	Give 1 mark for each •	Illustration(s) for awarding each mark
1(a)	ans: $k = 6$ (2 marks)	
	•1 knows to substitute point •2 establishes value of k	•1 $(0+4)^2 + k^2 = 52$ •2 $k = 6$
(b)	ans: $y = -\frac{2}{3}x + 6$ (4 marks)	
	•1 finds coordinates of C_1 •2 finds gradient of radius •3 finds gradient of tangent •4 substitutes into formula	•1 $C(-4, 0)$ •2 $m_{C_1P} = \frac{6}{4} = \frac{3}{2}$ •3 $m_{\tan} = -\frac{2}{3}$ •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 •2 finds distance between centres •3 establishes d	•1 radius $C_1 = 7{\cdot}2$ •2 $C_1C_2 = 13$ •3 $d = (7{\cdot}2 + 8) - 13 = 2{\cdot}2$
2	ans: $90°$, $199{\cdot}5°$, $340{\cdot}5°$ (5 marks)	
	•1 subs for $\cos 2x°$ •2 multiplies and simplifies •3 factorises •4 finds two solutions •5 finds third solution	•1 $3(1 - 2\sin^2 x°) + 4\sin x° - 1 = 0$ •2 $-6\sin^2 x° + 4\sin x + 2 = 0$ •3 $-2(3\sin x° + 1)(\sin x° - 1) = 0$ •4 $\sin x° = -\frac{1}{3}$; $x = 199{\cdot}5°, 340{\cdot}5°$ •5 $\sin x° = 1$; $x = 90°$

	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	•[1] $x^3 - x^2 - 5x - 3 = 0$
	•[2] solves for x and states cords of P	•[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	•[3] $y = (-2)^3 - (-2)^2 - 5(-2) - 3 = -5$
	•[4] subs into straight line formula	•[4] $y + 5 = 11(x + 2)$; $y - 11x = 17$
(d)	**ans:** Q(−1, 6) **(3 marks)**	
	•[1] knows to use sim. eqs.	•[1] evidence
	•[2] solves for x and y	•[2] $x = -1$ and $y = 6$
	•[3] states coordinates of Q	•[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	•[1] $0{\cdot}92^4 \times 200$
	•[2] answer	•[2] 143·3*gu's*
(b)	**ans:** 135·8 *gu's* **(3 marks)**	
	•[1] sets up recurrence relation	•[1] $U_{n+1} = 0{\cdot}92^4 U_n + 32$
	•[2] repeated calculations to answer	•[2] 175·3[after 4 hours]; 157·6[after 8 hours]
	•[3] repeated calculations to answer	•[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	•[1] $L = \frac{32}{1-0{\cdot}92^4}$
	•[2] finds limit	•[2] $L = 112{\cdot}8$
	•[3] realises lower limit is less than 100	•[3] brightness would fall below 100 since lower limit is 80.8gu

	Give 1 mark for each •	Illustration(s) for awarding each mark
6(a)	ans: proof (3 marks)	
	•1 cross multiplies and multiplies out	•1 $k(x^2+4) = x^2 - 2x + 1$
	•2 brings to LHS	•2 $kx^2 - x^2 + 2x + 4k - 1$
	•3 rearranges as required	•3 $(k-1)x^2 + 2x + (4k-1) = 0$
(b)	ans: $k = \frac{5}{4}$ (5 marks)	
	•1 states condition for equal roots	•1 $b^2 - 4ac = 0$ for equal roots [stated/implied]
	•2 states values of a, b and c	•2 $a = (k-1)$; $b = 2$; $c = (4k-1)$
	•3 substitutes into $b^2 - 4ac$	•3 $2^2 - 4(k-1)(4k-1) = 0$
	•4 multiplies out and simplifies	•4 $20k - 16k^2 = 0$
	•5 solves for k	•5 $k = \frac{5}{4}$
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 $\frac{dv}{dx} = 0$
	•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: proof: $k = 10$ (3 marks)	
	•1 assembles facts in rt. triangle	•1 
	•2 finds $\sin A$	•2 $\sin A = \frac{\sqrt{6}}{\sqrt{15}}$
	•3 rationalises denominator & states k	•3 $\frac{\sqrt{6}}{\sqrt{15}} \times \frac{\sqrt{15}}{\sqrt{15}} = \frac{\sqrt{10}}{5}$; $k = 10$
(b)	ans: proof (3 marks)	
	•1 knows to change $\cos 2A$	•1 $\cos 2A = 1 - 2\sin^2 A$
	•2 substitutes	•2 $1 - 2(\frac{\sqrt{10}}{5})^2$
	•3 simplifies to required answer	•3 $1 - 2 \times \frac{10}{25} = 1 - \frac{4}{5} = \frac{1}{5}$

Total: 60 marks