GCE AS/A level

0973/01

MATHEMATICS – C1

Pure Mathematics

A.M. WEDNESDAY, 13 May 2015

1 hour 30 minutes plus your additional time allowance

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, black ball-point pen or your usual method.

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 marks]

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

[2 marks]

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

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

2. Simplify

(a) $$\frac{4\sqrt{2} - \sqrt{11}}{3\sqrt{2} + \sqrt{11}}$$ **[4 marks]**

(b) $$\frac{7}{2\sqrt{14}} + \left(\frac{\sqrt{14}}{2}\right)^3$$ **[3 marks]**

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 marks]

(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 marks]

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 marks]

(b) USING YOUR ANSWER TO PART (a), solve the equation

$$4x^2 - 24x - 189 = 0$$

[3 marks]

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 marks]

(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 mark]

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 marks]

(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 marks]

7(a) Given that $y = 9x^2 - 8x - 3$

find $\frac{dy}{dx}$ from first principles. [5 marks]

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

[2 marks]

8(a) Given that $x - 3$ is a factor of

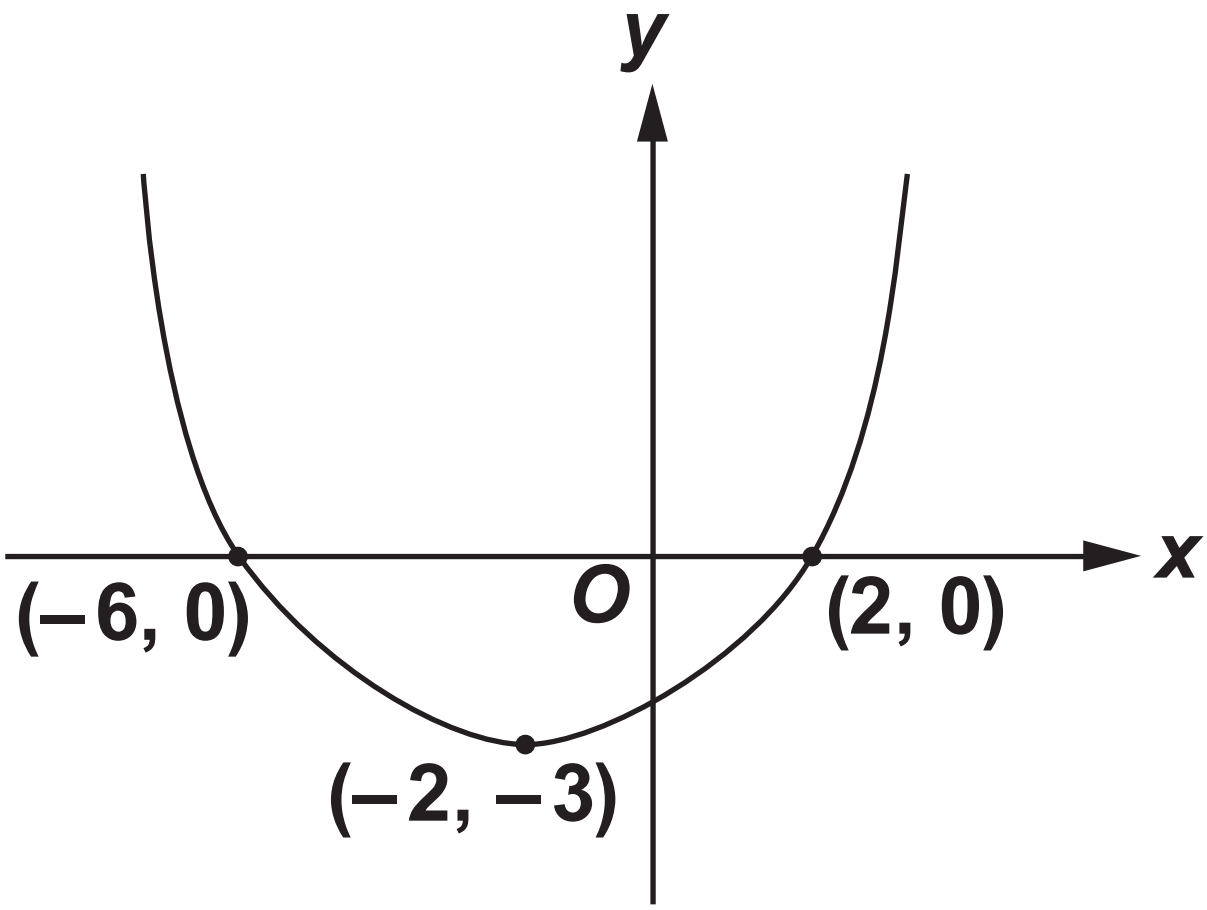
$px^3 - 13x^2 - 19x + 12$, write down an equation satisfied by p. Hence show that $p = 6$

[2 marks]

(b) Solve the equation

$$6x^3 - 13x^2 - 19x + 12 = 0$$

[4 marks]


y
x
O
(–6, 0)
(2, 0)
(–2, –3)

9. The diagram opposite 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 marks]**

(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 mark]**


Straight wall
y m
x m

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 $x\,\text{m}$ and $y\,\text{m}$, as shown in the diagram opposite, and the total length of the FENCING is $L\,\text{m}$.

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

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

END OF PAPER