Colby C. Bohanan
Fluid Mech
HW1.1

Ch: 1
48, 58, 63, 76, 92, 107

Ch: 2
17, 18, 27, 35, 61

48) A coin press requires 18,000 lb force
Diameter a 

$a = 2.50\,in$

$2.50\,in / 2 = r$

$A = \pi r^2$

$= \pi\, 1.25_{in}^2$

$= \pi\, 1.5625\,in^2$

$A = 4.908\,in^2$

$P = F/A$

$$P = \frac{18{,}000\ lb \cdot force}{4.908\ in^2}$$

$$\boxed{P = 3667.48\ psi}$$

58) Compute pressure Δ

$=$ volume $-\Delta$ (mercury 1.00 %)

$P = F/A$

$P_1 \quad P_2$

$(P_2 - P_1) = \Delta_p$

$(V_2 - V_1) = \Delta_v$

$$E = \frac{-\Delta p}{(\Delta V)/V}$$

CamScanner

MET 330
HW1

58) Compute pressure Δ required to achieve a -Δ in mercury of 1.00%

$$E = \frac{-\Delta p}{(\Delta V/V)}$$

$$\Delta p = \frac{-E}{\Delta V/V}$$

$$\Delta p = \frac{\cancel{-}\,3590000 \text{ psi}}{\cancel{-}\,0.01} = \frac{-24750 \text{ MPa}}{-0.01}$$

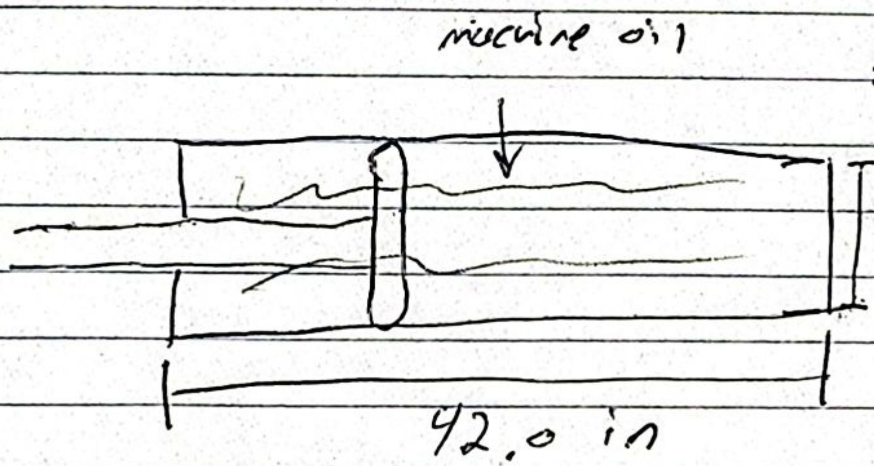
$$\Delta p = 3.59 \times 10^{8} \text{ psi}$$

$$\boxed{\begin{aligned}\Delta p &= 359{,}000{,}000 \text{ psi} \\ \Delta p &= 2{,}475{,}000 \text{ MPa}\end{aligned}}$$

Bulk Modulus

Colby C. Burnam
HW 1.1

(3) 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.



stiffness = linear deflection

also written as

Determine amount of force required to deflect $\boxed{1{,}890\ psi}$

- Bulk modulus for machine oil 189,000 psi

- Determine the amount of psi to cause a change in volume.

$$\Delta P = -E[\Delta V/V] = [-189{,}000_{psi}][-0.01] = [1{,}890$$

Colby Bertram

HW1.1 Chil ~~R~~ef Pg. 5

#7(a) In the United States, hamburger is sold by the pound. Assuming that this is a 1.00-lb force, compute the mass in slugs, the mass in kg, and the weight in N.

Assume - 1.00-lb·force $\times \dfrac{1}{\boxed{4.448\,N}}$

1 ~~lbf~~ Conversion constant $g_c = \dfrac{32.2\,lbm}{lbf/(ft/s^2)}$

$$\frac{32.2\,lbm\text{-}ft/s^2}{lbf}$$

$F = m(a/g_c)$

$F = m(g/g_c)$

$$W = F = m\frac{g}{g_c} = 1\,lbm \; \frac{32.2\,ft/s^2}{\dfrac{32.2\,lbm\text{-}ft/s^2}{lbf}} = \boxed{1\,lbf}$$

1 lbf → 0.453 kg

1 lbf → 0.031 s...

1 lbm = 0.45359237 kg

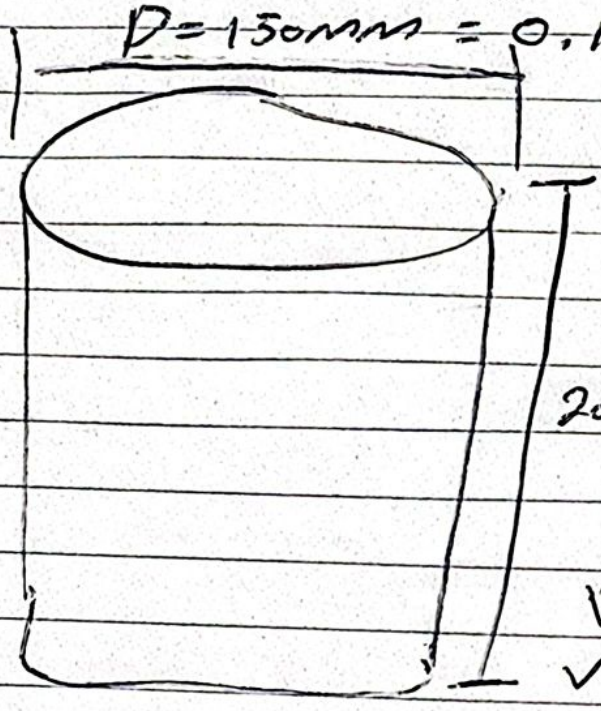
1 slug = 32.2 lbm

HW 1.1

Colby C. Burrows

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

D = 150mm = 0.150m



*Convert to meters

200mm = 0.200m

$$V = \pi r^2 h$$
$$V = \pi (0.075m)^2 (0.200m)$$
$$V = \pi (0.005625)(0.200m)$$
$$V = 0.0035325m^3$$

Empty = 2.25N

Full = 35.4N

$\Delta F = 33.15N$

$$\gamma = \frac{m \cdot g}{V} = \frac{33.15N}{0.0035325m^3} \rightarrow$$

$$\gamma = \frac{0.033 kN}{0.0035325m^3} = \boxed{9.34 kN/m^3}$$

HW.1,1 Colby C. Buham

107) Alcohol has a specific gravity of 0.79. Calculate it's density both in slugs/ft^3 and g/cm^3

$S_g = 0.79$

Density $\rho_g = (sg)\,1000\,kg/m^3)$

$= (0.79)(1000\,kg/m^3)$

$\boxed{\rho_g = 790\,kg/m^3}$

$\boxed{\rho_g = 0.79\,g/m^3}$

$1\,g/m^3 = 0.00000194032\,slug/ft^3$

$\boxed{\rho_g = 0.000001532853\,slug/ft^3}$

HW 1.1 Ch. 2 Colby C. Barnum

17) Give four example of the types of fluids that are non-Newtonian.

A: non-Newtonian fluids have ~~3~~ 2 major classifications,

1. Time-independent fluids
2. Time-dependent fluids

example 1) Liquid nylon
example 2) printer's ink
example 3) flour dough
example 4) some crude oils at low temperatures

Hw 1.1 Ch. 2 18, 27, 35 Colby C. Burnam

18) Appendix D gives dynamic viscosity for a variety of fluids as a function of temperature. Using this appendix, give the value of the viscosity for the following fluids:

$\boxed{\text{Water at } 40°C = 6.1\ N\,s/m^2}$

27) $\boxed{\text{Hydrogen at } 40°F = 1.9\ lb\text{-}s/ft^2}$

35) $\boxed{\text{SAE 30 oil at } 210°F = 2.1\ lb\text{-}s/ft^2}$

HW 1.1 Ch. 2

2.61) In a falling-ball viscometer, a steel ball 1.6mm (0.002m) in diameter is allowed to fall freely in a heavy fuel oil having a specific gravity of 0.94. Steel weighs 77 kN/m³. If the ball is observed to fall 250mm (0.250m) in 10.4 s, calculate the viscosity of the oil.

$D = 0.002m$

$V = \pi \frac{D^3}{6} = 0.021 m^3$

$\gamma_f = (0.94)\, 9.81\, kN/m^3 = 9.22\, kN/m^3$

$\gamma_s = 77\, kN/m^3$

$v = \frac{0.250m}{10.4 sec} = 0.024 m/sec$

$$\eta = \frac{(\gamma_s - \gamma_f) D^2}{18 v} = \frac{\left(77 \frac{kN}{m^3} - 9.22 \frac{kN}{m^3}\right) 0.002m^2}{(18)\, 0.024 m/sec}$$

$\eta = 0.000627$

$\boxed{\eta = 6.27 \times 10^{-4}}$

$\eta = \left(67.78 \frac{kN}{m^3}\right) 0.000004$