Question	Answer	Marks
1	$3x^2+2x+4=mx+1 \to 3x^2+x(2-m)+3\ (=0)$	**B1**
	$(2-m)^2-36$ SOI	**M1**
	$(m+4)(m-8)$ (>/= 0) **or** $2-m$ >/= 6 and $2-m$ </= –6 OE	**A1**
	$m<-4$, $m>8$ WWW	**A1**
	Alternative method for question 1	
	$\frac{dy}{dx}=6x+2 \to m=6x+2 \to 3x^2+2x+4=(6x+2)x+1$	**M1**
	$x=\pm 1$	**A1**
	$m=\pm 6+2 \to m=8$ or -4	**A1**
	$m<-4$, $m>8$ WWW	**A1**
		4

Question	Answer	Marks
2	$(y)=\frac{3x^{\frac{3}{2}}}{\frac{3}{2}}-\frac{3x^{\frac{1}{2}}}{\frac{1}{2}}\ (+c)$	**B1 B1**
	$7=16-12+c$ (**M1** for subsituting $x=4$, $y=7$ into *their* integrated expansion)	**M1**
	$y=2x^{\frac{3}{2}}-6x^{\frac{1}{2}}+3$	**A1**
		4

Question	Answer	Marks
3(a)	$(y)=\mathrm{f}(-x)$	B1
		1
3(b)	$(y)=2\mathrm{f}(x)$	B1
		1
3(c)	$(y)=\mathrm{f}(x+4)-3$	B1 B1
		2

Question	Answer	Marks
4(a)	$1+5a+10a^2+10a^3+\ldots$	B1
		1
4(b)	$1+5\left(x+x^2\right)+10\left(x+x^2\right)^2+10\left(x+x^2\right)^3+\ldots$ SOI	M1
	$1+5\left(x+x^2\right)+10\left(x^2+2x^3+\ldots\right)+10\left(x^3+\ldots\right)+\ldots$ SOI	A1
	$1+5x+15x^2+30x^3+\ldots$	A1
		3

Question	Answer	Marks
5	$\cos POA = \frac{5}{13} \rightarrow POA = 1.17(6)$ Allow 67.4° **or** sin = $\frac{12}{13}$ or tan = $\frac{12}{5}$	M1 A1
	Reflex AOB = $2\pi - 2\times \textit{their}\ 1.17(6)$ OE in degrees **or** minor arc AB = 5×2×*their*1.17(6)	M1
	Major arc = 5 × *their* 3.93(1) **or** $2\pi\times5$ - *their* 11.7(6)	M1
	AP (or BP) = $\sqrt{13^2 - 5^2}$ = 12	B1
	Cord length = 43.7	A1
		6

Question	Answer	Marks
6(a)	$\frac{dy}{dx} = \left[\frac{1}{2}(5x-1)^{-1/2}\right]\times[5]$	B1 B1
	Use $\frac{dy}{dt} = 2\times\left(\textit{their}\frac{dy}{dx} \text{ when } x = 1\right)$	M1
	$\frac{5}{2}$	A1
		4

Question	Answer	Marks
6(b)	$2\times \textit{their}\,\frac{5}{2}(5x-1)^{-1/2}=\frac{5}{8}$ oe	**M1**
	$(5x-1)^{1/2}=8$	**A1**
	$x=13$	**A1**
		3

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)	$\dfrac{2}{\sin\theta\cos\theta}=\dfrac{6\cos\theta}{\sin\theta}$	**M1**
	$\cos^2\theta=\dfrac{1}{3}\rightarrow\ \cos\theta=(\pm)0.5774$	**A1**
	54.7°, 125.3° (**FT** for 180° – 1st solution)	**A1** **A1FT**
		4

Question	Answer	Marks
8(a)	$r=\cos^2\theta$ SOI	**M1**
	$S_\infty=\dfrac{\sin^2\theta}{1-\cos^2\theta}$	**M1**
	1	**A1**
		3
8(b)(i)	$d=\sin^2\theta\cos^2\theta-\sin^2\theta$	**M1**
	$\sin^2\theta\left(\cos^2\theta-1\right)$	**M1**
	$-\sin^4\theta$	**A1**
		3

Question	Answer	Marks
8(b)(ii)	Use of $S_{16} = \frac{16}{2}[2a + 15d]$	M1
	With <u>both</u> $a = \frac{3}{4}$ and $d = -\frac{9}{16}$	A1
	$S_{16} = -55\frac{1}{2}$	A1
		3

Question	Answer	Marks
9(a)	$\left[(x-2)^2\right]$ $[-1]$	B1 B1
		2
9(b)	Smallest $c = 2$ (**FT** on *their* part **(a)**)	B1FT
		1
9(c)	$y = (x-2)^2 - 1 \rightarrow (x-2)^2 = y + 1$	*M1
	$x = 2(\pm)\sqrt{y+1}$	DM1
	$(\mathrm{f}^{-1}(x)) = 2 + \sqrt{x+1}$ for $x > 8$	A1
		3

Question	Answer	Marks
9(d)	$\mathrm{gf}(x) = \dfrac{1}{(x-2)^2 - 1 + 1} = \dfrac{1}{(x-2)^2}$ OE	**B1**
	Range of gf is $0 < \mathrm{gf}(x) < \dfrac{1}{9}$	**B1 B1**
		3

Question	Answer	Marks
10(a)	Mid-point is (–1, 7)	**B1**
	Gradient, m, of AB is 8/12 OE	**B1**
	$y - 7 = -\dfrac{12}{8}(x+1)$	**M1**
	$3x + 2y = 11$ **AG**	**A1**
		4
10(b)	Solve simultaneously $12x - 5y = 70$ and *their* $3x + 2y = 11$	**M1**
	$x = 5,\ y = -2$	**A1**
	Attempt to find distance between *their* (5, –2) and either (–7,3) or (5, 11)	**M1**
	$(r) = \sqrt{12^2 + 5^2}$ or $\sqrt{13^2 + 0} = 13$	**A1**
	Equation of circle is $(x-5)^2 + (y+2)^2 = 169$	**A1**
		5

Question	Answer	Marks
11(a)	$\dfrac{dy}{dx} = 3x^2 - 4bx + b^2$	B1
	$3x^2 - 4bx + b^2 = 0 \rightarrow (3x - b)(x - b)\ (= 0)$	M1
	$x = \dfrac{b}{3}$ or b	A1
	$a = \dfrac{b}{3} \rightarrow b = 3a$ **AG**	A1
	Alternative method for question 11(a)	
	$\dfrac{dy}{dx} = 3x^2 - 4bx + b^2$	B1
	Sub $b = 3a$ & obtain $\dfrac{dy}{dx} = 0$ when $x = a$ and when $x = 3a$	M1
	$\dfrac{d^2y}{dx^2} = 6x - 12a$	A1
	< 0 Max at $x = a$ and > 0 Min at $x = 3a$. Hence $b = 3a$ **AG**	A1
		4

Question	Answer	Marks
11(b)	Area under curve = $\int\left(x^3 - 6ax^2 + 9a^2x\right)\mathrm{d}x$	**M1**
	$\frac{x^4}{4} - 2ax^3 + \frac{9a^2x^2}{2}$	**B2,1,0**
	$\frac{a^4}{4} - 2a^4 + \frac{9a^4}{2}\ \left(= \frac{11a^4}{4}\right)$ (**M1** for applying limits $0 \to a$)	**M1**
	When $x = a,\ y = a^3 - 6a^3 + 9a^3 = 4a^3$	**B1**
	Area under line = $\frac{1}{2}a \times \textit{their}\ 4a^3$	**M1**
	Shaded area = $\frac{11a^4}{4} - 2a^4 = \frac{3}{4}a^4$	**A1**
		7