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

Question	Scheme	Marks
4.	$\int_1^4 \frac{10}{5x+2x\sqrt{x}}\,\mathrm{d}x$	
	$u=\sqrt{x} \Rightarrow x=u^2 \Rightarrow \frac{\mathrm{d}x}{\mathrm{d}u}=2u$	B1
	$\int \frac{10}{5x+2x\sqrt{x}}\,\mathrm{d}x = \int \frac{10}{5u^2+2u^3}2u\mathrm{d}u$	M1 A1
	$= \int \frac{20}{5u+2u^2}\mathrm{d}u = \int \frac{4}{u}-\frac{8}{5+2u}\mathrm{d}u$	dM1 A1
	$= 4\ln u - 4\ln(5+2u)$	ddM1
	$\text{Limits} = \left[4\ln u - 4\ln(5+2u)\right]_1^2 = 4\ln 2 - 4\ln 9 + 4\ln 7 = \ldots$	M1
	$= 4\ln\left(\frac{14}{9}\right)$	A1 **(8 marks)**

B1: For $\frac{\mathrm{d}x}{\mathrm{d}u}=2u$ or $\frac{\mathrm{d}u}{\mathrm{d}x}=\frac{1}{2}x^{-\frac{1}{2}}$ or equivalent

M1: Attempts to write all terms in the integral in terms of u (inc the dx)

Condone slips for this mark BUT the dx CANNOT just be replaced by du.

Look for either $x \to u^2$ or $x\sqrt{x} \to u^3$ with either $\mathrm{d}x \to \mathrm{f}(u)\mathrm{d}u$ or $\mathrm{d}x \to k \times \mathrm{d}u, k \neq 1$

A1: Correct integrand in terms of just u which may be unsimplified. E.g $\int \frac{10}{5u^2+2u^3}2u\mathrm{d}u$

dM1: Attempts to use PF and writes their integrand in terms of its component fractions.

Look for an integral of the form $\int \frac{P}{Qu+Ru^2}\mathrm{d}u \to \int \frac{p}{u}+\frac{q}{Q+Ru}\mathrm{d}u$

A1: Correct PF $\int \frac{4}{u}-\frac{8}{5+2u}(\mathrm{d}u)$

ddM1: For $\ldots\ln u \pm \ldots\ln(5+2u)$ but follow through on their PF's which must be of a similar form

M1: Uses the limits 1 and 2 within their attempted integral. The integration may be incorrect.

Alternatively substitutes $u=\sqrt{x}$ and uses the limits 1 and 4 within their attempted integral

A1: $4\ln\left(\frac{14}{9}\right)$