1. Water is being poured into a cone of height h cm and base radius r cm. The height of the cone is twice the radius of the base. The height of the water is increasing at a rate of $\frac{1}{3}$ cm/min. Find the rate at which the water is being poured, in cm³/min, when the height is 6 cm. (5 marks)

Mark scheme:

$$V = \frac{1}{3}\pi r^2 h$$

Given: $h = 2r$

$r = \frac{1}{2}h$

$V = \frac{1}{3}\pi\left(\frac{1}{2}h\right)^2 h$

$V = \frac{1}{12}\pi h^3$ (M1)

$\frac{dv}{dt} = \frac{1}{4}\pi h^2 \frac{dh}{dt}$ (A1)

$\frac{dv}{dt} = \frac{1}{4}\pi(6)^2\left(\frac{1}{3}\right)$ (M1)(A1)

$\frac{dv}{dt} = \frac{1}{4}\pi(36)\left(\frac{1}{3}\right)$

$\frac{dv}{dt} = 3\pi$ cm³/min (A1)