

	Give 1 mark for each •	Illustration(s) for awarding each mark
1(a)	<p>ans: $k = 6$ (2 marks)</p> <ul style="list-style-type: none"> •¹ knows to substitute point •² establishes value of k 	<ul style="list-style-type: none"> •¹ $(0 + 4)^2 + k^2 = 52$ •² $k = 6$
(b)	<p>ans: $y = -\frac{2}{3}x + 6$ (4 marks)</p> <ul style="list-style-type: none"> •¹ finds coordinates of C_1 •² finds gradient of radius •³ finds gradient of tangent •⁴ substitutes into formula 	<ul style="list-style-type: none"> •¹ $C(-4, 0)$ •² $m_{C_1P} = \frac{6}{4} = \frac{3}{2}$ •³ $m_{\text{tan}} -\frac{2}{3}$ •⁴ $y - 6 = -\frac{2}{3}(x - 0)$
(c)	<p>ans: $C_2(9, 0)$ (1 mark)</p> <ul style="list-style-type: none"> •¹ subs point, solves for x and states point 	<ul style="list-style-type: none"> •¹ $0 = -\frac{2}{3}x + 6; x = 9; (9, 0)$
(d)	<p>ans: 2.2 units (3 marks)</p> <ul style="list-style-type: none"> •¹ finds radius C_1 circle •² finds distance between centres •³ establishes d 	<ul style="list-style-type: none"> •¹ radius $C_1 = 7.2$ •² $C_1C_2 = 13$ •³ $d = (7.2 + 8) - 13 = 2.2$
2(a)	<p>ans: $3\cos(x - 35.3)^\circ$ (4 marks)</p> <ul style="list-style-type: none"> •¹ know to use, and use compound formulae •² equates coefficients •³ for α •⁴ for k 	<ul style="list-style-type: none"> •¹ $k\cos(x) \cos(\alpha) + k\sin(x) \sin(\alpha)$ •² $k \sin \alpha = \sqrt{3}$, $k \cos \alpha = \sqrt{6}$ <p><i>for 1&2 these must be stated explicitly</i></p> <ul style="list-style-type: none"> •³ $\tan \alpha = \frac{\sqrt{3}}{\sqrt{6}} \therefore \alpha = 35.3^\circ$ •⁴ $k^2 = (\sqrt{3})^2 + (\sqrt{6})^2 \therefore k = 3$
(b)	<p>ans: 105.8° and 324.8° (3 marks)</p> <ul style="list-style-type: none"> •¹ use transformed function •² solve trig equation for $(x - 35.3)$ •³ solve for x 	<ul style="list-style-type: none"> •¹ $3\cos(x - 35.3)^\circ = 1$ •² $x - 35.3 = 70.5, 289.5$ •³ $x = 105.8$ and 324.8 <p><i>(marks 2 & 3 marked in series or in parallel)</i></p>

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3	<p>ans: $y = x^2 + \frac{6}{x} - 4$ (4 marks)</p> <ul style="list-style-type: none"> •¹ knows and starts to integrate •² integrates remaining terms with constant •³ subs point •⁴ solves for C 	<ul style="list-style-type: none"> •¹ correct integration of one term •² $y = x^2 + \frac{6}{x} + C$ •³ $3 = 2^2 + \frac{6}{2} + C$ •⁴ $C = -4$
4(a)	<p>ans: $2y + 3x = 9$ (1 mark)</p> <ul style="list-style-type: none"> •¹ subs info into formula for straight line 	<ul style="list-style-type: none"> •¹ $y - 0 = -\frac{3}{2}(x - 3)$
(b)	<p>ans: $y + 5 = 11(x + 2)$ (5 marks)</p> <ul style="list-style-type: none"> •¹ knows to differentiate •² differentiates correctly •³ subs to find gradient •⁴ subs to find point of contact •⁵ subs into straight line formula 	<ul style="list-style-type: none"> •¹ $\frac{dy}{dx} =$ •² $\frac{dy}{dx} = 3x^2 - 2x - 5$ •³ $3(-2)^2 - 2(-2) - 5 = 11$ •⁴ $y = (-2)^3 - (-2)^2 - 5(-2) - 3 = -5$ •⁵ $y + 5 = 11(x + 2)$
(c)	<p>ans: Q(-1, 6) (3 marks)</p> <ul style="list-style-type: none"> •¹ knows to use sim. eqs. •² solves for x •³ solves for y 	<ul style="list-style-type: none"> •¹ evidence •² $x = -1$ •³ $y = 6$

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5(a)	<p>ans: 143.3gu's (2 marks)</p> <ul style="list-style-type: none"> •¹ knows how to calculate answer •² answer 	<ul style="list-style-type: none"> •¹ $0.92^4 \times 200$ •² 143.3gu's
(b)	<p>ans: 135.8 gu's (3 marks)</p> <ul style="list-style-type: none"> •¹ sets up recurrence relation •² repeated calculations to answer •³ repeated calculations to answer 	<ul style="list-style-type: none"> •¹ $U_{n+1} = 0.92^4 U_n + 32$ •² 175.3[after 4 hours]; 157.6[after 8 hours] •³ 144.9[after 12 hours]; 135.8[after 16 hours]
(c)	<p>ans: yes since lower limit is 80.8 (3 marks)</p> <ul style="list-style-type: none"> •¹ knows to find limit •² finds limit •³ realises lower limit is less than 100 	<ul style="list-style-type: none"> •¹ $L = \frac{32}{1-0.92^4}$ •² $L = 112.8$ •³ brightness would fall below 100 since lower limit is 80.8
6(a)	<p>ans: proof (3 marks)</p> <ul style="list-style-type: none"> •¹ cross multiplies and multiplies out •² brings to LHS •³ rearranges as required 	<ul style="list-style-type: none"> •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)	<p>ans: $k = \frac{5}{4}$ (5 marks)</p> <ul style="list-style-type: none"> •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 	<ul style="list-style-type: none"> •¹ $b^2 - 4ac = 0$ for equal roots (<i>must be stated explicitly for •¹</i>) •² $a = (k-1)$; $b = 2$; $c = (4k-1)$ (<i>•² given if stated or if implied at •³</i>) •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)

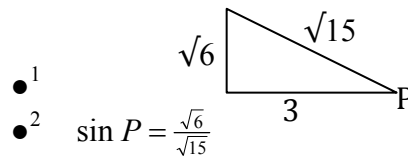
- ¹ finds expression for length of shed
- ² finds expression for area of g'house
- ³ simplifies to correct form
- ¹ length of shed = $\frac{3}{x}$ with some evidence
- ² $A = (x + 3)(4 + \frac{3}{x}) - 3$
- ³ $A = 4x + 3 + 12 + \frac{9}{x} - 3 \rightarrow$ answer

(b) ans: 15 (5 marks)

- ¹ knows to equate derivative to 0
- ² prepares to differentiate
- ³ differentiates
- ⁴ solves for x
- ⁵ justifies answer
- ¹ $\frac{dy}{dx} = 0$
- ² $A(x) = 12 + 4x + 9x^{-1}$
- ³ $A'(x) = 4 - \frac{9}{x^2} = 0$
- ⁴ $4 - \frac{9}{x^2} = 0; x^2 = \frac{9}{4}; x = \frac{3}{2}$
- ⁵ or other acceptable method

8(a) ans: $\sin P = \frac{\sqrt{6}}{\sqrt{15}}$ (2 marks)

- ¹ evaluates missing side in R.A.T.
- ² states $\sin P$



(b) ans: 77° or 103° (4 marks)

- ¹ expands trig formulae (must use P&Q)
- ² finds missing ratios
- ³ substitutes and evaluates formula
- ⁴ finds angle
- ¹ $\sin(P + Q) = \sin P \cos Q + \cos P \sin Q$
- ² $\cos P = \frac{3}{\sqrt{15}} \cos Q = \frac{\sqrt{15}}{\sqrt{24}} \sin Q = \frac{\sqrt{3}}{\sqrt{24}}$
- ³ $\frac{\sqrt{6}}{\sqrt{15}} \times \frac{\sqrt{15}}{\sqrt{24}} + \frac{3}{\sqrt{15}} \times \frac{3}{\sqrt{24}} = \frac{1}{2} + 3 \frac{\sqrt{10}}{20}$
- ⁴ 77° or 103°

Total: 60 marks