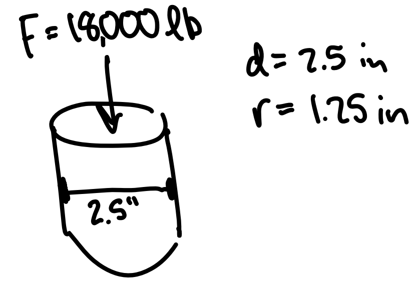
HW 1.1

Group 2: Sanchez, Perkins, Ashley, Wells, Watts

1.48 A coining press is used to produce commemorative coins with the likenesses of all the U.S. presidents. The coining process requires a force of 18 000 lb. The hydraulic cylinder has a diameter of 2.50 in. Compute the required oil pressure.

$P = F/A$ where $A = \pi(1.25'')^2 = 4.909\text{ in}^2$

$\rightarrow P = \dfrac{18{,}000\text{ lb}}{4.909\text{ in}^2} = $ **3666.93 psi**



1.58 Compute the pressure change required to cause a decrease in the volume of mercury by 1.00 percent. Express the result in both psi and MPa.

$E = \dfrac{-P}{\left(\frac{\Delta V}{V}\right)}$

* $E_{merc} = 3{,}590{,}000\text{ psi} \approx 24{,}750\text{ MPa}$

$\rightarrow P = -E\left(\frac{\Delta V}{V}\right) \rightarrow P = -3{,}590{,}000\text{ psi}(-0.01) = $ **35,900 psi**

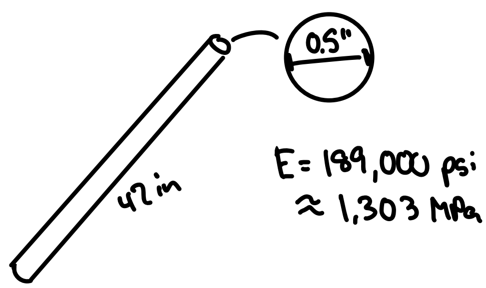
$\rightarrow P = -24{,}750\text{ MPa}(-0.01) = $ **247.5 MPa**

1.63 A measure of the stiffness of a linear actuator system is the amount of force required to cause a certain linear deflection. For an actuator that has an inside diameter of 0.50 in and a length of 42.0 in and that is filled with machine oil, compute the stiffness in lb/in.

$A = \frac{\pi}{4}(0.5\text{ in})^2 = 0.196\text{ in}^2$

$V = (0.196\text{ in}^2)(42\text{ in}) = 8.232\text{ in}^3$

$k = \dfrac{A^2 E}{LV} = \dfrac{(0.196)^2(189{,}000)}{(42)(8.232)} = $ **21**



1.76 In the United States, hamburger and other meats are sold by the pound. Assuming that this is 1.00-lb force, compute the mass in slugs, the mass in kg, and the weight in N.

$1\text{ lbf} = $ **4.44N**

$\dfrac{1\text{ slug}}{32.174\text{ lbm}}(1\text{ lbm}) = $ **0.0311 slug**

$\dfrac{1\text{ kg}}{2.209\text{ lbm}}(1\text{ lbm}) = $ **0.454 kg**

1.92 A cylindrical container is 150 mm in diameter and weighs 2.25 N when empty. When filled to a depth of 200 mm with a certain weighs 35.4 N. Calculate the specific gravity of the oil.

$d = 150\,mm$

$r = 75\,mm = 0.075\,m$

$A = \pi(0.075\,m)^2 = 0.0177\,m^2$

$V = (0.2\,m)(0.0177\,m^2) = 0.0035\,m^3$

$W_{net} = 33.15\,N$

$$\gamma_{oil} = \frac{W_{net}}{V} = \frac{33.15\,N}{0.0035\,m^3} = 9379.53\,N/m^3$$

$\gamma_{water} = 9810\,N/m^3$

$$\Longrightarrow s.g. = \frac{\gamma_{oil}}{\gamma_{water}} = \frac{9379.53\,N/m^3}{9810\,N/m} = 0.956$$

$s.g._{oil} = 0.956$

1.107 Alcohol has a specific gravity of 0.79. Calculate its density both in $\mathrm{slugs/ft^3}$ and $\mathrm{g/cm^3}$.

$$s.g. = 0.79 = \frac{\rho_{alc}}{\rho_{H_2O}}$$

$$\rightarrow \rho_{alc} = (0.79)(1000\,kg/m)^3 = 790\,kg/m^3$$

$$790\,\frac{kg}{m^3}\left(\frac{1000g}{1kg}\right)\left(\frac{1m}{100cm}\right)^3 = 0.79\,g/cm^3$$

$$790\,\frac{kg}{m^3}\left(\frac{1\,slug}{145,939\,kg}\right)\left(\frac{1m}{3.28084\,ft}\right)^3 = 1.533\,slug/ft^3$$