**MA131 Fall 2013 Section 06 Quiz 6 Hint**

**1. Solve the following problem.**

Water is leaking out of an inverted conical tank at a rate of 11,500 $cm^3/min$ at the same time that water is being pumped into the tank at a constant rate. The tank has height 6 m and the diameter at the top is 4 m. If the water level is rising at a rate of 20 cm/min when the height of the water is 2 m, find the rate at which water is being pumped into the tank. (Round your answer to the nearest integer.)

Hint:

We know that $V_{cone} = \frac{1}{3}\pi r^2 h$. Thus $\frac{dV}{dt} = \frac{\pi}{3}\frac{d(r^2h)}{dt} = \frac{\pi}{3}(2rh\frac{dh}{dt} + r^2\frac{dr}{dt})$ with product rule.

In a cone, r is proportional to h, which means $r = \alpha h$. From $h = 6m$ and $r = 2m$, we can calculate $\alpha = \frac{1}{3}$. Thus $r = \frac{1}{3}h$, and $\frac{dr}{dt} = \frac{1}{3}\frac{dh}{dt}$.

Thus $\frac{dV}{dt}$ can be written as $\frac{\pi}{3}(\frac{2h^2}{3}\frac{dh}{dt} + \frac{h^2}{9}\frac{dh}{dt})$.

From the question, $h$ is known here to be 2m and $\frac{dh}{dt}$ is known to be 20cm/min and we can calculate $\frac{dV}{dt}$.

We also notice that $\frac{dV}{dt} = VolumeChange_{in} - VolumeChange_{out}$, where $VolumeChange_{out}$ is a known number of 11,500 $cm^3/min$. It will be easy to calculate the volume out speed.