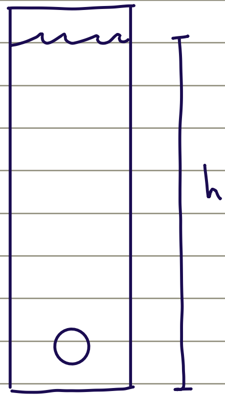


Incompressible fluid

$$A_1 v_1 = A_2 v_2$$

$$A_1 \frac{dh}{dt} = -A_2 \sqrt{2gh}$$

$$\frac{dh}{dt} = \frac{-A_2}{A_1} \sqrt{2g}\,\sqrt{h}$$

$$k = \frac{A_2}{A_1}\sqrt{2g}$$

$$\frac{dh}{dt} = -k\sqrt{h}$$

$$\int \frac{1}{\sqrt{h}}\,dh = -\int_0 k\,dt$$

$$2\sqrt{h} = -kt + c_1$$

$$\sqrt{h} = \frac{-kt}{2} + c$$

$$h(t) = \left(\frac{-kt}{2} + c\right)^2$$

$$h(0) = h_0 = c^2 \quad , \quad c = \sqrt{h_0}$$

$$h(t) = \left(\frac{-kt}{2} + \sqrt{h_0}\right)^2$$

$$mgh = \frac{1}{2}mv_1^2 + \frac{1}{2}mv_2^2$$

v_1 = velocity of water at the top

v_2 = velocity of water coming out of hole

$$v_2 >> v_1$$

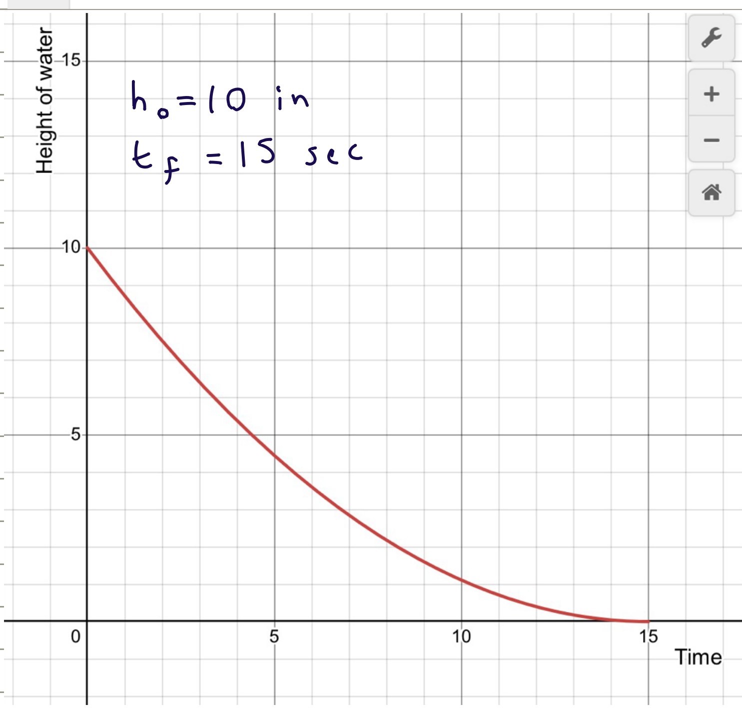
$$mgh \approx \frac{1}{2}mv_2^2$$

$$gh = \frac{1}{2}v_2^2$$

$$v_2 = \sqrt{2gh}$$

RATE OF CHANGE OF VOLUME $\propto \sqrt{h}$

$$h = \left(\frac{(-\sqrt{10}\,t)}{15} + \sqrt{10}\right)^2 \{0 < t < 15\}$$



k can be determined experimentally by measuring time to empty the tank, t_f

$$h(t_f) = 0 = \left(\frac{-kt_f}{2} + \sqrt{h_0}\right)^2$$

$$\frac{-kt_f}{2} + \sqrt{h_0} = 0$$

$$k = \frac{2\sqrt{h_0}}{t_f}$$

$$h(t) = \left(\frac{-\sqrt{h_0}\,t}{t_f} + \sqrt{h_0}\right)^2$$