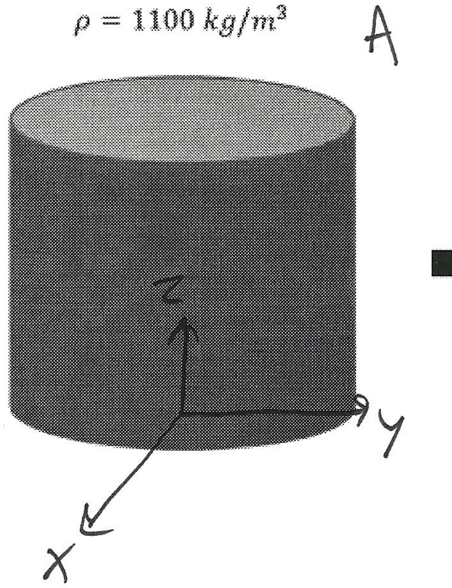
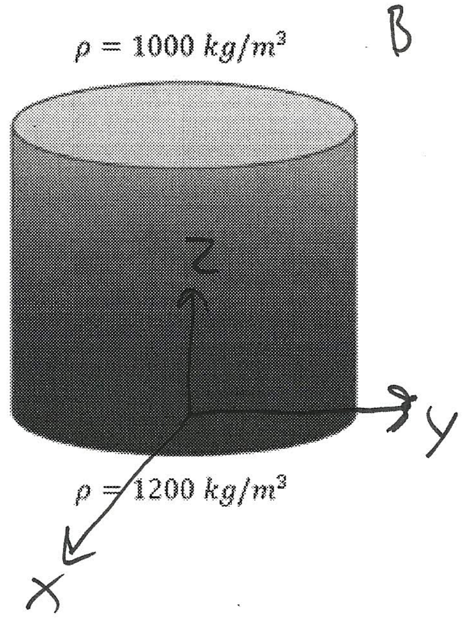
A water and ceramic slurry with a uniform density of 1100 kilograms per meter cubed enters a settling tank with a height of one meter and a diameter of one meter. After one hour in the tank, the density of the slurry at the top of the tank is measured to be 1000 kilograms per meter cubed and the density at the bottom of the tank is measured to be 1200 kilograms per meter cubed. Assume the density of the slurry varies linearly between the top and the bottom. How far has the center of mass of the slurry dropped between the initial conditions and the current state?





$\rho = 1100$

$\rho = 1200 - 200z$

$$m = \left(1100\ kg/m^3\right)(V)$$

$V = \pi(.5)^2(1)$

$$m = 864.9\ kg$$

A

$$\bar{z} = \frac{\int_0^1 (\rho)(dV)(z)}{m}$$

$$\bar{z} = \frac{\int_0^1 (1100)(\pi(.5)^2)(z)}{864.9}$$

$$\bar{z} = \frac{(1100)(\pi(.5)^2)}{864.9} \int_0^1 (z)$$

$$(1) \Big|_0^1 \tfrac{1}{2}z^2$$

$$(1)\left(\tfrac{1}{2}(1)^2 - \tfrac{1}{2}(0)^2\right)$$

$$\underline{\bar{z} = \tfrac{1}{2} = .5\text{m}}$$

B

$$\bar{z} = \frac{\int_0^1 (\rho)(dV)(z)}{m}$$

$$\bar{z} = \frac{\int_0^1 (1200-200z)(\pi(.5)^2)(z)}{864.9}$$

$$\bar{z} = \frac{\pi(.5)^2}{864.9} \int_0^1 1200z - 200z^2$$

$$\left(\frac{1}{1100}\right) \Big|_0^1 600z^2 - \frac{200}{3}z^3$$

$$\frac{1}{1100}\left(600(1)^2 - \frac{200}{3}(1)^3 - (0-0)\right)$$

$$\underline{\bar{z} = .485\text{m}}$$

$$\boxed{\text{the center of mass drops } .015\text{ m}}$$