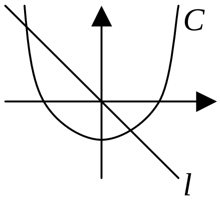
Question number	Scheme	Marks
1.	(a) $\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right) = \left(\frac{1+5}{2}, \frac{2+8}{2}\right) = (3, 5)$	M1 A1 (2)
	(b) Gradient = $\frac{y_2-y_1}{x_2-x_1} = \frac{8-2}{5-1}$	M1 A1
	$y-2=m(x-1)$ $\quad y=\frac{3}{2}x+\frac{1}{2}$	M1 A1 (4)
	Allow $y=\frac{3x+1}{2}$ or $y=\frac{1}{2}(3x+1)$	**6**
2.	(a) √8 = √4√2 = 2√2 (seen or implied)	B1
	(3 – √8)(3 – √8) = 9 – 6√8 + 8 = 17 – 12√2	M1 A1 (3)
	(b) $\frac{1}{4-\sqrt{8}}\times\frac{4+\sqrt{8}}{4+\sqrt{8}}$, $=\frac{4+\sqrt{8}}{16-8}=\frac{1}{2}+\frac{1}{4}\sqrt{2}$	M1, M1 A1 (3)
	Allow $\frac{1}{4}(2+\sqrt{2})$ or equiv. (in terms of √2)	**6**
3.	(a) $2x+2(x+20)<300$ (Using x – 20 is A0)	M1 A1 (2)
	(b) $x(x+20)>4800$ (Using x – 20 is A0)	M1 A1 (2)
	(c) 65 (i.e. Allow wrong inequality sign or x = 65).	B1ft
	Solving 3 term quadratic, $(x + 80)(x – 60) = 0$ $\quad x = \ldots$	M1
	$x > 60$ ($x < –80$ may be included here, but there must be no other wrong solution to the quadratic inequality such as $x > –80$)	A1
	$60 < x < 65$	A1 (4) **8**

Question number	Scheme	Marks
4.	(a)  C : "U" shape	B1
	C : Position	B1
	l : Straight line through origin with negative gradient	B1 (3)
	(b) (2, 0), (–2, 0), (0, – 4) 2 of these correct:	B1
	All 3 correct:	B1 (2)
	(c) $x^2 - 4 = -3x$	
	$x^2 + 3x - 4 = 0$ $(x+4)(x-1) = 0$ $x = ...$	M1
	$x = -4$ $x = 1$	A1
	$y = 12$ $y = -3$ M: Attempt one y value	M1 A1 (4)
		9
5.	(a) $\tan x = \frac{8}{3}$ (or exact equivalent, or 3 s.f. or better)	B1 (1)
	(b) $\tan x = \frac{8}{3}$ $x = 69.4°$ (α), $x = 249.4°$ ($180 + \alpha$)	M1 A1, A1ft (3)
	(c) $3(1-\cos^2 y) - 8\cos y = 0$ $3\cos^2 y + 8\cos y - 3 = 0$	M1 A1
	$(3\cos y - 1)(\cos y + 3) = 0$ $\cos y = ...,$ $\frac{1}{3}$ (or –3)	M1 A1
	$y = 70.5°$ (β), $x = 289.5°$ ($360 - \beta$)	A1 A1ft (6)
		10

Question number	Scheme	Marks	
6.	(a) $(x^4 - 6x^2 + 9)$	M1	
	$(x^4 - 6x^2 + 9) \div x^3 = x - 6x^{-1} + 9x^{-3}$ (*)	A1	(2)
	(b) $f'(x) = 1 + 6x^{-2} - 27x^{-4}$ First A1: 2 terms correct (unsimplified)	M1 A1 A1	(3)
	Second A1: all 3 correct (simplified)		
	(c) When $x = \pm\sqrt{3}$, $f'(x) = 1 + \frac{6}{(\sqrt{3})^2} - \frac{27}{(\sqrt{3})^4}$	M1	
	$\left(= 1 + \frac{6}{3} - \frac{27}{9}\right)$ $= 0$, $\therefore$ Stationary	A1	(2)
	(d) $f''(x) = -12x^{-3} + 108x^{-5}$ M: Attempt to diff. $f'(x)$, <u>not</u> $g(x)f'(x)$.	M1	
	$f''(\sqrt{3}) = -\frac{12}{(\sqrt{3})^3} + \frac{108}{(\sqrt{3})^5}$ $(\approx -2.309 + 6.928 = 4.619)\left(= \frac{8}{\sqrt{3}}\right)$	A1	
	> 0, $\therefore$ Minimum (not dependent on a numerical version of $f''(x)$)	A1ft	(3)
			10
7.	(a) $(S =)\ a + ar + ... + ar^{n-1}$ "$S =$" not required. Addition required.	B1	
	$(rS =)\ ar + ar^2 + ... + ar^n$ "$rS =$" not required (M: Multiply by r)	M1	
	$S(1-r) = a(1-r^n)$ $S = \frac{a(1-r^n)}{1-r}$ (M: Subtract and factorise each side) (*)	M1 A1	(4)
	(b) $r = 0.9$	B1	
	$S_{20} = \frac{10(1-0.9^{20})}{1-0.9} = 87.8$	M1 A1	(3)
	(c) Sum to infinity $= \frac{a}{1-r} = \frac{10}{1-0.9} = 100$ (ft only for $\lvert r \rvert < 1$)	M1 A1ft	(2)
	(d) $\frac{a}{1-r} = \frac{r}{1-r} = 10$ (Put $a = r$ in the formula from (c), and equate to 10)	M1	
	$r = 10(1-r)$ $r = ...,$ $\frac{10}{11}$ (or exact equivalent)	M1, A1	(3)
			12

Question number	Scheme	Marks
8.	(a) $\frac{dy}{dx} = 3x^2 - 14x + 15$	M1 A1 (2)
	(b) $3x^2 - 14x + 15 = 0$	M1
	$(3x-5)(x-3) = 0$ $x = ...,\ 3$ (A1 requires correct quadratic factors).	M1, A1
	$y = 12$ (Following from $x = 3$)	A1 (4)
	(c) P: $x = 1$ $y = 12$	B1
	Same y-coord. as Q (or "zero gradient"), so PQ is parallel to the x-axis	B1 (2)
	(d) $\int (x^3 - 7x^2 + 15x + 3)\,dx = \frac{x^4}{4} - \frac{7x^3}{3} + \frac{15x^2}{2} + 3x$	M1 A1 A1
	(First A1: 3 terms correct, Second A1: all correct)	
	$\left[\frac{x^4}{4} - \frac{7x^3}{3} + \frac{15x^2}{2} + 3x\right]_1^3 = \left(\frac{81}{4} - 63 + \frac{135}{2} + 9\right) - \left(\frac{1}{4} - \frac{7}{3} + \frac{15}{2} + 3\right)$	M1
	$\left(33\frac{3}{4} - 8\frac{5}{12}\right) - 24 = 25\frac{1}{3} - (2 \times 12) = 1\frac{1}{3}$ (or equiv. or 3 s.f or better)	M1 A1 (6)
		14