

	Give 1 mark for each •	Illustration(s) for awarding each mark
1.	<p><b>(a) ans:</b> <math>2y = -x - 11</math> (or equiv.) <b>2 marks</b></p> <ul style="list-style-type: none"> <li>•1 for gradient</li> <li>•2 for equation of line</li> </ul> <p><b>(b) ans:</b> <math>y = 2x + 2</math> <b>3 marks</b></p> <ul style="list-style-type: none"> <li>•1 knowing gradients mult. to -1</li> <li>•2 for gradient</li> <li>•3 equation of altitude</li> </ul> <p><b>(c) ans:</b> S(-3,-4) <b>4 marks</b></p> <ul style="list-style-type: none"> <li>•1 knowing to solve as a system</li> <li>•2 system strategy .... (subst. or elimin.)</li> <li>•3 first coordinate</li> <li>•4 second coordinate</li> </ul> <p><b>(d) ans:</b> <math>(x - 6)^2 + (y + 1)^2 = 90</math> <b>4 marks</b></p> <ul style="list-style-type: none"> <li>•1 realising strategy of R.A. <math>\therefore</math> QR = diam.</li> <li>•2 finding centre</li> <li>•3 calculating value of <math>r^2</math></li> <li>•4 equation of circle</li> </ul>	<p>(a)</p> <ul style="list-style-type: none"> <li>•1 <math>m = \frac{-10 + 2}{9 + 7} = -\frac{1}{2}</math></li> <li>•2 <math>y + 10 = -\frac{1}{2}(x - 9)</math> (or equivalent)</li> </ul> <p>(b)</p> <ul style="list-style-type: none"> <li>•1 if <i>perpen.</i> <math>m_1 \times m_2 = -1</math> stated or implied</li> <li>•2 <math>m = 2</math></li> <li>•3 <math>y - 8 = 2(x - 3)</math> (or equiv.)</li> </ul> <p>(c)</p> <ul style="list-style-type: none"> <li>•1 <math>2y = -x - 11</math> <math>y = 2x + 2</math></li> <li>•2 attempts to substitute or eliminate</li> <li>•3 <math>5y = -20 \therefore y = -4</math></li> <li>•4 <math>-4 = 2x + 2 \therefore x = -3</math></li> </ul> <p>(d)</p> <ul style="list-style-type: none"> <li>•1 strategy</li> <li>•2 <math>C(\frac{3+9}{2}, \frac{8+(-10)}{2}) \rightarrow C(6, -1)</math></li> <li>•3 <math>r^2 = 9^2 + 3^2 = 90</math></li> <li>•4 <math>(x - 6)^2 + (y + 1)^2 = 90</math></li> </ul>
2.	<p><b>ans:</b> 6.75 <b>5 marks</b></p> <ul style="list-style-type: none"> <li>•1 for finding <math>U_1</math></li> <li>•2 for <math>U_2</math> and <math>U_3</math></li> <li>•3 knowing how to find limit</li> <li>•4 finding limit</li> <li>•5 calculating difference</li> </ul>	<ul style="list-style-type: none"> <li>•1 <math>U_1 = 0.75(32) + 12 = 36</math></li> <li>•2 <math>U_2 = 0.75(36) + 12 = 39</math> <math>U_3 = 0.75(39) + 12 = 41.25</math></li> <li>•3 <math>L = \frac{b}{1 - a}</math> (or equivalent)</li> <li>•4 <math>L = \frac{12}{1 - 0.75} = 48</math></li> <li>•5 <math>\text{diff.} = 48 - 41.25 = 6.75</math></li> </ul>
3.	<p><b>ans:</b> T(7,9) <b>4 marks</b></p> <ul style="list-style-type: none"> <li>•1 knows to solve a system and sub. for <math>y</math></li> <li>•2 simplifies</li> <li>•3 first coordinate</li> <li>•4 second coordinate</li> </ul>	<ul style="list-style-type: none"> <li>•1 <math>2x - 5 = (x - 6)^2 + 8</math></li> <li>•2 <math>2x - 5 = x^2 - 12x + 36 + 8</math> <math>0 = x^2 - 14x + 49</math></li> <li>•3 <math>(x - 7)(x - 7) = 0 \therefore x = 7</math></li> <li>•4 <math>y = 2(7) - 5 = 9</math></li> </ul>

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4.	<p><b>ans:</b> A(2,0) , B(1,-4)      <b>7 marks</b></p> <ul style="list-style-type: none"> <li>•1 <b>to find A</b> ... set up synth. division</li> <li>•2 use -1 ..... or other</li> <li>•3 find <math>x</math> coordinate of A and hence A</li> <li>•4 <b>for B</b> ... know to diff. and solve to 0</li> <li>•5 differentiate correctly</li> <li>•6 find <math>x</math> coordinate of B</li> <li>•7 find <math>y</math> coordinate of B</li> </ul>	<ul style="list-style-type: none"> <li>•1 set up synth. division for root</li> <li>•2 <math display="block">\begin{array}{r rrrr} -1 &amp; 1 &amp; 0 &amp; -3 &amp; -2 \\ &amp; &amp; -1 &amp; 1 &amp; 2 \\ \hline &amp; 1 &amp; -1 &amp; -2 &amp; 0 \end{array}</math></li> <li>•3 <math>x^2 - x + 2 = 0 \therefore (x-2)(x+1) = 0</math> <math>x = 2</math> , <del><math>x = -1</math></del> <math>\therefore A(2,0)</math></li> <li>•4 know S.P. <math>\therefore \frac{dy}{dx} = 0</math></li> <li>•5 <math>\frac{dy}{dx} = 3x^2 - 3 = 0</math></li> <li>•6 <math>3(x^2 - 1) = 0 \therefore x = 1</math> (<i>discard</i> -1)</li> <li>•7 <math>y = 1^3 - 3(1) - 2 = -4 \therefore B(1,-4)</math></li> </ul>
5.	<p><b>(a) ans:</b> <math>k = 8</math>      <b>4 marks</b></p> <ul style="list-style-type: none"> <li>•1 for subst. point in equation</li> <li>•2 for simplifying to quadratic</li> <li>•3 factorise and solve for <math>k</math></li> <li>•4 discarding (or implied) and answer</li> </ul> <p><b>(b) ans:</b> <math>3y = 2x + 18</math>      <b>4 marks</b></p> <ul style="list-style-type: none"> <li>•1 for coordinates of centre</li> <li>•2 gradient of radius</li> <li>•3 gradient of tangent</li> <li>•4 equation of tangent</li> </ul> <p><b>(c) ans:</b> proof      <b>2 marks</b></p> <ul style="list-style-type: none"> <li>•1 drawing out centre</li> <li>•2 show point satisfies equation of tangent</li> </ul>	<p>(a)</p> <ul style="list-style-type: none"> <li>•1 <math>(3-9)^2 + (k+1)^2 = 117</math></li> <li>•2 <math>k^2 + 2k - 80 = 0</math></li> <li>•3 <math>(k+10)(k-8) = 0</math> , <math>k = -10</math> or 8</li> <li>•4 <math>k = 8</math></li> </ul> <p>(b)</p> <ul style="list-style-type: none"> <li>•1 C(9,-1)</li> <li>•2 <math>m_r = \frac{-1-8}{9-3} = -\frac{3}{2}</math></li> <li>•3 <math>m_T = \frac{2}{3}</math></li> <li>•4 <math>y - 8 = \frac{2}{3}(x - 3)</math> (or equivalent)</li> </ul> <p>(c)</p> <ul style="list-style-type: none"> <li>•1 C(-3,4)</li> <li>•2 <math>3(4) = 2(-3) + 18</math> <math>12 = -6 + 18</math> proved</li> </ul>
6.	<p><b>ans:</b> 23 seconds      <b>6 marks</b></p> <ul style="list-style-type: none"> <li>•1 for setting up equation to solve to 24</li> <li>•2 re-arranging</li> <li>•3 introducing logs</li> <li>•4 releasing power</li> <li>•5 <math>t</math> the subject</li> <li>•6 answer</li> </ul>	<ul style="list-style-type: none"> <li>•1 <math>60e^{-0.04t} = 24</math></li> <li>•2 <math>e^{-0.04t} = 0.4</math></li> <li>•3 <math>\ln e^{-0.04t} = \ln 0.4</math> (or equiv.)</li> <li>•4 <math>-0.04t \ln e = \ln 0.4</math></li> <li>•5 <math>t = \frac{\ln 0.4}{-0.04}</math></li> <li>•6 <math>t = 22.91 = 23</math> seconds</li> </ul> <p>Note: Do not penalise at Mark 6 if not rounded</p>

	<b>Give 1 mark for each •</b>	<b>Illustration(s) for awarding each mark</b>
<b>7.</b>	<p><b>(a) ans:</b> A(10,0) , B(2,0) <b>4 marks</b></p> <ul style="list-style-type: none"> <li>•1 for solving to zero</li> <li>•2 factorising and roots</li> <li>•3 stating A</li> <li>•4 finding B</li> </ul> <p><b>(b) ans:</b> <math>85\frac{1}{3} \text{ cm}^2</math> <b>4 marks</b></p> <ul style="list-style-type: none"> <li>•1 for setting up integral</li> <li>•2 for integration</li> <li>•3 substitution</li> <li>•4 correct calculation to answer</li> </ul> <p><b>(c) ans:</b> 10 litres <b>3 marks</b></p> <ul style="list-style-type: none"> <li>•1 knows to double area</li> <li>•2 finds volume</li> <li>•3 answers to nearest litre</li> </ul> <p>Note: Do not penalise at Mark 6 if not rounded</p>	<p>(a)</p> <ul style="list-style-type: none"> <li>•1 <math>\frac{1}{4}(60 + 4x - x^2) = 0</math></li> <li>•2 <math>\frac{1}{4}(10 - x)(6 + x) = 0</math> <math>x = 10 \text{ or } x = -6</math></li> <li>•3 A(10,0)</li> <li>•4 B half way between roots .... <math>(10 + (-6)) \div 2 = 2 \therefore B(2,0)</math></li> </ul> <p>(for B .. pupils may diff. find x-coordinate of S.P.)</p> <p>(b)</p> <ul style="list-style-type: none"> <li>•1 <math>A = \int_2^{10} (15 + x - \frac{1}{4}x^2) dx</math></li> <li>•2 <math>= [15x + \frac{x^2}{2} - \frac{x^3}{12}]_2^{10}</math></li> <li>•3 <math>= (150 + 50 - \frac{1000}{12}) - (30 + 2 - \frac{8}{12})</math></li> <li>•4 <math>= (116\frac{2}{3}) - (31\frac{1}{3}) = 85\frac{1}{3}</math> (or equiv.)</li> </ul> <p>(c)</p> <ul style="list-style-type: none"> <li>•1 <math>A_{\text{face}} = 85\frac{1}{3} \times 2 = 170\frac{2}{3} \text{ cm}^2</math></li> <li>•2 <math>V = 170\frac{2}{3} \times 60 = 10240 \text{ cm}^3</math></li> <li>•3 <math>V = 10</math> litres (to nearest litre)</li> </ul>
<b>8.</b>	<p><b>ans:</b> 0.61 <b>6 marks</b></p> <ul style="list-style-type: none"> <li>•1 for strategy and expansion</li> <li>•2 finding alpha</li> <li>•3 finding k</li> <li>•4 solving to 1</li> <li>•5 finding value in radians</li> <li>•6 knows to subtract <math>2\pi</math> to answer</li> </ul>	<ul style="list-style-type: none"> <li>•1 <math>\sqrt{6} \cos \theta - \sqrt{3} \sin \theta = k \cos(\theta - \alpha)</math> ..... = <math>k \cos \theta \cos \alpha + k \sin \theta \sin \alpha</math></li> <li>•2 <math>\tan \alpha = -\frac{\sqrt{3}}{\sqrt{6}} \therefore \alpha = 5.66</math></li> <li>•3 <math>k^2 = (\sqrt{6})^2 + (\sqrt{3})^2 = \sqrt{9} = 3</math></li> <li>•4 <math>3 \cos(\theta - 5.66) = 1</math></li> <li>•5 <math>\theta - 5.66 = 1.23 \therefore \theta = 6.89</math></li> <li>•6 <math>\therefore 6.89 - 6.28 = 0.61</math></li> </ul>
<b>9.</b>	<p><b>(a) ans:</b> proof <b>1 mark</b></p> <ul style="list-style-type: none"> <li>•1 clear working to answer</li> </ul> <p><b>(b) ans:</b> proof <b>2 marks</b></p> <ul style="list-style-type: none"> <li>•1 for knowing how to find surface area</li> <li>•2 substitution and manipulation to ans.</li> </ul> <p><b>(c) ans:</b> <math>r = 4 \text{ cm}</math> , <math>h = 4 \text{ cm}</math> <b>5 marks</b></p> <ul style="list-style-type: none"> <li>•1 knowing to differentiate and solve to zero</li> <li>•2 differentiating correctly</li> <li>•3 for dealing with fraction</li> <li>•4 solving to find r</li> <li>•5 finding h</li> </ul> <p><i>note: no justification of minimum necessary</i></p>	<p>(a)</p> <ul style="list-style-type: none"> <li>•1 <math>64\pi = \pi r^2 h</math> <math>64 = r^2 h \Rightarrow h = \frac{64}{r^2}</math></li> </ul> <p>(b)</p> <ul style="list-style-type: none"> <li>•1 <math>A = 2\pi r h + \pi r^2</math></li> <li>•2 <math>A = 2\pi r \frac{64}{r^2} + \pi r^2</math> <math>= \frac{128\pi}{r} + \pi r^2</math></li> </ul> <p>(c)</p> <ul style="list-style-type: none"> <li>•1 @ min <math>A'(r) = 0</math> (stated or implied)</li> <li>•2 <math>A'(r) = -128\pi r^{-2} + 2\pi r</math></li> <li>•3 <math>2\pi r - \frac{128\pi}{r^2} = 0</math> ..... <math>\times r^2</math> <math>2\pi r^3 - 128\pi = 0</math></li> <li>•4 <math>2r^3 = 128 \Rightarrow r^3 = 64 \therefore r = 4</math></li> </ul>

**Total 70 marks**