Question	Scheme	Marks	AOs
9(a)	$(4, 14),\ (1, 18) \Rightarrow 14 = a(4)^2 + b,\ 18 = a(1)^2 + b \Rightarrow a = ..., b = ...$	M1	3.3
	$a = -\frac{4}{15}, b = \frac{274}{15}$	A1	1.1b
		(2)	
(b)	$\pi \times 4^2 \times 14$ and $\pi \times 1^2 \times 10$	B1	1.1b
	$\pi \int x^2 \, dy = \frac{\pi}{4} \int (274 - 15y) \, dy$	B1ft	1.1a
	$= \frac{\pi}{4} \int_{14}^{18} (274 - 15y) \, dy$	M1	3.3
	$= \frac{\pi}{4} \left[274y - \frac{15y^2}{2} \right]_{14}^{18}$	M1 A1	1.1b 1.1b
	$V = 234\pi + \frac{\pi}{4} \left[274(18) - \frac{15(18)^2}{2} - \left(274(14) - \frac{15(14)^2}{2} \right) \right]$	ddM1	3.4
	$V = 268\pi \approx 842 \text{ cm}^3$	A1	2.2b
		(7)	
(c)	Any one of e.g. The measurements may not be accurate The equation of the curve may not be a suitable model The bottom of the bottle may not be flat The thickness of the glass may not have been considered The glass may not be smooth This part asks for a limitation of the model so their answer must refer to e.g. : • The measuring of the dimensions • The model used for the curve • The simplified model (the thickness of glass, the simplified shape, smoothness of the glass etc.)	B1	3.5b
		(1)	
(d)	There are 2 criteria for this mark: • A comparison of their value to 750 e.g. larger, smaller, about the same or a difference **<u>demonstrated</u>** e.g. 810 – 750 = … but not **<u>just</u>** a percentage error or **<u>just</u>** a difference with no calculation • A conclusion that is consistent with their values e.g. this is not a good model, this is a good model etc. If they reach an answer that is less than 750, they need to conclude that it is not a good model If they reach an answer that is greater than 750 then look for a sensible comment that is consistent with their value	B1ft	3.5a
		(1)	
			(11 marks)

Notes

(a)

M1: Chooses (4, 14) and (1, 18) and substitutes into the equation modelling the curve to obtain at least one correct equation and attempts to find the values of *a* and *b*.

A1: Infers from the data in the model, the values of *a* and *b*

(b)

B1: Correct expressions for the 2 cylindrical parts. May be seen as a sum or as separate cylinders.

B1ft: Uses the model to obtain $\pi\int\left(\frac{y-\text{their } b}{\text{their } a}\right)\mathrm{d}y$ (Note that the π may be recovered later)

M1: Chooses limits appropriate to the model i.e. 14 and 18

M1: Integrates to obtain an expression of the form $\alpha y+\beta y^2$

A1: Uses their model correctly to give $274y-\frac{15y^2}{2}$

ddM1: Uses the model to find the sum of their cylinders + their integrated volume. Must be a fully correct method here and is dependent on both previous method marks. So must have attempted the volumes of the cylinders "AHBG" and "CFED" and adds these to the magnitude of their integrated volume.

A1: 268π or awrt 842

(c)

B1: States an acceptable limitation of the model with no contradictory statements. (This is independent of part (b))

(d)

B1ft: Compares the actual volume to their answer to part (b) and makes an assessment of the model with a reason with no contradictory statements.