OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced Subsidiary General Certificate of Education
Advanced General Certificate of Education

MATHEMATICS   **4721**

Core Mathematics 1

Monday   **23 MAY 2005**   Morning   1 hour 30 minutes

Additional materials:
    Answer booklet
    Graph paper
    List of Formulae (MF1)

TIME   1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the spaces provided on the answer booklet.
- Answer **all** the questions.
- Give non-exact numerical answers correct to 3 significant figures unless a different degree of accuracy is specified in the question or is clearly appropriate.
- **You are not permitted to use a calculator in this paper.**

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is 72.
- Questions carrying smaller numbers of marks are printed earlier in the paper, and questions carrying larger numbers of marks later in the paper.
- **You are reminded of the need for clear presentation in your answers.**

✗ WARNING

You are not allowed to use a calculator in this paper.

This question paper consists of 4 printed pages.

1 Solve the inequality $x^2 - 6x - 40 \geqslant 0$. [4]

2 **(i)** Express $3x^2 + 12x + 7$ in the form $3(x + a)^2 + b$. [4]

  (ii) Hence write down the equation of the line of symmetry of the curve $y = 3x^2 + 12x + 7$. [1]

3 **(i)** Sketch the curve $y = x^3$. [1]

  (ii) Describe a transformation that transforms the curve $y = x^3$ to the curve $y = -x^3$. [2]

  (iii) The curve $y = x^3$ is translated by p units, parallel to the x-axis. State the equation of the curve after it has been transformed. [2]

4 Solve the equation $x^6 + 26x^3 - 27 = 0$. [5]

5 **(a)** Simplify $2x^{\frac{2}{3}} \times 3x^{-1}$. [2]

  (b) Express $2^{40} \times 4^{30}$ in the form 2^n. [2]

  (c) Express $\dfrac{26}{4 - \sqrt{3}}$ in the form $a + b\sqrt{3}$. [3]

6 Given that $f(x) = (x + 1)^2(3x - 4)$,

  (i) express $f(x)$ in the form $ax^3 + bx^2 + cx + d$, [3]

  (ii) find $f'(x)$, [2]

  (iii) find $f''(x)$. [2]

9 (i) Find the gradient of the line l_1 which has equation $4x - 3y + 5 = 0$. [1]

(ii) Find an equation of the line l_2, which passes through the point $(1, 2)$ and which is perpendicular to the line l_1, giving your answer in the form $ax + by + c = 0$. [4]

The line l_1 crosses the x-axis at P and the line l_2 crosses the y-axis at Q.

(iii) Find the coordinates of the mid-point of PQ. [3]

(iv) Calculate the length of PQ, giving your answer in the form $\dfrac{\sqrt{a}}{b}$, where a and b are integers. [3]

10 (i) Given that $y = \frac{1}{3}x^3 - 9x$, find $\dfrac{dy}{dx}$. [2]

(ii) Find the coordinates of the stationary points on the curve $y = \frac{1}{3}x^3 - 9x$. [3]

(iii) Determine whether each stationary point is a maximum point or a minimum point. [3]

(iv) Given that $24x + 3y + 2 = 0$ is the equation of the tangent to the curve at the point (p, q), find p and q. [5]

7 **(i)** Calculate the discriminant of each of the following:

   (a) $x^2 + 6x + 9,$

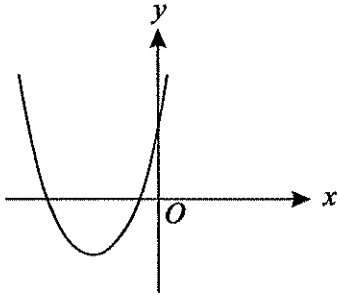   **(b)** $x^2 - 10x + 12,$

   (c) $x^2 - 2x + 5.$

[3]

(ii)
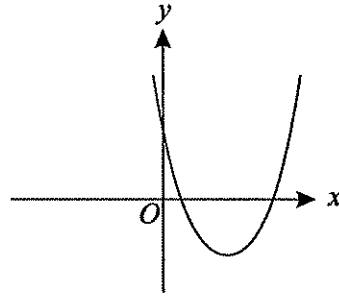

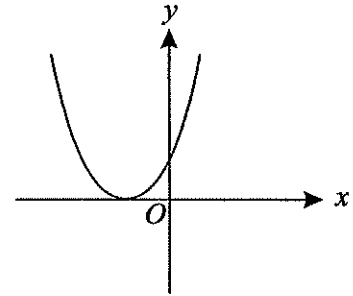Fig. 1   Fig. 2   Fig. 3

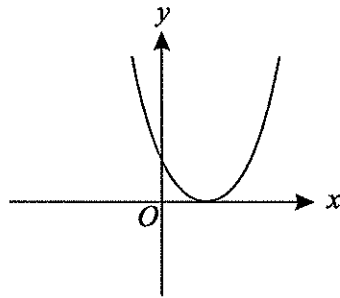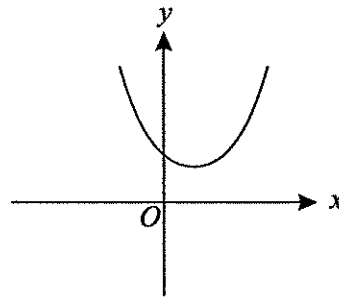

Fig. 4   Fig. 5

State with reasons which of the diagrams corresponds to the curve

   (a) $y = x^2 + 6x + 9,$

   (b) $y = x^2 - 10x + 12,$

   (c) $y = x^2 - 2x + 5.$

[4]

8 **(i)** Describe completely the curve $x^2 + y^2 = 25.$ [2]

   (ii) Find the coordinates of the points of intersection of the curve $x^2 + y^2 = 25$ and the line $2x + y - 5 = 0.$
[6]

[Questions 9 and 10 are printed overleaf.]

[Turn over