GCE AS/A level

0973/01

S15-0973-01

MATHEMATICS – C1
Pure Mathematics

A.M. WEDNESDAY, 13 May 2015

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 $(-7, 3)$, $(2, 0)$, $(-3, 5)$, respectively. The line L passes through C and is perpendicular to AB.

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

(ii) Show that the equation of AB is

$$x + 3y - 2 = 0.$$

(iii) Find the equation of L. [7]

(b) The line L intersects AB at the point D. Show that the coordinates of D are $(-4, 2)$. [2]

(c) Show that L is not the perpendicular bisector of AB. [2]

(d) Find the value of $\tan A\hat{B}C$. Give your answer in its simplest form. [5]

2. Simplify

(a) $\dfrac{4\sqrt{2} - \sqrt{11}}{3\sqrt{2} + \sqrt{11}}$, [4]

(b) $\dfrac{7}{2\sqrt{14}} + \left(\dfrac{\sqrt{14}}{2}\right)^3$. [3]

3. The curve C has equation $y = x^3 - x^2 - 13x + 18$.

(a) The point P, whose x-coordinate is 2, lies on C. Find the equation of the **normal** to C at P. [6]

(b) The point Q, whose x-coordinate is a, lies on C and is such that the **tangent** to C at Q is parallel to the line with equation $y = -8x + 7$.
Find the possible values of a. [3]

4. *(a)* Express $4x^2 - 24x - 189$ 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)***, solve the equation

$$4x^2 - 24x - 189 = 0.$$ [3]

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

$$kx^2 + (2k - 5)x + (k - 6) = 0$$

has **no real roots**. [4]

(b) Without carrying out any further calculation, write down the value of k for which the quadratic equation

$$kx^2 + (2k - 5)x + (k - 6) = 0$$

has **two equal roots**. [1]

6. *(a)* Using the binomial theorem, write down and simplify the first four terms in the expansion of $\left(1 - \frac{x}{2}\right)^8$ in ascending powers of x. [4]

(b) The first two terms in the expansion of $(2 + ax)^n$ in ascending powers of x are 32 and $-240x$ respectively. Find the value of n and the value of a. [4]

7. *(a)* Given that $y = 9x^2 - 8x - 3$, find $\frac{\mathrm{d}y}{\mathrm{d}x}$ from first principles. [5]

(b) Differentiate $\frac{3}{x^6} - 4x^{\frac{5}{3}}$ with respect to x. [2]

8. *(a)* Given that $x - 3$ is a factor of $px^3 - 13x^2 - 19x + 12$, write down an equation satisfied by p. Hence show that $p = 6$. [2]

(b) Solve the equation $6x^3 - 13x^2 - 19x + 12 = 0$. [4]

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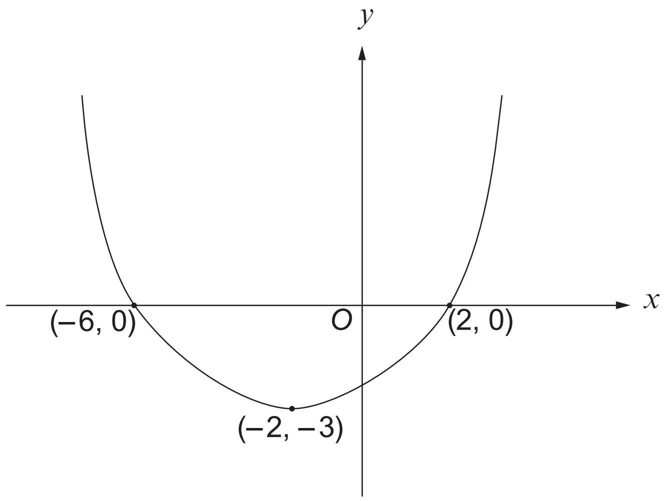
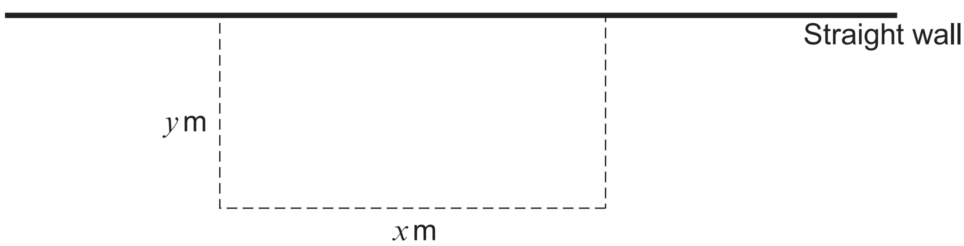
9. The diagram shows a sketch of the graph of $y = f(x)$. The graph passes through the points $(-6, 0)$ and $(2, 0)$ and has a minimum point at $(-2, -3)$.



(a) Sketch the graph of $y = f(\frac{1}{2}x)$, indicating the coordinates of the stationary point and the coordinates of the points of intersection of the graph with the x-axis. [3]

(b) Angharad is asked by her teacher to draw the graph of $y = af(x)$ for various non-zero values of the constant a. One of Angharad's graphs passes through the origin *O*. Explain why this cannot possibly be correct. [1]

10. A sheep farmer wishes to construct a rectangular enclosure for his animals. He decides to use a straight wall as one side of the enclosure and fencing for the other three sides. The area of the enclosure is to be $800\,\text{m}^2$. The lengths of the sides of the rectangular enclosure are x m and y m, as shown in the diagram, and the total length of the **fencing** is L m.



(a) Show that $L = x + \dfrac{1600}{x}$. [2]

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

END OF PAPER