Question	Answer	Marks	Guidance
1	$6C2 \times (2x)^4 \times \dfrac{1}{(4x^2)^2}$	**B1**	SOI **SC:** Condone errors in $(4^{-1})^2$ evaluation or interpretation for B1 only
	$15 \times 2^4 \times \dfrac{1}{4^2}$	**B1**	Identified as required term.
	15	**B1**	
		3	

Question	Answer	Marks	Guidance
2	Attempt to solve $f'(x) = 0$ or $f'(x) > 0$ or $f'(x) \geqslant 0$	**M1**	SOI
	$(x-2)(x-4)$	**A1**	2 and 4 seen
	(Least possible value of n is) 4	**A1**	Accept $n = 4$ or $n \geqslant 4$
		3	

Question	Answer	Marks	Guidance
3	$\frac{\mathrm{d}y}{\mathrm{d}x}=6x^2-10x-3$	B1	
	At $x=2$, $\frac{\mathrm{d}y}{\mathrm{d}x}=24-20-3=1 \to a=1$	M1 A1	
	$6=2+b \to b=4$	B1FT	Substitute $x=2$, $y=6$ in $y=(\textit{their } a)x+b$
	$6=16-20-6+c \to c=16$	B1	Substitute $x=2$, $y=6$ into equation of curve
		5	

Question	Answer	Marks	Guidance
4(i)	Identifies common ratio as 1.1	B1	
	Use of $x(1.1)^{20}=20$	M1	SOI
	$x\left(=\frac{20}{(1.1)^{20}}\right)=3.0$	A1	Accept 2.97
		3	
4(ii)	$\textit{their}3.0\times\frac{\left[(1.1)^{21}-1\right]}{1.1-1}\to 192$	M1 A1	Correct formula used for M mark. Allow 2.97 used from **(i)** Accept 190 from $x=2.97\ldots$
		2	

Question	Answer	Marks	Guidance
5(i)	$4\tan x + 3\cos x + \frac{1}{\cos x} = 0 \rightarrow 4\sin x + 3\cos^2 x + 1 = 0$	**M1**	Multiply by $\cos x$ or common denominator of $\cos x$
	$4\sin x + 3\left(1 - \sin^2 x\right) + 1 = 0 \rightarrow 3\sin^2 x - 4\sin x - 4 = 0$	**M1**	Use $\cos^2 x = 1 - \sin^2 x$ and simplify to 3-term quadratic in $\sin x$
	$\sin x = -\frac{2}{3}$	**A1**	AG
		3	
5(ii)	$2x - 20° = 221.8°, 318.2°$	**M1A1**	Attempt to solve $\sin(2x - 20) = -2/3$ (M1). At least 1 correct (A1)
	$x = 120.9°, 169.1°$	**A1** **A1FT**	FT for 290° – other solution. **SC** A1 both answers in radians
		4	

Question	Answer	Marks	Guidance
6	Equation of line is $y = mx - 2$	B1	**OR**
	$x^2 - 2x + 7 = mx - 2 \rightarrow x^2 - x(2+m) + 9 = 0$	M1	
	Apply $b^2 - 4ac(=0) \rightarrow (2+m)^2 - 4 \times 9\ (=0)$	*M1	
	$m = 4$ or -8	A1	
	$m = 4 \rightarrow x^2 - 6x + 9 = 0 \rightarrow x = 3$ $m = -8 \rightarrow x^2 + 6x + 9 = 0 \rightarrow x = -3$	DM1	
	(3, 10), (–3, 22)	A1A1	
	Alternative method for question 6		
	$\frac{dy}{dx} = 2x - 2$	B1	
	$2x - 2 = m$	M1	
	$x^2 - 2x + 7 = (2x-2)x - 2 = 2x^2 - 2x - 2$	M1	
	$x^2 - 9 = 0 \rightarrow x = \pm 3$	A1	
	(3, 10), (–3, 22)	A1A1	
	When $x = 3$, $m = 4$; when $x = -3$, $m = -8$	A1	
		7	

Question	Answer	Marks	Guidance
7(i)	Range of f is $0 < \text{f}(x) < 3$	B1B1	OE. Range cannot be defined using x
	Range of g is $\text{g}(x) > 2$	B1	OE
		3	
7(ii)	$\left(\text{fg}(x) =\right)\dfrac{3}{2\left(\frac{1}{x}+2\right)+1} = \dfrac{3x}{2+5x}$	B1B1	Second B mark implies first B mark
		2	
7(iii)	$y = \dfrac{3x}{2+5x} \rightarrow 2y + 5xy = 3x \rightarrow 3x - 5xy = 2y$	M1	Correct order of operations
	$x(3-5y) = 2y \quad \rightarrow \quad x = \dfrac{2y}{3-5y}$	M1	Correct order of operations
	$\left((\text{fg})^{-1}(x)\right) = \dfrac{2x}{3-5x}$	A1	
		3	

Question	Answer	Marks	Guidance
8(i)	$OA \times \frac{3}{8}\pi = 6$	M1	
	$OA = \frac{16}{\pi} = 5.093(0)$	A1	
8(ii)	$AB = their5.0930 \times \tan\frac{3}{16}\pi$	M1	
	Perimeter $= 2 \times 3.4030 + 6 = 12.8$	A1	
8(iii)	Area $OABC = (2 \times ½) \times their5.0930 \times their3.4030$	M1	
	Area sector $= ½ \times (their5.0930)^2 \times \frac{3}{8}\pi$	M1	
	Shaded area $= their17.331 - their15.279 = 2.05$	M1A1	

Question	Answer	Marks	Guidance
9(i)	$y = [(5x-1)^{1/2} \div \frac{3}{2} \ \div 5]\ [-2x]$	B1 B1	
	$3 = \dfrac{27}{(3/2)\times 5} - 4 + c$	M1	Substitute $x = 2$, $y = 3$
	$c = 7 - \dfrac{18}{5} = \dfrac{17}{5} \rightarrow \left(y = \dfrac{2(5x-1)^{\frac{3}{2}}}{15} - 2x + \dfrac{17}{5} \right)$	A1	
9(ii)	$d^2y/dx^2 = \left[½(5x-1)^{-1/2}\right]\ [\times 5]$	B1 B1	
9(iii)	$(5x-1)^{1/2} - 2 = 0 \rightarrow 5x - 1 = 4$ $x = 1$	M1A1	Set $\dfrac{dy}{dx} = 0$ and attempt solution (M1)
	$y = \dfrac{16}{25} - 2 + \dfrac{17}{5} = \dfrac{37}{15}$	A1	Or 2.47 or $\left(1, \dfrac{37}{15}\right)$
	$\dfrac{d^2y}{dx^x} = \dfrac{5}{2} \times \dfrac{1}{2} = \dfrac{5}{4}$ (> 0) hence minimum	A1	OE

Question	Answer	Marks	Guidance
10(i)	**AB** $= \begin{pmatrix} 2 \\ -3 \\ 5 \end{pmatrix} - \begin{pmatrix} -1 \\ 3 \\ -4 \end{pmatrix} = \begin{pmatrix} 3 \\ -6 \\ 9 \end{pmatrix}$, **BC** $= \begin{pmatrix} 4 \\ -2 \\ 5 \end{pmatrix} - \begin{pmatrix} 2 \\ -3 \\ 5 \end{pmatrix} = \begin{pmatrix} 2 \\ 1 \\ 0 \end{pmatrix}$	**B1B1**	Condone reversal of labels
	AB.BC = 6 – 6 → = 0 (hence perpendicular)	**B1**	AG
10(ii)	**DC** $= \begin{pmatrix} 4 \\ -2 \\ 5 \end{pmatrix} - \begin{pmatrix} 2 \\ 2 \\ -1 \end{pmatrix} = \begin{pmatrix} 2 \\ -4 \\ 6 \end{pmatrix}$	**B1**	Or: **CD** $= \begin{pmatrix} -2 \\ 4 \\ -6 \end{pmatrix}$
	AB = k**DC**	**M1**	OE Expect $k = \frac{3}{2}$ Or: **DC.BC** = 4 – 4 = 0 hence BC is also perpendicular to DC Or: **AB.DC** = 1 or **AB.CD** = –1, angle between lines is 0 or 180
	AB is parallel to DC, hence $ABCD$ is a trapezium	**A1**	
10(iii)	$\lvert\mathbf{AB}\rvert = \sqrt{9+36+81} = \sqrt{126} = 11.22$ $\lvert\mathbf{DC}\rvert = \sqrt{4+16+36} = \sqrt{56} = 7.483$ $\lvert\mathbf{BC}\rvert = \sqrt{4+1+0} = \sqrt{5} = 2.236$	**M1**	Method for finding at least 2 magnitudes
	Area = $\frac{1}{2}\left(theirAB + theirDC\right) \times theirBC = 20.92$	**M1A1**	OE

Question	Answer	Marks	Guidance
11(i)	$(y =)\ (x+2)^2 - 1$	**B1** **DB1**	2nd B1 dependent on 2 in bracket
	$x + 2 = (\pm)(y+1)^{1/2}$	**M1**	
	$x = -2 + (y+1)^{1/2}$	**A1**	
11(ii)	$x^2 = 4 + (y+1) -/+ 4(y+1)^{\frac{1}{2}}$	***M1A1**	SOI. Attempt to find x^2 .The last term can be – or + at this stage
	$(\pi)\int x^2\,(\mathrm{d}y) = (\pi)\left[5y + \frac{y^2}{2} - \frac{4(y+1)^{\frac{3}{2}}}{\frac{3}{2}}\right]$	**A2,1,0**	
	$(\pi)\left[15 + \frac{9}{2} - \frac{64}{3} - \left(-5 + \frac{1}{2}\right)\right]$	**DM1**	Apply y limits
	$\frac{8\pi}{3}$ or 8.38	**A1**	