

Centre No.						Paper Reference							Surname	Initial(s)
Candidate No.						6	6	6	3	/	0	1	Signature	

Paper Reference(s)

6663/01

Edexcel GCE

Core Mathematics C1

Advanced Subsidiary



Wednesday 9 January 2008 – Afternoon
Time: 1 hour 30 minutes

Examiner's use only

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Team Leader's use only

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[illegible]

Materials required for examination

Mathematical Formulae (Green)

Items included with question papers

Nil

Calculators may NOT be used in this examination.

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initials and signature.

Check that you have the correct question paper.

Answer ALL the questions.

You must write your answer for each question in the space following the question.

Information for Candidates

A booklet ‘Mathematical Formulae and Statistical Tables’ is provided.

Full marks may be obtained for answers to ALL questions.

The marks for individual questions and the parts of questions are shown in round brackets: e.g. (2).

There are 11 questions in this question paper. The total mark for this paper is 75.

There are 24 pages in this question paper. Any blank pages are indicated.

Advice to Candidates

You must ensure that your answers to parts of questions are clearly labelled.

You should show sufficient working to make your methods clear to the Examiner.

Answers without working may not gain full credit.

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1. Find $\int (3x^2 + 4x^5 - 7) dx$.

(4)

Q1

(Total 4 marks)



January 2008
6663 Core Mathematics C1
Mark Scheme

Question number	Scheme	Marks
1.	$3x^2 \rightarrow kx^3$ or $4x^5 \rightarrow kx^6$ or $-7 \rightarrow kx$ (k a non-zero constant) $\frac{3x^3}{3}$ or $\frac{4x^6}{6}$ (Either of these, simplified or unsimplified) $x^3 + \frac{2x^6}{3} - 7x$ or equivalent unsimplified, such as $\frac{3x^3}{3} + \frac{4x^6}{6} - 7x^1$ $+ C$ (or any other constant, e.g. $+ K$)	M1 A1 A1 B1 (4) 4
	<p>M: Given for increasing by one the power of x in one of the three terms.</p> <p>A marks: 'Ignore subsequent working' after a correct unsimplified version of a term is seen.</p> <p>B: Allow the mark (independently) for an integration constant appearing at any stage (even if it appears, then disappears from the final answer).</p> <p>This B mark can be allowed even when no other marks are scored.</p>	

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2. (a) Write down the value of $16^{\frac{1}{4}}$.

(1)

(b) Simplify $(16x^{12})^{\frac{3}{4}}$.

(2)

Q2

(Total 3 marks)



Question number	Scheme	Marks
2.	<p>(a) 2</p> <p>(b) x^9 seen, or $(\text{answer to (a)})^3$ seen, or $(2x^3)^3$ seen.</p> <p>$8x^9$</p>	<p>B1 (1)</p> <p>M1</p> <p>A1 (2)</p> <p>3</p>
	<p>(b) M: Look for x^9 first... if seen, this is M1.</p> <p>If not seen, look for $(\text{answer to (a)})^3$, e.g. 2^3... this would score M1 even if it does not subsequently become 8. (Similarly for other answers to (a)).</p> <p>In $(2x^3)^3$, the 2^3 is implied, so this scores the M mark.</p> <p><u>Negative answers:</u></p> <p>(a) Allow -2. Allow ± 2. Allow '2 or -2'.</p> <p>(b) Allow $\pm 8x^9$. Allow '$8x^9$ or $-8x^9$'.</p> <p>N.B. If part (a) is wrong, it is possible to 'restart' in part (b) and to score full marks in part (b).</p>	

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3. Simplify

$$\frac{5 - \sqrt{3}}{2 + \sqrt{3}},$$

giving your answer in the form $a + b\sqrt{3}$, where a and b are integers.

(4)

Q3

(Total 4 marks)



Question number	Scheme	Marks
3.	$\frac{(5-\sqrt{3})}{(2+\sqrt{3})} \times \frac{(2-\sqrt{3})}{(2-\sqrt{3})}$ $= \frac{10-2\sqrt{3}-5\sqrt{3}+(\sqrt{3})^2}{\dots} \quad \left(= \frac{10-7\sqrt{3}+3}{\dots} \right)$ $(=13-7\sqrt{3}) \quad \left(\text{Allow } \frac{13-7\sqrt{3}}{1} \right) \quad 13 \quad (a=13)$ $-7\sqrt{3} \quad (b=-7)$	<p>M1</p> <p>M1</p> <p>A1</p> <p>A1</p> <p>(4)</p> <p>4</p>
	<p>1st M: Multiplying top and bottom by $(2-\sqrt{3})$. (As shown above is sufficient).</p> <p>2nd M: Attempt to multiply out numerator $(5-\sqrt{3})(2-\sqrt{3})$. Must have at least 3 terms correct.</p> <p>Final answer: Although 'denominator = 1' may be <u>implied</u>, the $13-7\sqrt{3}$ must obviously be the final answer (not an intermediate step), to score full marks. (Also M0 M1 A1 A1 is <u>not</u> an option).</p> <p>The A marks cannot be scored unless the 1st M mark has been scored, but this 1st M mark <u>could</u> be implied by correct expansions of both numerator <u>and</u> denominator.</p> <p>It <u>is</u> possible to score M1 M0 A1 A0 or M1 M0 A0 A1 (after 2 correct terms in the numerator).</p> <p><u>Special case</u>: If numerator is multiplied by $(2+\sqrt{3})$ instead of $(2-\sqrt{3})$, the 2nd M can still be scored for at least 3 of these terms correct:</p> $10-2\sqrt{3}+5\sqrt{3}-(\sqrt{3})^2.$ <p>The maximum score in the special case is 1 mark: M0 M1 A0 A0.</p> <p><u>Answer only</u>: Scores no marks.</p> <p><u>Alternative method</u>:</p> $5-\sqrt{3} = (a+b\sqrt{3})(2+\sqrt{3})$ $(a+b\sqrt{3})(2+\sqrt{3}) = 2a+a\sqrt{3}+2b\sqrt{3}+3 \quad \text{M1: At least 3 terms correct.}$ $5 = 2a+3b$ $-1 = a+2b \quad a=\dots \text{ or } b=\dots \quad \text{M1: Form and attempt to solve simultaneous equations.}$ $a = 13, \quad b = -7 \quad \text{A1, A1}$	

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4. The point $A(-6, 4)$ and the point $B(8, -3)$ lie on the line L .

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

(4)

(b) Find the distance AB , giving your answer in the form $k\sqrt{5}$, where k is an integer.

(3)

Q4

(Total 7 marks)



Question number	Scheme	Marks
4.	<p>(a) $m = \frac{4 - (-3)}{-6 - 8}$ or $\frac{-3 - 4}{8 - (-6)}$, $= \frac{7}{-14}$ or $\frac{-7}{14}$ $\left(= -\frac{1}{2} \right)$</p> <p>Equation: $y - 4 = -\frac{1}{2}(x - (-6))$ or $y - (-3) = -\frac{1}{2}(x - 8)$</p> <p>$x + 2y - 2 = 0$ (or equiv. with <u>integer</u> coefficients... must have '=' 0')</p> <p>(e.g. $14y + 7x - 14 = 0$ and $14 - 7x - 14y = 0$ are acceptable)</p> <p>(b) $(-6 - 8)^2 + (4 - (-3))^2$</p> <p>$14^2 + 7^2$ or $(-14)^2 + 7^2$ or $14^2 + (-7)^2$ (M1 A1 may be implied by 245)</p> <p>$AB = \sqrt{14^2 + 7^2}$ or $\sqrt{7^2(2^2 + 1^2)}$ or $\sqrt{245}$</p> <p>$7\sqrt{5}$</p>	<p>M1, A1</p> <p>M1</p> <p>A1 (4)</p> <p>M1</p> <p>A1</p> <p>A1cso (3)</p> <p>7</p>
	<p>(a) 1st M: Attempt to use $m = \frac{y_2 - y_1}{x_2 - x_1}$ (may be implicit in an equation of L).</p> <p>2nd M: Attempting straight line equation in any form, e.g. $y - y_1 = m(x - x_1)$, $\frac{y - y_1}{x - x_1} = m$, with any value of m (except 0 or ∞) and either $(-6, 4)$ or $(8, -3)$.</p> <p>N.B. It is also possible to use a different point which lies on the line, such as the midpoint of AB (1, 0.5).</p> <p>Alternatively, the 2nd M may be scored by using $y = mx + c$ with a numerical gradient and substituting $(-6, 4)$ or $(8, -3)$ to find the value of c.</p> <p>Having coords the <u>wrong way round</u>, e.g. $y - (-6) = -\frac{1}{2}(x - 4)$, loses the 2nd M mark <u>unless</u> a correct general formula is seen, e.g. $y - y_1 = m(x - x_1)$.</p> <p>(b) M: Attempting to use $(x_2 - x_1)^2 + (y_2 - y_1)^2$.</p> <p><u>Missing bracket</u>, e.g. $-14^2 + 7^2$ implies M1 if no earlier version is seen.</p> <p>$-14^2 + 7^2$ with no further work would be M1 A0.</p> <p>$-14^2 + 7^2$ followed by 'recovery' can score full marks.</p>	

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- Given that $y = 5x - 7 + \frac{2\sqrt{x+3}}{x}$, $x > 0$,

- (b) find $\frac{dy}{dx}$, simplifying the coefficient of each term. (4)



Question number	Scheme	Marks
5.	<p>(a) $\left(2x^{-\frac{1}{2}} + 3x^{-1}\right)$ $p = -\frac{1}{2}, \quad q = -1$</p> <p>(b) $\left(y = 5x - 7 + 2x^{-\frac{1}{2}} + 3x^{-1}\right)$</p> <p>$\left(\frac{dy}{dx} = \right)$ 5 (or $5x^0$) (5x – 7 correctly differentiated)</p> <p>Attempt to differentiate either $2x^p$ with a fractional p, giving kx^{p-1} ($k \neq 0$), (the fraction p could be in decimal form) or $3x^q$ with a negative q, giving kx^{q-1} ($k \neq 0$).</p> <p>$\left(-\frac{1}{2} \times 2x^{-\frac{3}{2}} - 1 \times 3x^{-2} = \right)$ $-x^{-\frac{3}{2}}, -3x^{-2}$</p>	<p>B1, B1 (2)</p> <p>B1</p> <p>M1</p> <p>A1ft, A1ft (4)</p> <p>6</p>
	<p>(b):</p> <p>N.B. It is possible to ‘start again’ in (b), so the p and q may be different from those seen in (a), but note that the M mark is for the attempt to differentiate $\underline{2x^p}$ or $\underline{3x^q}$.</p> <p>However, marks for part (a) <u>cannot</u> be earned in part (b).</p> <p>1st A1ft: ft their $2x^p$, but p must be a fraction and coefficient must be simplified (the fraction p could be in decimal form).</p> <p>2nd A1ft: ft their $3x^q$, but q must be negative and coefficient must be simplified.</p> <p>‘Simplified’ coefficient means $\frac{a}{b}$ where a and b are integers with no common factors. Only a single + or – sign is allowed (e.g. – – must be replaced by +).</p> <p>Having +C loses the B mark.</p>	

6.

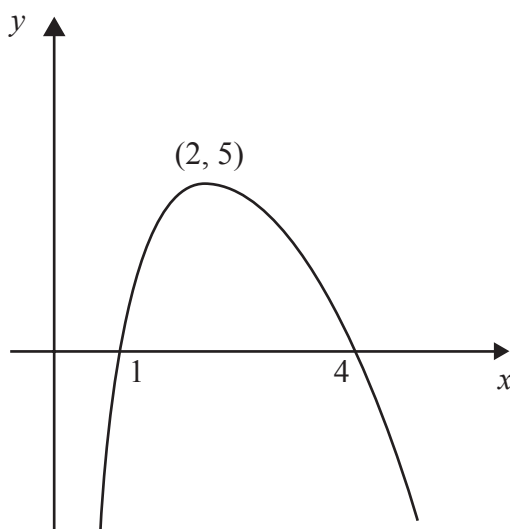
**Figure 1**

Figure 1 shows a sketch of the curve with equation $y = f(x)$. The curve crosses the x -axis at the points $(1, 0)$ and $(4, 0)$. The maximum point on the curve is $(2, 5)$.

In separate diagrams sketch the curves with the following equations.

On each diagram show clearly the coordinates of the maximum point and of each point at which the curve crosses the x -axis.

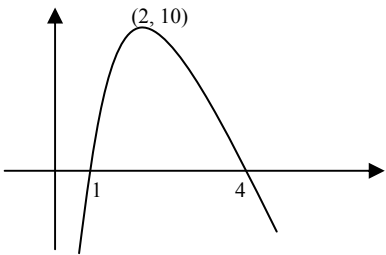
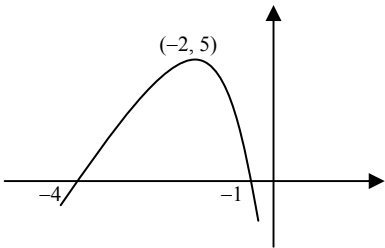

(a) $y = 2f(x)$, (3)

(b) $y = f(-x)$. (3)

The maximum point on the curve with equation $y = f(x + a)$ is on the y -axis.

(c) Write down the value of the constant a . (1)



Question number	Scheme	Marks
6.	<p>(a) </p> <p>Shape: Max in 1st quadrant and 2 intersections on positive x-axis</p> <p>1 and 4 labelled (in correct place) or clearly stated as coordinates</p> <p>(2, 10) labelled or clearly stated</p> <p>(b) </p> <p>Shape: Max in 2nd quadrant and 2 intersections on negative x-axis</p> <p>-1 and -4 labelled (in correct place) or clearly stated as coordinates</p> <p>(-2, 5) labelled or clearly stated</p> <p>(c) $(a =) 2$</p> <p>May be implicit, i.e. $f(x + 2)$</p> <p>Beware: The answer to part (c) may be seen on the first page.</p>	<p>B1</p> <p>B1</p> <p>B1 (3)</p> <p>B1</p> <p>B1</p> <p>B1 (3)</p> <p>B1 (1)</p> <p>7</p>
	<p>(a) and (b):</p> <p>1st B: 'Shape' is generous, providing the conditions are satisfied.</p> <p>2nd and 3rd B marks are dependent upon a sketch having been drawn.</p> <p>2nd B marks: Allow (0, 1), etc. (coordinates the wrong way round) <u>if</u> the sketch is correct.</p> <p>Points must be labelled correctly and be in appropriate place (e.g. (-2, 5) in the first quadrant is B0).</p> <p>(b) <u>Special case</u>:</p> <p>If the graph is reflected in the x-axis (instead of the y-axis), B1 B0 B0 can be scored. This requires shape and coordinates to be <u>fully correct</u>, i.e.</p> <p>Shape:  Minimum in 4th quadrant and 2 intersections on positive x-axis,</p> <p>1 and 4 labelled (in correct place) or clearly stated as coordinates,</p> <p>(2, -5) labelled or clearly stated.</p>	

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$$\begin{aligned} x_1 &= 1, \\ x_{n+1} &= x_n(p + x_n), \end{aligned}$$

(a) Find x_2 in terms of p . (1)

(b) Show that $x_3 = 1 + 3p + 2p^2$. (2)

(c) find the value of p ,

(3)

(d) write down the value of x_{2008} .

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Question number	Scheme	Marks
7.	<p>(a) $1(p+1)$ or $p+1$</p> <p>(b) $((a))(p+(a))$ [(a) must be a function of p]. $[(p+1)(p+p+1)]$ $= 1+3p+2p^2$ (*)</p> <p>(c) $1+3p+2p^2=1$ $p(2p+3)=0$ $p=...$ $p=-\frac{3}{2}$ (ignore $p=0$, if seen, even if 'chosen' as the answer)</p> <p>(d) Noting that even terms are the same. This M mark can be implied by listing at least 4 terms, e.g. $1, -\frac{1}{2}, 1, -\frac{1}{2}, \dots$ $x_{2008} = -\frac{1}{2}$</p>	<p>B1 (1)</p> <p>M1</p> <p>A1 cso (2)</p> <p>M1</p> <p>M1</p> <p>A1 (3)</p> <p>M1</p> <p>A1 (2)</p> <p>8</p>
	<p>(b) M: Valid attempt to use the given recurrence relation to find x_3. <u>Missing brackets</u>, e.g. $p+1(p+p+1)$ Condone for the M1, then if all terms in the expansion are correct, with working fully shown, M1 A1 is still allowed. Beware 'working back from the answer', e.g. $1+3p+2p^2=(1+p)(1+2p)$ scores no marks unless the recurrence relation is justified.</p> <p>(c) 2nd M: Attempt to solve a quadratic equation in p (e.g. quadratic formula or completing the square). The equation must be based on $x_3=1$. The attempt must lead to a non-zero solution, so just stating the zero solution $p=0$ is M0. A: The A mark is dependent on <u>both</u> M marks.</p> <p>(d) M: Can be implied by a correct answer for their p (answer is $p+1$), and can also be implied if the working is 'obscure'. Trivialising, e.g. $p=0$, so every term $=1$, is M0. If the <u>additional</u> answer $x_{2008}=1$ (from $p=0$) is seen, ignore this (isw).</p>	

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8. The equation

$$x^2 + kx + 8 = k$$

has no real solutions for x .

- (a) Show that k satisfies $k^2 + 4k - 32 < 0$.

(3)

- (b) Hence find the set of possible values of k .

(4)

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Question number	Scheme	Marks
8.	<p>(a) $x^2 + kx + (8 - k) = 0$ $8 - k$ need not be bracketed</p> <p>$b^2 - 4ac = k^2 - 4(8 - k)$</p> <p>$b^2 - 4ac < 0 \Rightarrow k^2 + 4k - 32 < 0$ (*)</p> <p>(b) $(k + 8)(k - 4) = 0$ $k = \dots$</p> <p>$k = -8$ $k = 4$</p> <p>Choosing 'inside' region (between the two k values)</p> <p>$-8 < k < 4$ or $4 > k > -8$</p>	<p>M1</p> <p>M1</p> <p>A1 cso (3)</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>A1 (4)</p> <p>7</p>
	<p>(a) 1st M: Using the k from the right hand side to form 3-term quadratic in x ('= 0' can be implied), or...</p> <p>attempting to complete the square $\left(x + \frac{k}{2}\right)^2 - \frac{k^2}{4} + 8 - k (= 0)$ or equiv., using the k from the right hand side.</p> <p>For either approach, <u>condone sign errors</u>.</p> <p>1st M may be implied when candidate moves straight to the discriminant.</p> <p>2nd M: Dependent on the 1st M.</p> <p>Forming expressions in k (with no x's) by using b^2 and $4ac$. (Usually seen as the discriminant $b^2 - 4ac$, but separate expressions are fine, and also allow the use of $b^2 + 4ac$.</p> <p>(For 'completing the square' approach, the expression must be clearly separated from the equation in x).</p> <p>If b^2 and $4ac$ are used in the <u>quadratic formula</u>, they must be clearly separated from the formula to score this mark.</p> <p>For any approach, <u>condone sign errors</u>.</p> <p>If the wrong statement $\sqrt{b^2 - 4ac} < 0$ is seen, maximum score is M1 M1 A0.</p> <p>(b) Condone the use of x (instead of k) in part (b).</p> <p>1st M: Attempt to solve a 3-term quadratic equation in k.</p> <p>It <u>might</u> be different from the given quadratic in part (a).</p> <p>Ignore the use of $<$ in solving the equation. The 1st M1 A1 can be scored if -8 and 4 are achieved, even if stated as $k < -8$, $k < 4$.</p> <p><u>Allow</u> the first M1 A1 to be scored in part (a).</p> <p>N.B. '$k > -8$, $k < 4$' scores 2nd M1 A0</p> <p>'$k > -8$ or $k < 4$' scores 2nd M1 A0</p> <p>'$k > -8$ and $k < 4$' scores 2nd M1 A1</p> <p>'$k = -7, -6, -5, -4, -3, -2, -1, 0, 1, 2, 3$' scores 2nd M0 A0</p> <p>Use of \leq (in the answer) loses the final mark.</p>	

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- Given that the point $P(4, 1)$ lies on C ,

- (a) find $f(x)$ and simplify your answer.

(6)

- (b) Find an equation of the normal to C at the point $P(4, 1)$.

(4)



Question number	Scheme	Marks
9.	<p>(a) $4x \rightarrow kx^2$ or $6\sqrt{x} \rightarrow kx^{3/2}$ or $\frac{8}{x^2} \rightarrow kx^{-1}$ (k a non-zero constant)</p> <p>$f(x) = 2x^2, -4x^{3/2}, -8x^{-1}$ (+ C) (+ C not required)</p> <p>At $x = 4, y = 1$: $1 = (2 \times 16) - \left(4 \times 4^{3/2}\right) - (8 \times 4^{-1}) + C$ <u>Must be in part (a)</u></p> <p>$C = 3$</p> <p>(b) $f'(4) = 16 - (6 \times 2) + \frac{8}{16} = \frac{9}{2} (= m)$ M: Attempt $f'(4)$ with the <u>given</u> f'. <u>Must be in part (b)</u></p> <p>Gradient of normal is $-\frac{2}{9} \left(= -\frac{1}{m}\right)$ M: Attempt perp. grad. rule. Dependent on the use of their $f'(x)$</p> <p>Eqn. of normal: $y - 1 = -\frac{2}{9}(x - 4)$ (or any equiv. form, e.g. $\frac{y-1}{x-4} = -\frac{2}{9}$)</p> <p>Typical answers for A1: $\left(y = -\frac{2}{9}x + \frac{17}{9}\right) (2x + 9y - 17 = 0) (y = -0.2\dot{x} + 1.\dot{8})$</p> <p>Final answer: gradient $-\frac{1}{\left(\frac{9}{2}\right)}$ or $-\frac{1}{4.5}$ is A0 (but all M marks are available).</p>	<p>M1</p> <p>A1, A1, A1</p> <p>M1</p> <p>A1 (6)</p> <p>M1</p> <p>M1</p> <p>M1 A1 (4)</p> <p>10</p>
	<p>(a) The first 3 A marks are awarded in the order shown, and the terms must be simplified.</p> <p>'Simplified' coefficient means $\frac{a}{b}$ where a and b are integers with no common factors. Only a single + or – sign is allowed (e.g. + – must be replaced by –).</p> <p>2nd M: Using $x = 4$ <u>and</u> $y = 1$ (<u>not</u> $y = 0$) to form an eqn in C. (No C is M0)</p> <p>(b) 2nd M: Dependent upon use of their $f'(x)$.</p> <p>3rd M: eqn. of a straight line through (4, 1) with any gradient except 0 or ∞.</p> <p><u>Alternative for 3rd M</u>: Using (4, 1) in $y = mx + c$ to <u>find a value</u> of c, but an equation (general or specific) must be seen.</p> <p>Having coords the <u>wrong way round</u>, e.g. $y - 4 = -\frac{2}{9}(x - 1)$, loses the 3rd M mark <u>unless</u> a correct general formula is seen, e.g. $y - y_1 = m(x - x_1)$.</p> <p>N.B. The A mark is scored for <u>any</u> form of the correct equation... be prepared to apply isw if necessary.</p>	

10. The curve C has equation

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

- (a) Sketch C showing clearly the coordinates of the points where the curve meets the coordinate axes.

(4)

- (b) Show that the equation of C can be written in the form

$$y = x^3 + x^2 - 5x + k,$$

where k is a positive integer, and state the value of k .

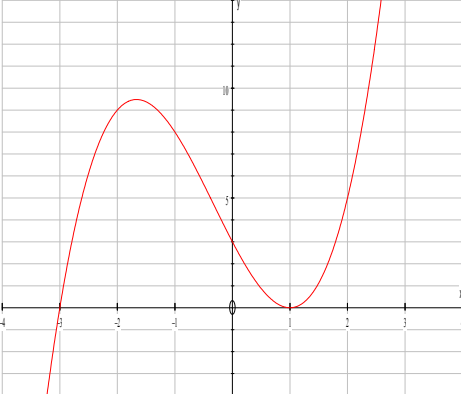

(2)

There are two points on C where the gradient of the tangent to C is equal to 3.

- (c) Find the x -coordinates of these two points.

(6)



Question number	Scheme	Marks
10.	<p>(a)</p>  <p>Shape  (drawn anywhere)</p> <p>Minimum at (1, 0) (perhaps labelled 1 on x-axis)</p> <p>(-3, 0) (or -3 shown on -ve x-axis)</p> <p>(0, 3) (or 3 shown on +ve y-axis)</p> <p>N.B. The max. can be anywhere.</p> <p>(b) $y = (x + 3)(x^2 - 2x + 1)$ $= x^3 + x^2 - 5x + 3$ ($k = 3$)</p> <p>(c) $\frac{dy}{dx} = 3x^2 + 2x - 5$</p> <p>$3x^2 + 2x - 5 = 3$ or $3x^2 + 2x - 8 = 0$</p> <p>$(3x - 4)(x + 2) = 0$ $x = \dots$</p> <p>$x = \frac{4}{3}$ (or exact equiv.) , $x = -2$</p>	<p>B1</p> <p>B1</p> <p>B1</p> <p>B1 (4)</p> <p>M1</p> <p>A1 cso (2)</p> <p>M1 A1</p> <p>M1</p> <p>M1</p> <p>A1, A1 (6)</p> <p>12</p>
	<p>(a) The individual marks are independent, <u>but</u> the 2nd, 3rd and 4th B's are dependent upon a sketch having been attempted.</p> <p>B marks for coordinates: Allow (0, 1), etc. (coordinates the wrong way round) <u>if</u> marked in the correct place on the sketch.</p> <p>(b) M: Attempt to multiply out $(x - 1)^2$ and write as a product with $(x + 3)$, or attempt to multiply out $(x + 3)(x - 1)$ and write as a product with $(x - 1)$, or attempt to expand $(x + 3)(x - 1)(x - 1)$ directly (at least 7 terms). The $(x - 1)^2$ or $(x + 3)(x - 1)$ expansion must have 3 (or 4) terms, so should not, for example, be just $x^2 + 1$.</p> <p>A: It is not necessary to state explicitly '$k = 3$'. Condone missing brackets if the intention seems clear and a fully correct expansion is seen.</p> <p>(c) 1st M: Attempt to differentiate (correct power of x in at least one term). 2nd M: Setting their derivative equal to 3. 3rd M: Attempt to solve a 3-term quadratic based on their derivative. The equation <u>could</u> come from $\frac{dy}{dx} = 0$. N.B. After an incorrect k value in (b), full marks are still possible in (c).</p>	

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(2)

(3)

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Question number	Scheme	Marks
11.	<p>(a) $u_{25} = a + 24d = 30 + 24 \times (-1.5)$ $= -6$</p> <p>(b) $a + (n-1)d = 30 - 1.5(r-1) = 0$ $r = 21$</p> <p>(c) $S_{20} = \frac{20}{2} \{60 + 19(-1.5)\}$ or $S_{21} = \frac{21}{2} \{60 + 20(-1.5)\}$ or $S_{21} = \frac{21}{2} \{30 + 0\}$ $= 315$</p>	<p>M1 A1 (2)</p> <p>M1 A1 (2)</p> <p>M1 A1ft A1 (3)</p> <p>7</p>
	<p>(a) M: Substitution of $a = 30$ and $d = \pm 1.5$ into $(a + 24d)$. Use of $a + 25d$ (or any other variations on 24) scores M0.</p> <p>(b) M: Attempting to use the term formula, equated to 0, to form an equation in r (with no other unknowns). Allow this to be called n instead of r. Here, being 'one off' (e.g. equivalent to $a + nd$), scores M1.</p> <p>(c) M: Attempting to use the correct sum formula to obtain S_{20}, S_{21}, or, with their r from part (b), S_{r-1} or S_r. 1st A(ft): A correct numerical expression for S_{20}, S_{21}, or, with their r from part (b), S_{r-1} or S_r but the ft is dependent on an <u>integer</u> value of r. Methods such as calculus to find a maximum only begin to score marks <u>after</u> establishing a value of r at which the maximum sum occurs. This value of r can be used for the M1 A1ft, but must be a positive integer to score A marks, so evaluation with, say, $n = 20.5$ would score M1 A0 A0.</p> <p><u>'Listing' and other methods</u></p> <p>(a) M: Listing terms (found by a correct method), and picking the <u>25th</u> term. (There may be numerical slips).</p> <p>(b) M: Listing terms (found by a correct method), until the zero term is seen. (There may be numerical slips). 'Trial and error' approaches (or where working is unclear or non-existent) score M1 A1 for 21, M1 A0 for 20 or 22, and M0 A0 otherwise.</p> <p>(c) M: Listing sums, or listing and adding terms (found by a correct method), at least as far as the 20th term. (There may be numerical slips). A2 (scored as A1 A1) for 315 (clearly selected as the answer). 'Trial and error' approaches essentially follow the main scheme, beginning to score marks when trying S_{20}, S_{21}, or, with their r from part (b), S_{r-1} or S_r. If no working (or no legitimate working) is seen, but the answer 315 is given, allow one mark (scored as M1 A0 A0).</p> <p><u>For reference:</u> Sums: 30, 58.5, 85.5, 111, 135, 157.5, 178.5, 198, 216, 232.5, 247.5, 261, 273, 283.5, 292.5, 300, 306, 310.5, 313.5, 315,</p>	