Question	Answer	Marks	Guidance
5(a)	Attempt correct process for solving 3-term quadratic equation in $\sqrt{x}$	M1	Accept $8y^2 - 6y - 9 \rightarrow (2y - 3)(4y + 3)$, if $y = \sqrt{x}$ specified.
	Obtain at least $2\sqrt{x} - 3 = 0$ or equivalent	A1	Ignore $4\sqrt{x} + 3 = 0$. **SC B1** for $\sqrt{x} = \frac{3}{2}$ with no method shown for solving the 3-term quadratic.
	Conclude $x = \frac{9}{4}$ ignore $\frac{9}{16}$	A1	**SC B1** if no method shown for solving the 3-term quadratic.
	Alternative Method for Q5(a)		
	$3\sqrt{x} = 4x - \frac{9}{2} \rightarrow 16x^2 - 45x + \frac{81}{4}$ o.e and attempt correct process to solve	M1	
	Obtain $x = \frac{9}{4}$ or $\frac{9}{16}$	A1	**SC B1** if no method shown for solving the 3-term quadratic.
	$x = \frac{9}{4}$ ignore $\frac{9}{16}$	A1	**SC B1** if no method shown for solving the 3-term quadratic.
		3	

Question	Answer	Marks	Guidance
5(b)	Integrate to obtain form $k_1x^2 + k_2x^{\frac{3}{2}} + k_3x$ where $k_1k_2k_3 \neq 0$	**M1**	
	Obtain correct $2x^2 - 2x^{\frac{3}{2}} + x$ or equivalent	**A1**	Allow unsimplified.
	Substitute $x = 4$ and $y = 11$ to attempt value of c	**M1**	Dependent on at least 2 correct terms involving x.
	Obtain $y = 2x^2 - 2x^{\frac{3}{2}} + x - 9$	**A1**	Must be simplified. Allow 'f(x) ='. Allow y missing if y appears previously.
		4	

Question	Answer	Marks	Guidance
7(a)	Differentiate to obtain form $k_1(2x+1)^{-\frac{4}{3}}$	**M1**	
	Obtain correct $-8(2x+1)^{-\frac{4}{3}}$ or unsimplified equivalent	**A1**	
	Attempt equation of tangent at $\left(\frac{7}{2}, 6\right)$ with numerical gradient	**M1**	Gradient must come from a differentiated expression.
	Obtain $y = -\frac{1}{2}x + \frac{31}{4}$ or equivalent of requested form	**A1**	
		4	

Question	Answer	Marks	Guidance
7(b)	Integrate to obtain form $k_2(2x+1)^{\frac{2}{3}}$	**M1**	
	Obtain correct $9(2x+1)^{\frac{2}{3}}$ or unsimplified equivalent	**A1**	
	Use correct limits correctly to find area	**M1**	Substitute correct limits into an integrated expression. 36 – 9 minimum working required.
	Obtain 27	**A1**	**SC B1** if M1 A1 M0 scored.
		4	

Question	Answer	Marks	Guidance
7(a)	$-2\left((x \pm p)^2 \pm q\right)$ or $-2(x \pm p)^2 \pm q$	M1*	$p \neq 0$.
	$-2\left((x-2)^2 \pm q\right)$ or $-2(x-2)^2 \pm q$	DM1	
	$-2(x-2)^2 + 19$ and (2, 19)	A1	Accept $x = 2, y = 19$ or 2, 19.
		3	

Question	Answer	Marks	Guidance
7(b)	**Method 1**		
	$[x=]\pm 1$	**B1***	Both x co-ordinates for the points of intersection.
	Subtract and attempt to integrate	**M1***	
	$\left[\int\left(-2x^2+2\right)\mathrm{d}x\right]-\frac{2}{3}x^3+2x$	**B1***	Both terms correct.
	$\left(-\frac{2}{3}+2\right)-\left(\frac{2}{3}-2\right)$	**M1**	Apply *their* limits, one positive and one negative, obtained from equating the line and the curve to their integrated expression.
	$=\frac{8}{3},\ 2\frac{2}{3}$	**DB1**	AWRT 2.67 WWW. Condone $\frac{-8}{3}\to\frac{8}{3}$. **SC B1** for mistaking triangle for trapezium leading to $\frac{11}{3}$, i.e. a total of 2/5.
	Method 2		
	$[x=]\pm 1$	**B1***	Both x co-ordinates for the points of intersection.
	Attempt to integrate and subtract	**M1***	The second integral can be replaced with what is clearly their area of a trapezium.
	$\left\{\frac{-2x^3}{3}+\frac{8}{2}x^2+11x\right\}[-]\left\{\frac{8}{2}x^2+9x\right\}$	**B1***	OE All terms correct. The second integral can be replaced by $\frac{1}{2}(1+17)\times 2$ OE.

Question	Answer	Marks	Guidance
7(b)	$\left\{\left(\frac{-2}{3}+4+11\right)-\left(\frac{2}{3}+4-11\right)\right\}$ [−] $\{(4+9)-(4-9)\}$	M1	Apply *their* limits, one positive and one negative, obtained from equating the line and the curve, to *their* integrated expressions. If the trapezium has been used, the second integral can be replaced by *their* 18.
	$=\frac{8}{3},\ 2\frac{2}{3}$	DB1	AWRT 2.67 WWW. Condone $\frac{-8}{3}\to\frac{8}{3}$. **SC B1** for mistaking triangle for trapezium leading to $\frac{11}{3}$, i.e. a total of 2/5.
	Method 3		
	$[x=]\pm 1$	B1*	Both x co-ordinates for the points of intersection.
	Subtract and attempt to integrate	M1*	
	$-\frac{2}{3}(x-2)^3-\frac{8}{2}x^2+10x$	B1*	All terms correct.
	$\left(\frac{2}{3}-4+10\right)-(18-4-10)$	M1	Apply *their* limits, one positive and one negative, obtained from equating the line and the curve, to *their* integrated expression.
	$=\frac{8}{3},\ 2\frac{2}{3}$	DB1	AWRT 2.67 WWW.

Question	Answer	Marks	Guidance
7(b)	**Method 4**		
	$[x=]\pm 1$	**B1***	Both x co-ordinates for the points of intersection.
	Attempt to integrate and subtract	**M1***	The second integral can be replaced with what is clearly *their* area of a trapezium.
	$\left\{-\frac{2}{3}(x-2)^3+19x\right\}$ $[-]$ $\left\{\frac{8}{2}x^2+9x\right\}$	**B1***	All terms correct. The second integral can be replaced with $\frac{1}{2}(1+17)\times 2$ OE.
	$\left\{\left(\frac{2}{3}+19\right)-(18-19)\right\}$ $[-]$ $\{(4+9)-(4-9)\}$	**M1**	Apply *their* limits, one positive and one negative, obtained from equating the line and the curve, to *their* integrated expression. If the trapezium has been used the second integral can be replaced with *their* 18 OE.
	$=\frac{8}{3},\ 2\frac{2}{3}$	**DB1**	AWRT 2.67 WWW. Condone $\frac{-8}{3}\rightarrow\frac{8}{3}$. **SC B1** for mistaking triangle for trapezium leading to $\frac{11}{3}$, i.e. a total of 2/5.
		5	

Question	Answer	Marks	Guidance
9(a)	$y = x^3 - 3x + 3$ and $y = 2x^3 - 4x^2 + 3 \Rightarrow x^3 - 4x^2 + 3x[=0]$	M1	Reducing to 3-term cubic or quadratic if x cancelled.
	$[x](x-1)(x-3)[=0]$	DM1	Factorising the cubic or quadratic.
	$x = 0$, 1 and 3 $\{x = 0$ may be seen in the working$\}$	A1	**SC B1** for $x = 1,\ 3$ only, with no M marks awarded.
		3	

Question	Answer	Marks	Guidance
9(b)	Attempt at integration of both functions. Can be before or after subtraction of the functions or integrals	M1	Expect integration of $\int\left(\left(x^3-3x+3\right)-\left(2x^3-4x^2+3\right)\right)\mathrm{d}x$ or $\int\left(-x^3+4x^2-3x\right)\mathrm{d}x$. At this stage, subtraction can be done either way.
	$=\pm\left(-\frac{x^4}{4}+\frac{4x^3}{3}-\frac{3x^2}{2}\right)$ or $\pm\left\{\left(\frac{x^4}{4}-\frac{3}{2}x^2+3x\right)-\left(\frac{2}{4}x^4-\frac{4}{3}x^3+3x\right)\right\}$	A1	OE $\pm$ covers A1 being awarded to those who subtract the 'other' way.
	$=\left[\left(-\frac{81}{4}+\frac{108}{3}-\frac{27}{2}\right)-\left(-\frac{1}{4}+\frac{4}{3}-\frac{3}{2}\right)\right]$, or $\left(\frac{81}{4}-\frac{27}{2}+9\right)-\left(\frac{1}{4}-\frac{3}{2}+3\right)-\left\{\left(\frac{81}{2}-\frac{108}{3}+9\right)-\left(\frac{1}{2}-\frac{4}{3}+3\right)\right\}$	DM1	OE Minimum required is $\left(\frac{63}{4}-\frac{7}{4}\right)-\left(\frac{27}{2}-\frac{13}{6}\right)$, i.e. four fractions. Correctly apply limits *their* 1 and 3. Do not allow if $x=0$ used. Need at least one correct substitution in every bracket. If two integrals, need to see substitution into both. Allow one sign error only in each expression, if brackets are not shown.
	$=\frac{8}{3}$	A1	Accept if this comes from use of limits $f(1)-f(3)$ or $\int\left(x^3-4x^2+3x\right)\mathrm{d}x$, if $\left\|\frac{-8}{3}\right\|$ used. Only dependent on the first method mark. Accept AWRT 2.67.
		4	