

Paper Reference(s)

6663/01

Edexcel GCE

Core Mathematics C1

Advanced Subsidiary

Friday 5 June 2009 – Afternoon

Time: 1 hour 30 minutes

Materials required for examination

Mathematical Formulae (Orange or Green)

Items included with question papers

Nil

Calculators may NOT be used in this examination.

Instructions to Candidates

Write the name of the examining body (Edexcel), your centre number, candidate number, the unit title (Core Mathematics C1), the paper reference (6663), your surname, initials and signature.

Information for Candidates

A booklet 'Mathematical Formulae and Statistical Tables' is provided.
Full marks may be obtained for answers to ALL questions.
There are 11 questions in this question paper. The total mark for this paper is 75.

Advice to Candidates

You must ensure that your answers to parts of questions are clearly labelled.
You must show sufficient working to make your methods clear to the Examiner.
Answers without working may not gain full credit.

1. Simplify

(a) $(3\sqrt{7})^2$ (1)

(b) $(8 + \sqrt{5})(2 - \sqrt{5})$ (3)

2. Given that $32\sqrt{2} = 2^a$, find the value of a . (3)

3. Given that $y = 2x^3 + \frac{3}{x^2}$, $x \neq 0$, find

(a) $\frac{dy}{dx}$, (3)

(b) $\int y \, dx$, simplifying each term. (3)

4. Find the set of values of x for which

(a) $4x - 3 > 7 - x$ (2)

(b) $2x^2 - 5x - 12 < 0$ (4)

(c) **both** $4x - 3 > 7 - x$ **and** $2x^2 - 5x - 12 < 0$ (1)

5. A 40-year building programme for new houses began in Oldtown in the year 1951 (Year 1) and finished in 1990 (Year 40).

The numbers of houses built each year form an arithmetic sequence with first term a and common difference d .

Given that 2400 new houses were built in 1960 and 600 new houses were built in 1990, find

(a) the value of d , (3)

(b) the value of a , (2)

(c) the total number of houses built in Oldtown over the 40-year period. (3)

6. The equation $x^2 + 3px + p = 0$, where p is a non-zero constant, has equal roots.

Find the value of p .

(4)

7. A sequence a_1, a_2, a_3, \dots is defined by

$$a_1 = k,$$

$$a_{n+1} = 2a_n - 7, \quad n \geq 1,$$

where k is a constant.

(a) Write down an expression for a_2 in terms of k .

(1)

(b) Show that $a_3 = 4k - 21$.

(2)

Given that $\sum_{r=1}^4 a_r = 43$,

(c) find the value of k .

(4)

8.

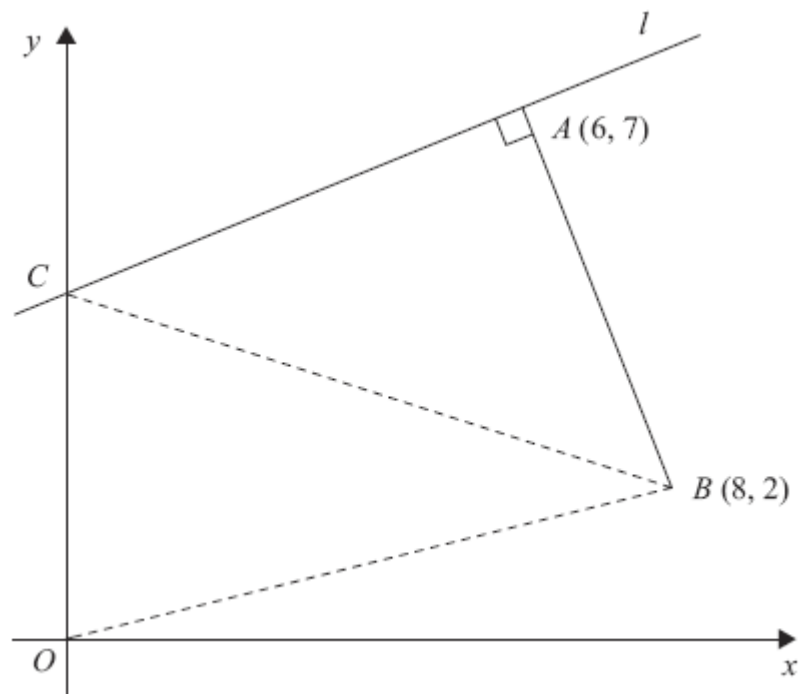


Figure 1

The points A and B have coordinates $(6, 7)$ and $(8, 2)$ respectively.

The line l passes through the point A and is perpendicular to the line AB , as shown in Figure 1.

(a) Find an equation for l in the form $ax + by + c = 0$, where a , b and c are integers. (4)

Given that l intersects the y -axis at the point C , find

(b) the coordinates of C , (2)

(c) the area of $\triangle OCB$, where O is the origin. (2)

9.

$$f(x) = \frac{(3-4\sqrt{x})^2}{\sqrt{x}}, \quad x > 0.$$

(a) Show that $f(x) = 9x^{-\frac{1}{2}} + Ax^{\frac{1}{2}} + B$, where A and B are constants to be found. (3)

(b) Find $f'(x)$. (3)

(c) Evaluate $f'(9)$. (2)

10. (a) Factorise completely $x^3 - 6x^2 + 9x$ (3)

(b) Sketch the curve with equation

$$y = x^3 - 6x^2 + 9x$$

showing the coordinates of the points at which the curve meets the x -axis. (4)

Using your answer to part (b), or otherwise,

(c) sketch, on a separate diagram, the curve with equation

$$y = (x-2)^3 - 6(x-2)^2 + 9(x-2)$$

showing the coordinates of the points at which the curve meets the x -axis. (2)

11. The curve C has equation

$$y = x^3 - 2x^2 - x + 9, \quad x > 0.$$

The point P has coordinates $(2, 7)$.

(a) Show that P lies on C .

(1)

(b) Find the equation of the tangent to C at P , giving your answer in the form $y = mx + c$, where m and c are constants.

(5)

The point Q also lies on C .

Given that the tangent to C at Q is perpendicular to the tangent to C at P ,

(c) show that the x -coordinate of Q is $\frac{1}{3}(2 + \sqrt{6})$.

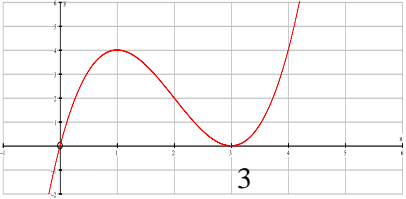

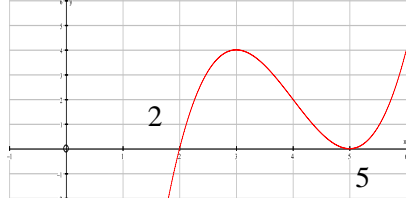
(5)

TOTAL FOR PAPER: 75 MARKS

END

Question Number	Scheme	Marks
<p>1. (a)</p> <p>(b)</p>	$(3\sqrt{7})^2 = 63$ $(8 + \sqrt{5})(2 - \sqrt{5}) = 16 - 5 + 2\sqrt{5} - 8\sqrt{5}$ $= 11, -6\sqrt{5}$	<p>B1 (1)</p> <p>M1</p> <p>A1, A1 (3)</p> <p>(4 marks)</p>
<p>2.</p>	$32 = 2^5 \text{ or } 2048 = 2^{11}, \quad \sqrt{2} = 2^{1/2} \text{ or } \sqrt{2048} = (2048)^{1/2}$ $a = \frac{11}{2} \quad \left(\text{or } 5\frac{1}{2} \text{ or } 5.5 \right)$	<p>B1, B1</p> <p>B1</p> <p>(3 marks)</p>
<p>3. (a)</p> <p>(b)</p>	$\frac{dy}{dx} = 6x^2 - 6x^{-3}$ $\frac{2x^4}{4} + \frac{3x^{-1}}{-1} (+C)$ $\frac{x^4}{2} - 3x^{-1} + C$	<p>M1 A1 A1 (3)</p> <p>M1 A1</p> <p>A1 (3)</p> <p>(6 marks)</p>
<p>4. (a)</p> <p>(b)</p> <p>(c)</p>	$5x > 10, \quad x > 2$ $(2x + 3)(x - 4) = 0, \quad \text{'Critical values' are } -\frac{3}{2} \text{ and } 4$ $-\frac{3}{2} < x < 4$ $2 < x < 4$	<p>[Condone $x > \frac{10}{2} = 2$]</p> <p>M1, A1 (2)</p> <p>M1, A1</p> <p>M1 A1ft (4)</p> <p>B1ft (1)</p> <p>(7 marks)</p>
<p>5. (a)</p> <p>(b)</p> <p>(c)</p>	$a + 9d = 2400 \quad a + 39d = 600$ $d = \frac{-1800}{30} \quad d = -60 \quad (\text{accept } \pm 60 \text{ for A1})$ $a - 540 = 2400 \quad a = 2940$ $\text{Total} = \frac{1}{2}n\{2a + (n-1)d\} = \frac{1}{2} \times 40 \times (5880 + 39 \times -60) \quad (\text{ft values of } a \text{ and } d)$ $= \underline{70\,800}$	<p>M1</p> <p>M1 A1 (3)</p> <p>M1 A1 (2)</p> <p>M1 A1ft</p> <p>A1cao (3)</p> <p>(8 marks)</p>

Question Number	Scheme	Marks
6.	$b^2 - 4ac$ attempted, in terms of p . $(3p)^2 - 4p = 0$ or equivalent Attempt to solve for p e.g. $p(9p - 4) = 0$ Must potentially lead to $p = k, k \neq 0$ $p = \frac{4}{9}$ (Ignore $p = 0$, if seen)	M1 A1 M1 A1 cso (4 marks)
7.	$(a_2 =) 2k - 7$ $(a_3 =) 2(2k - 7) - 7$ or $4k - 14 - 7, = 4k - 21$ (*) $(a_4 =) 2(4k - 21) - 7 (= 8k - 49)$ $\sum_{r=1}^4 a_r = k + "(2k - 7)" + (4k - 21) + "(8k - 49)"$ $k + (2k - 7) + (4k - 21) + (8k - 49) = 15k - 77 = 43$ $k = 8$	B1 (1) M1, A1 cso (2) M1 M1 M1 A1 (4) (7 marks)
8. (a)	$AB: m = \frac{2-7}{8-6}, \left(= -\frac{5}{2} \right)$ Using $m_1 m_2 = -1: m_2 = \frac{2}{5}$ $y - 7 = \frac{2}{5}(x - 6),$ $2x - 5y + 23 = 0$ (o.e. with integer coefficients)	B1 M1 M1, A1 (4)
(b)	Using $x = 0$ in the answer to (a), $y = \frac{23}{5}$ or 4.6	M1, A1ft(2)
(c)	Area of triangle = $\frac{1}{2} \times 8 \times \frac{23}{5} = \frac{92}{5}$ (o.e) e.g. $\left(18\frac{2}{5}, 18.4, \frac{184}{10} \right)$	M1 A1 (2)
9. (a)	$\left[(3 - 4\sqrt{x})^2 = \right] 9 - 12\sqrt{x} - 12\sqrt{x} + (-4)^2 x$ $9x^{-\frac{1}{2}} + 16x^{\frac{1}{2}} - 24$	M1 A1, A1 (3)
(b)	$f'(x) = -\frac{9}{2}x^{-\frac{3}{2}}, + \frac{16}{2}x^{-\frac{1}{2}}$	M1 A1, A1ft (3)
(c)	$f'(9) = -\frac{9}{2} \times \frac{1}{27} + \frac{16}{2} \times \frac{1}{3} = -\frac{1}{6} + \frac{16}{6} = \frac{5}{2}$	M1 A1 (2)

Question Number	Scheme	Marks
<p>10. (a)</p> <p>(b)</p> <p>(c)</p>	<p>$x(x^2 - 6x + 9)$ $= x(x - 3)(x - 3)$</p>  <p>Shape </p> <p><u>Through</u> origin (<u>not</u> touching) Touching x-axis only once Touching at $(3, 0)$, or 3 on x-axis [Must be on graph not in a table]</p>  <p>Moved horizontally (either way) $(2, 0)$ and $(5, 0)$, or 2 and 5 on x-axis</p>	<p>B1</p> <p>M1 A1 (3)</p> <p>B1</p> <p>B1</p> <p>B1</p> <p>B1ft (4)</p> <p>M1</p> <p>A1 (2)</p> <p>(9 marks)</p>
<p>11. (a)</p> <p>(b)</p> <p>(c)</p>	<p>$x = 2: y = 8 - 8 - 2 + 9 = 7$ (*)</p> <p>$\frac{dy}{dx} = 3x^2 - 4x - 1$</p> <p>$x = 2: \frac{dy}{dx} = 12 - 8 - 1 (= 3)$</p> <p>$y - 7 = 3(x - 2),$ <u>$y = 3x + 1$</u></p> <p>$m = -\frac{1}{3}$ (for $-\frac{1}{m}$ with their m)</p> <p>$3x^2 - 4x - 1 = -\frac{1}{3}, 9x^2 - 12x - 2 = 0$ or $x^2 - \frac{4}{3}x - \frac{2}{9} = 0$ (o.e.)</p> <p>$\left(x = \frac{12 + \sqrt{144 + 72}}{18}\right) (\sqrt{216} = \sqrt{36}\sqrt{6} = 6\sqrt{6})$ or $(3x - 2)^2 = 6 \rightarrow 3x = 2 \pm \sqrt{6}$</p> <p>$x = \frac{1}{3}(2 + \sqrt{6})$ (*)</p>	<p>B1 (1)</p> <p>M1 A1</p> <p>A1ft</p> <p>M1, <u>A1</u> (5)</p> <p>B1ft</p> <p>M1, A1</p> <p>M1</p> <p>A1cso (5)</p> <p>(11 marks)</p>