Q	Scheme	Marks	AOs	Pearson Progression Step and Progress Descriptor
1	States $V = \pi\int_0^2 y^2\ dx = \pi\int_0^2 x^4(2-x)\,\mathrm{d}x$, using the formula for volume of revoltuion about the y-axis.	M1	1.1b	TBC
	Correctly finds $\pi\left[\frac{2}{5}x^5 - \frac{1}{6}x^6\right]_0^2$	M1	1.1b	
	Makes an attempt to substitute the limits. For example: $\pi\left[\left(\frac{2}{5}(2)^5 - \frac{1}{6}(2)^6\right) - \left(\frac{2}{5}(0)^5 - \frac{1}{6}(0)^6\right)\right]$	M1	1.1b	
	Correctly finds $V = \frac{32}{15}\pi$. Accept $V = \frac{64}{30}\pi$	A1	1.1b	
		(4)		
(4 marks)				
Notes				

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress Descriptor
2	States $y^2 = \frac{3x^2}{2} - \frac{x}{2} + \frac{\sqrt{5}x}{2}$	M1	2.2a	TBC
	States $V = \pi\int_0^4 y^2 \, \mathrm{d}x = \pi\int_0^4 \frac{3x^2}{2} - \frac{x}{2} + \frac{\sqrt{5}x}{2} \, \mathrm{d}x$, using the formula for volume of revoltuion about the y-axis.	M1	1.1b	
	Correctly finds $\pi\left[\frac{1}{2}x^3 - \frac{1}{4}x + \frac{\sqrt{5}}{3}x^{\frac{3}{2}}\right]_0^4$	M1	1.1b	
	Makes an atempt to substitute the limits. For example: $\pi\left[\left(\frac{1}{2}(4)^3 - \frac{1}{4}(4) + \frac{\sqrt{5}}{3}(4)^{\frac{3}{2}}\right) - \left(\frac{1}{2}(0)^3 - \frac{1}{4}(0) + \frac{\sqrt{5}}{3}(0)^{\frac{3}{2}}\right)\right]$	M1	1.1b	
	Correctly finds $V = \left(\frac{90 + 8\sqrt{5}}{3}\right)\pi$	A1	1.1b	
		(5)		
				(5 marks)

Notes

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress Descriptor
3	Writes $y = 3x^2 - 24x + 48$ as $y = 3(x-4)^2$	**M1**	2.2a	TBC
	Correctly finds $x^2 = 16 + \frac{y}{3} - 8\sqrt{\frac{y}{3}}$	**M1**	3.1a	
	States $V = \pi\int_0^{12} x^2 \, dy = \pi\int_0^{12} 16 + \frac{y}{3} - \frac{8}{\sqrt{3}} y^{\frac{1}{2}} \, dy$, using the formula for volume of revolution about the x-axis.	**M1**	1.1b	
	Integrates to find $V = \pi\left[16y + \frac{y^2}{6} - \frac{16y^{\frac{3}{2}}}{3\sqrt{3}}\right]_0^{12}$	**M1**	1.1b	
	Makes an attempt to substitute: $\pi\left[\left(16(12) + \frac{(12)^2}{6} - \frac{16(12)^{\frac{3}{2}}}{3\sqrt{3}}\right) - \left(16(0) + \frac{(0)^2}{6} - \frac{16(0)^{\frac{3}{2}}}{3\sqrt{3}}\right)\right]$	**M1**	1.1b	
	Correctly finds $V = 88\pi$ cm^3.	**A1**	3.4	
		(6)		
				(6 marks)

Notes

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress Descriptor
4	States, or subsequently implies, that when $x = 9$, $y = \frac{1}{9}(9)^{\frac{3}{2}} = 3$	M1	2.2a	TBC.
	Uses the fact that $y = \frac{1}{9}x^{\frac{3}{2}}$ to write $x = (9)^{\frac{2}{3}}(y)^{\frac{2}{3}}$ or $x^2 = (9)^{\frac{4}{3}}(y)^{\frac{4}{3}}$	M1	2.2a	
	States $V = \pi\int_0^3 x^2\ \mathrm{d}y = \pi(9)^{\frac{4}{3}}\int_0^3 y^{\frac{4}{3}}\ \mathrm{d}y$, using the formula for volume of revoltuion about the *y*-axis.	M1	1.1b	
	Integrates to find: $V = \pi(9)^{\frac{4}{3}}\left[\frac{3}{7}y^{\frac{7}{3}}\right]_0^3$	M1	1.1b	
	Makes an attempt to substitute: $\pi(9)^{\frac{4}{3}}\left[\left(\frac{3}{7}(3)^{\frac{7}{3}}\right)-\left(\frac{3}{7}(0)^{\frac{7}{3}}\right)\right]$	M1	1.1b	
	Correctly finds $V = \frac{729}{7}\pi$	A1	1.1b	
	Finds the volume of the cone using $V = \frac{1}{3}\pi r^2 h = \frac{1}{3}\pi(6)^2(2) = 24\pi$	M1	2.2a	
	Subtracts to find: $V = \frac{729}{7}\pi - 24\pi = \frac{561}{7}\pi$	A1	3.4	
		(8)		
				(8 marks)

Notes

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress Descriptor
5	Uses the fact that $\frac{x^2}{16}+\frac{(y-10)^2}{64}=1$ to write $x^2=\frac{-y^2+20y-36}{4}$	M1	2.2a	TBC
	States $V=\pi\int_2^{10} x^2\ \mathrm{d}y=\frac{\pi}{4}\int_2^{10} -y^2+20y-36\ \mathrm{d}y$, using the formula for volume of revoltuion about the y-axis.	M1	1.1b	
	Integrates to find: $V=\frac{\pi}{4}\left[-\frac{1}{3}y^3+10y^2-36y\right]_2^{10}$	M1	1.1b	
	Makes an attempt to substitute: $V=\frac{\pi}{4}\left[\left(-\frac{1}{3}(10)^3+10(10)^2-36(10)\right)-\left(-\frac{1}{3}(2)^3+10(2)^2-36(2)\right)\right]$	M1	1.1b	
	Correctly finds $V=\frac{256}{3}\pi$	A1	1.1b	
	Finds the volume of the cylinder using $V=\pi r^2h=\pi(5)^2(10)=250\pi$	M1	2.2a	
	Subtracts to find $V=250\pi-\frac{256}{3}\pi=\frac{494}{3}\pi$	A1	3.4	
		(7)		
				(7 marks)

Notes

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress Descriptor
6a	States $\pi\int_{-1}^{1} x^2 \ \mathrm{d}y = \pi\int_{-1}^{1} y^8 + 2y^4 + 1 \ \mathrm{d}y$, using the formula for volume of revoltuion about the *y*-axis.	**M1**	1.1b	TBC
	Correctly finds $\pi\left[\frac{1}{9}y^9 + \frac{2}{5}y^5 + y\right]_{-1}^{1}$	**M1**	1.1b	
	Substitutes the limits and correctly finds $V = \frac{136}{45}\pi$	**A1**	3.4	
	States $\pi\int_{-1}^{1} x^2 \ \mathrm{d}y = \pi\int_{-1}^{1} y^8 - 6y^4 + 9 \ \mathrm{d}y$, using the formula for volume of revoltuion about the *y*-axis.	**M1**	1.1b	
	Correctly finds $\pi\left[\frac{1}{9}y^9 - \frac{6}{5}y^5 + 9y\right]_{-1}^{1}$	**M1**	1.1b	
	Substitutes the limits and correctly finds $V = \frac{712}{45}\pi$	**A1**	3.4	
	Subtracts to find $V = \frac{712}{45}\pi - \frac{136}{45}\pi = \frac{576}{45}\pi = \frac{64}{5}\pi$	**A1**	3.4	
		(7)		

6b	States or implies that the scale factor is 20	**M1**	3.1a	
	Finds the volume: $V=\frac{64}{5}\pi\times 20^3=102\,400\pi\text{ cm}^3$	**A1**	3.1a	
		(2)		
6c	Must use their values to approximate the percentage error: $\left(\frac{102\,400\pi-32\,000\pi^2}{32\,000\pi^2}\right)\times 100\approx 1.9\%$ and states that this is a reasonable estimate as it is less than 2% out or states that the actual capacity of the floatation device will be less than the model.	**B1**	3.5a	
		(1)		
(10 marks)				

Notes

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress Descriptor
7a	Uses the fact that $x-1=\frac{1}{4}(y-4)^2$ to write: $x^2=\left(\frac{1}{4}y^2-2y+5\right)\left(\frac{1}{4}y^2-2y+5\right)$, so $x^2=\frac{1}{16}y^4-y^3+\frac{13}{2}y^2-20y+25$	**M1**	2.2a	TBC
	States $V=\pi\int_2^6 x^2\ \mathrm{d}y=\pi\int_2^6 \frac{1}{16}y^4-y^3+\frac{13}{2}y^2-20y+25\ \mathrm{d}y$, using the formula for volume of revoltuion about the y-axis.	**M1**	1.1b	
	Correctly finds $V=\pi\left[\frac{1}{80}y^5-\frac{1}{4}y^4+\frac{13}{6}y^3-10y^2+25y\right]_2^6$	**M1**	1.1b	
	Substitutes the limits and correctly finds $V=\frac{106}{15}\pi$	**A1**	2.1	
		(4)		

7b	States $V = \int_{13}^{14} x^2 \text{ d}y = \int_{13}^{14} y - 13 \text{ d}y$, using the formula for volume of revoltuion about the *y*-axis.	**M1**	3.1a	
	Correctly finds $V = \pi\left[\frac{1}{2}y^2 - 13y\right]_{13}^{14}$	**M1**	1.1b	
	Substitutes the limits and correctly finds $V = \frac{1}{2}\pi$	**M1**	1.1b	
	States that the volume of each cylinder is $V = \pi(2)^2(2) = 8\pi$	**M1**	3.4	
	Finds the volume of the model: $V = 3(8\pi) + \frac{224}{15}\pi - \frac{\pi}{2} = \frac{1153}{30}\pi$	**A1**	3.4	
	Finds the volume of the actual candlestick: $V = \frac{1153}{30}\pi \times 2^3 = \frac{4612}{15}\pi$	**A1**	3.1a	
		(4)		
				(10 marks)

Notes