Question	Answer	Marks	Guidance
6(a)	Integrate to obtain form $k(5x-3)^{-1}$	*M1	OE
	$4(5x-3)^{-1}$	A1	Or unsimplified equivalent. Condone absence of $...+c$ so far.
	Substitute $x=\frac{4}{5}$ and $y=-3$ to attempt value of c	DM1	DM0 for substituting $\left(-3,\frac{4}{5}\right)$.
	$y=4(5x-3)^{-1}-7$ allow f(x) *or* $f=4(5x-3)^{-1}-7$	A1	OE Condone $c=-7$ as the final answer providing $y=$ or $f(x)=\frac{4}{(5x-3)}+c$ OE is seen earlier. Attempts to write equation in $y=mx+c$ form scores A0. Do not ISW. Gains max 3/4.
		4	
6(b)	Carry out stretch by replacing x by $2x$ in *their* equation	M1	Award if given as the second transformation. Do not ignore sign errors.
	Carry out translation by replacing x by $x-2$ and y by $y-10$	M1	OE Award if given as the first transformation. Do not ignore sign errors.
	$y=\frac{4}{10x-23}+3$	A1	Or similarly simplified equivalent, WWW.
		3	

Question	Scheme	Marks
10(a)(i)	Equation is $y=\frac{1}{2}(x+2)$	**B1**
		(1)
(ii)	l_1 intersect parabola $\Rightarrow -\frac{1}{4}(x+2)(x-b)=\frac{1}{2}(x+2)\Rightarrow x=...$	**M1**
	$x=b-2$	**A1**
	$y=\frac{1}{2}b$	**A1**
		(3)
(b)	l_2 passes through $(b, 0)$ and has gradient $-2 \Rightarrow y=...$	**M1**
	$y-0=-2(x-b)$	**A1**
		(2)
(c)	So equation is $y-"\frac{1}{2}b"="-2"(x-"b-2")$	**M1**
	$y-\frac{1}{2}b=-2x+2b-4\Rightarrow y=-2x+\frac{5}{2}b-4$ *	**A1***
		(2)
(d)	$y=-2x+2b=-2x+\frac{5}{2}b-4\Rightarrow 2b=\frac{5}{2}b-4\Rightarrow b=...$ or $y=-2x+\frac{5}{2}b-4,\ x=b,\ y=0\Rightarrow 0=-2b+\frac{5}{2}b-4\Rightarrow b=...$ or $-\frac{1}{4}(x+2)(x-b)=-2(x-b)\Rightarrow x=...(6)\Rightarrow b-2=6\Rightarrow b=...$	**M1**
	$b=8$	**A1**
		(2)
		(10 marks)

Question	Answer	Marks	Guidance
10(c)	$\left\{\frac{9x^2}{2}\right\}+\left\{\frac{-(2x+1)^{\frac{5}{2}}}{\frac{5}{2}\times 2}\right\}$	B1 B1	Integrating y with respect to x.
	$\left\{\frac{9}{2}7.5^2-\frac{1}{5}(2\times7.5+1)^{2.5}\right\}-\left\{\frac{9}{2}1.5^2-\frac{1}{5}(2\times1.5+1)^{2.5}\right\}$ or $\left(\frac{9}{2}\times\frac{225}{4}-\frac{1024}{5}\right)-\left(\frac{81}{8}-\frac{32}{5}\right)$ or $\frac{1933}{40}-\frac{149}{40}$ or 48.325 – 3.725	M1	OE Apply limits 1½ to 7½ to an integral. Working must be seen. Expect 44.6 .
	$\frac{1}{2}\left(5\frac{1}{2}+3\frac{1}{2}\right)\times6$ or $\int_{\frac{3}{2}}^{\frac{15}{2}}(\frac{-1}{3}x+6)\mathrm{d}x=$ $\left(\frac{-1}{6}\times\left(\frac{15}{2}\right)^2+6\times\frac{15}{2}\right)-\left(\frac{-1}{6}\times\left(\frac{3}{2}\right)^2+6\times\frac{3}{2}\right)$ or $\frac{285}{8}-\frac{69}{8}$ [= 27]	B1	SOI Area of trapezium. May be seen combined with the area under the curve integral.
	[Shaded area = 44.6 – 27 =] 17.6	A1	**SC B1** if no substitution of the limits seen.
		5	

Question	Answer	Marks	Guidance
10(a)	$x^2+(2x-1)^2-2[=0]\rightarrow 5x^2-4x-1\,[=0]$	*M1 A1	Or $5y^2+2y-7\,[=0]$.
	$(5x+1)(x-1)[=0]$ or $(5y+7)(y-1)[=0]$	DM1	May see factors or formula or completing square.
	$x=1,\ y=1$ or (1, 1) only	A1	May be implied on the diagram.
		4	

Question	Answer	Marks	Guidance
10(b)	$(\pi)\int(2-x^2)\mathrm{d}x\ =\ (\pi)\left(2x-\frac{x^3}{3}\right)$	*M1 A1	Attempt integration of y^2, allow $\int(2-y^2)\mathrm{d}y$.
	$(\pi)\left(2\sqrt{2}-\frac{(\sqrt{2})^3}{3}\right)-\left(2-\frac{1}{3}\right))$	DM1	Apply limits 1 → √2.
	$\frac{\pi}{3}(4\sqrt{2}-5)$	A1	CAO, allow $\frac{\pi}{3}(2\sqrt{8}-5)$, must be in given form.
		4	
10(c)	Arc length = $\frac{1}{8}(2\pi\sqrt{2})$ or $\frac{\pi\sqrt{2}}{4}$ oe	B1	Must be exact.
	Perimeter = $\sqrt{2}$ + *their* arc length	B1 FT	Must be exact, do not allow inverse trig functions.
		2	

Question Number	Scheme	Marks
11a	$2(x\pm...)^2$	B1
	$...(x\pm 3)^2...$	M1
	$2(x-3)^2-4$	A1
		(3)
b	$(3, -4)$	B1ft
		(1)
c	$m=\dfrac{28--4}{-1-3}\quad(=-8)$	M1
	$y-28=-8(x+1)$	dM1
	$y=-8x+20$	A1
		(3)
d	$y\leqslant"-8x+20"$ and $y\geqslant 2x^2-12x+14$ (or $y\geqslant"2(x-3)^2-4"$)	B1ftB1ft
	$y\leqslant -8x+20\qquad y\geqslant 2x^2-12x+14\qquad y\geqslant 0,\ x\geqslant 0$	B1cso
		(3)
		(10 marks)

Question	Answer	Marks	Guidance
11(b)	y-coordinate of $P=3$, y-coordinate of $Q=\frac{20}{9}$	**B1**	Both required.
	$\left\{\frac{2(2x-1)^{-1}}{-1\times 2}\right\}+\left\{\frac{1}{2}x^2\right\}$	**B1 B1**	Area below curve.
	$\left[\left(-\frac{1}{3}+2\right)-\left(-1+\frac{1}{2}\right)\right]=\frac{5}{3}-\left(-\frac{1}{2}\right)$	**M1**	Apply limits 1→2 to an integral. Expect $\frac{13}{6}$.
	$\frac{1}{2}\left(3+\frac{20}{9}\right)=\frac{47}{18}$	**M1**	Area of trapezium, only allow errors in y-coordinate of Q.
	$\frac{47}{18}-\frac{13}{6}=\frac{4}{9}$	**A1**	Shaded region.
		6	
	Alternative method 1: Changes the award of the first M1		
	Their equation of line PQ:[$y=\frac{-7}{9}x+\frac{34}{9}$]. Integrating between 1 and 2.	**M1**	Must be some evidence of use of limits.
	Alternative method 2: Changes the award of the first M1, a B1 and the second M1		
	Combining line and curve: $\int\left(\frac{-16}{9}x+\frac{34}{9}-\frac{2}{(2x-1)^2}\right)dx$	**M1**	For area under the line if *their* $\frac{34}{9}$ is seen integrated correctly and limits used. Correct first and 3rd terms.
	$=\frac{-8}{9}x^2+\frac{34}{9}x+\frac{1}{(2x-1)}$	**B1 B1**	
	Use of limits on the whole integral	**M1**	

Question Number	Scheme	Marks
9 (a)	$x \ldots -5$	B1 (1)
(b)	$f(x)=(x+5)(3x^2-4x+20)=3x^3+11x^2+100$	M1
	$f'(x)=9x^2+22x$	M1 A1cso (3)
(c)	Finds $f'(-4)=9\times(-4)^2+22\times -4=(56)$	M1
	Sets $f'(x)="9x^2+22x"="56"$	dM1
	$9x^2+22x-56=0 \Rightarrow x=\frac{14}{9},(-4)$	ddM1 A1cso (4)
(d)(i)	$(-1, 84)$	B1
(ii)	$(-4, 336)$	B1 (2) (10 marks)

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 $\int((x^3-3x+3)-(2x^3-4x^2+3))\mathrm{d}x$ or $\int(-x^3+4x^2-3x)\mathrm{d}x$. 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 ± 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 $\int(x^3-4x^2+3x)\mathrm{d}x$, if $\left\|\frac{-8}{3}\right\|$ used. Only dependent on the first method mark. Accept AWRT 2.67.
		4	

Question	Answer	Marks	Guidance
3	$\left(\frac{1}{-1\times 4}\right)a(4x-3)^{-1}+2x$	B1	OE Do not accept $(-2+1)$ as equivalent to -1.
	Apply correct limits, $x=3$ & 1, to *their* integral	*M1	*Their* integral must contain $(4x-3)^{-1}$. Condone using $x=1$ and 3.
	$\frac{-a}{36}+6-\left(\frac{-a}{4}+2\right)=12 \Rightarrow \left[\frac{8a}{36}+4=12\right]$	DM1	OE Equate *their* linear unsimplified expression in a to 12.
	$a=36$	A1	
		4	

Question	Answer	Marks	Guidance
10(a)	$\frac{dy}{dx}=\left[\frac{x^{-1/2}}{2k}\right]-\left[\frac{x^{-3/2}}{2}\right]+([0])$	B2, 1, 0	$([0])$ implies that more than 2 terms counts as an error
	Sub $\frac{dy}{dx}=3$ when $x=\frac{1}{4}$ Expect $3=\frac{1}{k}-4$	M1	
	$k=\frac{1}{7}$ (or 0.143)	A1	
		4	

Question	Answer	Marks	Guidance
10(b)	$\int\frac{1}{k}x^{1/2}+x^{-1/2}+\frac{1}{k^2}=\left[\frac{2x^{3/2}}{3k}\right]+\left[2x^{1/2}\right]+\left[\frac{x}{k^2}\right]$	B2, 1, 0	OE
	$\left(\frac{2k^2}{3}+2k+1\right)-\left(\frac{k^2}{12}+k+\frac{1}{4}\right)$	M1	Apply limits $\frac{k^2}{4}\to k^2$ to an integrated expression. Expect $\frac{7}{12}k^2+k+\frac{3}{4}$
	$\frac{7}{12}k^2+k+\frac{3}{4}=\frac{13}{12}$	M1	Equate to $\frac{13}{12}$ and simplify to quadratic. OE, expect $7k^2+12k-4\ (=0)$
	$k=\frac{2}{7}$ only (or 0.286)	A1	Dependent on $(7k-2)(k+2)\ (=0)$ or formula or completing square.
		5	