GCE AS/A level

0973/01

MATHEMATICS C1
Pure Mathematics

A.M. WEDNESDAY, 16 May 2012

1½ hours

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, B, C are such that A, B have coordinates $(-4, 7)$, $(2, -1)$ respectively and C is the mid-point of AB. The line L is the perpendicular bisector of AB.

(a) Find the gradient of AB. [2]

(b) Find the coordinates of C. [2]

(c) Show that the equation of L is

$$3x - 4y + 15 = 0.$$ [4]

(d) The point D lies on L and has coordinates $(7, k)$.

(i) Show that $k = 9$.

(ii) Find the length of CA and the length of DA.

(iii) Hence show that the value of $\sin A\hat{D}C$ may be expressed in the form $\frac{1}{\sqrt{a}}$, where a is an integer whose value is to be found. [7]

2. Simplify

(a) $\dfrac{10}{7 + 2\sqrt{11}}$, [3]

(b) $\left(4\sqrt{3}\right)^2 - \left(\sqrt{8} \times \sqrt{50}\right) - \dfrac{5\sqrt{63}}{\sqrt{7}}$. [4]

3. The curve C has equation $y = 2x^2 - 11x + 13$.

(a) The point P has coordinates $(2, -1)$ and lies on C. Find the equation of the **tangent** to C at P. [4]

(b) The point Q lies on C and is such that the gradient of the **normal** to C at Q is $-\frac{1}{9}$.
Find the x-coordinate of Q. [3]

4. Using the binomial theorem, write down and simplify the first four terms in the expansion of $(1 - 2x)^6$ in ascending powers of x. [4]

5. *(a)* Express $3x^2 - 12x + 29$ in the form $a(x + b)^2 + c$, where the values of the constants a, b and c are to be found. [3]

(b) **Using your answer to part *(a)***, write down the stationary value of $y = 3x^2 - 12x + 29$.
State whether this stationary value is a maximum or a minimum. [2]

6. *(a)* Show that the equation

$$x^2 + (2k - 1)x + (k^2 - k + 2) = 0$$

has no real roots, whatever the value of the constant k. [4]

(b) Find the range of values of x satisfying the inequality

$$3x^2 + 16x - 12 > 0.$$ [3]

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

(b) Differentiate $\frac{2}{3}x^{\frac{1}{4}} + \frac{12}{x^3}$ with respect to x. [2]

8. *(a)* Solve the equation $6x^3 - 19x^2 + 11x + 6 = 0$. [6]

(b) When $x^3 - 53$ is divided by $x - a$, the remainder is 11. Find the value of the constant a. [2]

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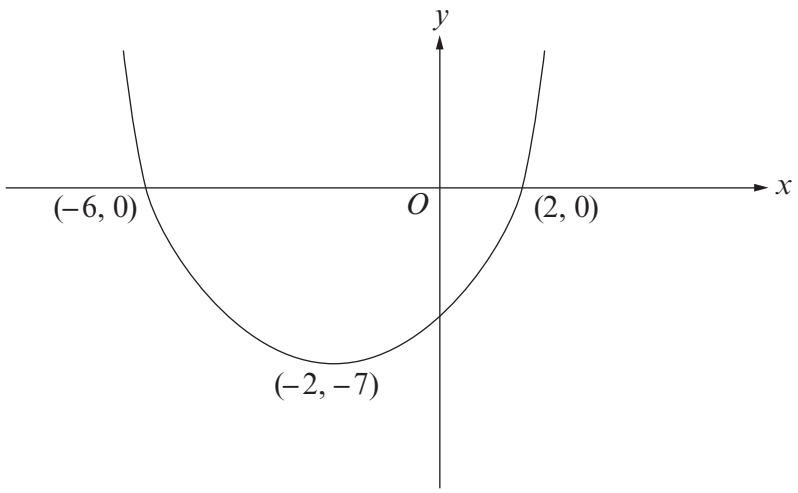
9. The diagram shows a sketch of the graph of $y = f(x)$. The graph passes through the points $(-6, 0)$ and $(2, 0)$ and has a minimum point at $(-2, -7)$.



Sketch the following graphs, using a separate set of axes for each graph. In each case, you should indicate the coordinates of the stationary point and the coordinates of the points of intersection of the graph with the x-axis.

(a) $y = f(x - 5)$ [3]

(b) $y = f\left(\frac{x}{2}\right)$ [3]

10. The curve C has equation

$$y = x^3 + 3x^2 - 1.$$

(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) Write down the number of **positive** real roots of the equation

$$x^3 + 3x^2 - 1 = 0.$$ [1]

