

- 1 D
- 2 A
- 3 B
- 4 C
- 5 C
- 6 A
- 7 B
- 8 C
- 9 B
- 10 D
- 11 D
- 12 B
- 13 A
- 14 C
- 15 B
- 16 B
- 17 A
- 18 A
- 19 C
- 20 C

	A	B	C	D
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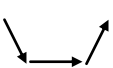
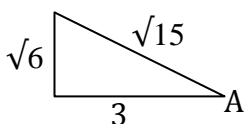
	Give 1 mark for each •	Illustration(s) for awarding each mark
21(a)	ans: P(2, 4) (4 marks)	
	<ul style="list-style-type: none"> <li>•<sup>1</sup> knows to make derivative equal to 0</li> <li>•<sup>2</sup> finds derivative</li> <li>•<sup>3</sup> solves for <math>x</math></li> <li>•<sup>4</sup> states coordinates of P</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>\frac{dy}{dx} = 0</math></li> <li>•<sup>2</sup> <math>\frac{dy}{dx} = 6x - 3x^2 = 0</math></li> <li>•<sup>3</sup> <math>3x(2 - x) = 0; x = 0, 2</math></li> <li>•<sup>4</sup> P(2, 4)</li> </ul>
(b)	ans: Q(-1, 4) (3 marks)	
	<ul style="list-style-type: none"> <li>•<sup>1</sup> knows to equate functions</li> <li>•<sup>2</sup> uses app method to factorise expression</li> <li>•<sup>3</sup> solves and states coordinates of Q</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>3x^2 - x^3 = 4</math></li> <li>•<sup>2</sup> evidence leading to <math>(x - 2)(x - 2)(x + 1)</math></li> <li>•<sup>3</sup> Q(-1, 4)</li> </ul>
(c)	ans: $6\frac{3}{4}$ units <sup>2</sup> (6 marks)	
	<ul style="list-style-type: none"> <li>•<sup>1</sup> knows to use integration</li> <li>•<sup>2</sup> uses correct integration</li> <li>•<sup>3</sup> integrates</li> <li>•<sup>4</sup> subs values</li> <li>•<sup>5</sup> evaluates</li> <li>•<sup>6</sup> subtracts from 12 to answer</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>\int \dots\dots</math></li> <li>•<sup>2</sup> <math>\int_{-1}^2 3x^2 - x^3 dx</math></li> <li>•<sup>3</sup> <math>\left[ x^3 - \frac{x^4}{4} \right]_{-1}^2</math></li> <li>•<sup>4</sup> <math>\left[ (2)^3 - \frac{(2)^4}{4} \right] - \left[ (-1)^3 - \frac{(-1)^4}{4} \right]</math></li> <li>•<sup>5</sup> <math>(8 - 4) - (-1 - \frac{1}{4}) = 4 + 1\frac{1}{4} = 5\frac{1}{4}</math></li> <li>•<sup>6</sup> <math>12 - 5\frac{1}{4} = 6\frac{3}{4}</math> units<sup>2</sup></li> </ul>
22(a)	ans: $p = 1, q = -4, r = 3$ (4 marks)	
	<ul style="list-style-type: none"> <li>•<sup>1</sup> substitutes</li> <li>•<sup>2</sup> multiplies out and reorganises</li> <li>•<sup>3</sup> states values of <math>p, q</math> and <math>r</math></li> <li>•<sup>4</sup> states values of <math>p, q</math> and <math>r</math></li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>f(g(a)) = (2 - a)^2 - 1</math></li> <li>•<sup>2</sup> <math>4 - 4a + a^2 - 1 = a^2 - 4a + 3</math></li> <li>•<sup>3</sup> <math>p = 1, q = -4, r = 3</math></li> <li>•<sup>4</sup> award 1 mark for any two correct and 1 mark for third value correct</li> </ul>
(b)	ans: $a = 5$ (2 marks)	
	<ul style="list-style-type: none"> <li>•<sup>1</sup> equates to 8, reorganises and factorises</li> <li>•<sup>2</sup> solves and chooses correct value for <math>a</math></li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>a^2 - 4a + 3 = 8; a^2 - 4a - 5 = 0</math> <math>(a - 5)(a + 1) = 0</math></li> <li>•<sup>2</sup> <math>a = 5</math></li> </ul>

	Give 1 mark for each •	Illustration(s) for awarding each mark
23	<p>ans: <math>A(\frac{11\pi}{12}, \frac{1}{2})</math> (4 marks)</p> <ul style="list-style-type: none"> <li>•<sup>1</sup> equates line &amp; curve, reorganises</li> <li>•<sup>2</sup> finds values for <math>2x</math></li> <li>•<sup>3</sup> finds values for <math>x</math></li> <li>•<sup>4</sup> states coordinates of A</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>\sin 2x + 1 = \frac{1}{2}; \sin 2x = -\frac{1}{2}</math></li> <li>•<sup>2</sup> <math>2x = \frac{7\pi}{6}, \frac{11\pi}{6}</math></li> <li>•<sup>3</sup> <math>x = \frac{7\pi}{12}, \frac{11\pi}{12}</math></li> <li>•<sup>4</sup> <math>A(\frac{11\pi}{12}, \frac{1}{2})</math></li> </ul>
24(a)	<p>ans: 60 (2 marks)</p> <ul style="list-style-type: none"> <li>•<sup>1</sup> knows how to find limit</li> <li>•<sup>2</sup> moves term to LHS and divides</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>L = \frac{24}{1-0.6}</math></li> <li>•<sup>2</sup> 60</li> </ul>
(b)	<p>ans: 10 (2 marks)</p> <ul style="list-style-type: none"> <li>•<sup>1</sup> makes RR equal to 30</li> <li>•<sup>2</sup> solves for <math>U_0</math></li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>0.6U_0 + 24 = 30</math> [stated or implied]</li> <li>•<sup>2</sup> <math>0.6U_0 = 6; U_0 = 10</math></li> </ul>
(c)	<p>ans: <math>a = \frac{2}{5}; b = 36</math> (3 marks)</p> <ul style="list-style-type: none"> <li>•<sup>1</sup> subs for <math>b</math> and finds expression for limit</li> <li>•<sup>2</sup> equates limit to 60 and solves for <math>a</math></li> <li>•<sup>3</sup> finds value of <math>b</math></li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>U_{n+1} = aU_n + 90a; L = \frac{90a}{1-a}</math></li> <li>•<sup>2</sup> <math>\frac{90a}{1-a} = 60; 60 - 60a = 90a; a = \frac{2}{5};</math></li> <li>•<sup>3</sup> <math>b = 90 \times \frac{2}{5} = 36</math></li> </ul>

	Give 1 mark for each •	Illustration(s) for awarding each mark
1(a)	<b>ans: <math>k = 6</math> (2 marks)</b> • <sup>1</sup> knows to substitute point • <sup>2</sup> establishes value of $k$	• <sup>1</sup> $(0+4)^2 + k^2 = 52$ • <sup>2</sup> $k = 6$
(b)	<b>ans: <math>y = -\frac{2}{3}x + 6</math> (4 marks)</b> • <sup>1</sup> finds coordinates of $C_1$ • <sup>2</sup> finds gradient of radius • <sup>3</sup> finds gradient of tangent • <sup>4</sup> substitutes into formula	• <sup>1</sup> $C(-4, 0)$ • <sup>2</sup> $m_{C_1P} = \frac{6}{4} = \frac{3}{2}$ • <sup>3</sup> $m_{\tan} -\frac{2}{3}$ • <sup>4</sup> $y = -\frac{2}{3}x + 6$
(c)	<b>ans: <math>C_2(9, 0)</math> (1 mark)</b> • <sup>1</sup> subs point, solves for $x$ and states point	• <sup>1</sup> $0 = -\frac{2}{3}x + 6; x = 9; (9, 0)$
(d)	<b>ans: 2.2 units (3 marks)</b> • <sup>1</sup> finds radius $C_1$ circle • <sup>2</sup> finds distance between centres • <sup>3</sup> establishes $d$	• <sup>1</sup> radius $C_1 = 7.2$ • <sup>2</sup> $C_1C_2 = 13$ • <sup>3</sup> $d = (7.2 + 8) - 13 = 2.2$
2	<b>ans: <math>90^\circ, 199.5^\circ, 340.5^\circ</math> (5 marks)</b> • <sup>1</sup> subs for $\cos 2x^\circ$ • <sup>2</sup> multiplies and simplifies • <sup>3</sup> factorises • <sup>4</sup> finds two solutions • <sup>5</sup> finds third solution	• <sup>1</sup> $3(1 - 2\sin^2 x^\circ) + 4\sin x^\circ - 1 = 0$ • <sup>2</sup> $-6\sin^2 x^\circ + 4\sin x^\circ + 2 = 0$ • <sup>3</sup> $2(3\sin x^\circ + 1)(\sin x^\circ - 1) = 0$ • <sup>4</sup> $\sin x^\circ = -\frac{1}{3}; x = 199.5^\circ, 340.5^\circ$ • <sup>5</sup> $\sin x^\circ = 1; x = 90^\circ$

	Give 1 mark for each •	Illustration(s) for awarding each mark
3(a)	<b>ans:</b> $y = x^2 + \frac{6}{x} - 4$ (4 marks) <ul style="list-style-type: none"> <li>•<sup>1</sup> knows to integrate</li> <li>•<sup>2</sup> integrates</li> <li>•<sup>3</sup> subs point</li> <li>•<sup>4</sup> solves for <math>C</math> and states function</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>y = \int 2x - \frac{6}{x^2} dx</math></li> <li>•<sup>2</sup> <math>y = x^2 + \frac{6}{x} + C</math></li> <li>•<sup>3</sup> <math>3 = 2^2 + \frac{6}{2} + C</math></li> <li>•<sup>4</sup> <math>y = x^2 + \frac{6}{x} - 4</math></li> </ul>
(b)	<b>ans:</b> $p = 7$ (1 mark) <ul style="list-style-type: none"> <li>•<sup>1</sup> subs point and solves for <math>p</math></li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>p = 3^2 + \frac{6}{3} - 4 = 7</math></li> </ul>
4(a)	<b>ans:</b> $P(3, 0)$ (2 marks) <ul style="list-style-type: none"> <li>•<sup>1</sup> knows to make function equal to 0</li> <li>•<sup>2</sup> solves for <math>x</math> and states cords of P</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>x^3 - x^2 - 5x - 3 = 0</math></li> <li>•<sup>2</sup> <math>x = 3; P(3, 0)</math></li> </ul>
(b)	<b>ans:</b> $2y + 3x = 9$ (1 mark) <ul style="list-style-type: none"> <li>•<sup>1</sup> subs info into formula for straight line</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>y = -\frac{3}{2}(x - 3)</math></li> </ul>
(c)	<b>ans:</b> $y - 11x = 17$ (4 marks) <ul style="list-style-type: none"> <li>•<sup>1</sup> knows to take derivative</li> <li>•<sup>2</sup> subs to find gradient</li> <li>•<sup>3</sup> subs to find point of contact</li> <li>•<sup>4</sup> subs into straight line formula</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>\frac{dy}{dx} = 3x^2 - 2x - 5</math></li> <li>•<sup>2</sup> <math>3(-2)^2 - 2(-2) - 5 = 11</math></li> <li>•<sup>3</sup> <math>y = (-2)^3 - (-2)^2 - 5(-2) - 3 = -5</math></li> <li>•<sup>4</sup> <math>y + 5 = 11(x + 2); y - 11x = 17</math></li> </ul>
(d)	<b>ans:</b> $Q(-1, 6)$ (3 marks) <ul style="list-style-type: none"> <li>•<sup>1</sup> knows to use sim. eqs.</li> <li>•<sup>2</sup> solves for <math>x</math> and <math>y</math></li> <li>•<sup>3</sup> states coordinates of Q</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> evidence</li> <li>•<sup>2</sup> <math>x = -1</math> and <math>y = 6</math></li> <li>•<sup>3</sup> <math>Q(-1, 6)</math></li> </ul>

	Give 1 mark for each •	Illustration(s) for awarding each mark
5(a)	<b>ans: 143.3 gu's (2 marks)</b> • <sup>1</sup> knows how to calculate answer • <sup>2</sup> answer	• <sup>1</sup> $0.92^4 \times 200$ • <sup>2</sup> 143.3 gu's
(b)	<b>ans: 135.8 gu's (3 marks)</b> • <sup>1</sup> sets up recurrence relation • <sup>2</sup> repeated calculations to answer • <sup>3</sup> repeated calculations to answer	• <sup>1</sup> $U_{n+1} = 0.92^4 U_n + 32$ • <sup>2</sup> 175.3[after 4 hours]; 157.6[after 8 hours] • <sup>3</sup> 144.9[after 12 hours]; 135.8[after 16 hours]
(c)	<b>ans: yes since lower limit is 80.8 (3 marks)</b> • <sup>1</sup> knows to find limit • <sup>2</sup> finds limit • <sup>3</sup> realises lower limit is less than 100	• <sup>1</sup> $L = \frac{32}{1-0.92^4}$ • <sup>2</sup> $L = 112.8$ • <sup>3</sup> brightness would fall below 100 since lower limit is 80.8
6(a)	<b>ans: proof (3 marks)</b> • <sup>1</sup> cross multiplies and multiplies out • <sup>2</sup> brings to LHS • <sup>3</sup> rearranges as required	• <sup>1</sup> $k(x^2 + 4) = x^2 - 2x + 1$ • <sup>2</sup> $kx^2 - x^2 + 2x + 4k - 1$ • <sup>3</sup> $(k - 1)x^2 + 2x + (4k - 1) = 0$
(b)	<b>ans: <math>k = \frac{5}{4}</math> (5 marks)</b> • <sup>1</sup> states condition for equal roots • <sup>2</sup> states values of $a$ , $b$ and $c$ • <sup>3</sup> substitutes into $b^2 - 4ac$ • <sup>4</sup> multiplies out and simplifies • <sup>5</sup> solves for $k$	• <sup>1</sup> $b^2 - 4ac = 0$ for equal roots [stated/implied] • <sup>2</sup> $a = (k - 1)$ ; $b = 2$ ; $c = (4k - 1)$ • <sup>3</sup> $2^2 - 4(k - 1)(4k - 1) = 0$ • <sup>4</sup> $20k - 16k^2 = 0$ • <sup>5</sup> $k = \frac{5}{4}$

	Give 1 mark for each •	Illustration(s) for awarding each mark
7(a)	ans: proof (3 marks)	
	<ul style="list-style-type: none"> <li>•<sup>1</sup> finds expression for length of shed</li> <li>•<sup>2</sup> finds expression for area of g'house</li> <li>•<sup>3</sup> simplifies to correct form</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> length of shed = <math>\frac{3}{x}</math></li> <li>•<sup>2</sup> <math>A = (x + 3)(4 + \frac{3}{x}) - 3</math></li> <li>•<sup>3</sup> <math>A = 4x + 3 + 12 + \frac{9}{x} - 3 \rightarrow</math> answer</li> </ul>
(b)	ans: 15 (5 marks)	
	<ul style="list-style-type: none"> <li>•<sup>1</sup> knows to equate derivative to 0</li> <li>•<sup>2</sup> prepares to differentiate</li> <li>•<sup>3</sup> differentiates</li> <li>•<sup>4</sup> solves for <math>x</math></li> <li>•<sup>5</sup> justifies answer</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>\frac{dy}{dx} = 0</math></li> <li>•<sup>2</sup> <math>A(x) = 12 + 4x + 9x^{-1}</math></li> <li>•<sup>3</sup> <math>A'(x) = 4 - \frac{9}{x^2} = 0</math></li> <li>•<sup>4</sup> <math>4 - \frac{9}{x^2} = 0; x^2 = \frac{9}{4}; x = \frac{3}{2}</math></li> <li>•<sup>5</sup>  or other acceptable method</li> </ul>
8(a)	ans: proof; $k = 10$ (3 marks)	
	<ul style="list-style-type: none"> <li>•<sup>1</sup> assembles facts in rt. triangle</li> <li>•<sup>2</sup> finds <math>\sin A</math></li> <li>•<sup>3</sup> rationalises denominator &amp; states <math>k</math></li> </ul>	 <ul style="list-style-type: none"> <li>•<sup>1</sup></li> <li>•<sup>2</sup> <math>\sin A = \frac{\sqrt{6}}{\sqrt{15}}</math></li> <li>•<sup>3</sup> <math>\frac{\sqrt{6}}{\sqrt{15}} \times \frac{\sqrt{15}}{\sqrt{15}} = \frac{\sqrt{10}}{5}; k = 10</math></li> </ul>
(b)	ans: proof (3 marks)	
	<ul style="list-style-type: none"> <li>•<sup>1</sup> knows to change <math>\cos 2A</math></li> <li>•<sup>2</sup> substitutes</li> <li>•<sup>3</sup> simplifies to required answer</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>\cos 2A = 1 - 2\sin^2 A</math></li> <li>•<sup>2</sup> <math>1 - 2(\frac{\sqrt{10}}{5})^2</math></li> <li>•<sup>3</sup> <math>1 - 2 \times \frac{10}{25} = 1 - \frac{4}{5} = \frac{1}{5}</math></li> </ul>
		Total: 60 marks