GCE AS/A level

0973/01

S16-0973-01

MATHEMATICS – C1
Pure Mathematics

A.M. WEDNESDAY, 18 May 2016

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, B, C have coordinates $(-6, -3)$, $(4, 2)$, $(-2, 5)$, respectively.

(a) (i) Find the gradient of AB.

(ii) Find the equation of AB and simplify your answer. [5]

(b) Find the lengths of AB and AC. Hence find the value of the constant k such that $AB = kAC$, giving your answer in its simplest form. [4]

(c) The point D has coordinates $(4, m)$, where m is a constant.

(i) Write down the equation of BD.

(ii) Given that CD is perpendicular to AB, find the value of m. [5]

2. Simplify $\dfrac{5\sqrt{7}+4\sqrt{2}}{3\sqrt{7}+5\sqrt{2}}$. [4]

3. The curve C has equation $y = \dfrac{12}{x^2} + 7x - 6$. The point P, whose x-coordinate is 2, lies on C.

Find the equation of the tangent to C at P. [6]

4. **Use the binomial theorem** to express $\left(\sqrt{3}-1\right)^5$ in the form $a + b\sqrt{3}$, where a, b are integers whose values are to be found. [5]

5. *(a)* Express $x^2 + 4x - 8$ in the form $(x + a)^2 + b$, where a and b are constants whose values are to be found. [2]

(b) Use an algebraic method to solve the simultaneous equations $y = x^2 + 4x - 8$ and $y = 2x + 7$. [4]

(c) Draw a sketch illustrating geometrically the results of both part *(a)* and part *(b)*. [4]

6. *(a)* Find the range of values of k for which the quadratic equation

$$9x^2 + 8x - 2k = 0$$

has **two distinct real roots**. [4]

(b) Solve the inequality $x(5x - 7) \geqslant 6$. [4]

7. Figure 1 shows a sketch of the graph of $y = f(x)$. The graph has a minimum point at (1, –3) and intersects the x-axis at the points (– 4, 0) and (6, 0).

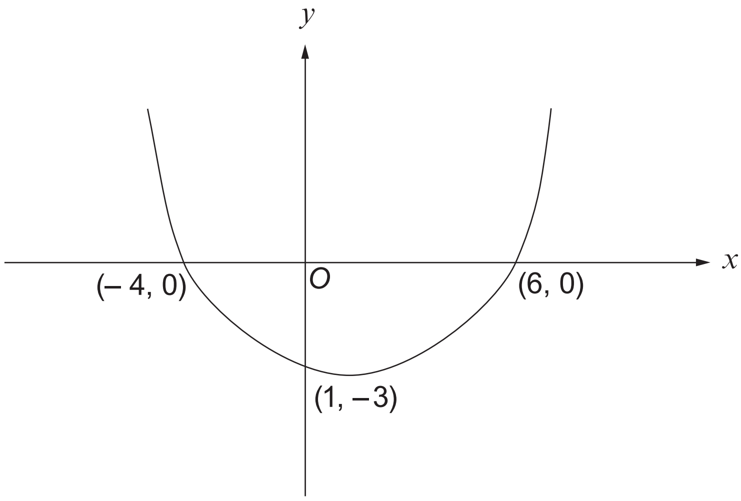

Figure 1

(a) Sketch the graph of $y = -3f(x)$, 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 of $y = g(x)$, where
$g(x) = f(x) + p$, where p is a constant,
or $g(x) = f(qx)$, where q is a constant,
or $g(x) = rf(x)$, where r is a constant,
or $g(x) = f(x + s)$, where s is a constant.

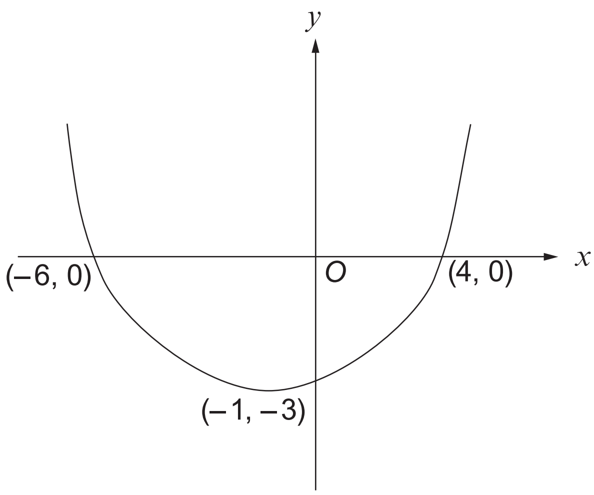

Figure 2

The function g can in fact be any one of **two** of the above functions. In each of these two cases, write down the expression for $g(x)$, including the value of the corresponding constant. [2]

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8. *(a)* Given that $y = 10x^2 - 7x - 13$, find $\frac{dy}{dx}$ from first principles. [5]

(b) Given that $y = 4\sqrt{x} + \frac{45}{x}$, find the value of $\frac{dy}{dx}$ when $x = 9$. [4]

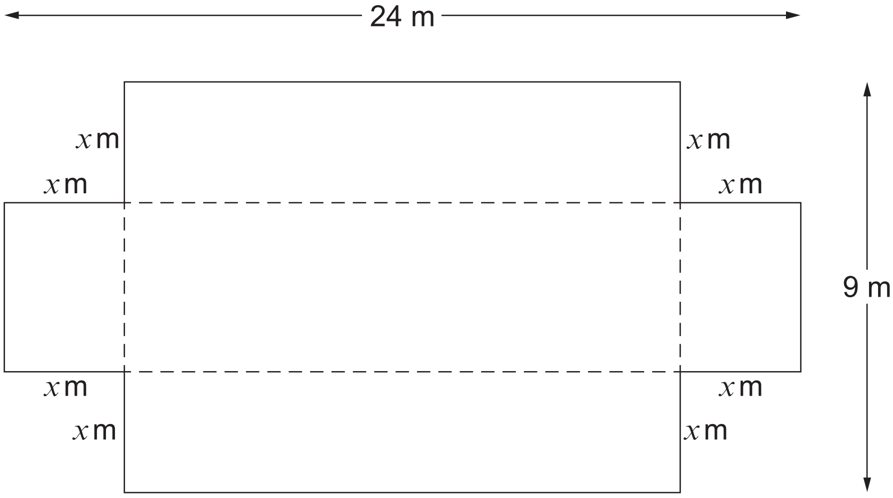
9. The polynomial $f(x)$ is given by

$$f(x) = 8x^3 + 2x^2 - 41x + 10.$$

(a) Factorise $f(x)$. [5]

(b) Hence or otherwise, evaluate $f(2{\cdot}25)$. [2]

10. A rectangular sheet of metal has length 24 m and width 9 m. Four squares, each of side x m, where $x < 4{\cdot}5$, have been cut away from the corners of the rectangular sheet, as shown in the diagram below. The rest of the metal sheet is now bent along the dotted lines to form an open tank in the form of a cuboid.



(a) Show that the volume V m^3 of this tank is given by

$$V = 4x^3 - 66x^2 + 216x.$$ [2]

(b) Find the maximum value of V, showing that the value you have found is a maximum value. [5]

END OF PAPER