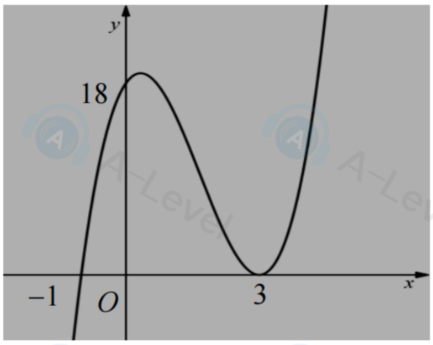
Question	Answer	Marks	Guidance
8(a)	$[\text{fg}(x)=]1/(2x+1)^2-1$	B1	SOI
	$1/(2x+1)^2-1=3$ leading to $4(2x+1)^2=1$ or $\frac{1}{(2x+1)}=[\pm]2$ or $16x^2+16x+3=0$	M1	Setting $\text{fg}(x)=3$ and reaching a stage before $2x+1=\pm½$ or reaching a 3 term quadratic in x
	$2x+1=\pm½$ or $2x+1=-½$ or $(4x+1)(4x+3)[=0]$	A1	Or formula or completing square on quadratic
	$x=-\frac{3}{4}$ only	A1	
	Alternative method for Question 8(a)		
	$x^2-1=3$	M1	
	$g(x)=-2$	A1	
	$\frac{1}{(2x+1)}=-2$	M1	
	$x=-\frac{3}{4}$ only	A1	
		4	

Question	Answer	Marks	Guidance
8(b)	$y=\frac{1}{(2x+1)^2}-1$ leading to $(2x+1)^2=\frac{1}{y+1}$ leading to $2x+1=[\pm]\frac{1}{\sqrt{y+1}}$	*M1	Obtain $2x+1$ or $2y+1$ as the subject
	$x=[\pm]\frac{1}{2\sqrt{y+1}}-\frac{1}{2}$	DM1	Make $x(\text{or } y)$ the subject
	$-\frac{1}{2\sqrt{x+1}}-\frac{1}{2}$	A1	OE e.g. $-\frac{\sqrt{x+1}}{2x+2}-\frac{1}{2}$, $-\left(\sqrt{\frac{-x}{4x+4}+\frac{1}{4}}+\frac{1}{2}\right)$
		3	

Question Number	Scheme	Marks
5(a)	$f'(x)=12x^{-\frac{1}{2}}+\frac{x}{3}-4$	
	One of $x^{-\frac{1}{2}}\to x^{\frac{1}{2}}$, $-4\to -4x$, $x\to x^2$	M1
	$f(x)=\int 12x^{-\frac{1}{2}}+\frac{x}{3}-4\,dx=24x^{\frac{1}{2}}+\frac{x^2}{6}-4x+c$	A1A1
	$8=24(9)^{\frac{1}{2}}+\frac{(9)^2}{6}-4(9)+c\Rightarrow c=\ldots$	dM1
	$(f(x)=)\ \ 24x^{\frac{1}{2}}+\frac{x^2}{6}-4x-\frac{83}{2}$	A1
		(5)
(b)	$f'(9)=\frac{12}{\sqrt{9}}+\frac{9}{3}-4\quad(=3)$	M1
	$3\to -\frac{1}{3}$	dM1
	$y-8=\text{"}-\frac{1}{3}\text{"}(0-9)$	M1
	(0, 11)	A1
		(4)
		(9 marks)

Question	Answer	Marks	Guidance
5(d)	(1, 5)	B1 FT	FT each coordinate, (*their*8 – 7, *their*2 + 3) Allow vector notation and absence of brackets.
		B1 FT	
		2	

Question Number	Scheme		Marks
6.(a)		 Positive cubic shape anywhere with 1 maximum and 1 minimum	M1
		Positive cubic shape that at least reaches the x-axis at $x = -1$ and with a minimum on the x-axis at $x = 3$	A1
		y intercept at 18. Must correspond with their sketch	B1
	For the intercepts allow as numbers as above or allow as coordinates e.g. (18, 0), (0, −1), (0, 3) as long as they are marked in the correct place.		
			(3)
(b)	E.g. $(2x+2)(x^2-6x+9)=\ldots$		M1
	$= 2x^3-10x^2+6x+18$		A1 A1
			(3)
(c)	$(\mathrm{f}'(x)=)6x^2-20x+6$		B1ft
	$\mathrm{f}'\left(\frac{1}{3}\right)=6\left(\frac{1}{3}\right)^2-20\left(\frac{1}{3}\right)+6$		M1
	$\mathrm{f}'\left(\frac{1}{3}\right)=0$		A1
	$y=\dfrac{512}{27}$		A1
			(4)
			(10 marks)

Question	Answer	Marks	Guidance
6(b)	$y=\dfrac{-x}{\sqrt{4-x^2}}$ leading to $x^2=y^2\left(4-x^2\right)$	*M1	Squaring and clearing the fraction. Condone one error in squaring $-x$ or y
	$x^2\left(1+y^2\right) = 4y^2$	DM1	OE. Factorisation of the new subject with order of operations correct. Condone sign errors.
	$x=(\pm)\dfrac{2y}{\sqrt{1+y^2}}$	DM1	$x=(\pm)\sqrt{\left(\dfrac{4y^2}{(1+y^2)}\right)}$ OE is acceptable for this mark. Isolating the new subject. Order of operations correct. Condone sign errors.
	$\mathrm{f}^{-1}(x)=\dfrac{-2x}{\sqrt{1+x^2}}$	A1	Selecting the correct square root. Must not have fractions in numerator or denominator.
		4	
6(c)	1 or $a=1$	B1	Do not allow $x=1$ or $-1<x<1$
		1	
6(d)	$[\mathrm{fg}(x)=\mathrm{f}(2x)=]\ \dfrac{-2x}{\sqrt{4-4x^2}}$	B1	Allow $\dfrac{-2x}{\sqrt{4-(2x)^2}}$ or any correct unsimplified form.
	$\mathrm{fg}(x)=\dfrac{-x}{\sqrt{1-x^2}}$ or $\dfrac{-x}{1-x^2}\sqrt{1-x^2}$ or $\dfrac{x}{x^2-1}\sqrt{1-x^2}$	B1	Result of cancelling 2 in numerator and denominator.
		2	

Question	Answer	Marks	Guidance
6(a)	$f(x)=(x-1)^2+4$	B1	
	$g(x)=(x+2)^2+9$	B1	
	$g(x)=f(x+3)+5$	B1 B1	B1 for each correct element. Accept $p=3, q=5$
		4	

Question	Answer	Marks	Guidance
6(b)	Translation or Shift	B1	
	$\begin{pmatrix}-3\\5\end{pmatrix}$ or acceptable explanation	B1 FT	If given as 2 single translations both must be described correctly e.g. $\begin{pmatrix}-3\\0\end{pmatrix}$ & $\begin{pmatrix}0\\5\end{pmatrix}$ FT from *their* $f(x+p)+q$ *or their* $f(x)\to g(x)$ Do not accept $\begin{pmatrix}1\\4\end{pmatrix}$ or $\begin{pmatrix}-2\\9\end{pmatrix}$
		2	

Question	Answer	Marks
7(a)	$\frac{\tan\theta}{1+\cos\theta}+\frac{\tan\theta}{1-\cos\theta}=\frac{\tan\theta(1-\cos\theta)+\tan\theta(1+\cos\theta)}{1-\cos^2\theta}$	M1
	$=\frac{2\tan\theta}{\sin^2\theta}$	M1
	$=\frac{2\sin\theta}{\cos\theta\sin^2\theta}$	M1
	$=\frac{2}{\sin\theta\cos\theta}$ **AG**	A1
		4

Question	Answer	Marks
7(b)	$\frac{2}{\sin\theta\cos\theta}=\frac{6\cos\theta}{\sin\theta}$	M1
	$\cos^2\theta=\frac{1}{3}\to\ \cos\theta=(\pm)0.5774$	A1
	54.7°, 125.3° (**FT** for 180° – 1st solution)	A1 A1FT
		4

Question	Answer	Marks	Guidance
6(a)	$\left\{2(x-4)^2\right\}$ $\{-9\}$	B1 B1	OE When *a* and *b* stated give priority to marking algebraic expression.
		2	
6(b)	$y > -7$	B1	Allow f(x) > –7 or (–7, ∞) Don't allow $x > -7$.
		1	
6(c)	$(x-4)^2 = \frac{y+9}{2}$	M1	2 operations correct. Allow a sign error.
	$x = 4\ [\pm]\sqrt{\frac{y+9}{2}}$	M1	2 operations correct. Allow a sign error.
	$[\mathrm{f}^{-1}(x) =]\, 4 - \sqrt{\frac{x+9}{2}}$	A1 FT	OE FT on *their* answer to **(a)** i.e. $-a - \sqrt{\left(\frac{x-b}{2}\right)}$.
		3	
6(d)	$\mathrm{fg}(x) = \mathrm{f}(2x+4) = 2(2x+4-4)^2 - 9$	M1	Allow $2(2x+4)^2 - 16(2x+4) + 23$.
	$8x^2 - 9$ only	A1	
		2	

Question Number	Scheme	Marks
8 (a)	States or implies that gradient of tangent is 24	B1
	Solves $\mathrm{f}'(3) = 24$ to find k. E.g $4\times3^2 + k\times3 + 3 = 24 \Rightarrow k = \ldots$	M1
	$3k + 39 = 24 \Rightarrow k = \frac{24-39}{3} = -5$ *	A1*
		(3)
(b)	$\mathrm{f}'(x) = 4x^2 - 5x + 3 \Rightarrow \mathrm{f}(x) = \frac{4}{3}x^3 - \frac{5}{2}x^2 + 3x + c$	M1 A1
	Substitutes $x = 3, y = -\frac{3}{24} + 5$ into $y = \mathrm{f}(x)$ to find "c"	dM1
	$\mathrm{f}(x) = \frac{4}{3}x^3 - \frac{5}{2}x^2 + 3x - \frac{141}{8}$	A1
		(4)
		(7 marks)

Question	Answer	Marks	Guidance
8(d)	Finding $\mathrm{f}^{-1}(29)$ [= 5]	M1	Or solving f(x) = 29 [using *their* completed square form, OE].
	Finding f^{-1}(*their* 5)	M1	Or solving f(x) = *their* 5.
	$x = 3$	A1	If using f(x) method, x = 1 must be discarded.
	Alternative solution for Question 8(d)		
	$3\left(3(x-2)^2+2\right) - 2)^2 + 2 = 29$ using *their* completed square form	M1	Or $3\left(3x^2 - 12x + 14\right)^2 - 12\left(3x^2 - 12x + 14\right) + 14 = 29$. Allow if the '$= 29$' appears later in the working.
	Solving as far as $9(x-2)^4 = 9$ or $x^2 - 4x + 3 = 0$	DM1	OE Or $[27]\left(x^4 - 8x^3 + 24x^2 - 32x + 15\right) = 0$.
	$x = 3$ only	A1	WWW Only dependent on the first M1.
		3	

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	Answer	Marks	Guidance
6	Use of $\sin^2\alpha+\cos^2\alpha=1$ eg $\sin\alpha=[\pm]\sqrt{1-\left(\frac{8}{17}\right)^2}$	*M1	Or Pythagoras seen (may quote 8, 15, 17 triple).
	$\sin\alpha=\frac{15}{17}$	A1	
	$\tan\alpha=\frac{15}{8}$	A1	
	$\frac{1}{\sin\alpha}+\frac{1}{\tan\alpha}=\frac{17}{15}+\frac{8}{15}$	DM1	Dealing with reciprocals and addition of fractions correctly.
	$=\frac{5}{3}$ oe	A1	Correct answer with no working shown scores 0. Extra answers from $\sin\alpha=-\frac{15}{17}$ are allowed.
		5	