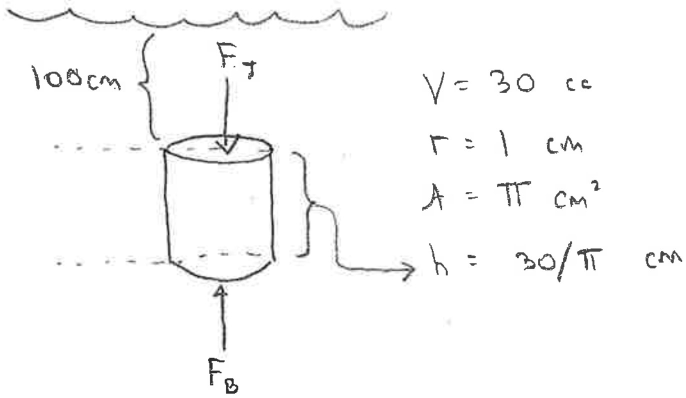
ASGv2 EX 15.1 (Hydrostatic pressure & buoyancy)

Volume of gold = 30 cc. Assume $g = 1000\ cm/s^2$



a)
- The force acting on the top is pressure × area, where pressure is $P = \frac{W}{A} = \frac{\text{density} \times \text{volume} \times g}{\text{area}} = \frac{\rho A y g}{A} = \rho g y$
- This is the pressure at depth y below the surface of a fluid of density ρ.
- $F_T = \rho g y_T A = (1\ g/cc)(1000\ \frac{cm}{s^2})(100\ cm)(\pi\ cm^2)$

  $= \pi \times 10^5\ g\,cm/sec = \pi \times 10^5$ dynes $= \boxed{3.1416N}$

  $F_B = \rho g y_B A = (1\ g/cc)(1000\ cm/s^2)(100\ cm + \frac{30}{\pi} cm)(\pi\ cm^2)$

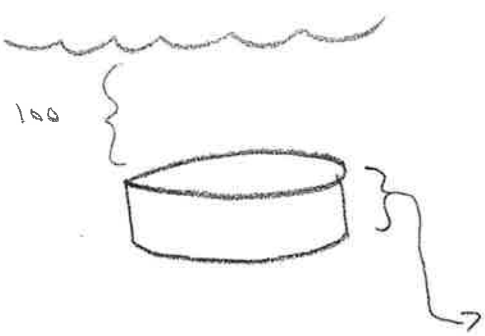
  $= \boxed{3.4416\ N}$
- The net force is $F_B - F_T = \boxed{0.3N \text{ upwards}}$

b) If it is submerge 2 meters, rather than one,

$$F_{Net} = F_B - F_T = \rho g y_B A - \rho g y_T A = \rho g A (y_B - y_T)$$

This depends <u>not</u> on the depth, but only on the factors $y_B - y_T$ and A. So the $\boxed{\text{net force is unchanged}}$

c) What if



$V = 30$

$r = 10\ cm$

$A = 100\pi\ cm^2$

$h = \frac{30}{100\pi}\ cm$

$$F_T = \rho g y_T A = (1\ g/cc)(1000\ cm/s^2)(100\ cm)(100\pi\ cm^2) =$$

$$= \pi \times 10^7\ \text{dynes} = \boxed{314.16\ N}$$

$$F_B = \rho g y_B A = (1\ g/cc)(1000\ cm/s^2)\left(100\ cm + \frac{30}{100\pi}\ cm\right)(100\pi\ cm^2)$$

$$= \boxed{314.46\ N}$$

Net force is $F_B - F_T = \boxed{0.3\ N}$

d) The net force is the same, whether the cylinder is tall or flat. This is consistent with ...

Archimedes principle, which says the buoyant force is

$$B = \rho g V = (1\ g/cc)(1000\ cm/s^2)(30\ cc) = \boxed{0.3\ N}$$