

Question number	Scheme	Marks
3	$\left(\frac{dV}{dt} = 27 \right)$ $r = \frac{3h}{2}$ $V = \frac{1}{3}\pi r^2 h \Rightarrow V = \frac{3}{4}\pi h^3$ $\frac{dV}{dh} = \frac{9}{4}\pi h^2$ $\frac{dh}{dt} = \frac{dV}{dt} \times \frac{dh}{dV}$ $\frac{dh}{dt} = 27 \times \frac{4}{9\pi h^2} = 27 \times \frac{4}{9\pi 4^2} = 0.23873... \quad \frac{dh}{dt} = 0.239$	<p>B1</p> <p>M1A1</p> <p>M1</p> <p>M1dd A1</p> <p>[6]</p>

Additional Notes	
Mark	Guidance
B1	For using the given $r = 1.5h$ to find the correct expression for the volume in terms of h only. Need not be simplified. Accept $V = \frac{1}{3}\pi\left(\frac{3h}{2}\right)^2 h$ or $V = \frac{1}{3}\pi \times \frac{9h^2}{4} \times h$ sc You may see $27 = \frac{3}{4}\pi h^3$ Award B1 here if this is later differentiated and used correctly.
M1	For attempting to differentiate their V provided it is in terms of h only. Must be a dimensionally correct V . See general guidance for the definition of an attempt.
A1	For the correct derivative $\frac{dV}{dh} = \frac{9}{4}\pi h^2$
M1	For a correct expression of chain rule. Accept any correct equivalent. Eg., $\frac{dV}{dt} = \frac{dV}{dh} \times \frac{dh}{dt}$ oe Please check this carefully. Chain rule may not be explicitly stated, but may be implied from correct work.
M1dd	For substituting $h = 4$ and $\frac{dV}{dt} = 27$ into their expression of chain rule. It must be correct, but not necessarily with $\frac{dh}{dt}$ as the subject Note: this mark is dependent on BOTH previous Method marks scored.
A1	For $\frac{dh}{dt} = 0.239$ rounded correctly.
ALT	
B1	For using the given $r = 1.5h$ to find the correct expression for the volume in terms of h only.
M1	For attempting to differentiate their V wrt to t provided V is in terms of h only. Must be a dimensionally correct V . $\frac{dV}{dt} = \frac{9}{4}\pi h^2 \frac{dh}{dt}$
A1	For a correct expression for $\frac{dV}{dt}$ in terms of h and $\frac{dh}{dt}$
M1	For re-arranging their $\frac{dV}{dt} = \frac{9}{4}\pi h^2 \frac{dh}{dt}$ to $\frac{dh}{dt} = \frac{4}{9\pi h^2} \times \frac{dV}{dt}$ Please check their re-arrangement, it must be correct for this mark.
M1dd	For substituting $h = 4$ and $\frac{dV}{dt} = 27$ into their $\frac{dh}{dt}$ Note: This M mark and the previous M mark may be in either order.
A1	For $\frac{dh}{dt} = 0.239$ rounded correctly.