Question Number	Scheme	Marks
2	Achieves a lower limit of 2	B1
	Attempts $\alpha\int y^2\,\mathrm{d}x = \alpha\int \frac{81}{(2x-3)^{2.5}}\mathrm{d}x = \alpha\times\frac{-27}{(2x-3)^{1.5}}$	M1, A1
	Correct attempt at volume of solid generated **under** curve $= \pi\int_{"2"}^{6} y^2\,\mathrm{d}x = \left[\frac{k}{(2x-3)^{1.5}}\right]_{"2"}^{6} = \left(\left(-\frac{27}{27}\right)-\left(-\frac{27}{1}\right)\right)$	dM1
	$\text{Volume} = 26\pi$	A1
	Correct attempt at volume of solid $= \pi\times 9^2\times(6-"2")-"26\pi"$	ddM1
	$= 298\pi$	A1
		(7 marks)

B1: Finds the lower limit. This may be awarded anywhere. Accept on the diagram or in the limits of an integral

M1: Integrates an expression of the form $\int \frac{\ldots}{(2x-3)^{2.5}}\mathrm{d}x$ and achieves $\frac{\ldots}{(2x-3)^{1.5}}$ oe

A1: Correct integration of $\alpha\int y^2\,\mathrm{d}x = \alpha\int \frac{81}{(2x-3)^{2.5}}\mathrm{d}x$ giving a solution $\alpha\times\frac{-27}{(2x-3)^{1.5}}$ o.e.

following through on their α. Typical values of α will be 1, π or 2π. No need to simplify here

dM1: Attempts to find the volume of the solid generated by rotating the area under the curve.

Look for $\left[\frac{\ldots}{(2x-3)^{1.5}}\right]_{"2"}^{6} = \ldots$ It is dependent upon the previous M1.

The top limit must be 6 and the bottom limit must be their solution to $\frac{9}{(2x-3)^{1.25}} = 9$

A1: Correct exact volume for the solid generated by rotating the area under the curve. $\text{Volume} = 26\pi$

This may be the second part of a larger/complete expression. E.g. $\ldots. - 26\pi$

ddM1: Correct method for the volume of the solid formed by rotating the area above the curve.

Accept $\pi\times 9^2\times(6-"2")-"26\pi"$

It is dependent both previous M's

A1: 298π

Question Number	Scheme	Marks
3 (a)	Attempts to find $\frac{\frac{1}{3}\times 20^2\times 24}{160}=20$ seconds	M1 A1 **(2)**
(b)	Attempts $\frac{\mathrm{d}V}{\mathrm{d}h}=h^2+\frac{8}{3}h$	M1
	Attempts to use $\frac{\mathrm{d}V}{\mathrm{d}t}=\frac{\mathrm{d}V}{\mathrm{d}h}\times\frac{\mathrm{d}h}{\mathrm{d}t}\Rightarrow 160=\left(h^2+\frac{8}{3}h\right)\times\frac{\mathrm{d}h}{\mathrm{d}t}$	M1 A1
	Substitutes $h=5\Rightarrow 160=\left(5^2+\frac{40}{3}\right)\times\frac{\mathrm{d}h}{\mathrm{d}t}\Rightarrow\frac{\mathrm{d}h}{\mathrm{d}t}=\frac{96}{23}$ (4.2) cm s $^{-1}$	dM1 A1 **(5)**
		(7 marks)

(a)

M1: Attempts to find the volume, using the given formula, at $h=20$ and dividing by 160. Implied by 20
Condone slips. For example they may have incorrectly multiplied out/calculated the expression for V

A1: 20 seconds. This requires the correct units as well

(b)

M1: For an attempt to differentiate V

Scored for an attempt to multiply out and then differentiate term by term to achieve $\frac{\mathrm{d}V}{\mathrm{d}h}=\alpha h^2+\beta h$

or via the product rule to achieve $V=\frac{1}{3}h^2(h+4)\Rightarrow\frac{\mathrm{d}V}{\mathrm{d}h}=(h+4)\times ph+qh^2$

M1: Attempts to use $\frac{\mathrm{d}V}{\mathrm{d}t}=\frac{\mathrm{d}V}{\mathrm{d}h}\times\frac{\mathrm{d}h}{\mathrm{d}t}$ (or equivalent) with $\frac{\mathrm{d}V}{\mathrm{d}t}=160$ and their $\frac{\mathrm{d}V}{\mathrm{d}h}$.

A1: Correct expression involving $\frac{\mathrm{d}h}{\mathrm{d}t}$ and h E.g. $160=\left(h^2+\frac{8}{3}h\right)\times\frac{\mathrm{d}h}{\mathrm{d}t}$

dM1: Dependent upon the previous M only. It is for substituting $h=5$ and proceeding to a value for $\frac{\mathrm{d}h}{\mathrm{d}t}=...$

A1: Either $\frac{96}{23}$ or awrt 4.2 cm s $^{-1}$ There is no requirement for the units here