Question Number	Scheme	Marks
4. (a)	Attempts to find the time = $\left(\frac{1}{3}\times 21^2\sqrt{(21+4)}\right)\div 30$	M1
	Time = $\frac{735}{30}=24.5$ seconds	A1
		(2)
(b)	$V=\frac{1}{3}h^2\sqrt{(h+4)}\Rightarrow\frac{\mathrm{d}V}{\mathrm{d}h}=\frac{2h}{3}\times\sqrt{(h+4)}+\frac{1}{6}h^2(h+4)^{-\frac{1}{2}}$	M1, A1
	States or uses $\frac{\mathrm{d}V}{\mathrm{d}t}=30$	B1
	Uses $30=\frac{\mathrm{d}V}{\mathrm{d}h}\times\frac{\mathrm{d}h}{dt}$ with $h=5\Rightarrow\frac{\mathrm{d}h}{\mathrm{d}t}=\frac{108}{41}\,\mathrm{cms}^{-1}$	M1, A1
		(5)
		(7 marks)

(a)

M1: Attempts to find the time = $\left(\frac{1}{3}\times 21^2\sqrt{(21+4)}\right)\div 30$ condoning slips when substituting $h=21$ into the formula. E.g. condone slips where the 21^2 appears as 21

A1: Reaches a time of 24.5 seconds (including units). Allow variations like $\frac{49}{2}$ s or 24.5 sec.

(b)

M1: Attempts to differentiate using the product rule achieving a correct form.

Look for $\frac{\mathrm{d}V}{\mathrm{d}h}=Ah\sqrt{(h+4)}+Bh^2(h+4)^{-\frac{1}{2}}\quad A,B>0$

A1: Correct $\frac{\mathrm{d}V}{\mathrm{d}h}$ which may be left unsimplified

B1: States or uses $\frac{\mathrm{d}V}{\mathrm{d}t}=30$ which may be awarded from anywhere within the solution and even in the body of the question. Note that using 30 in part (a) does not score this unless you see the lhs

M1: Uses $\frac{\mathrm{d}V}{\mathrm{d}t}=\frac{\mathrm{d}V}{\mathrm{d}h}\times\frac{\mathrm{d}h}{dt}$ with $\frac{\mathrm{d}V}{\mathrm{d}t}=30$ and $\frac{\mathrm{d}V}{\mathrm{d}h}$ with $h=5$ to find $\frac{\mathrm{d}h}{\mathrm{d}t}$. A correct $\left.\frac{\mathrm{d}V}{\mathrm{d}h}\right|_{h=5}$ is $\frac{205}{18}$

There must have been some attempt at differentiation to find $\frac{\mathrm{d}V}{\mathrm{d}h}$ but the form is not important and the M1 does not need to have been scored. If the attempt to find $\frac{\mathrm{d}h}{\mathrm{d}t}$

is via $\frac{\mathrm{d}V}{\mathrm{d}t} \times \frac{\mathrm{d}h}{\mathrm{d}V}$ DON'T allow attempts at the reciprocal like the following

$$\frac{\mathrm{d}h}{\mathrm{d}V} = \frac{1}{Ah\sqrt{(h+4)}} + \frac{1}{Bh^2(h+4)^{-\frac{1}{2}}}$$

A1: $\frac{108}{41}$ o.e. such as $\frac{540}{205}$ but isw after a correct answer seen.

Note that the exact answer is required so 2.63 scores A0 unless $\frac{108}{41}$ is seen first

Question Number	Scheme	Marks
5 (a)	Attempts $\begin{pmatrix}2\\3\\-2\end{pmatrix}\bullet\begin{pmatrix}6\\-2\\-8\end{pmatrix}=2\times6+3\times-2+-2\times-8$	M1
	Attempts $\begin{pmatrix}2\\3\\-2\end{pmatrix}\bullet\begin{pmatrix}6\\-2\\-8\end{pmatrix}=\begin{vmatrix}2\\3\\-2\end{vmatrix}\begin{vmatrix}6\\-2\\-8\end{vmatrix}\cos(BAC)\Rightarrow 22=\sqrt{17}\times\sqrt{104}\times\cos(BAC)\Rightarrow\cos(BAC)=\frac{22}{\sqrt{17}\sqrt{104}}$	dM1
	angle $BAC=58.5°$	A1
		(3)
(b)	Area triangle $ABC=\frac{1}{2}\times\sqrt{17}\times\sqrt{104}\sin58.5°=17.9$	M1, A1
		(2)
(c)	Attempts $\pm\overrightarrow{DC}=\begin{pmatrix}6-2\lambda\\-2-3\lambda\\-8+2\lambda\end{pmatrix}$ with any constant λ	M1, A1
	Attempts $\begin{pmatrix}2\\3\\-2\end{pmatrix}\bullet\begin{pmatrix}6-2\lambda\\-2-3\lambda\\-8+2\lambda\end{pmatrix}=0\Rightarrow\lambda=\frac{22}{17}$	dM1
	$\overrightarrow{AD}=\frac{44}{17}\mathbf{i}+\frac{66}{17}\mathbf{j}-\frac{44}{17}\mathbf{k}$ o.e. $\frac{22}{17}\left(2\,\mathbf{i}+3\,\mathbf{j}-2\mathbf{k}\right)$	A1
		(4)
		(9 marks)

(a)

M1: Attempts the scalar product of $\pm\overrightarrow{AB}\bullet\pm\overrightarrow{AC}$.

Condone slips, e.g. in sign, but the intention must be clear.

If the calculation is not seen in full, expect to see 2 out of 3 of $\left(\pm12\right)+\left(\pm6\right)+\left(\pm16\right)$

If no intermediary calculation is seen it must be correct, so look for ±22

dM1: Full method to find $\cos(BAC)$ or BAC. It is dependent upon the previous M.

If the calculations for the modulus are not written out, at least one must be correct

A1: Angle $BAC=$ awrt $58.5°$. Note that $BAC=$ awrt $121.5°$ will be A0

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Alternatives exist, for example using the cosine rule