Fluids HW 1

48) $P_{oil} = \frac{F}{A}$

$= \frac{18{,}000 lb}{(2.5)^2 \frac{\pi}{4}} = \boxed{3666.92 \ \frac{lb}{in^2}}$

58) $\Delta P = -E\left(\frac{\Delta V}{V}\right)$ $E = 3.59 \times 10^6$

$-3.59 \times 10^6 \left(\frac{-1.00}{100}\right)$

$-3.59 \times 10^6 (-0.01)$

$\boxed{= 35900 \ psi}$

$-24{,}750(-0.01)$

$= \boxed{247.5 \ MPa}$

63) $E_{Oil} = 189{,}000 \ psi$

$A = \frac{\pi}{4} d^2$

$= \frac{\pi}{4}(0.5)^2 = \boxed{0.1963 \ in^2}$

$\frac{(E)(A)}{L}$

$= \frac{\left(189{,}000 \frac{lb}{in^2}\right)\left(0.1963 in^2\right)}{42 \ in} = \boxed{883.57 \ in}$

7b) $\frac{1.0016}{32.174} = 0.0311$ slugs

$1.0016\left(\frac{1}{2.205}\right) = \boxed{0.4535\ kg}$

$1.0016 = \boxed{4.45N}$

1.92

$D_c = 150\,mm$, $W_c = 2.25\,N$, $L_o = 200\,mm$, $W_o = 35.4\,N$

$A = \frac{\pi}{4} D^2 = \frac{\pi}{4}(0.15\,m)^2 = 0.01767\ m^2$

$V = A \times L = (0.01767\,m^2)(0.2\,m) = 0.00353\,m^3$

$W = W_o - W_c = 35.4\,N - 2.25\,N = 33.15\,N$

$\gamma_{oil} = \frac{W}{V} = \frac{33.15\,N}{0.00353\,m^3} = 9390\,N = 9.39\,KN$

$sg = \frac{\gamma_{oil}}{9.81\ KN/m^3} = \frac{9.39\,KN}{9.81\ KN/m^3} = 0.957\ m^3$

1.107

$sg_{\text{Alichol}} = 0.79$,

$\rho_{slug/ft^3} = sg_{\text{Alchol}} \cdot g = (0.79)(1.94\,slugs/ft^3) = 1.533\,\frac{slugs}{ft^3}$

$\rho_{g/cm^3} = sg_{\text{Alchol}} \cdot g = (0.79)(1\,g/cm^3) = 0.79\,g/cm^3$

2.17 Types of non-Newtonian fluids:

Pseudoplastic

Dilatant Fluids

Bingham Fluids

Rheopoetic Fluids

2.18 $T_{water} = 40°c$

$\eta = 6.2 \times 10^{-4} \, N \cdot s/m^2$

HW 1.1
27, 35, 61

27. Give the value of the Viscosity for Hydrogen @ 40°F

$$\eta = 1.9 \times 10^{-7} \ \frac{lb \cdot s}{ft^2}$$

35. Give the value of the viscosity for SAE 30 oil @ 210°F

$$\eta = 2.2 \times 10^{-4} \ \frac{lb \cdot s}{ft^2}$$

61. In a falling-ball viscometer, a steel ball 1.6mm in diameter is allowed to fall freely in a heavy fuel oil having a specific gravity of .94. Steel weights 77 kN/m³. If the ball is observed to fall 250 mm in 10.4sec, Calculate the viscosity of the oil.

Given: $D = 1.66mm \rightarrow .00166m$ $\quad \eta = \frac{(\gamma_b - \gamma_f) D^2}{18v}$

$Sg = .94$

$\gamma_b = 77 \ kN/m^3$

$h = 250mm \rightarrow .25m$

$t = 10.4 \ sec$

$\text{Velocity} = h/t = .25\,m / 10.4\,sec = .024\ m/s$

$\text{Specific gravity} = \frac{\gamma_f}{\gamma_{water}} \rightarrow .94 = \frac{\gamma_f}{9.81\,kN/m^3} \rightarrow \gamma_f = 9.221\ kN/m^3$

$$\eta = \frac{(77 - 9.221\,\frac{kN}{m^3})(.00166m)^2}{18(.024\ m/s)} = 4.32 \times 10^{-4}\ \frac{kN \cdot s}{m^2}$$

$$\boxed{\eta = 0.432\ \frac{N \cdot s}{m^2} \quad \text{or} \quad \eta = 0.432\ Pa \cdot s}$$