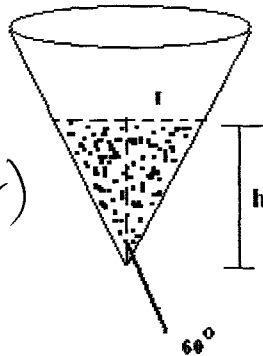


Calculus Worksheet: Rate of Change (1)

Water is poured at the rate of 0.01 liter/second into the conical container shown below. Assume the container is empty at the start of the experiment ($t = 0$), find the rate of change of h the height of the water in the container at $t = 3$ seconds.

Note: 1 liter = 1 (dm)³
all length will be
in dm. (decimeter)



Water poured at rate of 0.01 L/s \Rightarrow Volume V of water is given by.

$$V = 0.01 \cdot t$$

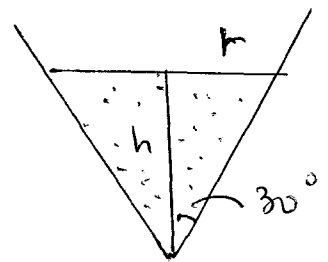
V in liters, t in seconds

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

$$\tan 30^\circ = r/h \Rightarrow r = h \tan 30^\circ$$

$$\Rightarrow V = \frac{1}{3} \pi (h \tan 30^\circ)^2 \cdot h = 0.01 t$$

$$\Rightarrow h^3 \frac{\pi \tan^2 30^\circ}{3} = 0.01 t$$



Solve for h .

$$h = \sqrt[3]{\frac{0.03 t}{\pi \tan^2(30^\circ)}} = \left(\frac{0.03}{\pi \tan^2 30^\circ}\right)^{\frac{1}{3}} t^{\frac{1}{3}}$$

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$$\frac{dh}{dt} = \frac{1}{3} \left(\frac{0.03}{\pi \tan^2 30^\circ}\right)^{\frac{1}{3}} t^{-2/3}$$

at $t = 3$ sec $\frac{dh}{dt} = 0.05$ dm/sec.