

# Mark Scheme (Results)

## January 2011

GCE

### GCE Core Mathematics C1 (6663) Paper 1

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## General Instructions for Marking

1. The total number of marks for the paper is 75.
2. The Edexcel Mathematics mark schemes use the following types of marks:
  - **M** marks: method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
  - **A** marks: Accuracy marks can only be awarded if the relevant method (M) marks have been earned.
  - **B** marks are unconditional accuracy marks (independent of M marks)
  - Marks should not be subdivided.

3. Abbreviations

These are some of the traditional marking abbreviations that will appear in the mark schemes and can be used if you are using the annotation facility on ePEN.

- bod - benefit of doubt
- ft - follow through
- the symbol  $\sqrt{\phantom{x}}$  will be used for correct ft
- cao - correct answer only
- cso - correct solution only. There must be no errors in this part of the question to obtain this mark
- isw - ignore subsequent working
- awrt - answers which round to
- SC: special case
- oe - or equivalent (and appropriate)
- dep - dependent
- indep - independent
- dp decimal places
- sf significant figures
- \* The answer is printed on the paper
- $\square$  The second mark is dependent on gaining the first mark

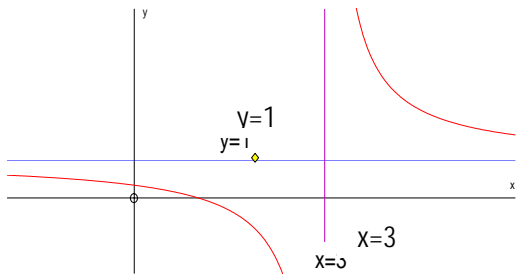
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Mark Scheme

| Question Number | Scheme   | Marks                            |
|-----------------|--|----------------------------------|
| 1.<br>(a)       | $16^{\frac{1}{4}} = 2$ or $\frac{1}{16^{\frac{1}{4}}}$ or better<br>$\left(16^{-\frac{1}{4}} = \right) \frac{1}{2}$ or 0.5 (ignore $\pm$ )   | M1<br><br>A1<br><br>(2)          |
| (b)             | $\left(2x^{-\frac{1}{4}}\right)^4 = 2^4 x^{-\frac{4}{4}}$ or $\frac{2^4}{x^{\frac{4}{4}}}$ or equivalent<br>$x\left(2x^{-\frac{1}{4}}\right)^4 = 2^4$ or 16  | M1<br><br>A1 cao<br><br>(2)<br>4 |
| <b>Notes</b>    |  |                                  |
| (a)             | M1 for a correct statement dealing with the $\frac{1}{4}$ or the $-$ power<br>This may be awarded if 2 is seen or for reciprocal of their $16^{\frac{1}{4}}$<br>s.c $\frac{1}{4}$ is M1 A0 , also $2^{-1}$ is M1 A0<br>$\pm \frac{1}{2}$ is not penalised so M1 A1 |                                  |
| (b)             | M1 for <b>correct</b> use of the power 4 on both the 2 and the $x$ terms<br>A1 for cancelling the $x$ and simplifying to one of these two forms.<br>Correct answers with no working get full marks   |                                  |

| Question Number | Scheme   | Marks                                |
|-----------------|--|--------------------------------------|
| 2.              | $\left(\int\right)\frac{12x^6}{6}, -\frac{3x^3}{3}, +\frac{4x^{\frac{4}{3}}}{\frac{4}{3}}, (+c)$ $= \underline{2x^6 - x^3 + 3x^{\frac{4}{3}} + c}$   | <p>M1A1,A1,A1</p> <p>A1</p> <p>5</p> |
|                 | <b>Notes</b>   |                                      |
|                 | <p>M1 for some attempt to integrate: <math>x^n \rightarrow x^{n+1}</math> i.e <math>ax^6</math> or <math>ax^3</math> or <math>ax^{\frac{4}{3}}</math> or <math>ax^{\frac{1}{3}}</math>, where <math>a</math> is a non zero constant</p> <p>1<sup>st</sup> A1 for <math>\frac{12x^6}{6}</math> or better</p> <p>2<sup>nd</sup> A1 for <math>-\frac{3x^3}{3}</math> or better</p> <p>3<sup>rd</sup> A1 for <math>\frac{4x^{\frac{4}{3}}}{\frac{4}{3}}</math> or better</p> <p>4<sup>th</sup> A1 for each term correct and simplified and the <math>+c</math> occurring in the final answer</p> |                                      |

| Question Number | Scheme   | Marks   |
|-----------------|--|---|
| 3.              | $\frac{5-2\sqrt{3}}{\sqrt{3}-1} \times \frac{(\sqrt{3}+1)}{(\sqrt{3}+1)}$ $= \frac{\dots}{2} \quad \text{denominator of 2}$ <p>Numerator = <math>5\sqrt{3} + 5 - 2\sqrt{3}\sqrt{3} - 2\sqrt{3}</math></p> <p>So <math>\frac{5-2\sqrt{3}}{\sqrt{3}-1} = -\frac{1}{2} + \frac{3}{2}\sqrt{3}</math></p>   | <p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p><b>4</b></p> |
|                 | <p><b>Alternative:</b> <math>(p+q\sqrt{3})(\sqrt{3}-1) = 5-2\sqrt{3}</math>, and form simultaneous equations in <math>p</math> and <math>q</math></p> <p><math>-p+3q=5</math> and <math>p-q=-2</math></p> <p>Solve simultaneous equations to give <math>p = -\frac{1}{2}</math> and <math>q = \frac{3}{2}</math>.</p>  | <p>M1</p> <p>A1</p> <p>M1 A1</p>                        |
|                 | <b>Notes</b>   |   |
|                 | <p>1<sup>st</sup> M1 for multiplying numerator and denominator by same correct expression</p> <p>1<sup>st</sup> A1 for a correct denominator as a single number (NB depends on M mark)</p> <p>2<sup>nd</sup> M1 for an attempt to multiply the numerator by <math>(\sqrt{3} \pm 1)</math> and get 4 terms with at least 2 correct.</p> <p>2<sup>nd</sup> A1 for the answer as written or <math>p = -\frac{1}{2}</math> and <math>q = \frac{3}{2}</math>. Allow <math>-0.5</math> and <math>1.5</math>. (Apply isw if correct answer seen, then slip writing <math>p = , q =</math> )</p> |   |
|                 | Answer only (very unlikely) is full marks if correct – no part marks   |   |

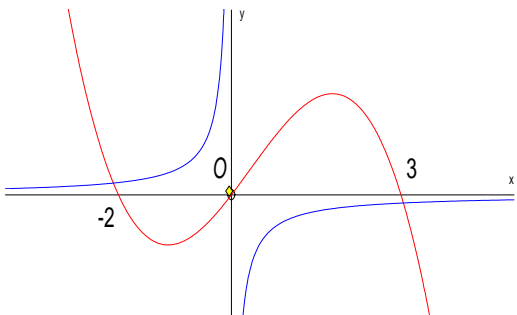
| Question Number | Scheme  | Marks                                    |
|-----------------|---|--|
| 4               |   |  |
| (a)             | $(a_2 =) 6 - c$   | B1<br>(1)                                |
| (b)             | $a_3 = 3(\text{their } a_2) - c \quad (= 18 - 4c)$<br>$a_1 + a_2 + a_3 = 2 + "(6 - c)" + "(18 - 4c)"$<br>$"26 - 5c" = 0$<br>So $c = 5.2$  | M1<br>M1<br>A1ft<br>A1 o.a.e<br>(4)<br>5 |
|                 | <b>Notes</b>  |  |
| (b)             | 1 <sup>st</sup> M1 for attempting $a_3$ . Can follow through their answer to (a) but it must be an expression in $c$ .<br>2 <sup>nd</sup> M1 for an attempt to find the sum $a_1 + a_2 + a_3$ must see evidence of sum<br>1 <sup>st</sup> A1ft for their sum put equal to 0. Follow through their values but answer must be in the form $p + qc = 0$<br>A1 – accept any correct equivalent answer |  |

| Question Number | Scheme  | Marks   |
|-----------------|---|---|
| 5.<br>(a)       |  <p>Correct shape with a single crossing of each axis</p> <p><math>y = 1</math> labelled or stated</p> <p><math>x = 3</math> labelled or stated</p>  | <p>B1</p> <p>B1</p> <p>B1</p> <p>(3)</p>                    |
| (b)             | <p>Horizontal translation so crosses the <math>x</math>-axis at <math>(1, 0)</math></p> <p>New equation is <math>(y =) \frac{x \pm 1}{(x \pm 1) - 2}</math></p> <p>When <math>x = 0</math> <math>y =</math></p> $= \frac{1}{3}$   | <p>B1</p> <p>M1</p> <p>M1</p> <p>A1</p> <p>(4)</p> <p>7</p> |
| <b>Notes</b>    |   |   |
| (b)             | <p>B1 for point <math>(1, 0)</math> identified - this may be marked on the sketch as 1 on <math>x</math> axis. Accept <math>x = 1</math>.</p> <p>1<sup>st</sup> M1 for attempt at new equation and either numerator or denominator correct</p> <p>2<sup>nd</sup> M1 for setting <math>x = 0</math> in their new equation and solving as far as <math>y = \dots</math></p> <p>A1 for <math>\frac{1}{3}</math> or exact equivalent. Must see <math>y = \frac{1}{3}</math> or <math>(0, \frac{1}{3})</math> or point marked on <math>y</math>-axis.</p> <p><b>Alternative</b></p> <p><math>f(-1) = \frac{-1}{-1-2} = \frac{1}{3}</math> scores M1M1A0 unless <math>x = 0</math> is seen or they write the point as <math>(0, \frac{1}{3})</math> or give <math>y = 1/3</math></p> <p>Answers only: <math>x = 1</math>, <math>y = 1/3</math> is full marks as is <math>(1, 0)</math> <math>(0, 1/3)</math></p> <p>Just 1 and <math>1/3</math> is B0 M1 M1 A0</p> <p>Special case : Translates 1 unit to left</p> <p>(a) B0, B1, B0</p> <p>(b) Mark (b) as before</p> <p>May score B0 M1 M1 A0 so 3/7 or may ignore sketch and start again scoring full marks for this part.</p> |   |

| Question Number | Scheme  | Marks   |
|-----------------|---|---|
| 6.<br>(a)       | $S_{10} = \frac{10}{2}[2a + 9d] \text{ or}$ $S_{10} = a + a + d + a + 2d + a + 3d + a + 4d + a + 5d + a + 6d + a + 7d + a + 8d + a + 9d$ $162 = 10a + 45d \quad *$  | M1<br><br>A1cso<br>(2)                                |
| (b)             | $(u_n = a + (n-1)d \Rightarrow ) 17 = a + 5d$<br>$10 \times (b) \text{ gives } 10a + 50d = 170$ $(a) \text{ is } 10a + 45d = 162$<br>Subtract $5d = 8$ so $d = \underline{1.6}$ o.e.<br>Solving for $a$ $a = 17 - 5d$<br>so $a = \underline{9}$ | B1<br>(1)<br><br>M1<br><br>A1<br>M1<br>A1<br>(4)<br>7 |
|                 | <b>Notes</b>  |   |
| (a)             | M1 for use of $S_n$ with $n = 10$   |   |
| (b)             | 1 <sup>st</sup> M1 for an attempt to eliminate $a$ or $d$ from their two linear equations<br>2 <sup>nd</sup> M1 for using their value of $a$ or $d$ to find the other value.  |   |

| Question Number | Scheme   | Marks                                |
|-----------------|--|--------------------------------------|
| 7.              | $(f(x) =) \frac{12x^3}{3} - \frac{8x^2}{2} + x(+c)$ $(f(-1) = 0 \Rightarrow) 0 = 4 \times (-1) - 4 \times 1 - 1 + c$ $c = 9$ $[f(x) = 4x^3 - 4x^2 + x + 9]$  | M1 A1 A1<br>M1<br>A1<br><br>5        |
|                 | <b>Notes</b>   |                                      |
|                 | 1 <sup>st</sup> M1 for an attempt to integrate $x^n \rightarrow x^{n+1}$<br>1 <sup>st</sup> A1 for at least 2 terms in $x$ correct - needn't be simplified, ignore $+c$<br>2 <sup>nd</sup> A1 for all the terms in $x$ correct but they need not be simplified. No need for $+c$<br>2 <sup>nd</sup> M1 for using $x = -1$ and $y = 0$ to form a linear equation in $c$ . No $+c$ gets M0A0<br>3 <sup>rd</sup> A1 for $c = 9$ . Final form of $f(x)$ is not required. |                                      |
| 8 .             | (a) $b^2 - 4ac = (k-3)^2 - 4(3-2k)$<br>$k^2 - 6k + 9 - 4(3-2k) > 0$ or $(k-3)^2 - 12 + 8k > 0$ or better<br>$\underline{k^2 + 2k - 3 > 0}$ *   | M1<br><br>M1<br>A1cso<br>(3)         |
|                 | (b) $(k+3)(k-1)[= 0]$<br>Critical values are $k = 1$ or $-3$<br>(choosing "outside" region)<br>$\underline{k > 1}$ or $\underline{k < -3}$   | M1<br>A1<br>M1<br>A1 cao<br>(4)<br>7 |
|                 | <b>Notes</b>   |                                      |
|                 | (a) 1 <sup>st</sup> M1 for attempt to find $b^2 - 4ac$ with one of $b$ or $c$ correct<br>2 <sup>nd</sup> M1 for a correct inequality symbol and an attempt to expand.<br>A1cso no incorrect working seen   |                                      |
|                 | (b) 1 <sup>st</sup> M1 for an attempt to factorize <b>or</b> solve leading to $k = (2 \text{ values})$<br>2 <sup>nd</sup> M1 for a method that leads them to choose the "outside" region. Can follow through their critical values.<br>2 <sup>nd</sup> A1 Allow " , " instead of "or"<br>$\geq$ loses the final A1<br>$1 < k < -3$ scores M1A0 unless a correct version is seen before or after this one.  |                                      |

| Question Number | Scheme   | Marks                       |
|-----------------|--|-----------------------------|
| 9.              |  |                             |
| (a)             | $(8 - 3 - k = 0)$ so $k = 5$   | B1<br>(1)                   |
| (b)             | $2y = 3x + k$<br>$y = \frac{3}{2}x + \dots$ and so $m = \frac{3}{2}$ o.e.  | M1<br>A1<br>(2)             |
| (c)             | Perpendicular gradient = $-\frac{2}{3}$<br>Equation of line is: $y - 4 = -\frac{2}{3}(x - 1)$<br><u><math>3y + 2x - 14 = 0</math></u> o.e.   | B1ft<br>M1A1ft<br>A1<br>(4) |
| (d)             | $y = 0, \Rightarrow B(7, 0)$ or <u><math>x = 7</math></u> $x = 7$ or $-\frac{c}{a}$  | M1A1ft<br>(2)               |
| (e)             | $AB^2 = (7 - 1)^2 + (4 - 0)^2$<br>$AB = \sqrt{52}$ or $2\sqrt{13}$   | M1<br>A1<br>(2)<br>11       |
| <b>Notes</b>    |  |                             |
| (b)             | M1 for an attempt to rearrange to $y = \dots$<br>A1 for clear statement that gradient is 1.5, can be $m = 1.5$ o.e.  |                             |
| (c)             | B1ft for using the perpendicular gradient rule correctly on their "1.5"<br><br>M1 for an attempt at finding the equation of the line through A using their gradient. Allow a sign slip<br>1 <sup>st</sup> A1ft for a correct equation of the line follow through their changed gradient<br><br>2 <sup>nd</sup> A1 as printed or equivalent with integer coefficients – allow<br><u><math>3y + 2x = 14</math></u> or <u><math>3y = 14 - 2x</math></u> |                             |
| (d)             | M1 for use of $y = 0$ to find $x = \dots$ in their equation<br>A1ft for $x = 7$ or $-\frac{c}{a}$  |                             |
| (e)             | M1 for an attempt to find $AB$ or $AB^2$<br>A1 for any correct surd form- need not be simplified   |                             |

| Question Number | Scheme  | Marks  |
|-----------------|---|--|
| 10.<br>(a)      |  <p>(i) correct shape ( -ve cubic)<br/>Crossing at (-2, 0)<br/>Through the origin<br/>Crossing at (3,0)</p> <p>(ii) 2 branches in correct quadrants not crossing axes<br/>One intersection with cubic on each branch</p> | <p>B1<br/>B1<br/>B1<br/>B1</p> <p>B1</p> <p>B1</p> <p>(6)</p>              |
| (b)             | <p>“2” solutions</p> <p>Since only “2” intersections</p>  | <p>B1ft</p> <p>dB1ft</p> <p>(2)</p> <p>8</p>                               |
| <b>Notes</b>    |   |  |
| (b)             | <p>B1ft for a value that is compatible with their sketch</p> <p>dB1ft This mark is dependent on the value being compatible with their sketch.</p> <p>For a comment relating the number of solutions to the number of intersections.</p> <p>[ Only allow 0, 2 or 4]</p>                                    |  |
| 11.<br>(a)      | $\left(\frac{dy}{dx} = \right) \frac{3}{2}x^2 - \frac{27}{2}x^{\frac{1}{2}} - 8x^{-2}$  | <p>M1A1A1A1</p> <p>(4)</p>   |
| (b)             | $x = 4 \Rightarrow y = \frac{1}{2} \times 64 - 9 \times 2^3 + \frac{8}{4} + 30$ $= 32 - 72 + 2 + 30 = -8 *$   | <p>M1</p> <p>A1cso</p> <p>(2)</p>  |
| (c)             | $x = 4 \Rightarrow y' = \frac{3}{2} \times 4^2 - \frac{27}{2} \times 2 - \frac{8}{16}$ $= 24 - 27 - \frac{1}{2} = -\frac{7}{2}$ <p>Gradient of the normal = <math>-1 \div -\frac{7}{2}</math></p> <p>Equation of normal: <math>y - -8 = \frac{2}{7}(x - 4)</math></p> $7y - 2x + 64 = 0$                  | <p>M1</p> <p>A1</p> <p>M1</p> <p>M1A1ft</p> <p>A1</p> <p>(6)</p> <p>12</p> |

| Question Number | Scheme   | Marks |
|-----------------|--|-------|
|                 | <b>Notes</b>   |       |
| (a)             | 1 <sup>st</sup> M1 for an attempt to differentiate $x^n \rightarrow x^{n-1}$<br>1 <sup>st</sup> A1 for one correct term in $x$<br>2 <sup>nd</sup> A1 for 2 terms in $x$ correct<br>3 <sup>rd</sup> A1 for all correct $x$ terms. No 30 term and no $+c$ .  |       |
| (b)             | M1 for substituting $x = 4$ into $y =$ and attempting $4^{\frac{3}{2}}$<br>A1 note this is a printed answer  |       |
| (c)             | 1 <sup>st</sup> M1 Substitute $x = 4$ into $y'$ (allow slips)<br>A1 Obtains $-3.5$ or equivalent<br>2 <sup>nd</sup> M1 for correct use of the perpendicular gradient rule using their gradient. (May be slip doing the division) Their gradient must have come from $y'$<br><br>3 <sup>rd</sup> M1 for an attempt at equation of tangent or normal at $P$<br>2 <sup>nd</sup> A1ft for correct use of their changed gradient to find <b>normal</b> at $P$ . Depends on 1 <sup>st</sup> , 2 <sup>nd</sup> and 3 <sup>rd</sup> Ms<br>3 <sup>rd</sup> A1 for any equivalent form with integer coefficients |       |

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