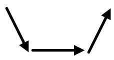
	Give 1 mark for each •	Illustration(s) for awarding each mark
1(a)	**ans: $k = 6$** **(2 marks)**	
	•[1] knows to substitute point	•[1] $(0+4)^2 + k^2 = 52$
	•[2] establishes value of k	•[2] $k = 6$
(b)	**ans: $y = -\frac{2}{3}x + 6$** **(4 marks)**	
	•[1] finds coordinates of C_1	•[1] $C(-4, 0)$
	•[2] finds gradient of radius	•[2] $m_{C_1P} = \frac{6}{4} = \frac{3}{2}$
	•[3] finds gradient of tangent	•[3] $m_{\tan} - \frac{2}{3}$
	•[4] substitutes into formula	•[4] $y = -\frac{2}{3}x + 6$
(c)	**ans: $C_2(9, 0)$** **(1 mark)**	
	•[1] subs point, solves for x and states point	•[1] $0 = -\frac{2}{3}x + 6;\ x = 9;\ (9,0)$
(d)	**ans: 2·2 units** **(3 marks)**	
	•[1] finds radius C_1 circle	•[1] radius $C_1 = 7{\cdot}2$
	•[2] finds distance between centres	•[2] $C_1C_2 = 13$
	•[3] establishes d	•[3] $d = (7{\cdot}2 + 8) - 13 = 2{\cdot}2$
2	**ans: 60, 120, 240, 300** **(5 marks)**	
	•[1] obtains composite	•[1] $h(x)=4\cos^2 x + 1$
	•[2] equates to 0	•[2] $4\cos^2 x + 1 = 0$
	•[3] solves	•[3] $\cos x = \frac{1}{2}$ and $\cos x = -\frac{1}{2}$
	•[4] finds two solutions	•[4] x = 60, 300
	•[5] finds two solutions	•[5] x = 120, 240

	Give 1 mark for each •	Illustration(s) for awarding each mark
3(a)	**ans:** $y = x^2 + \frac{6}{x} - 4$ **(4 marks)**	
	•[1] knows to integrate	•[1] $y = \int 2x - \frac{6}{x^2}\, dx$
	•[2] integrates	•[2] $y = x^2 + \frac{6}{x} + C$
	•[3] subs point	•[3] $3 = 2^2 + \frac{6}{2} + C$
	•[4] solves for C and states function	•[4] $y = x^2 + \frac{6}{x} - 4$
(b)	**ans:** $p = 7$ **(1 mark)**	
	•[1] subs point and solves for p	•[1] $p = 3^2 + \frac{6}{3} - 4 = 7$
4(a)	**ans:** **P(3, 0)** **(2 marks)**	
	•[1] knows to make function equal to 0 •[2] solves for x and states cords of P	•[1] $x^3 - x^2 - 5x - 3 = 0$ •[2] $x = 3$; P(3, 0)
(b)	**ans:** $2y + 3x = 9$ **(1 mark)**	
	•[1] subs info into formula for straight line	•[1] $y = -\frac{3}{2}(x - 3)$
(c)	**ans:** $y - 11x = 17$ **(4 marks)**	
	•[1] knows to take derivative	•[1] $\frac{dy}{dx} = 3x^2 - 2x - 5$
	•[2] subs to find gradient	•[2] $3(-2)^2 - 2(-2) - 5 = 11$
	•[3] subs to find point of contact •[4] subs into straight line formula	•[3] $y = (-2)^3 - (-2)^2 - 5(-2) - 3 = -5$ •[4] $y + 5 = 11(x + 2)$; $y - 11x = 17$
(d)	**ans:** **Q(–1, 6)** **(3 marks)**	
	•[1] knows to use sim. eqs. •[2] solves for x and y •[3] states coordinates of Q	•[1] evidence •[2] $x = -1$ and $y = 6$ •[3] Q(–1, 6)

	Give 1 mark for each •	Illustration(s) for awarding each mark
5(a)	**ans: 143·3*gu's*** **(2 marks)**	
	•[1] knows how to calculate answer •[2] answer	•[1] $0{\cdot}92^4 \times 200$ •[2] 143·3*gu's*
(b)	**ans: 135·8 *gu's*** **(3 marks)**	
	•[1] sets up recurrence relation •[2] repeated calculations to answer •[3] repeated calculations to answer	•[1] $U_{n+1} = 0\cdot 92^4 U_n + 32$ •[2] 175·3[after 4 hours]; 157·6[after 8 hours] •[3] 144·9[after 12 hours]; 135·8[after 16 hours]
(c)	**ans: yes since lower limit is 80·8** **(3 marks)**	
	•[1] knows to find limit •[2] finds limit •[3] realises lower limit is less than 100	•[1] $L = \frac{32}{1-0{\cdot}92^4}$ •[2] $L = 112{\cdot}8$ •[3] brightness would fall below 100 since lower limit is 80·8
6(a)	**ans: proof** **(3 marks)**	
	•[1] cross multiplies and multiplies out •[2] brings to LHS •[3] rearranges as required	•[1] $k(x^2+4) = x^2 - 2x + 1$ •[2] $kx^2 - x^2 + 2x + 4k - 1$ •[3] $(k-1)x^2 + 2x + (4k-1) = 0$
(b)	**ans: $k = \frac{5}{4}$** **(5 marks)**	
	•[1] states condition for equal roots •[2] states values of a, b and c •[3] substitutes into $b^2 - 4ac$ •[4] multiplies out and simplifies •[5] solves for k	•[1] $b^2 - 4ac = 0$ for equal roots [stated/implied] •[2] $a = (k-1)$; $b = 2$; $c = (4k-1)$ •[3] $2^2 - 4(k-1)(4k-1) = 0$ •[4] $20k - 16k^2 = 0$ •[5] $k = \frac{5}{4}$

	Give 1 mark for each •	Illustration(s) for awarding each mark
7(a)	**ans: proof** **(3 marks)**	
	•1 finds expression for length of shed	•1 length of shed $= \frac{3}{x}$
	•2 finds expression for area of g'house	•2 $A = (x+3)(4+\frac{3}{x}) - 3$
	•3 simplifies to correct form	•3 $A = 4x + 3 + 12 + \frac{9}{x} - 3 \rightarrow$ answer
(b)	**ans: 15** **(5 marks)**	
	•1 knows to equate derivative to 0	•1 $\frac{dy}{dx} = 0$
	•2 prepares to differentiate	•2 $A(x) = 12 + 4x + 9x^{-1}$
	•3 differentiates	•3 $A'(x) = 4 - \frac{9}{x^2} = 0$
	•4 solves for x	•4 $4 - \frac{9}{x^2} = 0;\ x^2 = \frac{9}{4};\ x = \frac{3}{2}$
	•5 justifies answer	•5  or other acceptable method
8(a)	**ans: $\frac{\pi}{2}$ radians** **(6 marks)**	
	•1 identifies coefficients	•1 1 -1 4 -4
	•2 identifies one factor	•2 $(\sin\theta - 1)$
	•3 correct second factor	•3 $(\sin^2\theta + 4)$
	•4	•4 $\sin\theta = 1$ **and** $\sin^2\theta = -4$
	•5 solves	•5 $\theta = \frac{\pi}{2}$ radians
	•6 valid conclusion for $\sin^2\theta = -4$	•6 $\sin 2\theta = -4$ has no solution

Total: 60 marks