

# Mark Scheme (Results) January 2009

GCE

GCE Mathematics (6663/01)

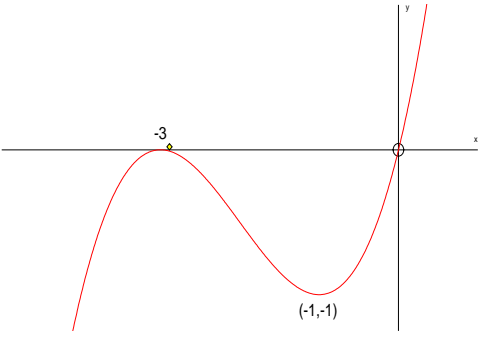

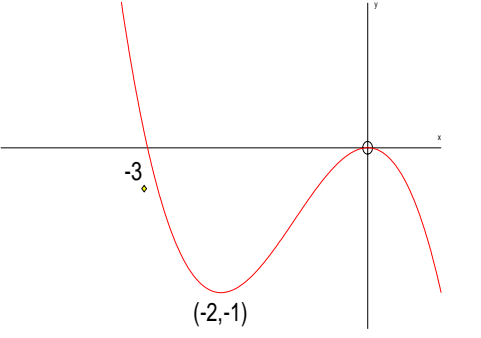

January 2009  
6663 Core Mathematics C1  
Mark Scheme

Question Number	Scheme	Marks
1	<p>(a) <b>5</b> (<math>\pm 5</math> is B0)</p> <p>(b) <math>\frac{1}{(\text{their } 5)^2}</math> or <math>\left(\frac{1}{\text{their } 5}\right)^2</math>  <math>= \frac{1}{25}</math> <b>or 0.04</b> (<math>\pm \frac{1}{25}</math> is A0)</p>	<p>B1 (1)</p> <p>M1</p> <p>A1 (2) [3]</p>
(b)	<p>M1 follow through their value of 5. Must have reciprocal and square.  <math>5^{-2}</math> is <u>not</u> sufficient to score this mark, unless <math>\frac{1}{5^2}</math> follows this.            A negative introduced at any stage can score the M1 but not the A1,            e.g. <math>125^{-2/3} = \left(-\frac{1}{5}\right)^2 = \frac{1}{25}</math> scores M1 A0  <math>125^{-2/3} = -\left(\frac{1}{5}\right)^2 = -\frac{1}{25}</math> scores M1 A0.            Correct answer with no working scores both marks.</p> <p><u>Alternative:</u> <math>\frac{1}{\sqrt[3]{125^2}}</math> or <math>\frac{1}{(125^2)^{1/3}}</math> M1 (reciprocal and the correct number squared)  <math>\left( = \frac{1}{\sqrt[3]{15625}} \right)</math>  <math>= \frac{1}{25}</math> A1</p>	

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2	$(I =) \frac{12}{6}x^6 - \frac{8}{4}x^4 + 3x + c$ $= 2x^6 - 2x^4 + 3x + c$	M1 A1A1A1 [4]
	<p>M1 for an attempt to integrate <math>x^n \rightarrow x^{n+1}</math>  (i.e. <math>ax^6</math> or <math>ax^4</math> or <math>ax</math>, where <math>a</math> is any non-zero constant).  Also, this M mark can be scored for just the <math>+c</math> (seen at some stage), even if no other terms are correct.</p> <p>1<sup>st</sup> A1 for <math>2x^6</math>  2<sup>nd</sup> A1 for <math>-2x^4</math>  3<sup>rd</sup> A1 for <math>3x + c</math> (or <math>3x + k</math>, etc., any appropriate letter can be used as the constant)</p> <p>Allow <math>3x^1 + c</math>, but <u>not</u> <math>\frac{3x^1}{1} + c</math>.</p> <p>Note that the A marks can be awarded at separate stages, e.g.</p> $\frac{12}{6}x^6 - 2x^4 + 3x \quad \text{scores 2nd A1}$ $\frac{12}{6}x^6 - 2x^4 + 3x + c \quad \text{scores 3rd A1}$ $2x^6 - 2x^4 + 3x \quad \text{scores 1st A1 (even though the } c \text{ has now been lost).}$ <p>Remember that all the A marks are dependent on the M mark.</p> <p>If applicable, isw (ignore subsequent working) after a correct answer is seen.</p> <p>Ignore wrong notation if the intention is clear, e.g. Answer <math>\int 2x^6 - 2x^4 + 3x + c \, dx</math>.</p>	

Question Number	Scheme	Marks
3	$\sqrt{7}^2 + 2\sqrt{7} - 2\sqrt{7} - 2^2, \text{ or } 7 - 4 \text{ or an exact equivalent such as } \sqrt{49} - 2^2$ $= 3$	M1 A1 [2]
	<p>M1 for an expanded expression. At worst, there can be <u>one wrong term</u> and <u>one wrong sign</u>, or <u>two wrong signs</u>.</p> <p>e .g. <math>7 + 2\sqrt{7} - 2\sqrt{7} - 2</math> is M1 (one wrong term <math>- 2</math>)  <math>7 + 2\sqrt{7} + 2\sqrt{7} + 4</math> is M1 (two wrong signs <math>+ 2\sqrt{7}</math> and <math>+ 4</math>)  <math>7 + 2\sqrt{7} + 2\sqrt{7} + 2</math> is M1 (one wrong term <math>+ 2</math>, one wrong sign <math>+ 2\sqrt{7}</math>)  <math>\sqrt{7} + 2\sqrt{7} - 2\sqrt{7} + 4</math> is M1 (one wrong term <math>\sqrt{7}</math>, one wrong sign <math>+ 4</math>)  <math>\sqrt{7} + 2\sqrt{7} - 2\sqrt{7} - 2</math> is M0 (two wrong terms <math>\sqrt{7}</math> and <math>- 2</math>)  <math>7 + \sqrt{14} - \sqrt{14} - 4</math> is M0 (two wrong terms <math>\sqrt{14}</math> and <math>-\sqrt{14}</math>)</p> <p>If only 2 terms are given, they must be correct, i.e. <math>(7 - 4)</math> or an equivalent unsimplified version to score M1.</p> <p>The terms can be seen <u>separately</u> for the M1.</p> <p>Correct answer with <u>no working</u> scores both marks.</p>	

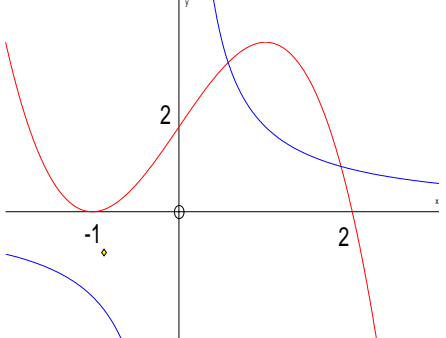
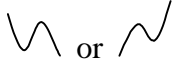
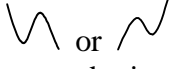
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4	$(f(x) =) \frac{3x^3}{3} - \frac{3x^{\frac{3}{2}}}{\frac{3}{2}} - 7x(+c)$ $= x^3 - 2x^{\frac{3}{2}} - 7x (+c)$ $f(4) = 22 \Rightarrow 22 = 64 - 16 - 28 + c$ $\mathbf{c = 2}$	M1  A1A1 M1 A1cso (5)  [5]
	<p>1<sup>st</sup> M1 for an attempt to integrate (<math>x^3</math> or <math>x^{\frac{3}{2}}</math> seen). The <math>x</math> term is insufficient for this mark and similarly the <math>+c</math> is insufficient.</p> <p>1<sup>st</sup> A1 for <math>\frac{3}{3}x^3</math> or <math>-\frac{3x^{\frac{3}{2}}}{\frac{3}{2}}</math> (An unsimplified or simplified correct form)</p> <p>2<sup>nd</sup> A1 for all three <math>x</math> terms correct and simplified... (the simplification may be seen later). The <math>+c</math> is not required for this mark.</p> <p>Allow <math>-7x^1</math>, but <u>not</u> <math>-\frac{7x^1}{1}</math>.</p> <p>2<sup>nd</sup> M1 for an attempt to use <math>x = 4</math> <u>and</u> <math>y = 22</math> in a changed function (even if differentiated) to form an equation in <math>c</math>.</p> <p>3<sup>rd</sup> A1 for <math>c = 2</math> with no earlier incorrect work (a final expression for <math>f(x)</math> is not required).</p>	

Question Number	Scheme	Marks
5 (a)	 <p>Shape , touching the <math>x</math>-axis at its maximum.</p> <p>Through <math>(0,0)</math> &amp; <math>-3</math> marked on <math>x</math>-axis, or <math>(-3,0)</math> seen. Allow <math>(0,-3)</math> if marked on the <math>x</math>-axis. Marked in the correct place, but <math>3</math>, is A0.</p> <p>Min at <math>(-1,-1)</math></p>	M1 A1 A1 (3)
5 (b)	 <p>Correct shape  (top left - bottom right)</p> <p>Through <math>-3</math> and max at <math>(0, 0)</math>. Marked in the correct place, but <math>3</math>, is B0.</p> <p>Min at <math>(-2,-1)</math></p>	B1 B1 B1 (3) [6]
(a)	<p>M1 as described above. Be generous, even when the curve seems to be composed of straight line segments, but there must be a discernible 'curve' at the max. and min.</p> <p>1<sup>st</sup> A1 for curve passing through <math>-3</math> and the origin. Max at <math>(-3,0)</math></p> <p>2<sup>nd</sup> A1 for minimum at <math>(-1,-1)</math>. Can simply be indicated on sketch.</p>	
(b)	<p>1<sup>st</sup> B1 for the correct shape. A negative cubic passing from top left to bottom right. Shape: Be generous, even when the curve seems to be composed of straight line segments, but there must be a discernible 'curve' at the max. and min.</p> <p>2<sup>nd</sup> B1 for curve passing through <math>(-3,0)</math> having a max at <math>(0,0)</math> and no other max.</p> <p>3<sup>rd</sup> B1 for minimum at <math>(-2,-1)</math> and no other minimum. If in correct quadrant but labelled, e.g. <math>(-2,1)</math>, this is B0.</p> <p>In each part the <math>(0,0)</math> does <u>not</u> need to be written to score the second mark... having the curve pass through the origin is sufficient.</p> <p>The last mark (for the minimum) in each part is dependent on a sketch being attempted, and the sketch must show the minimum in approximately the correct place (not, for example, <math>(-2,-1)</math> marked in the wrong quadrant).</p> <p>The mark for the minimum is <u>not</u> given for the coordinates just marked on the axes <u>unless</u> these are clearly linked to the minimum by vertical and horizontal lines.</p>	

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6	<p>(a) <math>2x^{3/2}</math> or <math>p = \frac{3}{2}</math> (<u>Not</u> <math>2x\sqrt{x}</math>)</p> <p><math>-x</math> or <math>-x^1</math> or <math>q = 1</math></p> <p>(b) <math>\left(\frac{dy}{dx} = \right) 20x^3 + 2 \times \frac{3}{2}x^{1/2} - 1</math></p> <p><math>= \underline{20x^3 + 3x^{1/2} - 1}</math></p>	<p>B1</p> <p>B1 (2)</p> <p>M1</p> <p>A1A1ftA1ft (4)</p> <p>[6]</p>
	<p>(a) 1<sup>st</sup> B1 for <math>p = 1.5</math> or exact equivalent 2<sup>nd</sup> B1 for <math>q = 1</math></p> <p>(b) M1 for an attempt to differentiate <math>x^n \rightarrow x^{n-1}</math> (for any of the 4 terms) 1<sup>st</sup> A1 for <math>20x^3</math> (the <math>-3</math> must 'disappear') 2<sup>nd</sup> A1ft for <math>3x^{1/2}</math> or <math>3\sqrt{x}</math>. Follow through their <math>p</math> but they must be differentiating <math>2x^p</math>, where <math>p</math> is a <u>fraction</u>, and the coefficient must be simplified if necessary. 3<sup>rd</sup> A1ft for <math>-1</math> (<u>not</u> the unsimplified <math>-x^0</math>), or follow through for correct differentiation of their <math>-x^q</math> (i.e. coefficient of <math>x^q</math> is <math>-1</math>). If it is applied, the coefficient must be simplified if necessary. 'Simplified' coefficient means <math>\frac{a}{b}</math> where <math>a</math> and <math>b</math> are integers with no common factors. Only a single <math>+</math> or <math>-</math> sign is allowed (e.g. <math>--</math> must be replaced by <math>+</math>).  If there is a 'restart' in part (b) it can be marked independently of part (a), but marks for part (a) cannot be scored for work seen in (b).  <u>Multiplying by <math>\sqrt{x}</math></u>: (assuming this is a restart) e.g. <math>y = 5x^4\sqrt{x} - 3\sqrt{x} + 2x^2 - x^{3/2}</math> <math>\left(\frac{dy}{dx} = \right) \frac{45}{2}x^{7/2} - \frac{3}{2}x^{-1/2} + 4x - \frac{3}{2}x^{1/2}</math> scores M1 A0 A0 (<math>p</math> not a fraction) A1ft.  <u>Extra term included</u>: This invalidates the final mark. e.g. <math>y = 5x^4 - 3 + 2x^2 - x^{3/2} - x^{1/2}</math> <math>\left(\frac{dy}{dx} = \right) 20x^3 + 4x - \frac{3}{2}x^{1/2} - \frac{1}{2}x^{-1/2}</math> scores M1 A1 A0 (<math>p</math> not a fraction) A0.  <u>Numerator and denominator differentiated separately</u>: For this, neither of the last two (ft) marks should be awarded.  <u>Quotient/product rule</u>: Last two terms must be correct to score the last 2 marks. (If the M mark has not already been earned, it can be given for the quotient/product rule attempt.)</p>	

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7	<p>(a) <math>b^2 - 4ac &gt; 0 \Rightarrow 16 - 4k(5 - k) &gt; 0</math> or equiv., e.g. <math>16 &gt; 4k(5 - k)</math></p> <p>So <math>k^2 - 5k + 4 &gt; 0</math> (Allow any order of terms, e.g. <math>4 - 5k + k^2 &gt; 0</math>) (*)</p> <p>(b) <u>Critical Values</u> <math>(k - 4)(k - 1) = 0</math> <math>k = \dots</math></p> <p style="text-align: center;"><math>k = 1</math> or <math>4</math></p> <p style="text-align: right;">Choosing "outside" region</p> <p style="text-align: center;"><u><math>k &lt; 1</math> or <math>k &gt; 4</math></u></p>	<p>M1A1</p> <p>A1cso (3)</p> <p>M1 A1</p> <p>M1</p> <p>A1 (4) [7]</p>
	<p>For this question, ignore (a) and (b) labels and award marks wherever correct work is seen.</p> <p>(a) M1 for attempting to use the discriminant of the initial equation (<math>&gt; 0</math> not required, but substitution of <math>a</math>, <math>b</math> and <math>c</math> in the correct formula is required). If the formula <math>b^2 - 4ac</math> is seen, at least 2 of <math>a</math>, <math>b</math> and <math>c</math> must be correct. If the formula <math>b^2 - 4ac</math> is <u>not</u> seen, all 3 (<math>a</math>, <math>b</math> and <math>c</math>) must be correct. This mark can still be scored if substitution in <math>b^2 - 4ac</math> is within the quadratic formula. This mark can also be scored by comparing <math>b^2</math> and <math>4ac</math> (with substitution). However, use of <math>b^2 + 4ac</math> is M0.</p> <p>1<sup>st</sup> A1 for fully correct expression, possibly unsimplified, with <math>&gt;</math> symbol. NB must appear before the last line, even if this is simply in a statement such as <math>b^2 - 4ac &gt; 0</math> or 'discriminant positive'. Condone a bracketing slip, e.g. <math>16 - 4 \times k \times 5 - k</math> if subsequent work is correct and convincing.</p> <p>2<sup>nd</sup> A1 for a fully correct derivation with no incorrect working seen. Condone a bracketing slip if otherwise correct and convincing.</p> <p><u>Using</u> <math>\sqrt{b^2 - 4ac} &gt; 0</math>: Only available mark is the first M1 (unless recovery is seen).</p> <p>(b) 1<sup>st</sup> M1 for attempt to solve an appropriate 3TQ 1<sup>st</sup> A1 for both <math>k = 1</math> and <math>4</math> (only the critical values are required, so accept, e.g. <math>k &gt; 1</math> and <math>k &gt; 4</math>). ** 2<sup>nd</sup> M1 for choosing the "outside" region. A diagram or table alone is not sufficient. Follow through their values of <math>k</math>. The set of values must be 'narrowed down' to score this M mark... listing everything <math>k &lt; 1</math>, <math>1 &lt; k &lt; 4</math>, <math>k &gt; 4</math> is M0.</p> <p>2<sup>nd</sup> A1 for correct answer only, condone "<math>k &lt; 1</math>, <math>k &gt; 4</math>" and even "<math>k &lt; 1</math> and <math>k &gt; 4</math>", but "<math>1 &gt; k &gt; 4</math>" is A0.</p> <p>** Often the statement <math>k &gt; 1</math> and <math>k &gt; 4</math> is followed by the correct final answer. Allow full marks.</p> <p><u>Seeing 1 and 4 used as critical values</u> gives the first M1 A1 by implication.</p> <p>In part (b), condone working with <math>x</math>'s except for the final mark, where the set of values must be a set of values of <math>k</math> (i.e. 3 marks out of 4).</p> <p>Use of <math>\leq</math> (or <math>\geq</math>) in the final answer loses the final mark.</p>	



Question Number	Scheme	Marks
8	<p>(a) <math>(a =) (1+1)^2(2-1) = \underline{4}</math> (1, 4) or <math>y = 4</math> is also acceptable</p> <p>(b)</p>  <p>(i) Shape  anywhere</p> <p>Min at <math>(-1, 0)</math> ... can be <math>-1</math> on <math>x</math>-axis. Allow <math>(0, -1)</math> if marked on the <math>x</math>-axis. Marked in the correct place, but 1, is B0.</p> <p><math>(2, 0)</math> and <math>(0, 2)</math> can be 2 on axes</p> <p>(ii)</p> <p>Top branch in 1<sup>st</sup> quadrant with 2 intersections</p> <p>Bottom branch in 3<sup>rd</sup> quadrant (ignore any intersections)</p> <p>(c) <math>(2</math> intersections therefore) <math>\underline{2}</math> (roots)</p>	<p>B1 (1)</p> <p>B1</p> <p>B1</p> <p>B1</p> <p>B1 (5)</p> <p>B1ft (1)</p> <p>[7]</p>
	<p>(b) 1<sup>st</sup> B1 for shape  Can be anywhere, but there must be one max. and one min. and no further max. and min. turning points. Shape: Be generous, even when the curve seems to be composed of straight line segments, but there must be a discernible 'curve' at the max. and min.</p> <p>2<sup>nd</sup> B1 for minimum at <math>(-1, 0)</math> (even if there is an additional minimum point shown)</p> <p>3<sup>rd</sup> B1 for the sketch meeting axes at <math>(2, 0)</math> and <math>(0, 2)</math>. They can simply mark 2 on the axes. The marks for minimum and intersections are dependent upon having a sketch. Answers on the diagram for min. and intersections take precedence over answers seen elsewhere.</p> <p>4<sup>th</sup> B1 for the branch fully within 1<sup>st</sup> quadrant having 2 intersections with (not just 'touching') the other curve. The curve can 'touch' the axes. A curve of (roughly) the correct shape is required, but be very generous, even when the arc appears to turn 'inwards' rather than approaching the axes, and when the curve looks like two straight lines with a small curve at the join. Allow, for example, shapes like these:</p> <p>5<sup>th</sup> B1 for a branch fully in the 3<sup>rd</sup> quadrant (ignore any intersections with the other curve for this branch). The curve can 'touch' the axes. A curve of (roughly) the correct shape is required, but be very generous, even when the arc appears to turn 'inwards' rather than approaching the axes.</p> <p>(c) B1ft for a statement about the number of roots - compatible with their sketch. No sketch is B0. The answer 2 <u>incompatible with the sketch</u> is B0 (ignore any algebra seen). If the sketch shows the 2 correct intersections <u>and</u>, for example, one other intersection, the answer here should be 3, not 2, to score the mark.</p>	

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9	<p>(a) <math>a + 17d = 25</math> or equiv. (for 1<sup>st</sup> B1), <math>a + 20d = 32.5</math> or equiv. (for 2<sup>nd</sup> B1),</p> <p>(b) <u>Solving</u> (Subtract) <math>3d = 7.5</math> so <math>d = \underline{2.5}</math>  <math>a = 32.5 - 20 \times 2.5</math> so <math>a = \underline{-17.5}</math> (*)</p> <p>(c) <math>2750 = \frac{n}{2} \left[ -35 + \frac{5}{2}(n-1) \right]</math>  <math>\{ 4 \times 2750 = n(5n - 75) \}</math>  <math>4 \times 550 = n(n - 15)</math>  <math>\underline{n^2 - 15n = 55 \times 40}</math> (*)</p> <p>(d) <math>n^2 - 15n - 55 \times 40 = 0</math> or <math>n^2 - 15n - 2200 = 0</math>  <math>(n - 55)(n + 40) = 0</math> <math>n = \dots</math>  <math>\underline{n = 55}</math> (ignore - 40)</p>	<p>B1, B1 (2)</p> <p>M1 A1cso (2)</p> <p>M1A1ft</p> <p>M1 A1cso (4)</p> <p>M1 M1 A1 (3)</p> <p>[11]</p>
	<p>Mark parts (a) and (b) as ‘one part’, ignoring labelling.</p> <p>(a) <u>Alternative:</u>  1<sup>st</sup> B1: <math>d = 2.5</math> or equiv. or <math>d = \frac{32.5 - 25}{3}</math>. No method required, but <math>a = -17.5</math> must not be assumed.  2<sup>nd</sup> B1: Either <math>a + 17d = 25</math> or <math>a + 20d = 32.5</math> seen, or used with a value of <math>d \dots</math>  or for ‘listing terms’ or similar methods, ‘counting back’ 17 (or 20) terms.</p> <p>(b) M1: In main scheme: for a full method (allow numerical or sign slips) leading to solution for <math>d</math> or <math>a</math> without assuming <math>a = -17.5</math>  In alternative scheme: for using a <math>d</math> value to find a value for <math>a</math>.  A1: Finding correct values for both <math>a</math> and <math>d</math> (allowing equiv. fractions such as <math>d = \frac{15}{6}</math>), with no incorrect working seen.</p> <p>(c) In the main scheme, if the given <math>a</math> is used to find <math>d</math> from one of the equations, then allow M1A1 if both values are <u>checked</u> in the 2<sup>nd</sup> equation.  1<sup>st</sup> M1 for attempt to form equation with correct <math>S_n</math> formula and 2750, with values of <math>a</math> and <math>d</math>.  1<sup>st</sup> A1ft for a correct equation following through their <math>d</math>.  2<sup>nd</sup> M1 for expanding and simplifying to a 3 term quadratic.</p> <p>(d) 2<sup>nd</sup> A1 for correct working leading to printed result (no incorrect working seen).  1<sup>st</sup> M1 forming the correct 3TQ = 0. Can condone missing “= 0” but all terms must be on one side. First M1 can be implied (perhaps seen in (c), but there must be an attempt at (d) for it to be scored).  2<sup>nd</sup> M1 for attempt to solve 3TQ, by factorisation, formula or completing the square (see general marking principles at end of scheme). If this mark is earned for the ‘completing the square’ method or if the factors are written down directly, the 1<sup>st</sup> M1 is given by implication.  A1 for <math>n = 55</math> dependent on both Ms. Ignore - 40 if seen.  <u>No working</u> or ‘trial and improvement’ methods in (d) score all 3 marks for the answer 55, otherwise no marks.</p>	

Question Number	Scheme	Marks
10	<p>(a) <math>y - 5 = -\frac{1}{2}(x - 2)</math> or equivalent, e.g. <math>\frac{y - 5}{x - 2} = -\frac{1}{2}</math>, <math>y = -\frac{1}{2}x + 6</math></p> <p>(b) <math>x = -2 \Rightarrow y = -\frac{1}{2}(-2) + 6 = 7</math> (therefore <math>B</math> lies on the line) (or equivalent verification methods)</p> <p>(c) <math>(AB^2 =) (2 - (-2))^2 + (7 - 5)^2, = 16 + 4 = 20, AB = \sqrt{20} = 2\sqrt{5}</math></p> <p>(d) <math>C</math> is <math>(p, -\frac{1}{2}p + 6)</math>, so <math>AC^2 = (p - 2)^2 + \left(-\frac{1}{2}p + 6 - 5\right)^2</math></p> <p>Therefore <math>25 = p^2 - 4p + 4 + \frac{1}{4}p^2 - p + 1</math></p> <p><math>25 = 1.25p^2 - 5p + 5</math> or <math>100 = 5p^2 - 20p + 20</math> (or better, RHS simplified to 3 terms)</p> <p>Leading to: <math>0 = p^2 - 4p - 16</math> (*)</p>	<p>M1A1, A1cao (3)</p> <p>B1 (1)</p> <p>M1, A1, A1 (3)</p> <p>M1</p> <p>M1</p> <p>A1 A1cso (4)</p> <p>[11]</p>
	<p>(a) M1 A1 The version in the scheme above can be written down directly (for 2 marks), and M1 A0 can be allowed if there is just one slip (sign or number). If the 5 and 2 are the wrong way round the M mark can still be given if a correct formula (e.g. <math>y - y_1 = m(x - x_1)</math>) is seen, otherwise M0. If (2, 5) is substituted into <math>y = mx + c</math> to find <math>c</math>, the M mark is for attempting this and the 1<sup>st</sup> A mark is for <math>c = 6</math>. Correct answer without working or from a sketch scores full marks.</p> <p>(b) A conclusion/comment is not required, except when the method used is to establish that the line through <math>(-2, 7)</math> with gradient <math>-\frac{1}{2}</math> has the same eqn. as found in part (a), or to establish that the line through <math>(-2, 7)</math> and <math>(2, 5)</math> has gradient <math>-\frac{1}{2}</math>. In these cases a comment 'same equation' or 'same gradient' or 'therefore on same line' is sufficient.</p> <p>(c) M1 for attempting <math>AB^2</math> or <math>AB</math>. Allow one slip (sign or number) <u>inside</u> a bracket, i.e. do <u>not</u> allow <math>(2 - (-2))^2 - (7 - 5)^2</math>. 1<sup>st</sup> A1 for 20 (condone bracketing slips such as <math>-2^2 = 4</math>) 2<sup>nd</sup> A1 for <math>2\sqrt{5}</math> or <math>k = 2</math> (Ignore <math>\pm</math> here).</p> <p>(d) 1<sup>st</sup> M1 for <math>(p - 2)^2 + (\text{linear function of } p)^2</math>. The linear function may be unsimplified but must be equivalent to <math>ap + b</math>, <math>a \neq 0</math>, <math>b \neq 0</math>. 2<sup>nd</sup> M1 (dependent on 1<sup>st</sup> M) for forming an equation in <math>p</math> (using 25 or 5) and attempting (perhaps not very well) to multiply out both brackets. 1<sup>st</sup> A1 for collecting like <math>p</math> terms and having a correct expression. 2<sup>nd</sup> A1 for correct work leading to printed answer. <u>Alternative, using the result:</u> Solve the quadratic <math>(p = 2 \pm 2\sqrt{5})</math> and use one or both of the two solutions to find the length of <math>AC^2</math> or <math>C_1C_2^2</math>: e.g. <math>AC^2 = (2 + 2\sqrt{5} - 2)^2 + (5 - \sqrt{5} - 5)^2</math> scores 1<sup>st</sup> M1, and 1<sup>st</sup> A1 if fully correct. Finding the length of <math>AC</math> or <math>AC^2</math> for both values of <math>p</math>, or finding <math>C_1C_2</math> with some evidence of halving (or intending to halve) scores the 2<sup>nd</sup> M1. Getting <math>AC = 5</math> for both values of <math>p</math>, or showing <math>\frac{1}{2}C_1C_2 = 5</math> scores the 2<sup>nd</sup> A1 (cso).</p>	

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11 (a)	$\left(\frac{dy}{dx} = \right) -4 + 8x^{-2} \quad (4 \text{ or } 8x^{-2} \text{ for M1... sign can be wrong})$ $x = 2 \Rightarrow m = -4 + 2 = -2$ $y = 9 - 8 - \frac{8}{2} = -3$ <p style="text-align: center;">The first 4 marks <u>could</u> be earned in part (b)</p> <p>Equation of tangent is: <math>y + 3 = -2(x - 2) \rightarrow y = 1 - 2x \quad (*)</math></p>	M1A1 M1 B1 M1 A1cso (6)
(b)	<p>Gradient of normal = <math>\frac{1}{2}</math></p> <p>Equation is: <math>\frac{y+3}{x-2} = \frac{1}{2}</math> or better equivalent, e.g. <math>y = \frac{1}{2}x - 4</math></p>	B1ft M1A1
(c)	<p>(A:) <math>\frac{1}{2}</math>, (B:) 8</p> <p>Area of triangle is: <math>\frac{1}{2}(x_B \pm x_A) \times y_P</math> with values for all of <math>x_B, x_A</math> and <math>y_P</math></p> $\frac{1}{2}\left(8 - \frac{1}{2}\right) \times 3 = \frac{45}{4} \text{ or } 11.25$	(3) B1, B1 M1 A1 (4)
(a)	<p>1<sup>st</sup> M1 for 4 or <math>8x^{-2}</math> (ignore the signs).  1<sup>st</sup> A1 for both terms correct (including signs).  2<sup>nd</sup> M1 for substituting <math>x = 2</math> into their <math>\frac{dy}{dx}</math> (must be different from their <math>y</math>)  B1 for <math>y_P = -3</math>, but not if clearly found from the given equation of the <u>tangent</u>.  3<sup>rd</sup> M1 for attempt to find the equation of tangent at <math>P</math>, follow through their <math>m</math> and <math>y_P</math>.  Apply general principles for straight line equations (see end of scheme).  <u>NO DIFFERENTIATION ATTEMPTED</u>: Just assuming <math>m = -2</math> at this stage is M0  2<sup>nd</sup> A1cso for correct work leading to printed answer (allow equivalents with <math>2x, y</math>, and 1 terms... such as <math>2x + y - 1 = 0</math>).</p>	
(b)	<p>B1ft for correct use of the perpendicular gradient rule. Follow through their <math>m</math>, but if <math>m \neq -2</math> there must be clear evidence that the <math>m</math> is thought to be the gradient of the tangent.  M1 for an attempt to find normal at <math>P</math> using their changed gradient and their <math>y_P</math>.  Apply general principles for straight line equations (see end of scheme).  A1 for any correct form as specified above (correct answer only).</p>	
(c)	<p>1<sup>st</sup> B1 for <math>\frac{1}{2}</math> and 2<sup>nd</sup> B1 for 8.  M1 for a full method for the area of triangle <math>ABP</math>. Follow through their <math>x_A, x_B</math> and their <math>y_P</math>, but the mark is to be awarded 'generously', condoning sign errors..  The final answer must be positive for A1, with negatives in the working condoned.</p> <p><u>Determinant</u>: Area = <math>\frac{1}{2} \begin{vmatrix} x_1 &amp; y_1 &amp; 1 \\ x_2 &amp; y_2 &amp; 1 \\ x_3 &amp; y_3 &amp; 1 \end{vmatrix} = \frac{1}{2} \begin{vmatrix} 2 &amp; -3 &amp; 1 \\ 0.5 &amp; 0 &amp; 1 \\ 8 &amp; 0 &amp; 1 \end{vmatrix} = \dots</math> (Attempt to multiply out required for M1)</p> <p><u>Alternative</u>: <math>AP = \sqrt{(2 - 0.5)^2 + (-3)^2}</math>, <math>BP = \sqrt{(2 - 8)^2 + (-3)^2}</math>, Area = <math>\frac{1}{2} AP \times BP = \dots</math> M1</p> <p><u>Intersections with y-axis instead of x-axis</u>: Only the M mark is available B0 B0 M1 A0.</p>	