

# Mark Scheme (Results)

## Summer 2008

GCE Mathematics (6664/01)

GCE



**June 2008**  
**Core Mathematics C2**  
**Mark Scheme**

| Question number | Scheme                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Marks                                                                                         |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| 1.              | <p>(a) Attempt to find <math>f(-4)</math> or <math>f(4)</math>. <math>\left(f(-4) = 2(-4)^3 - 3(-4)^2 - 39(-4) + 20\right)</math><br/> <math>(= -128 - 48 + 156 + 20) = 0</math>, so <math>(x + 4)</math> is a factor.</p> <p>(b) <math>2x^3 - 3x^2 - 39x + 20 = (x + 4)(2x^2 - 11x + 5)</math><br/> <math>\dots(2x - 1)(x - 5)</math> (The 3 brackets need not be written together)<br/> or <math>\dots\left(x - \frac{1}{2}\right)(2x - 10)</math> or equivalent</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <p>M1<br/>A1 (2)</p> <p>M1 A1<br/>M1 A1cso (4)</p> <p style="text-align: right;"><b>6</b></p> |
|                 | <p>(a) Long division scores no marks in part (a). The <u>factor theorem</u> is required. However, the first two marks in (b) can be earned from division seen in (a)...<br/> ... but if a different long division result is seen in (b), the work seen in (b) takes precedence for marks in (b).<br/> A1 requires zero and a simple <u>conclusion</u> (even just a tick, or Q.E.D.), or may be scored by a <u>preamble</u>, e.g. 'If <math>f(-4) = 0</math>, <math>(x + 4)</math> is a factor.....'</p> <p>(b) First M requires use of <math>(x + 4)</math> to obtain <math>(2x^2 + ax + b)</math>, <math>a \neq 0, b \neq 0</math>, even with a remainder. Working need not be seen... this could be done 'by inspection'.<br/> Second M for the attempt to factorise their three-term quadratic.<br/> Usual rule: <math>(kx^2 + ax + b) = (px + c)(qx + d)</math>, where <math> cd  =  b </math> and <math> pq  =  k </math>.<br/> If 'solutions' appear before or after factorisation, ignore...<br/> ... but factors must be seen to score the second M mark.</p> <p><u>Alternative (first 2 marks):</u><br/> <math>(x + 4)(2x^2 + ax + b) = 2x^3 + (8 + a)x^2 + (4a + b)x + 4b = 0</math>, then compare coefficients to find <u>values</u> of <math>a</math> and <math>b</math>. [M1]<br/> <math>a = -11, b = 5</math> [A1]</p> <p><u>Alternative:</u><br/> Factor theorem: Finding that <math>f\left(\frac{1}{2}\right) = 0 \therefore</math> factor is, <math>(2x - 1)</math> [M1, A1]<br/> Finding that <math>f(5) = 0 \therefore</math> factor is, <math>(x - 5)</math> [M1, A1]<br/> "Combining" all 3 factors is <u>not</u> required.<br/> If just one of these is found, score the <u>first 2 marks</u> M1 A1 M0 A0.<br/> <u>Losing a factor of 2:</u> <math>(x + 4)\left(x - \frac{1}{2}\right)(x - 5)</math> scores M1 A1 M1 A0.<br/> <u>Answer only, one sign wrong:</u> e.g. <math>(x + 4)(2x - 1)(x + 5)</math> scores M1 A1 M1 A0</p> |                                                                                               |

**June 2008**  
**Core Mathematics C2**  
**Mark Scheme**

| Question number | Scheme                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Marks                                                                   |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|
| 2.              | <p>(a) 1.732, 2.058, 5.196 awrt (One or two correct B1 B0, All correct B1 B1)</p> <p>(b) <math>\frac{1}{2} \times 0.5 \dots\dots</math><br/> <math>\dots\dots \{(1.732 + 5.196) + 2(2.058 + 2.646 + 3.630)\}</math><br/> <math>= 5.899</math> (awrt 5.9, allowed even after minor slips in values)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <p>B1 B1 (2)</p> <p>B1</p> <p>M1 A1ft</p> <p>A1 (4)</p> <p><b>6</b></p> |
|                 | <p>(a) Accept awrt (but <u>less</u> accuracy loses these marks).<br/> Also accept <u>exact</u> answers, e.g. <math>\sqrt{3}</math> at <math>x = 0</math>, <math>\sqrt{27}</math> or <math>3\sqrt{3}</math> at <math>x = 2</math>.</p> <p>(b) For the M mark, the first bracket must contain the 'first and last' values, and the second bracket must have no additional values. If the only mistake is to <u>omit</u> one of the values from the second bracket, this can be considered as a slip and the M mark can be allowed.</p> <p>Bracketing mistake: i.e. <math>\frac{1}{2} \times 0.5(1.732 + 5.196) + 2(2.058 + 2.646 + 3.630)</math></p> <p>scores B1 M1 A0 A0 <u>unless</u> the final answer implies that the calculation has been done correctly (then full marks can be given).</p> <p><u>x values</u>: M0 if the values used in the brackets are x values instead of y values.</p> <p><u>Alternative</u>:<br/> Separate trapezia may be used, and this can be marked equivalently.</p> $\left[ \frac{1}{4}(1.732 + 2.058) + \frac{1}{4}(2.058 + 2.646) + \frac{1}{4}(2.646 + 3.630) + \frac{1}{4}(3.630 + 5.196) \right]$ |                                                                         |

**June 2008**  
**Core Mathematics C2**  
**Mark Scheme**

| Question number | Scheme                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Marks                                                                  |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|
| 3.              | <p>(a) <math>(1+ax)^{10} = 1+10ax.....</math> (<u>Not</u> unsimplified versions)<br/> <math>+ \frac{10 \times 9}{2}(ax)^2 + \frac{10 \times 9 \times 8}{6}(ax)^3</math> Evidence from <u>one</u> of these terms is sufficient<br/> <math>+ 45(ax)^2, +120(ax)^3</math> or <math>+45a^2x^2, +120a^3x^3</math></p> <p>(b) <math>120a^3 = 2 \times 45a^2</math> <math>a = \frac{3}{4}</math> or equiv. <math>\left( \text{e.g. } \frac{90}{120}, 0.75 \right)</math> Ignore <math>a = 0</math>, if seen</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <p>B1</p> <p>M1</p> <p>A1, A1 (4)</p> <p>M1 A1 (2)</p> <p><b>6</b></p> |
|                 | <p>(a) The terms can be ‘listed’ rather than added.</p> <p>M1: Requires correct structure: ‘binomial coefficient’ (perhaps from Pascal’s triangle) and the correct power of <math>x</math>.<br/>         (The M mark can also be given for an expansion in <u>descending</u> powers of <math>x</math>).<br/>         Allow ‘slips’ such as:<br/> <math>\frac{10 \times 9}{2}ax^2, \frac{10 \times 9}{3 \times 2}(ax)^3, \frac{10 \times 9}{2}x^2, \frac{9 \times 8 \times 7}{3 \times 2}a^3x^3</math><br/>         However, <math>45 + a^2x^2 + 120 + a^3x^3</math> or similar is M0.<br/> <math>\binom{10}{2}</math> and <math>\binom{10}{3}</math> or equivalent such as <math>{}^{10}C_2</math> and <math>{}^{10}C_3</math> are acceptable, and<br/>         even <math>\left(\frac{10}{2}\right)</math> and <math>\left(\frac{10}{3}\right)</math> are acceptable for the method mark.</p> <p>1<sup>st</sup> A1: Correct <math>x^2</math> term. 2<sup>nd</sup> A1: Correct <math>x^3</math> term (These <u>must</u> be simplified).<br/>         If simplification is not seen in (a), but correct simplified terms are seen in (b), these marks can be awarded. However, if <u>wrong</u> simplification is seen in (a), this takes precedence.<br/> <u>Special case:</u><br/>         If <math>(ax)^2</math> and <math>(ax)^3</math> are seen within the working, but then lost...<br/>         ... A1 A0 can be given if <math>45ax^2</math> and <math>120ax^3</math> are <u>both</u> achieved.</p> <p>(b) M: Equating their coefficient of <math>x^3</math> to twice their coefficient of <math>x^2</math>...<br/>         ... <u>or</u> equating their coefficient of <math>x^2</math> to twice their coefficient of <math>x^3</math>.<br/>         (... or coefficients can be <u>correct</u> coefficients rather than their coefficients).<br/>         Allow this mark even if the equation is trivial, e.g. <math>120a = 90a</math>.<br/>         An equation in <math>a</math> alone is required for this M mark, although...<br/>         ...condone, e.g. <math>120a^3x^3 = 90a^2x^2 \Rightarrow (120a^3 = 90a^2 \Rightarrow) a = \frac{3}{4}</math>.</p> <p><u>Beware:</u> <math>a = \frac{3}{4}</math> following <math>120a = 90a</math>, which is A0.</p> |                                                                        |

**June 2008**  
**Core Mathematics C2**  
**Mark Scheme**

| Question number | Scheme                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Marks                                                                    |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|
| 4.              | <p>(a) <math>x = \frac{\log 7}{\log 5}</math> or <math>x = \log_5 7</math> (i.e. correct method up to <math>x = \dots</math>)<br/> 1.21 Must be this answer (3 s.f.)</p> <p>(b) <math>(5^x - 7)(5^x - 5)</math> Or another variable, e.g. <math>(y - 7)(y - 5)</math>, even <math>(x - 7)(x - 5)</math><br/> <math>(5^x = 7 \text{ or } 5^x = 5)</math> <math>x = 1.2</math> (awrt) ft from the answer to (a), if used<br/> <math>x = 1</math> (allow 1.0 or 1.00 or 1.000)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <p>M1<br/> A1 (2)</p> <p>M1 A1<br/> A1ft<br/> B1 (4)</p> <p><b>6</b></p> |
|                 | <p>(a) 1.21 with no working: M1 A1 (even if it left as <math>5^{1.21}</math>).<br/> Other answers which round to 1.2 with no working: M1 A0.</p> <p>(b) M: Using the <u>correct</u> quadratic equation, attempt to factorise <math>(5^x \pm 7)(5^x \pm 5)</math>, or attempt quadratic formula.<br/> Allow <math>\log_5 7</math> or <math>\frac{\log 7}{\log 5}</math> instead of 1.2 for A1ft.<br/> No marks for simply substituting a decimal answer from (a) into the given equation (perhaps showing that it gives approximately zero).<br/> <u>However</u>, note the following <u>special case</u>:<br/> Showing that <math>5^x = 7</math> satisfies the given equation, therefore 1.21 is a solution scores 0, 0, 1, 0 (and could score <u>full marks</u> if the <math>x = 1</math> were also found).<br/> e.g. If <math>5^x = 7</math>, then <math>5^{2x} = 49</math>, and <math>5^{2x} - 12(5^x) + 35 = 49 - 84 + 35 = 0</math>,<br/> so one solution is <math>x = 1.21</math> ('conclusion' must be seen).<br/> To score this special case mark, values substituted into the equation must be <u>exact</u>. Also, the mark would <u>not</u> be scored in the following case:<br/> e.g. If <math>5^x = 7</math>, <math>5^{2x} - 84 + 35 = 0 \Rightarrow 5^{2x} = 49 \Rightarrow x = 1.21</math><br/> (Showing no appreciation that <math>5^{2x} = (5^x)^2</math>)<br/> B1: Do not award this mark if <math>x = 1</math> clearly follows from <u>wrong</u> working.</p> |                                                                          |

**June 2008**  
**Core Mathematics C2**  
**Mark Scheme**

| Question number | Scheme                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Marks                                                                            |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| 5.              | <p>(a) <math>(8-3)^2 + (3-1)^2</math> or <math>\sqrt{(8-3)^2 + (3-1)^2}</math><br/> <math>(x \pm 3)^2 + (y \pm 1)^2 = k</math> or <math>(x \pm 1)^2 + (y \pm 3)^2 = k</math> (<math>k</math> a positive <u>value</u>)<br/> <math>(x-3)^2 + (y-1)^2 = 29</math> (<u>Not</u> <math>(\sqrt{29})^2</math> or <math>5.39^2</math>)</p> <p>(b) Gradient of radius = <math>\frac{2}{5}</math> (or exact equiv.) Must be seen or used in (b)<br/> Gradient of tangent = <math>-\frac{5}{2}</math> (Using perpendicular gradient method)<br/> <math>y-3 = -\frac{5}{2}(x-8)</math> (ft gradient of radius, dependent upon <u>both</u> M marks)<br/> <math>5x + 2y - 46 = 0</math> (Or equiv., equated to zero, e.g. <math>92 - 4y - 10x = 0</math>)<br/> (Must have <u>integer</u> coefficients)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <p>M1 A1<br/>M1<br/>A1 (4)<br/>B1<br/>M1<br/>M1 A1ft<br/>A1 (5)<br/><b>9</b></p> |
|                 | <p>(a) For the M mark, condone <u>one</u> slip <u>inside</u> a bracket, e.g. <math>(8-3)^2 + (3+1)^2</math>,<br/> <math>(8-1)^2 + (1-3)^2</math><br/> The first two marks may be gained implicitly from the circle equation.</p> <p>(b) 2<sup>nd</sup> M: Eqn. of line through (8, 3), in any form, with any grad.(except 0 or <math>\infty</math>).<br/> If the 8 and 3 are the 'wrong way round', this M mark is only given if a correct general formula, e.g. <math>y - y_1 = m(x - x_1)</math>, is quoted.<br/> <u>Alternative:</u> 2<sup>nd</sup> M: Using (8, 3) and an <math>m</math> value in <math>y = mx + c</math> to find a value of <math>c</math>.<br/> A1ft: as in main scheme.<br/> (Correct substitution of 8 and 3, then a wrong <math>c</math> value will still score the A1ft)</p> <p>(b) <u>Alternatives for the first 2 marks:</u> (but in these 2 cases the 1<sup>st</sup> A mark is <u>not</u> ft)</p> <p>(i) Finding gradient of tangent by <u>implicit</u> differentiation<br/> <math>2(x-3) + 2(y-1)\frac{dy}{dx} = 0</math> (or equivalent) B1<br/> Subs. <math>x = 8</math> <u>and</u> <math>y = 3</math> into a 'derived' expression to find a value for <math>dy/dx</math> M1</p> <p>(ii) Finding gradient of tangent by differentiation of <math>y = 1 + \sqrt{20 + 6x - x^2}</math><br/> <math>\frac{dy}{dx} = \frac{1}{2}(20 + 6x - x^2)^{-\frac{1}{2}}(6 - 2x)</math> (or equivalent) B1<br/> Subs. <math>x = 8</math> into a 'derived' expression to find a value for <math>dy/dx</math> M1</p> <p><u>Another alternative:</u><br/> Using <math>xx_1 + yy_1 + g(x + x_1) + f(y + y_1) + c = 0</math><br/> <math>x^2 + y^2 - 6x - 2y - 19 = 0</math> B1<br/> <math>8x + 3y, -3(x+8) - (y+3) - 19 = 0</math> M1, M1 A1ft (ft from circle eqn.)<br/> <math>5x + 2y - 46 = 0</math> A1</p> |                                                                                  |

**June 2008**  
**Core Mathematics C2**  
**Mark Scheme**

| Question number | Scheme                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Marks                                                                                                          |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|
| 6.              | <p>(a) <math>T_{20} = 5 \times \left(\frac{4}{5}\right)^{19} = 0.072</math> (Accept awrt)      Allow <math>5 \times \frac{4^{19}}{5}</math> for M1</p> <p>(b) <math>S_{\infty} = \frac{5}{1-0.8} = 25</math></p> <p>(c) <math>\frac{5(1-0.8^k)}{1-0.8} &gt; 24.95</math> (Allow with = or &lt;)</p> <p><math>1-0.8^k &gt; 0.998</math> (or equiv., see below) (Allow with = or &lt;)</p> <p><math>k \log 0.8 &lt; \log 0.002</math> or <math>k &gt; \log_{0.8} 0.002</math> (Allow with = or &lt;)</p> <p><math>k &gt; \frac{\log 0.002}{\log 0.8}</math> (*)</p> <p>(d) <math>k = 28</math> (Must be this integer value) <u>Not</u> <math>k &gt; 27</math>, or <math>k &lt; 28</math>, or <math>k &gt; 28</math></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <p>M1 A1 (2)</p> <p>M1 A1 (2)</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>A1cso (4)</p> <p>B1 (1)</p> <p><b>9</b></p> |
|                 | <p>(a) and (b): Correct answer without working scores both marks.</p> <p>(a) M: Requires use of the correct formula <math>ar^{n-1}</math>.</p> <p>(b) M: Requires use of the correct formula <math>\frac{a}{1-r}</math></p> <p>(c) 1<sup>st</sup> M: The sum may have already been 'manipulated' (perhaps wrongly), but this mark can still be allowed.</p> <p>1<sup>st</sup> A: A 'numerically correct' version that has dealt with <math>(1-0.8)</math> denominator,</p> <p>e.g. <math>1 - \left(\frac{4}{5}\right)^k &gt; 0.998</math>, <math>5(1-0.8^k) &gt; 4.99</math>, <math>25(1-0.8^k) &gt; 24.95</math>,</p> <p><math>5 - 5(0.8^k) &gt; 4.99</math>. In any of these, <math>\frac{4}{5}</math> instead of 0.8 is fine,</p> <p>and condone <math>\frac{4^k}{5}</math> if correctly treated later.</p> <p>2<sup>nd</sup> M: Introducing logs and using laws of logs correctly (this must include dealing with the power <math>k</math> so that <math>p^k = k \log p</math>).</p> <p>2<sup>nd</sup> A: An <u>incorrect</u> statement (including equalities) at any stage in the working loses this mark (this is often identifiable at the stage <math>k \log 0.8 &gt; \log 0.002</math>). (So a fully correct method with inequalities is required.)</p> |                                                                                                                |

**June 2008**  
**Core Mathematics C2**  
**Mark Scheme**

| Question number | Scheme                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Marks                                                                                                                |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|
| 7.              | <p>(a) <math>r\theta = 7 \times 0.8 = 5.6</math> (cm)</p> <p>(b) <math>\frac{1}{2}r^2\theta = \frac{1}{2} \times 7^2 \times 0.8 = 19.6</math> (cm<sup>2</sup>)</p> <p>(c) <math>BD^2 = 7^2 + (\text{their } AD)^2 - (2 \times 7 \times (\text{their } AD) \times \cos 0.8)</math><br/> <math>BD^2 = 7^2 + 3.5^2 - (2 \times 7 \times 3.5 \times \cos 0.8)</math> (or awrt 46° for the angle)<br/> <math>(BD = 5.21)</math><br/> Perimeter = (their <math>DC</math>) + “5.6” + “5.21” = 14.3 (cm) (Accept awrt)</p> <p>(d) <math>\Delta ABD = \frac{1}{2} \times 7 \times (\text{their } AD) \times \sin 0.8</math> (or awrt 46° for the angle) (ft their <math>AD</math>)<br/> <math>(= 8.78\dots)</math><br/> (If the correct formula <math>\frac{1}{2}ab \sin C</math> is <u>quoted</u> the use of any two of the sides of <math>\Delta ABD</math> as <math>a</math> and <math>b</math> scores the M mark).<br/> Area = “19.6” – “8.78...” = 10.8 (cm<sup>2</sup>) (Accept awrt)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <p>M1 A1 (2)</p> <p>M1 A1 (2)</p> <p>M1<br/>A1</p> <p>M1 A1 (4)</p> <p>M1 A1ft</p> <p>M1 A1 (4)</p> <p><b>12</b></p> |
|                 | <p>Units (cm or cm<sup>2</sup>) are not required in any of the answers.</p> <p>(a) and (b): Correct answers without working score both marks.</p> <p>(a) M: Use of <math>r\theta</math> (with <math>\theta</math> in radians), or equivalent (could be working in degrees with a correct degrees formula).</p> <p>(b) M: Use of <math>\frac{1}{2}r^2\theta</math> (with <math>\theta</math> in radians), or equivalent (could be working in degrees with a correct degrees formula).</p> <p>(c) 1<sup>st</sup> M: Use of the (correct) cosine rule formula to find <math>BD^2</math> or <math>BD</math>.<br/> Any other methods need to be complete methods to find <math>BD^2</math> or <math>BD</math>.<br/> 2<sup>nd</sup> M: Adding their <math>DC</math> to their arc <math>BC</math> and their <math>BD</math>.<br/> <u>Beware:</u> If 0.8 is used, but calculator is in degree mode, this can still earn M1 A1 (for the required expression), but this gives <math>BD = 3.50\dots</math> so the perimeter may appear as <math>3.5 + 5.6 + 3.5</math> (earning M1 A0).</p> <p>(d) 1<sup>st</sup> M: Use of the (correct) area formula to find <math>\Delta ABD</math>.<br/> Any other methods need to be complete methods to find <math>\Delta ABD</math>.<br/> 2<sup>nd</sup> M: Subtracting their <math>\Delta ABD</math> from their sector <math>ABC</math>.<br/> Using segment formula <math>\frac{1}{2}r^2(\theta - \sin \theta)</math> scores no marks in part (d).</p> |                                                                                                                      |

**June 2008**  
**Core Mathematics C2**  
**Mark Scheme**

| Question number | Scheme                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Marks                                                                                                  |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|
| 8.              | <p>(a) <math>\left(\frac{dy}{dx} = \right) 8 + 2x - 3x^2</math> (M: <math>x^n \rightarrow x^{n-1}</math> for one of the terms, <u>not</u> just <math>10 \rightarrow 0</math>)</p> <p><math>3x^2 - 2x - 8 = 0</math> <math>(3x + 4)(x - 2) = 0</math> <math>x = 2</math> (Ignore other solution) (*)</p> <p>(b) Area of triangle = <math>\frac{1}{2} \times 2 \times 22</math> (M: Correct method to find area of triangle)</p> <p>(Area = 22 with no working is acceptable)</p> <p><math>\int 10 + 8x + x^2 - x^3 dx = 10x + \frac{8x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4}</math> (M: <math>x^n \rightarrow x^{n+1}</math> for one of the terms)</p> <p>Only one term correct: M1 A0 A0<br/>2 or 3 terms correct: M1 A1 A0</p> <div style="border: 1px solid black; padding: 5px; display: inline-block;">Integrating the <u>gradient function</u> loses this M mark.</div> <p><math>\left[ 10x + \frac{8x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} \right]_0^2 = \dots\dots</math> (Substitute limit 2 into a 'changed function')</p> <p><math>\left( = 20 + 16 + \frac{8}{3} - 4 \right)</math> (This M can be awarded even if the other limit is wrong)</p> <p>Area of R = <math>34\frac{2}{3} - 22 = \frac{38}{3} \left( = 12\frac{2}{3} \right)</math> (Or 12.6)</p> <p>M: <u>Dependent on use of calculus in (b) and correct overall 'strategy':</u><br/>subtract either way round.<br/>A: Must be <u>exact</u>, not 12.67 or similar.<br/>A negative area at the end, even if subsequently made positive, loses the A mark.</p> | <p>M1 A1</p> <p>A1cso (3)</p> <p>M1 A1</p> <p>M1 A1 A1</p> <p>M1</p> <p>M1 A1 (8)</p> <p><b>11</b></p> |
|                 | <p>(a) The final mark may also be scored by <u>verifying</u> that <math>\frac{dy}{dx} = 0</math> at <math>x = 2</math>.</p> <p>(b) <u>Alternative:</u><br/>Eqn. of line <math>y = 11x</math>. (Marks dependent on subsequent use in integration)<br/>(M1: Correct method to find equation of line. A1: Simplified form <math>y = 11x</math>)</p> <p><math>\int 10 + kx + x^2 - x^3 dx = 10x + \frac{kx^2}{2} + \frac{x^3}{3} - \frac{x^4}{4}</math> (k perhaps -3)</p> <p><math>\left[ 10x + \frac{kx^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} \right]_0^2 = \dots\dots</math> (Substitute limit 2 into a 'changed function')</p> <p>Area of R = <math>\left[ 10x - \frac{3x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} \right]_0^2 = 20 - 6 + \frac{8}{3} - 4 = \frac{38}{3} \left( = 12\frac{2}{3} \right)</math></p> <p>Final M1 for <math>\int(\text{curve}) - \int(\text{line})</math> or <math>\int(\text{line}) - \int(\text{curve})</math>.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <p>M1 A1</p> <p>M1 A1 A1</p> <p>M1</p> <p>M1 A1 (8)</p>                                                |

**June 2008**  
**Core Mathematics C2**  
**Mark Scheme**

| Question number | Scheme                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Marks                                                                                           |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| 9.              | <p>(a) 45 (<math>\alpha</math>) (This mark can be implied by an answer 65)<br/> <math>180 - \alpha</math>, Add 20 (for at least one angle)<br/> 65 155</p> <p>(b) 120 or 240 (<math>\beta</math>): (This mark can be implied by an answer 40 or 80)<br/> (Could be achieved by working with 60, using <math>180 - 60</math> and/or <math>180 + 60</math>)<br/> <math>360 - \beta</math>, <math>360 + \beta</math> (or <math>120 +</math> an angle that has been divided by 3)<br/> Dividing by 3 (for at least one angle)<br/> 40 80 160 200 280 320 First A1: at least 3 correct</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <p>B1<br/> M1, M1<br/> A1 (4)</p> <p>B1<br/> M1, M1<br/> M1<br/> A1 A1 (6)</p> <p><b>10</b></p> |
|                 | <p>(a) Extra solution(s) in range: Loses the A mark.<br/> Extra solutions outside range: Ignore (whether correct or not).<br/> Common solutions:<br/> 65 (only correct solution) will score B1 M0 M1 A0 (2 marks)<br/> 65 and 115 will score B1 M0 M1 A0 (2 marks)<br/> 44.99 (or similar) for <math>\alpha</math> is B0, and 64.99, 155.01 (or similar) is A0.</p> <p>(b) Extra solution(s) in range: Loses the final A mark.<br/> Extra solutions outside range: Ignore (whether correct or not).<br/> Common solutions:<br/> 40 (only correct solution) will score B1 M0 M0 M1 A0 A0 (2 marks)<br/> 40 and 80 (only correct solutions) B1 M1 M0 M1 A0 A0 (3 marks)<br/> 40 and 320 (only correct solutions) B1 M0 M0 M1 A0 A0 (2 marks)</p> <p><u>Answers without working:</u><br/> Full marks can be given (in both parts), B and M marks by implication.</p> <p><u>Answers given in radians:</u><br/> Deduct a maximum of 2 marks (misread) from B and A marks. (Deduct these at first and second occurrence.)</p> <p><u>Answers that begin</u> with statements such as <math>\sin(x - 20) = \sin x - \sin 20</math> or <math>\cos x = -\frac{1}{6}</math>, then go on to find a value of '<math>\alpha</math>' or '<math>\beta</math>', however badly, <u>can</u> continue to earn the first M mark in either part, but will score <u>no further marks</u>.</p> <p><u>Possible misread:</u> <math>\cos 3x = \frac{1}{2}</math>, giving 20, 100, 140, 220, 260, 340<br/> Could score up to 4 marks B0 M1 M1 M1 A0 A1 for the above answers.</p> |                                                                                                 |