



GCE AS/A level

0973/01

MATHEMATICS – C1
Pure Mathematics

A.M. MONDAY, 13 January 2014

1 hour 30 minutes

ADDITIONAL MATERIALS

In addition to this examination paper, you will need:

- a 12 page answer book;
- a Formula Booklet.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Answer **all** questions.

Sufficient working must be shown to demonstrate the **mathematical** method employed.

Calculators are **not** allowed for this paper.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

1. The points A and B have coordinates $(6, -2)$ and $(4, 1)$, respectively. The line L_1 passes through the point B and is perpendicular to AB .
- (a) (i) Find the gradient of AB .
 (ii) Find the equation of L_1 . [5]
- (b) The line L_2 passes through A and has equation $x - 8y - 22 = 0$. The lines L_1 and L_2 intersect at the point C .
- (i) Show that C has coordinates $(-2, -3)$.
 (ii) Find the coordinates of the mid-point of AC .
 (iii) Find the area of triangle ABC , simplifying your answer. [9]
2. Simplify $\frac{3\sqrt{3} - 2\sqrt{5}}{2\sqrt{3} + \sqrt{5}}$. [4]
3. The curve C has equation $y = \frac{20}{x} + 2x^2 - 11$. The point P has coordinates $(2, 7)$ and lies on C . Find the equation of the **normal** to C at P . [6]
4. Show that $x^2 + 1.6x - 24.36$ may be expressed in the form $(x + p)^2 - 25$, where p is a constant whose value is to be found.
Hence solve the quadratic equation $x^2 + 1.6x - 24.36 = 0$. [5]
5. (a) **Use the binomial theorem** to express $(1 + \sqrt{6})^5$ in the form $a + b\sqrt{6}$, where a, b are integers whose values are to be found. [5]
 (b) The coefficient of x^2 in the expansion of $(1 + 3x)^n$ is 495. Given that n is a positive integer, find the value of n . [3]
6. Given that the quadratic equation
- $$(2k - 3)x^2 + 8x + (2k + 3) = 0$$
- has no real roots, show that k satisfies an inequality of the form
- $$m - nk^2 < 0,$$
- where m, n are integers whose values are to be found.
- Hence find the range of values of k such that the quadratic equation
- $$(2k - 3)x^2 + 8x + (2k + 3) = 0$$
- has no real roots. [6]

7. **Figure 1** shows a sketch of the graph of $y = f(x)$. The graph has a maximum point at $(2, 6)$ and intersects the x -axis at the points $(-4, 0)$ and $(8, 0)$.

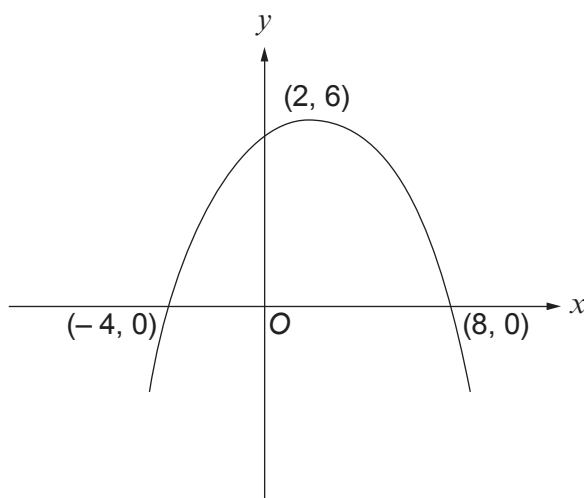


Figure 1

- (a) Sketch the graph of $y = f(x - 3)$, indicating the coordinates of the stationary point and the coordinates of the points of intersection of the graph with the x -axis. [3]
- (b) **Figure 2** shows a sketch of the graph having **one** of the following equations with an appropriate value of p , q or r .

$$y = f(x) + p, \text{ where } p \text{ is a constant}$$

$$y = f(qx), \text{ where } q \text{ is a constant}$$

$$y = rf(x), \text{ where } r \text{ is a constant}$$

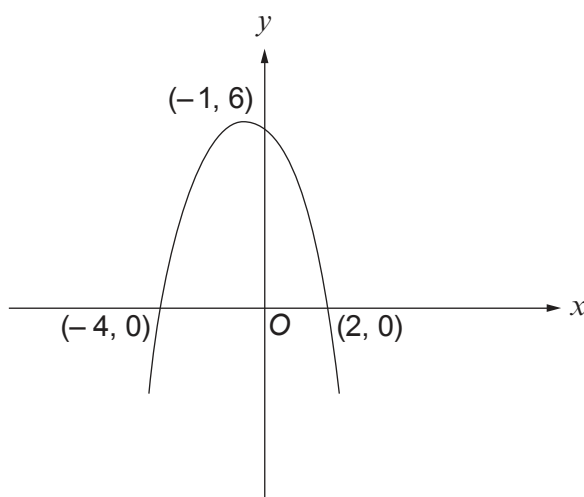


Figure 2

Write down the equation of the graph sketched in **Figure 2**, together with the value of the corresponding constant. [2]

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8. (a) Given that $y = 7x^2 - 6x - 3$, find $\frac{dy}{dx}$ from first principles. [5]

(b) Given that $y = ax^{\frac{4}{3}} + 24x^{\frac{1}{2}}$ and that $\frac{dy}{dx} = \frac{11}{2}$ when $x = 64$,
find the value of the constant a . [4]

9. (a) When $ax^3 + 13x^2 - 10x - 24$ is divided by $x + 3$, the remainder is -39 .
Write down an equation satisfied by a and hence show that $a = 6$. [2]

(b) Solve the equation $6x^3 + 13x^2 - 10x - 24 = 0$. [6]

10. The curve C has equation

$$y = -2x^3 + 12x^2 - 18x + 5.$$

(a) Find the coordinates and the nature of each of the stationary points of C . [6]

(b) Sketch C , indicating the coordinates of each of the stationary points. [2]

(c) Given that the equation

$$-2x^3 + 12x^2 - 18x + 5 = k$$

has three distinct real roots, find the range of possible values for k . [2]