2x+3)} = 3$$

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

(b) If $\log_2 a = 3$ what is the value of a? [1]

(c) If $\log 6 = p$ and $\log 4 = q$ express $\log 36$ in terms of p and hence $\log 9$ in terms of p and q. [3]

8 Mary entered a forest, which was on level horizontal ground, at a point O. She intended to walk along a straight path to a camp site at X.

The distance OX was 6.25 km and the path OX was in a direction of 47.50° east of north, as shown in **Fig. 3**.

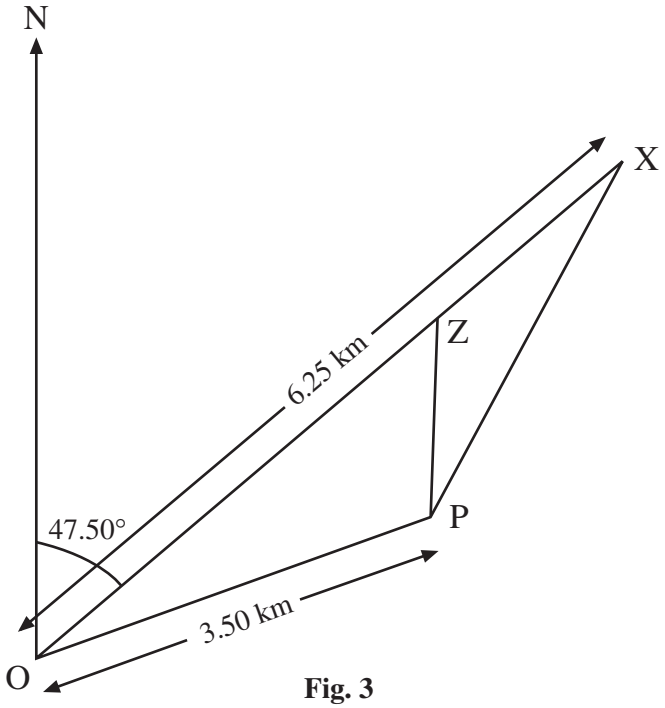

Fig. 3

As the path OX was closed near O she had to take an alternative route.

She travelled along another straight path from O to P, where the distance OP was 3.50 km and the direction of OP was 75.00° east of north. From P she walked along a straight path which went due north and joined the path OX at Z.

(i) Calculate the size of the angle $X\hat{O}P$. [1]

(ii) Calculate the distance PX. [3]

(iii) Calculate the size of the angle $O\hat{X}P$. [3]

(iv) Show that the angle $X\hat{Z}P$ is 132.50° [1]

(v) Find the size of the angle $X\hat{P}Z$. [1]

(vi) Calculate the distance ZX that Mary still had to walk after she reached the path OX. [3]

9 In an area prone to hurricanes the wind pressure P (kg/m^2) was measured for various hurricane wind speeds V (km/h) and the results are given in **Table 1**.

Table 1

Wind speed V (km/h)	**Wind pressure** P (kg/m^2)
119.1	106.9
154.5	180.2
178.6	240.7
210.8	334.9
249.5	469.2

It is believed that a relationship of the form

$$P = kV^n$$

exists between P and V, 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 three decimal places. **Label the axes clearly**. [6]

(ii) Hence, or otherwise, obtain values for k and n. [4]

A builder states that his buildings can withstand a wind pressure of 400 kg/m^2 without structural damage.

(iii) Use the formula $P = kV^n$ with the values you obtained for k and n to calculate the wind speed that his buildings can withstand. [2]

A tropical storm has a wind speed of 62.8 km/h.

(iv) Calculate the wind pressure resulting from this tropical storm. State any assumption which you make. [2]

10 Jack and Jill were on different mobile phone tariffs.

One day Jack sent 20 texts and 8 pictures and made 12 minutes of calls for a total cost of £8.60

Let x and y represent the costs, in pence, of sending a text and a picture respectively, and let z represent the cost, in pence per minute, of making a call.

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

$$5x + 2y + 3z = 215 \qquad [1]$$

The next day Jack sent 9 texts and 9 pictures and made 6 minutes of calls for a total cost of £5.70.

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

$$3x + 3y + 2z = 190 \qquad [1]$$

On Jill's tariff texts were 20% dearer, pictures cost 6p more but calls were 5p per minute cheaper.

She sent 10 texts and 10 pictures and made 10 minutes of calls for a total cost of £7.80.

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

$$6x + 5y + 5z = 385 \qquad [3]$$

(iv) Solve these equations, showing clearly each stage of your solution. [8]

(v) How much would Jack have spent over the two days if he had been on Jill's tariff? [2]

11 A curve is defined by the equation

$$y = x(3x^2 + 2x - 5)$$

The curve crosses the x-axis at the origin and at two other points.

(i) Find the coordinates of these two points. [2]

(ii) Find the coordinates of the turning points and identify each as either a maximum or a minimum point. [8]

(iii) Using your results from **(i)** and **(ii)** **sketch** the curve using **Fig. 5** in your Supplementary Answer Booklet. [3]

(iv) Find the area enclosed by the curve and the **positive** x-axis. [3]