Question	Answer	Marks	Guidance
10(a)	$f'(x)=-\left(\frac{1}{2}x+k\right)^{-3}$	B1	
	$f'(2)>0 \Rightarrow -(1+k)^{-3}>0$	M1	Allow for solving *their* $f''(2)>0$
	$k<-1$	A1	WWW
		3	
10(b)	$\left[f(x)=\int\left(\left(\frac{1}{2}x-3\right)^{-2}-(-2)^{-2}\right)dx=\right]\left\{\frac{\left(\frac{1}{2}x-3\right)^{-1}}{-1\times\frac{1}{2}}\right\}\left\{-\frac{x}{4}\right\}$	B1 B1	Allow $-2\left(\frac{1}{2}x+k\right)^{-1}$ OE for 1st B1 and $-(1+k)^{-2}x$ OE for 2nd B1
	$3\frac{1}{2}=1-\frac{1}{2}+c$	M1	Substitute $x=2$, $y=3\frac{1}{2}$ into *their* integral with c present.
	$f(x)=\frac{-2}{\left(\frac{1}{2}x-3\right)}-\frac{x}{4}+3$	A1	OE
		4	
10(c)	$\left(\frac{1}{2}x-3\right)^{-2}-(-2)^{-2}=0$	M1	Substitute $k=-3$ and set to zero.
	leading to $\left(\frac{1}{2}x-3\right)^2=4$ $\left[\frac{1}{2}x-3=(\pm)2\right]$ leading to $x=10$	A1	
	$(10,-\frac{1}{2})$	A1	Or when $x=10$, $y=-1-2\frac{1}{2}+3=-\frac{1}{2}$
	$f'(10)\left[=-(5-3)^{-3}\rightarrow\right]<0$ $\rightarrow$ MAXIMUM	A1	WWW
		4	

Question	Answer	Marks	Guidance
3	$\left(\frac{1}{-1\times4}\right)a(4x-3)^{-1}+2x$	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
1	$\left[f(x)=\right]\ 2x^3+\frac{8}{x}\ [+c]$	B1	Allow any correct form
	$7=16+4+c$	M1	Substitute $f(2)=7$ into an integral. c must be present. Expect $c=-13$
	$f(x)=\ 2x^3+\frac{8}{x}-13$	A1	Allow $y=$, $f(x)$ or y can appear earlier in answer
		3	

Question	Answer	Marks	Guidance
3(a)	$\left\{5(y-3)^2\right\}$ $\{+5\}$	B1 B1	Accept $a=-3$, $b=5$
		2	
3(b)	$\left[f'(x)=\right]5x^4-30x^2+50$	B1	
	$5\left(x^2-3\right)^2+5$ or $b^2<4ac$ and at least one value of $f'(x)>0$	M1	
	>0 and increasing	A1	WWW
		3	

Question Number	Scheme	Marks
9 (a)	$x \ldots -5$	B1 **(1)**
(b)	$f(x)=(x+5)\left(3x^2-4x+20\right)=3x^3+11x^2+100$	M1
	$f'(x)=9x^2+22x$	M1 A1cso **(3)**
(c)	Finds $f'(-4)=9\times\left(-4\right)^2+22\times-4=\left(56\right)$	M1
	Sets $f'(x)="9x^2+22x"="56"$	dM1
	$9x^2+22x-56=0\Rightarrow x=\frac{14}{9},\left(-4\right)$	ddM1 A1cso **(4)**
(d)(i)	$\left(-1,84\right)$	B1
(ii)	$\left(-4,336\right)$	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 $\int\left(\left(x^3-3x+3\right)-\left(2x^3-4x^2+3\right)\right)\mathrm{d}x$ 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 ± 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 $\left\lvert\frac{-8}{3}\right\rvert$ used. Only dependent on the first method mark. Accept AWRT 2.67.
		4	

Question	Answer	Marks	Guidance
10(a)	$\left\{\frac{(4x+2)^{-1}}{-1}\right\}\{\div 4\}$ or eg $\left\{\frac{1}{16}\right\}\left\{-(x+0.5)^{-1}\right\}$ or $\frac{-1}{(16x+8)}$	**B1 B1**	OE If more than one function of x present then B0 B0.
	$0-(-1/24)$	**M1**	Apply limits to an integral, ∞ must be used correctly.
	1/24	**A1**	Allow 0.0417 AWRT.
		4	
10(b)	$\frac{\mathrm{d}y}{\mathrm{d}x}=\left\{-2(4x+2)^{-3}\right\}\ \{\times 4\}$	**B1 B1**	Allow unsimplified forms.
	Recognise $\frac{\mathrm{d}y}{\mathrm{d}x}=-1$	**B1**	SOI
	their $\frac{-8}{(4x+2)^3}=$ *their* -1	**M1**	Must be numerical. Must be some attempt to solve *their* equation and $\frac{\mathrm{d}y}{\mathrm{d}x}\neq 0$.
	(0, ¼)	**A1 A1**	Accept $x=0$, $y=¼$. $y=¼$ must be from $x=0$ not $x=-1$.
		6	

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 $\ldots+c$ 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	Answer	Marks	Guidance
4	$\left[\frac{dv}{dx}\right]=(9-x)^2$	B1	Allow unsimplified forms. Allow any or no notation
	Substitute $x=4$ into *their* differentiated V,	*M1	Expect 25.
	$\frac{dx}{dt}=\frac{1}{\text{their derivative}}\times 3.6$ (accept $\frac{dt}{dx}=\frac{\text{their derivative}}{3.6}$)	M1	Correct use of the chain rule, ignore incorrect conversions at this point. Expect 0.144
	$=\frac{1}{\text{their numerical derivative}}\times 3.6\times\frac{100}{60}$	DM1	Correct use of the conversion factors.
	$=\frac{1}{25}\times 3.6\times\frac{100}{60}=0.24$	A1	
		5	

Question	Answer	Marks	Guidance
8(a)	$\left[\frac{dy}{dx}=\right]\frac{1}{2}x^{-1/2}-2x^{-3/2}$	B1 B1	Allow unsimplified versions.
	At $x=1$, $\frac{dy}{dx}=\frac{1}{2}-2=-\frac{3}{2}$	M1	Substitute $x=1$ into a differentiated y.
	Equation of tangent is $y-5=-\frac{3}{2}(x-1)$	A1	WWW Or $y=-\frac{3}{2}x+\frac{13}{2}$.
		4	

Question	Answer	Marks	Guidance
8(b)	$\frac{x^{3/2}}{3/2}+8x^{1/2}$	B1	OE Integrate to find area under curve, allow unsimplified versions.
	$\left[\left(\frac{128}{3}+32\right)-\left(\frac{2}{3}+8\right)\right]$	M1	Apply limits 1 → 16 to an integrated expression.
	Area under line = 15 × 5 = 75	B1	Or by $\int_1^{16}5dx$.
	Required area = 75 – 66 = 9	A1	
		4	