





January 2010  
Core Mathematics C2 6664  
Mark Scheme

Question Number	Scheme	Marks
Q1	$\begin{aligned} [(3-x)^6] &= 3^6 + 3^5 \times 6 \times (-x) + 3^4 \times \binom{6}{2} \times (-x)^2 \\ &= 729, -1458x, +1215x^2 \end{aligned}$	M1 B1,A1, A1 [4]
Notes	<p><b>M1</b> for <u>either</u> the <math>x</math> term <u>or</u> the <math>x^2</math> term. Requires <u>correct</u> binomial coefficient in any form with the correct power of <math>x</math> – condone lack of negative sign and wrong power of 3. This mark may be given if no working is shown, but one of the terms including <math>x</math> is correct. Allow <math>\frac{6}{1}</math>, or <math>\frac{6}{2}</math> (must have a power of 3, even if only power 1)</p> <p>First term must be 729 for <b>B1</b>, ( writing just <math>3^6</math> is <b>B0</b> ) can isw if numbers added to this constant later. Can allow 729(1...</p> <p>Term must be simplified to <math>-1458x</math> for <b>A1cao</b>. The <math>x</math> is required for this mark.</p> <p><b>Final A1</b> is c.a.o and needs to be <math>+1215x^2</math> (can follow omission of negative sign in working)</p> <p>Descending powers of <math>x</math> would be <math>x^6 + 3 \times 6 \times (-x)^5 + 3^2 \times \binom{6}{4} \times (-x)^4 + ..</math></p> <p>i.e. <math>x^6 - 18x^5 + 135x^4 + ..</math> This is M1B1A0A0 if completely “correct” or M1 B0A0A0 for <u>correct</u> binomial coefficient in any form with the correct power of <math>x</math> as before</p>	
Alternative	<p><b>NB Alternative method:</b> <math>(3-x)^6 = 3^6(1 + 6 \times (-\frac{x}{3}) + \binom{6}{2} \times (-\frac{x}{3})^2 + ..)</math> is <b>M1B0A0A0</b></p> <p>– answers must be simplified to 729, <math>-1458x</math>, <math>+1215x^2</math> for full marks (awarded as before)</p> <p>The mistake <math>(3-x)^6 = 3(1 - \frac{x}{3})^6 = 3(1 + 6 \times (-\frac{x}{3}) + \binom{6}{2} \times (-\frac{x}{3})^2 + ..)</math> may also be awarded <b>M1B0A0A0</b></p> <p>Another mistake <math>3^6(1 - 6x + 15x^2 ... ) = 729...</math> would be M1B1A0A0</p>	



Question Number	Scheme	Marks
Q2 (a)	$5 \sin x = 1 + 2(1 - \sin^2 x)$ $2 \sin^2 x + 5 \sin x - 3 = 0 \quad (*)$	M1 A1cso (2)
(b)	$(2s - 1)(s + 3) = 0 \text{ giving } s =$ $[\sin x = -3 \text{ has no solution}] \text{ so } \sin x = \frac{1}{2}$ $\therefore x = 30, 150$	M1 A1 B1, B1ft (4) [6]
(a)	<p>M1 for a correct method to change <math>\cos^2 x</math> into <math>\sin^2 x</math> (must use <math>\cos^2 x = 1 - \sin^2 x</math>)</p> <p>A1 need 3 term quadratic printed in any order with =0 included</p>	
(b)	<p>M1 for attempt to solve given quadratic (usual rules for solving quadratics) (can use any variable here, <math>s, y, x,</math> or <math>\sin x</math>)</p> <p>A1 requires no incorrect work seen and is for <math>\sin x = \frac{1}{2}</math> or <math>x = \sin^{-1} \frac{1}{2}</math></p> <p><math>y = \frac{1}{2}</math> is A0 (unless followed by <math>x = 30</math>)</p> <p>B1 for 30 (<math>\alpha</math>) not dependent on method</p> <p>2<sup>nd</sup> B1 for <math>180 - \alpha</math> provided in required range (otherwise <math>540 - \alpha</math>)</p> <p><u>Extra solutions outside required range:</u> Ignore</p> <p><u>Extra solutions inside required range:</u> Lose final B1</p> <p><u>Answers in radians:</u> Lose final B1</p> <p>S.C. Merely writes down two correct answers is M0A0B1B1</p> <p>Or <math>\sin x = \frac{1}{2} \therefore x = 30, 150</math> is <b>M1A1B1B1</b></p> <p>Just gives one answer : 30 only is M0A0B1B0 or 150 only is M0A0B0B1</p> <p><b>NB</b> Common error is to factorise wrongly giving <math>(2 \sin x + 1)(\sin x - 3) = 0</math></p> <p><math>[\sin x = 3 \text{ gives no solution}] \sin x = -\frac{1}{2} \Rightarrow x = 210, 330</math></p> <p>This earns M1 A0 B0 B1ft</p> <p>Another common error is to factorise correctly <math>(2 \sin x - 1)(\sin x + 3) = 0</math> and follow this with <math>\sin x = \frac{1}{2}, \sin x = 3</math> then <math>x = 30^\circ, 150^\circ</math></p> <p>This would be M1 A0 B1 B1</p>	



Question Number	Scheme	Marks
Q3 (a)	$f\left(\frac{1}{2}\right) = 2 \times \frac{1}{8} + a \times \frac{1}{4} + b \times \frac{1}{2} - 6$ $f\left(\frac{1}{2}\right) = -5 \Rightarrow \frac{1}{4}a + \frac{1}{2}b = \frac{3}{4} \text{ or } a + 2b = 3$ $f(-2) = -16 + 4a - 2b - 6$ $f(-2) = 0 \Rightarrow 4a - 2b = 22$ <p>Eliminating one variable from 2 linear simultaneous equations in <math>a</math> and <math>b</math></p> $a = 5 \text{ and } b = -1$	M1 A1 M1 A1 M1 A1 M1 M1A1 [9]
(b)	$2x^3 + 5x^2 - x - 6 = (x+2)(2x^2 + x - 3)$ $= (x+2)(2x+3)(x-1)$ <p>NB <math>(x+2)\left(x+\frac{3}{2}\right)(2x-2)</math> is A0 But <math>2(x+2)\left(x+\frac{3}{2}\right)(x-1)</math> is A1</p>	(6) (3)
(a)	<p>1<sup>st</sup> M1 for attempting <math>f(\pm\frac{1}{2})</math> Treat the omission of the <math>-5</math> here as a slip and allow the M mark.                      1<sup>st</sup> A1 for first correct equation in <math>a</math> and <math>b</math> simplified to three non zero terms (needs <math>-5</math> used)                      s.c. If it is not simplified to three terms but is correct and is then used correctly with second equation to give correct answers- this mark can be awarded later.                      2<sup>nd</sup> M1 for attempting <math>f(\mp 2)</math>                      2<sup>nd</sup> A1 for the second correct equation in <math>a</math> and <math>b</math>. simplified to three terms (needs 0 used) s.c. If it is not simplified to three terms but is correct and is then used correctly with first equation to give correct answers - this mark can be awarded later.                      3<sup>rd</sup> M1 for an attempt to eliminate one variable from 2 linear simultaneous equations in <math>a</math> and <math>b</math>                      3<sup>rd</sup> A1 for both <math>a = 5</math> and <math>b = -1</math> (Correct answers here imply previous two A marks)</p>	
(b)	<p>1<sup>st</sup> M1 for attempt to divide by <math>(x+2)</math> leading to a 3TQ beginning with correct term usually <math>2x^2</math>                      2<sup>nd</sup> M1 for attempt to factorize their quadratic provided no remainder                      A1 is cao and needs all three factors                      Ignore following work (such as a solution to a quadratic equation).</p>	
(a)	<p><u>Alternative;</u>                      M1 for dividing by <math>(2x-1)</math>, to get <math>x^2 + (\frac{a+1}{2})x + \text{constant}</math> <b>with remainder as a function of <math>a</math> and <math>b</math></b>, and A1 as before for equations stated in scheme .                      M1 for dividing by <math>(x+2)</math>, to get <math>2x^2 + (a-4)x...</math> (No need to see remainder as it is zero and comparison of coefficients may be used) with A1 as before</p>	
(b)	<p><u>Alternative;</u>                      M1 for finding second factor correctly by factor theorem, usually <math>(x-1)</math>                      M1 for using two known factors to find third factor, usually <math>(2x \pm 3)</math>                      Then A1 for correct factorisation written as product <math>(x+2)(2x+3)(x-1)</math></p>	





Question Number	Scheme	Marks
<p>Q4</p> <p>(a)</p> <p>(b)</p>	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p><b>Either</b> <math>\frac{\sin(\hat{A}CB)}{5} = \frac{\sin 0.6}{4}</math></p> <p><math>\therefore \hat{A}CB = \arcsin(0.7058\dots)</math></p> <p><math>= [0.7835\dots \text{ or } 2.358]</math></p> <p>Use angles of triangle</p> <p><math>\hat{A}BC = \pi - 0.6 - \hat{A}CB</math></p> <p>(But as AC is the longest side so)</p> <p><math>\hat{A}BC = 1.76</math> (*) (3sf) [Allow <math>100.7^\circ \rightarrow 1.76</math>]</p> <p>In degrees <math>0.6 = 34.377^\circ</math>, <math>\hat{A}CB = 44.9^\circ</math></p> </div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p><b>or</b> <math>4^2 = b^2 + 5^2 - 2 \times b \times 5 \cos 0.6</math></p> <p><math>\therefore b = \frac{10 \cos 0.6 \pm \sqrt{(100 \cos^2 0.6 - 36)}}{2}</math></p> <p><math>= [6.96 \text{ or } 1.29]</math></p> <p>Use sine / cosine rule with value for <math>b</math></p> <p><math>\sin B = \frac{\sin 0.6}{4} \times b</math> or <math>\cos B = \frac{25 + 16 - b^2}{40}</math></p> <p>(But as AC is the longest side so)</p> <p><math>\hat{A}BC = 1.76</math> (*) (3sf)</p> </div> <p><math>[C\hat{B}D = \pi - 1.76 = 1.38]</math> Sector area <math>= \frac{1}{2} \times 4^2 \times (\pi - 1.76) = [11.0 \sim 11.1]</math> <math>\frac{1}{2} \times 4^2 \times 79.3</math> is M0</p> <p>Area of <math>\triangle ABC = \frac{1}{2} \times 5 \times 4 \times \sin(1.76) = [9.8]</math> or <math>\frac{1}{2} \times 5 \times 4 \times \sin 101</math></p> <p>Required area = awrt 20.8 or 20.9 or 21.0 or gives 21 (2sf) after correct work.</p>	<p>M1</p> <p>M1</p> <p>M1,</p> <p>A1 (4)</p> <p>M1</p> <p>M1</p> <p>A1 (3)</p> <p>[7]</p>
<p>(a)</p> <p>(b)</p>	<p>1<sup>st</sup> M1 for correct use of sine rule to find <math>ACB</math> or cosine rule to find <math>b</math> (M0 for <math>ABC</math> here or for use of <math>\sin x</math> where <math>x</math> could be <math>ABC</math>)</p> <p>2<sup>nd</sup> M1 for a correct expression for angle <math>ACB</math> (This mark may be implied by .7835 or by <math>\arcsin(.7058)</math>) and needs accuracy. In second method this M1 is for correct expression for <math>b</math> – may be implied by 6.96. [Note <math>10 \cos 0.6 \approx 8.3</math> ] (do not need two answers)</p> <p>3<sup>rd</sup> M1 for a correct method to get angle <math>ABC</math> in method (i) or <math>\sin ABC</math> or <math>\cos ABC</math> , in method (ii) (If <math>\sin B &gt; 1</math>, can have M1A0)</p> <p>A1cso for correct work leading to 1.76 3sf . Do not need to see angle 0.1835 considered and rejected.</p> <p>1<sup>st</sup> M1 for a correct expression for sector area or a value in the range 11.0 – 11.1</p> <p>2<sup>nd</sup> M1 for a correct expression for the area of the triangle or a value of 9.8</p> <p>Ignore 0.31 (working in degrees) as subsequent work.</p> <p>A1 for answers which round to 20.8 or 20.9 or 21.0. No need to see units.</p>	
<p>(a)</p>	<p><b>Special case</b> If answer 1.76 is assumed then usual mark is M0 M0 M0 A0. A Fully checked method may be worth M1 M1 M0 A0. A maximum of 2 marks. The mark is either 2 or 0.</p> <p><b>Either M1</b> for <math>\hat{A}CB</math> is found to be 0,7816 (angles of triangle) then</p> <p><b>M1</b> for checking <math>\frac{\sin(\hat{A}CB)}{5} = \frac{\sin 0.6}{4}</math> with conclusion giving numerical answers</p> <p><b>This gives a maximum mark of 2/4</b></p> <p><b>OR M1</b> for <math>b</math> is found to be 6.97 (cosine rule)</p> <p><b>M1</b> for checking <math>\frac{\sin(ABC)}{b} = \frac{\sin 0.6}{4}</math> with conclusion giving numerical answers</p> <p><b>This gives a maximum mark of 2/4</b></p> <p>Candidates making this assumption need a complete method. They cannot earn M1M0.</p> <p>So the score will be 0 or 2 for part (a). Circular arguments earn 0/4.</p>	



Question Number	Scheme	Marks
Q5 (a)	$\log_x 64 = 2 \Rightarrow 64 = x^2$ <p style="text-align: center;">So <math>x = 8</math></p>	M1 A1 (2)
(b)	$\log_2(11-6x) = \log_2(x-1)^2 + 3$ $\log_2 \left[ \frac{11-6x}{(x-1)^2} \right] = 3$ $\frac{11-6x}{(x-1)^2} = 2^3$ $\{11-6x = 8(x^2 - 2x + 1)\} \text{ and so } 0 = 8x^2 - 10x - 3$ $0 = (4x+1)(2x-3) \Rightarrow x = \dots$ $x = \frac{3}{2}, \left[ -\frac{1}{4} \right]$	M1 M1 M1 A1 dM1 A1 (6) [8]
(a)	<p>M1 for getting out of logs A1 Do not need to see <math>x = -8</math> appear and get rejected. Ignore <math>x = -8</math> as extra solution. <math>x = 8</math> with no working is M1 A1</p>	
(b)	<p>1<sup>st</sup> M1 for using the <math>n \log x</math> rule 2<sup>nd</sup> M1 for using the <math>\log x - \log y</math> rule or the <math>\log x + \log y</math> rule as appropriate 3<sup>rd</sup> M1 for using 2 to the power– need to see <math>2^3</math> or 8 (May see <math>3 = \log_2 8</math> used) <b>If all three M marks have been earned and logs are still present</b> in equation <b>do not give</b> final M1. So solution stopping at <math>\log_2 \left[ \frac{11-6x}{(x-1)^2} \right] = \log_2 8</math> would earn M1M1M0 1<sup>st</sup> A1 for a correct 3TQ 4<sup>th</sup> dependent M1 for attempt to solve or factorize their 3TQ to obtain <math>x = \dots</math> (mark depends on three previous M marks) 2<sup>nd</sup> A1 for 1.5 (ignore -0.25) s.c 1.5 only – no working – is 0 marks</p>	
(a)	<p><u>Alternatives</u> Change base : (i) <math>\frac{\log_2 64}{\log_2 x} = 2</math>, so <math>\log_2 x = 3</math> and <math>x = 2^3</math>, is M1 or (ii) <math>\frac{\log_{10} 64}{\log_{10} x} = 2</math>, <math>\log x = \frac{1}{2} \log 64</math> so <math>x = 64^{\frac{1}{2}}</math> is M1 then <math>x = 8</math> is A1 <b>BUT</b> <math>\log x = 0.903</math> so <math>x = 8</math> is M1A0 (loses accuracy mark) (iii) <math>\log_{64} x = \frac{1}{2}</math> so <math>x = 64^{\frac{1}{2}}</math> is M1 then <math>x = 8</math> is A1</p>	



Question Number	Scheme	Marks
Q6	<p>(a) <math>18000 \times (0.8)^3 = \text{£}9216</math> * [may see <math>\frac{4}{5}</math> or 80% or equivalent].</p> <p>(b) <math>18000 \times (0.8)^n &lt; 1000</math>  <math>n \log(0.8) &lt; \log\left(\frac{1}{18}\right)</math>  <math>n &gt; \frac{\log\left(\frac{1}{18}\right)}{\log(0.8)} = 12.952\dots</math> so <math>n = 13</math>.</p> <p>(c) <math>u_5 = 200 \times (1.12)^4, = \text{£}314.70</math> or <math>\text{£}314.71</math></p> <p>(d) <math>S_{15} = \frac{200(1.12^{15} - 1)}{1.12 - 1}</math> or <math>\frac{200(1 - 1.12^{15})}{1 - 1.12}, = 7455.94\dots</math> awrt <math>\text{£}7460</math></p>	<p>B1cso (1)</p> <p>M1</p> <p>M1</p> <p>A1 cso (3)</p> <p>M1, A1 (2)</p> <p>M1A1, A1 (3)</p> <p>[9]</p>
	<p>(a) B1 NB Answer is printed <b>so need working</b>. May see as above or <math>\times 0.8</math> in three steps giving 14400, 11520, 9216. Do not need to see £ sign but should see 9216 .</p> <p>(b) 1<sup>st</sup> M1 for an attempt to use <math>n</math>th term and 1000. Allow <math>n</math> or <math>n - 1</math> and allow <math>&gt;</math> or <math>=</math>                  2<sup>nd</sup> M1 for use of logs to find <math>n</math> Allow <math>n</math> or <math>n - 1</math> and allow <math>&gt;</math> or <math>=</math>                  A1 Need <math>n = 13</math> This is an accuracy mark and must follow award of both M marks but should not follow incorrect work using <math>n - 1</math> for example.                  Condone slips in inequality signs here.</p> <p>(c) M1 for use of their <math>a</math> and <math>r</math> in formula for 5<sup>th</sup> term of GP                  A1 cao need one of these answers – answer can imply method here                  NB 314.7 – A0</p> <p>(d) M1 for use of sum to 15 terms of GP using their <math>a</math> and their <math>r</math> ( allow if formula stated correctly and one error in substitution, but must use <math>n</math> not <math>n - 1</math>)                  1<sup>st</sup> A1 for a fully correct expression ( not evaluated)</p>	
	<p>(b) Alternative Methods                  Trial and Improvement                  See 989.56 ( or 989 or 990) identified with 12, 13 or 14 years for <b>first M1</b>                  See 1236.95 ( or 1236 or 1237) identified with 11, 12 or 13 years for <b>second M1</b>                  Then <math>n = 13</math> is <b>A1 (needs both Ms)</b>  <b>Special case</b> <math>18000 \times (0.8)^n &lt; 1000</math> so <math>n = 13</math> as <math>989.56 &lt; 1000</math> is M1M0A0 (not discounted <math>n = 12</math>)</p> <p>(c) May see the terms 224, 250.88, 280.99, 314.71 with a small slip for M1 A0, or done accurately for M1A1</p> <p>(d) Adds 15 terms <math>200 + 224 + 250.88 + \dots + (977.42)</math> <b>M1</b>                  Seeing 977... is <b>A1</b>                  Obtains answer 7455.94 <b>A1</b> or awrt <math>\text{£}7460</math> NOT 7450</p>	



Question Number	Scheme	Marks
Q7	<p>(a) <b>Puts</b> <math>y = 0</math> and attempts to solve quadratic e.g. <math>(x-4)(x-1) = 0</math> Points are (1,0) and (4, 0)</p> <p>(b) <math>x = 5</math> gives <math>y = 25 - 25 + 4</math> and so (5, 4) lies on the curve</p> <p>(c) <math>\int (x^2 - 5x + 4) dx = \frac{1}{3}x^3 - \frac{5}{2}x^2 + 4x \quad (+ c)</math></p> <p>(d) Area of triangle = <math>\frac{1}{2} \times 4 \times 4 = 8</math> or <math>\int (x-1) dx = \frac{1}{2}x^2 - x</math> with limits 1 and 5 to give 8</p> <p>Area under the curve = <math>\int_4^5 \left( \frac{1}{3}x^3 - \frac{5}{2}x^2 + 4x \right) dx</math> <math>\left[ = -\frac{5}{6} \right]</math>  <math>\int_4^5 \left( \frac{1}{3}x^3 - \frac{5}{2}x^2 + 4x \right) dx</math> <math>\left[ = -\frac{8}{3} \right]</math></p> <p><math>\int_4^5 = -\frac{5}{6} - \left(-\frac{8}{3}\right) = \frac{11}{6}</math> or equivalent (allow 1.83 or 1.8 here)</p> <p>Area of <math>R = 8 - \frac{11}{6} = 6\frac{1}{6}</math> or <math>\frac{37}{6}</math> or <math>6.16\bar{6}</math> (not 6.17)</p>	<p>M1 A1 (2)</p> <p>B1cso (1)</p> <p>M1A1 (2)</p> <p>B1 M1 M1 A1 cao A1 cao (5)</p> <p>[10]</p>
	<p>(a) M1 for attempt to find <math>L</math> and <math>M</math> A1 Accept <math>x = 1</math> and <math>x = 4</math>, then isw or accept <math>L = (1,0)</math>, <math>M = (4,0)</math> Do not accept <math>L = 1</math>, <math>M = 4</math> nor <math>(0, 1)</math>, <math>(0, 4)</math> (unless subsequent work) Do not need to distinguish <math>L</math> and <math>M</math>. Answers imply M1A1.</p> <p>(b) See substitution, working should be shown, need conclusion which could be just <math>y = 4</math> or a tick. Allow <math>y = 25 - 25 + 4 = 4</math> But not <math>25 - 25 + 4 = 4</math>. (<math>y = 4</math> may appear at start) Usually <math>0 = 0</math> or <math>4 = 4</math> is B0</p> <p>(c) M1 for attempt to integrate <math>x^2 \rightarrow kx^3</math>, <math>x \rightarrow kx^2</math> or <math>4 \rightarrow 4x</math> A1 for correct integration of all three terms (do not need constant) isw. Mark correct work when seen. So e.g. <math>\frac{1}{3}x^3 - \frac{5}{2}x^2 + 4x</math> is A1 then <math>2x^3 - 15x^2 + 24x</math> would be ignored as subsequent work.</p> <p>(d) B1 for this triangle only (not triangle <math>LMN</math>) 1<sup>st</sup> M1 for substituting 5 into their changed function 2<sup>nd</sup> M1 for substituting 4 into their changed function</p>	
	<p>(d) Alternative method: <math>\int_1^5 (x-1) - (x^2 - 5x + 4) dx + \int_1^4 x^2 - 5x + 4 dx</math> can lead to correct answer</p> <p>Constructs <math>\int_1^5 (x-1) - (x^2 - 5x + 4) dx</math> is B1</p> <p>M1 for substituting 5 and 1 and subtracting in first integral M1 for substituting 4 and 1 and subtracting in second integral A1 for answer to first integral i.e. <math>\frac{32}{3}</math> (allow 10.7) and A1 for final answer as before..</p>	

(d)	<p>Another alternative</p> $\int_4^5 (x-1) - (x^2 - 5x + 4) dx + \text{area of triangle } LMP$ <p>Constructs <math>\int_4^5 (x-1) - (x^2 - 5x + 4) dx</math> is B1</p> <p>M1 for substituting 5 and 4 and subtracting in first integral</p> <p>M1 for complete method to find area of triangle (4.5)</p> <p>A1 for answer to first integral i.e. <math>\frac{5}{3}</math> and A1 for final answer as before.</p>
(d)	<p>Could also use</p> $\int_4^5 (4x-16) - (x^2 - 5x + 4) dx + \text{area of triangle } LMN$ <p>Similar scheme to previous one. Triangle has area 6</p> <p>A1 for finding Integral has value <math>\frac{1}{6}</math> and A1 for final answer as before.</p>



8.

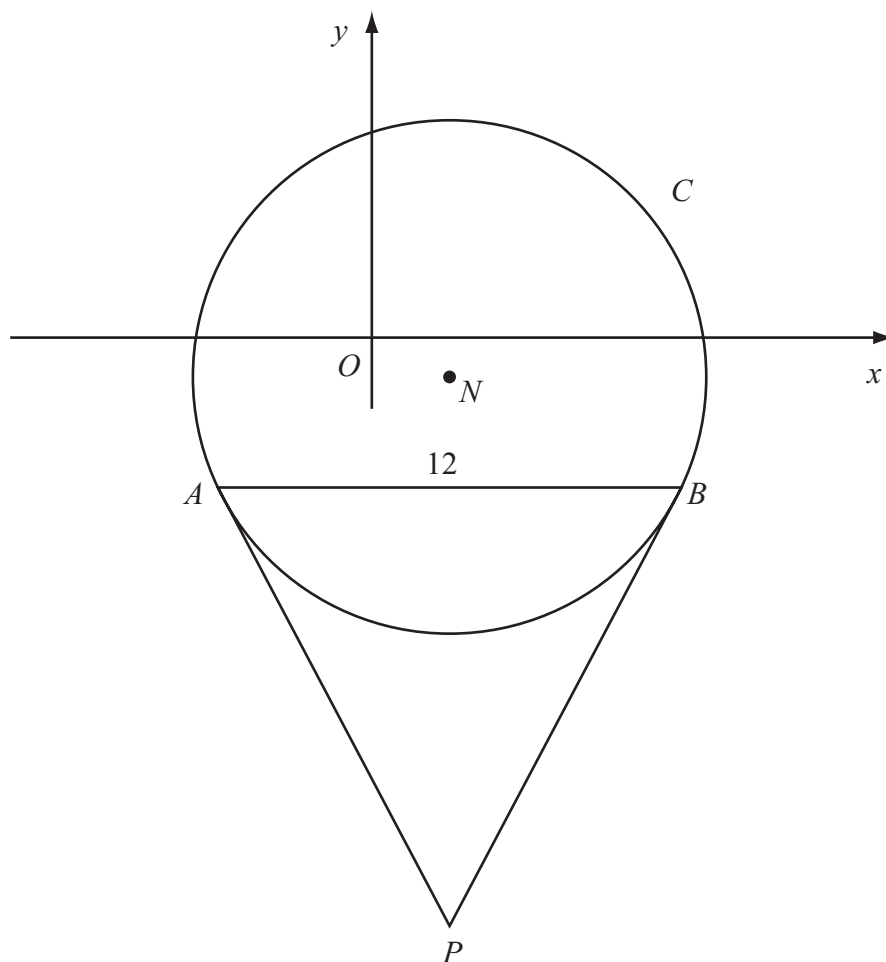


Figure 3

Figure 3 shows a sketch of the circle  $C$  with centre  $N$  and equation

$$(x - 2)^2 + (y + 1)^2 = \frac{169}{4}$$

(a) Write down the coordinates of  $N$ . (2)

(b) Find the radius of  $C$ . (1)

The chord  $AB$  of  $C$  is parallel to the  $x$ -axis, lies below the  $x$ -axis and is of length 12 units as shown in Figure 3.

(c) Find the coordinates of  $A$  and the coordinates of  $B$ . (5)

(d) Show that angle  $ANB = 134.8^\circ$ , to the nearest 0.1 of a degree. (2)

The tangents to  $C$  at the points  $A$  and  $B$  meet at the point  $P$ .

(e) Find the length  $AP$ , giving your answer to 3 significant figures. (2)



Question Number	Scheme	Marks
<p>Q8 (a)</p> <p>(b)</p> <p>(c)</p> <p>(d)</p> <p>(e)</p>	<p><math>N(2, -1)</math></p> <p><math>r = \sqrt{\frac{169}{4}} = \frac{13}{2} = 6.5</math></p> <p>Complete Method to find <math>x</math> coordinates, <math>x_2 - x_1 = 12</math> and <math>\frac{x_1 + x_2}{2} = 2</math> then solve To obtain <math>x_1 = -4, x_2 = 8</math> Complete Method to find <math>y</math> coordinates, using equation of circle or Pythagoras i.e. let <math>d</math> be the distance below <math>N</math> of <math>A</math> then <math>d^2 = 6.5^2 - 6^2 \Rightarrow d = 2.5 \Rightarrow y = ..</math> So <math>y_2 = y_1 = -3.5</math></p> <p>Let <math>\widehat{ANB} = 2\theta \Rightarrow \sin \theta = \frac{6}{"6.5"} \Rightarrow \theta = (67.38)...</math> So angle <math>ANB</math> is <math>134.8^*</math></p> <p><math>AP</math> is perpendicular to <math>AN</math> so using triangle <math>ANP</math> <math>\tan \theta = \frac{AP}{"6.5"}</math></p> <p>Therefore <math>AP = 15.6</math></p>	<p>B1, B1 (2)</p> <p>B1 (1)</p> <p>M1 A1ft A1ft M1 A1 (5)</p> <p>M1 A1 (2)</p> <p>M1 A1cao (2)</p> <p>[12]</p>
<p>(a)</p> <p>(b)</p> <p>(c)</p> <p>(d)</p> <p>(e)</p>	<p>B1 for 2 (<math>\alpha</math>), B1 for <math>-1</math></p> <p>B1 for 6.5 o.e.</p> <p>1<sup>st</sup> M1 for finding <math>x</math> coordinates – may be awarded if either <math>x</math> co-ord is correct A1ft,A1ft are for <math>\alpha - 6</math> and <math>\alpha + 6</math> if <math>x</math> coordinate of <math>N</math> is <math>\alpha</math> 2<sup>nd</sup> M1 for a method to find <math>y</math> coordinates – may be given if <math>y</math> co-ordinate is correct A marks is for <math>-3.5</math> only.</p> <p>M1 for a full method to find <math>\theta</math> or angle <math>ANB</math> (eg sine rule or cosine rule directly or finding another angle and using angles of triangle.) <b>ft their 6.5 from radius or wrong y.</b> <math>(\cos ANB = \frac{"6.5"{}^2 + "6.5"{}^2 - 12^2}{2 \times "6.5" \times "6.5"} = -0.704)</math> A1 is a printed answer and must be 134.8 – do not accept 134.76.</p> <p>M1 for a full method to find <math>AP</math> <u>Alternative Methods</u> N.B. May use triangle <math>AXP</math> where <math>X</math> is the mid point of <math>AB</math>. Or may use triangle <math>ABP</math>. From circle theorems may use angle <math>BAP = 67.38</math> or some variation. Eg <math>\frac{AP}{\sin 67.4} = \frac{12}{\sin 45.2}</math>, <math>AP = \frac{6}{\sin 22.6}</math> or <math>AP = \frac{6}{\cos 67.4}</math> are each worth M1</p>	



Question Number	Scheme	Marks
Q9 (a)	$\left[ y = 12x^{\frac{1}{2}} - x^{\frac{3}{2}} - 10 \right]$ $[y' =] \quad 6x^{-\frac{1}{2}} - \frac{3}{2}x^{\frac{1}{2}}$ <p><b>Puts their</b> <math>\frac{6}{x^{\frac{1}{2}}} - \frac{3}{2}x^{\frac{1}{2}} = 0</math></p> <p>So <math>x = \frac{12}{3} = 4</math> (If <math>x = 0</math> appears also as solution then lose A1)</p> <p><math>x = 4, \Rightarrow y = 12 \times 2 - 4^{\frac{3}{2}} - 10, \quad \text{so } y = 6</math></p>	<p>M1 A1</p> <p>M1</p> <p>M1, A1</p> <p>dM1, A1 (7)</p>
(b)	$y'' = -3x^{-\frac{3}{2}} - \frac{3}{4}x^{-\frac{1}{2}}$	M1A1 (2)
(c)	[Since $x > 0$ ] It is a maximum	B1 (1)
(a)	<p>1<sup>st</sup> M1 for an attempt to differentiate a fractional power <math>x^n \rightarrow x^{n-1}</math></p> <p>A1 a.e.f – can be unsimplified</p> <p>2<sup>nd</sup> M1 for forming a suitable equation using their <math>y' = 0</math></p> <p>3<sup>rd</sup> M1 for correct processing of fractional powers leading to <math>x = \dots</math> (Can be implied by <math>x = 4</math>)</p> <p>A1 is for <math>x = 4</math> only. If <math>x = 0</math> also seen and not discarded they lose this mark only.</p> <p>4<sup>th</sup> M1 for substituting their value of <math>x</math> back into <math>y</math> to find <math>y</math> value. Dependent on three previous M marks. Must see evidence of the substitution with attempt at fractional powers to give M1A0, but <math>y = 6</math> can imply M1A1</p>	<p>(1)</p> <p>[10]</p>
(b)	<p>M1 for differentiating their <math>y'</math> again</p> <p>A1 should be simplified</p>	
(c)	<p>B1 . Clear conclusion needed and must follow correct <math>y''</math> It is dependent on previous A mark (Do not need to have found <math>x</math> earlier).</p> <p>(Treat parts (a),(b) and (c) together for award of marks)</p>	