

GCE

Edexcel GCE

Mathematics

Core Mathematics C1 (6663)

June 2006

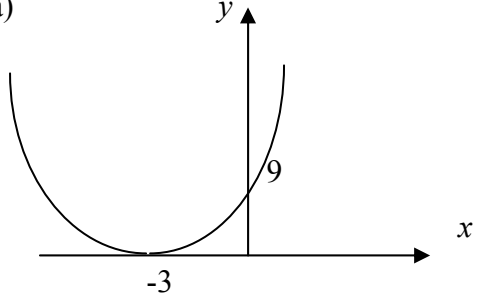
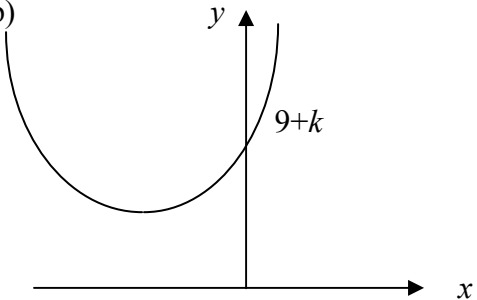
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Mark Scheme (Results)

June 2006  
6663 Core Mathematics C1  
Mark Scheme

| Question number | Scheme   | Marks  |
|-----------------|--|--|
| 1.              | $\frac{6x^3}{3} + 2x + \frac{x^{\frac{1}{2}}}{\frac{1}{2}} \quad (+c)$ $= 2x^3 + 2x + 2x^{\frac{1}{2}} + c$  | M1<br>A1<br>A1<br>B1<br><p style="text-align: right;"><b>4</b></p> |
|                 | <p>M1 for some attempt to integrate <math>x^n \rightarrow x^{n+1}</math></p> <p>1<sup>st</sup> A1 for either <math>\frac{6}{3}x^3</math> or <math>\frac{x^{\frac{1}{2}}}{\frac{1}{2}}</math> or better</p> <p>2<sup>nd</sup> A1 for all terms in <math>x</math> correct. Allow <math>2\sqrt{x}</math> and <math>2x^1</math>.</p> <p>B1 for <math>+c</math>, when first seen with a changed expression.</p> |  |



| Question number | Scheme  |  | Marks   |
|-----------------|---|--|---|
| 3.              | <p>(a)</p>  <p>(b)</p>  | <p>U shape touching <math>x</math>-axis</p> <p><math>(-3, 0)</math></p> <p><math>(0, 9)</math></p><br><p>Translated parallel to <math>y</math>-axis up</p> <p><math>(0, 9+k)</math></p>          | <p>B1</p> <p>B1</p> <p>B1</p> <p>(3)</p><br><p>M1</p> <p>B1f.t.</p> <p>(2)</p> <p style="text-align: right;"><b>5</b></p> |
| (a)             | <p>2<sup>nd</sup> B1</p> <p>2<sup>nd</sup> B1 &amp; 3<sup>rd</sup> B1</p>   | <p>They can score this even if other intersections with the <math>x</math>-axis are given.</p> <p>The -3 and 9 can appear on the sketch as shown</p>   |   |
| (b)             | <p>M1</p> <p>B1f.t.</p>   | <p>Follow their curve in (a) up only.</p> <p>If it is not obvious do not give it. e.g. if it cuts <math>y</math>-axis in (a) but doesn't in (b) then it is M0.</p> <p>Follow through their 9</p> |   |

| Question number | Scheme  | Marks  |
|-----------------|---|--|
| 4. (a)          | $a_2 = 4$<br>$a_3 = 3 \times a_2 - 5 = 7$   | B1<br>B1f.t. (2)                                 |
| (b)             | $a_4 = 3a_3 - 5 (= 16)$ and $a_5 = 3a_4 - 5 (= 43)$<br><br>$3 + 4 + 7 + 16 + 43$<br><br>$= 73$  | M1<br><br>M1<br><br>Alc.a.o. (3)<br><br><b>5</b> |
| (a)             | <p>2<sup>nd</sup> B1f.t. Follow through their <math>a_2</math> but it must be a value. <math>3 \times 4 - 5</math> is B0 Give wherever it is first seen.</p>  |  |
| (b)             | <p>1<sup>st</sup> M1 For two further attempts to use of <math>a_{n+1} = 3a_n - 5</math>, wherever seen. Condone arithmetic slips</p> <p>2<sup>nd</sup> M1 For attempting to add 5 relevant terms (i.e. terms derived from an attempt to use the recurrence formula) or an expression. Follow through their values for <math>a_2 - a_5</math></p> <p>Use of formulae for arithmetic series is M0A0 but could get 1<sup>st</sup> M1 if <math>a_4</math> and <math>a_5</math> are correctly attempted.</p> |  |

| Question number | Scheme   | Marks                     |
|-----------------|--|---------------------------|
| 5. (a)          | $(y = x^4 + 6x^{\frac{1}{2}} \Rightarrow y' =) 4x^3 + 3x^{-\frac{1}{2}}$ or $4x^3 + \frac{3}{\sqrt{x}}$  | M1A1A1 (3)                |
| (b)             | $(x+4)^2 = x^2 + 8x + 16$<br>$\frac{(x+4)^2}{x} = x + 8 + 16x^{-1}$ (allow 4+4 for 8)<br>$(y = \frac{(x+4)^2}{x} \Rightarrow y' =) 1 - 16x^{-2}$ o.e.  | M1<br>A1<br>M1A1 (4)<br>7 |
| (a)             | M1 For some attempt to differentiate $x^n \rightarrow x^{n-1}$<br>1 <sup>st</sup> A1 For one correct term as printed.<br>2 <sup>nd</sup> A1 For both terms correct as printed.<br>$4x^3 + 3x^{-\frac{1}{2}} + c$ scores M1A1A0   |                           |
| (b)             | 1 <sup>st</sup> M1 For attempt to expand $(x+4)^2$ , must have $x^2, x, x^0$ terms and at least 2 correct<br>e.g. $x^2 + 8x + 8$ or $x^2 + 2x + 16$<br>1 <sup>st</sup> A1 Correct expression for $\frac{(x+4)^2}{x}$ . As printed but allow $\frac{16}{x}$ and $8x^0$ .<br>2 <sup>nd</sup> M1 For some correct differentiation, any term. Can follow through their simplification.<br>N.B. $\frac{x^2 + 8x + 16}{x}$ giving rise to $(2x + 8)/1$ is M0A0 |                           |
| ALT             | <u>Product or Quotient rule (If in doubt send to review)</u><br>M2 For correct use of product or quotient rule. Apply usual rules on formulae.<br>1 <sup>st</sup> A1 For $\frac{2(x+4)}{x}$ or $\frac{2x(x+4)}{x^2}$<br>2 <sup>nd</sup> A1 for $-\frac{(x+4)^2}{x^2}$  |                           |

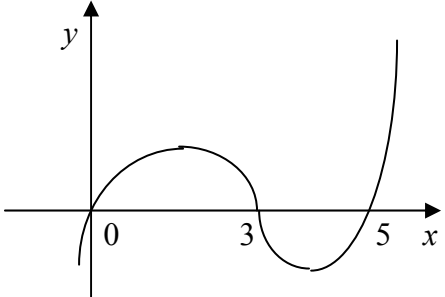
| Question number | Scheme  | Marks                    |
|-----------------|---|--------------------------|
| 6. (a)          | $16 + 4\sqrt{3} - 4\sqrt{3} - (\sqrt{3})^2 \text{ or } 16 - 3$ $= 13$   | M1<br>A1c.a.o (2)        |
| (b)             | $\frac{26}{4 + \sqrt{3}} \times \frac{4 - \sqrt{3}}{4 - \sqrt{3}}$ $= \frac{26(4 - \sqrt{3})}{13} = \underline{8 - 2\sqrt{3}} \quad \text{or} \quad 8 + (-2)\sqrt{3} \quad \text{or} \quad a = 8 \text{ and } b = -2$   | M1<br>A1 (2)<br><b>4</b> |
| (a)             | <p>M1 For 4 terms, at least 3 correct</p> <p>e.g. <math>8 + 4\sqrt{3} - 4\sqrt{3} - (\sqrt{3})^2</math> or <math>16 \pm 8\sqrt{3} - (\sqrt{3})^2</math> or <math>16 + 3</math></p> <p><math>4^2</math> instead of 16 is OK</p> <p><math>(4 + \sqrt{3})(4 + \sqrt{3})</math> scores M0A0</p> |                          |
| (b)             | <p>M1 For a correct attempt to rationalise the denominator</p> <p>Can be implied</p> <p>NB <math>\frac{-4 + \sqrt{3}}{-4 + \sqrt{3}}</math> is OK</p>   |                          |

| Question number | Scheme   | Marks                                      |
|-----------------|--|--|
| 7.              | $a + (n-1)d = k \quad k = 9 \text{ or } 11$ $(u_{11} =) a + 10d = 9$ $\frac{n}{2}[2a + (n-1)d] = 77 \text{ or } \frac{(a+l)}{2} \times n = 77 \quad l = 9 \text{ or } 11$ $(S_{11} =) \frac{11}{2}(2a + 10d) = 77 \text{ or } \frac{(a+9)}{2} \times 11 = 77$ <p>e.g. <math>a + 10d = 9</math> or <math>a + 9 = 14</math><br/> <math>a + 5d = 7</math></p> $a = 5 \text{ and } d = 0.4 \text{ or exact equivalent}$  | M1<br>A1 c.a.o.<br>M1<br>A1<br>M1<br>A1 A1 |
|                 | <p>1<sup>st</sup> M1 Use of <math>u_n</math> to form a linear equation in <math>a</math> and <math>d</math>. <math>a + nd = 9</math> is M0A0</p> <p>1<sup>st</sup> A1 For <math>a + 10d = 9</math>.</p> <p>2<sup>nd</sup> M1 Use of <math>S_n</math> to form an equation for <math>a</math> and <math>d</math> (LHS) or in <math>a</math> (RHS)</p> <p>2<sup>nd</sup> A1 A correct equation based on <math>S_n</math>.<br/>For 1<sup>st</sup> 2 Ms they must write <math>n</math> or use <math>n = 11</math>.</p> <p>3<sup>rd</sup> M1 Solving (LHS simultaneously) or (RHS a linear equation in <math>a</math>)<br/>Must lead to <math>a = \dots</math> or <math>d = \dots</math> and depends on one previous M</p> <p>3<sup>rd</sup> A1 for <math>a = 5</math></p> <p>4<sup>th</sup> A1 for <math>d = 0.4</math> (o.e.)</p> <p><u>ALT</u> Uses <math>\frac{(a+l)}{2} \times n = 77</math> to get <math>a = 5</math>, gets second and third M1A1 i.e. 4/7<br/>Then uses <math>\frac{n}{2}[2a + (n-1)d] = 77</math> to get <math>d</math>, gets 1<sup>st</sup> M1A1 and 4<sup>th</sup> A1</p> <p><u>MR</u> Consistent MR of 11 for 9 leading to <math>a = 3</math>, <math>d = 0.8</math> scores M1A0M1A0M1A1ftA1ft</p> | 7  |



| Question number              | Scheme  | Marks                            |
|------------------------------|---|----------------------------------|
| 8. (a)                       | $b^2 - 4ac = 4p^2 - 4(3p + 4) = 4p^2 - 12p - 16 (=0)$ <p>or <math>(x + p)^2 - p^2 + (3p + 4) = 0 \Rightarrow p^2 - 3p - 4 (=0)</math></p> $(p - 4)(p + 1) = 0$ $p = (-1 \text{ or } 4)$   | M1, A1<br><br>M1<br>A1c.s.o. (4) |
| (b)                          | $x = \frac{-b}{2a} \text{ or } (x + p)(x + p) = 0 \Rightarrow x = \dots$ $x (= -p) = \underline{-4}$  | M1<br><br>A1f.t. (2)             |
| (a)                          | 1 <sup>st</sup> M1      For use of $b^2 - 4ac$ or a full attempt to complete the square leading to a 3TQ in $p$ .<br>May use $b^2 = 4ac$ . One of $b$ or $c$ must be correct.<br>1 <sup>st</sup> A1      For a correct 3TQ in $p$ . Condone missing “=0” but all 3 terms must be on one side.<br>2 <sup>nd</sup> M1      For attempt to solve their 3TQ leading to $p = \dots$<br>2 <sup>nd</sup> A1      For $p = 4$ (ignore $p = -1$ ).<br>$b^2 = 4ac$ leading to $p^2 = 4(3p + 4)$ and then "spotting" $p = 4$ scores 4/4. |                                  |
| (b)                          | M1      For a full method leading to a repeated root $x = \dots$<br>A1f.t.      For $x = -4$ (- their $p$ )   |                                  |
| <u>Trial and Improvement</u> |   |                                  |
|                              | M2      For substituting values of $p$ into the equation and attempting to factorize.<br>(Really need to get to $p = 4$ or $-1$ )   |                                  |
|                              | A2c.s.o.      Achieve $p = 4$ . Don't give without valid method being seen.   |                                  |

**6**

| Question number | Scheme   | Marks   |
|-----------------|--|---|
| 9. (a)          | $f(x) = x[(x-6)(x-2)+3]$ or $x^3 - 6x^2 - 2x^2 + 12x + 3x = x(x^2 - 8x + 15)$<br>$f(x) = x(x^2 - 8x + 15)$   | M1<br>A1<br>A1 (3)  |
| (b)             | $(x^2 - 8x + 15) = (x-5)(x-3)$<br>$f(x) = x(x-5)(x-3)$   | M1<br>A1 (2)  |
| (c)             |    | Shape<br>their 3 <u>or</u> their 5<br><u>both</u> their 3 <u>and</u> their 5 and (0,0) by implication<br>B1<br>B1f.t.<br>B1f.t. (3) |
| (a)             | M1 for a correct method to get the factor of $x$ . $x($ as printed is the minimum.<br>1 <sup>st</sup> A1 for $b = -8$ or $c = 15$ .<br>-8 comes from $-6-2$ and must be coefficient of $x$ , and 15 from $6x^2+3$ and must have no $x$ s.<br>2 <sup>nd</sup> A1 for $a=1$ , $b = -8$ and $c = 15$ . Must have $x(x^2 - 8x + 15)$ . | <b>8</b>  |
| (b)             | M1 for attempt to factorise their 3TQ from part (a).<br>A1 for all 3 terms correct. They must include the $x$ .<br>For part (c) they must have <u>at most</u> 2 non-zero roots of their $f(x) = 0$ to fit their 3 and their 5.   |   |
| (c)             | 1 <sup>st</sup> B1 for correct shape (i.e. from bottom left to top right and two turning points.)<br>2 <sup>nd</sup> B1f.t. for crossing at their 3 or their 5 indicated on graph or in text.<br>3 <sup>rd</sup> B1f.t. if graph passes through (0, 0) [needn't be marked] and both their 3 and their 5.                           |   |

| Question number                                   | Scheme  | Marks  |
|---|---|--|
| 10.(a)  | $f(x) = \frac{2x^2}{2} + \frac{3x^{-1}}{-1} (+c)$ $(3, 7\frac{1}{2}) \text{ gives } \frac{15}{2} = 9 - \frac{3}{3} + c$ $c = -\frac{1}{2}$  | $-\frac{3}{x}$ is OK<br>$3^2$ or $3^{-1}$ are OK instead of 9 or $\frac{1}{3}$<br>M1A1<br>M1A1f.t.<br>A1 (5) |
| (b)   | $f(-2) = 4 + \frac{3}{2} - \frac{1}{2} \quad (*)$   | B1c.s.o. (1)   |
| (c)   | $m = -4 + \frac{3}{4}, = -3.25$<br>Equation of tangent is: $y - 5 = -3.25(x + 2)$<br><u><math>4y + 13x + 6 = 0</math></u>   | M1,A1<br>M1<br>A1 (4)<br>o.e.  |
| <b>10</b>   |   |  |
| (a)   | 1 <sup>st</sup> M1 for some attempt to integrate $x^n \rightarrow x^{n+1}$<br>1 <sup>st</sup> A1 for both $x$ terms as printed or better. Ignore $(+c)$ here.<br>2 <sup>nd</sup> M1 for use of $(3, 7\frac{1}{2})$ or $(-2, 5)$ to form an equation for $c$ . There must be some correct substitution. No $+c$ is M0. Some changes in $x$ terms of function needed.<br>2 <sup>nd</sup> A1f.t. for a correct equation for $c$ . Follow through their integration. They must tidy up fraction/fraction and signs (e.g. - - to +). |  |
| (b)   | B1cso If $(-2, 5)$ is used to find $c$ in (a) B0 here unless they verify $f(3)=7.5$ .   |  |
| (c)   | 1 <sup>st</sup> M1 for attempting $m = f'(\pm 2)$<br>1 <sup>st</sup> A1 for $-\frac{13}{4}$ or $-3.25$<br>2 <sup>nd</sup> M1 for attempting equation of tangent at $(-2, 5)$ , f.t. their $m$ , based on $\frac{dy}{dx}$ .<br>2 <sup>nd</sup> A1 o.e. must have $a, b$ and $c$ integers and $= 0$ .   |  |
| Treat (a) and (b) together as a batch of 6 marks. |   |  |

| Question number | Scheme  | Marks   |
|-----------------|---|---|
| 11.(a)          | $m = \frac{8-2}{11+1} (= \frac{1}{2})$ $y - 2 = \frac{1}{2}(x - -1) \quad \text{or} \quad y - 8 = \frac{1}{2}(x - 11) \quad \text{o.e.}$ $y = \frac{1}{2}x + \frac{5}{2} \quad \text{accept exact equivalents e.g. } \frac{6}{12}$ <p>(b) Gradient of <math>l_2 = -2</math></p> <p>Equation of <math>l_2: y - 0 = -2(x - 10) \quad [y = -2x + 20]</math></p> $\frac{1}{2}x + \frac{5}{2} = -2x + 20$ $\underline{x = 7 \quad \text{and} \quad y = 6}$ <p>(c) <math>RS^2 = (10 - 7)^2 + (0 - 6)^2 (= 3^2 + 6^2)</math></p> $RS = \sqrt{45} = 3\sqrt{5} \quad (*)$ <p>(d) <math>PQ = \sqrt{12^2 + 6^2} = 6\sqrt{5} \quad \text{or} \quad \sqrt{180} \quad \text{or} \quad PS = 4\sqrt{5} \quad \text{and} \quad SQ = 2\sqrt{5}</math></p> $\text{Area} = \frac{1}{2}PQ \times RS = \frac{1}{2}6\sqrt{5} \times 3\sqrt{5}$ $\underline{= 45}$  | <p>M1 A1</p> <p>M1</p> <p>A1c.a.o. (4)</p> <p>M1</p> <p>M1</p> <p>M1</p> <p>A1, A1 (5)</p> <p>M1</p> <p>A1c.s.o. (2)</p> <p>M1, A1</p> <p>dM1</p> <p>A1 c.a.o. (4)</p> <p><b>15</b></p> |
| (a)             | <p>1<sup>st</sup> M1 for attempting <math>\frac{y_1 - y_2}{x_1 - x_2}</math>, must be <math>y</math> over <math>x</math>. No formula condone one sign slip, but if formula is quoted then there must be some correct substitution.</p> <p>1<sup>st</sup> A1 for a fully correct expression, needn't be simplified.</p> <p>2<sup>nd</sup> M1 for attempting to find equation of <math>l_1</math>.</p> <p>(b) 1<sup>st</sup> M1 for using the perpendicular gradient rule</p> <p>2<sup>nd</sup> M1 for attempting to find equation of <math>l_2</math>. Follow their gradient provided different.</p> <p>3<sup>rd</sup> M1 for forming a suitable equation to find <math>S</math>.</p> <p>(c) M1 for expression for <math>RS</math> or <math>RS^2</math>. Ft their <math>S</math> coordinates</p> <p>(d) 1<sup>st</sup> M1 for expression for <math>PQ</math> or <math>PQ^2</math>. <math>PQ^2 = 12^2 + 6^2</math> is M1 but <math>PQ = 12^2 + 6^2</math> is M0</p> <p>Allow one numerical slip.</p> <p>2<sup>nd</sup> dM1 for a full, correct attempt at area of triangle. Dependent on previous M1.</p> |   |

## GENERAL PRINCIPLES FOR C1 MARKING

### Method mark for solving 3 term quadratic:

#### 1. Factorisation

$(x^2 + bx + c) = (x + p)(x + q)$ , where  $|pq| = |c|$ , leading to  $x = \dots$

$(ax^2 + bx + c) = (mx + p)(nx + q)$ , where  $|pq| = |c|$  and  $|mn| = |a|$ , leading to  $x = \dots$

#### 2. Formula

Attempt to use correct formula (with values for  $a$ ,  $b$  and  $c$ ).

#### 3. Completing the square

Solving  $x^2 + bx + c = 0$ :  $(x \pm p)^2 \pm q \pm c$ ,  $p \neq 0$ ,  $q \neq 0$ , leading to  $x = \dots$

### Method marks for differentiation and integration:

#### 1. Differentiation

Power of at least one term decreased by 1. ( $x^n \rightarrow x^{n-1}$ )

#### 2. Integration

Power of at least one term increased by 1. ( $x^n \rightarrow x^{n+1}$ )

### Use of a formula

Where a method involves using a formula that has been learnt, the advice given in recent examiners' reports is that the formula should be quoted first.

Normal marking procedure is as follows:

Method mark for quoting a correct formula and attempting to use it, even if there are mistakes in the substitution of values. There must be some correct substitution.

Where the formula is not quoted, the method mark can be gained by implication from correct working with values, but will be lost if there is any mistake in the working.

### Exact answers

Examiners' reports have emphasised that where, for example, an exact answer is asked for, or working with surds is clearly required, marks will normally be lost if the candidate resorts to using rounded decimals.

### Answers without working

The rubric says that these may gain no credit. Individual mark schemes will give details of what happens in particular cases. General policy is that if it could be done "in your head", detailed working would not be required. Most candidates do show working, but there are occasional awkward cases and if the mark scheme does not cover this, please contact your team leader for advice.

### Misreads

A misread must be consistent for the whole question to be interpreted as such.

These are not common. In clear cases, please deduct the first 2 A (or B) marks which would have been lost by following the scheme. (Note that 2 marks is the maximum misread penalty, but that misreads which alter the nature or difficulty of the question cannot be treated so generously and it will usually be necessary here to follow the scheme as written).

Sometimes following the scheme as written is more generous to the candidate than applying the misread rule, so in this case use the scheme as written.