

1.48) Given:

- Coining press requires 18,000 lbf
- Hydraulic cylinder = 2.50 in diameter

Required: Required oil pressureSolution:

$$\text{Pressure (p)} = \frac{F}{A} \rightarrow P = \frac{18000}{\pi \left(\frac{2.50}{2}\right)^2}$$

$$P = 3666.93 \text{ psi}$$

1.58) Given:

- Mercury Bulk modulus E : $3,590,000$ psi
 $24,750$ MPa

Required:

- Pressure change needed to change vol. of mercury by 1%
- Express value in psi + MPa

Solution:

$$E = \frac{-\Delta P}{\Delta V/V_0} \rightarrow$$

$$-\Delta P = E(\Delta V/V_0)$$

$$-\Delta P = 24,750(0.01)$$

$$\boxed{247.5 \text{ MPa}}$$

$$3,590,000(0.01)$$

$$\boxed{35,900 \text{ psi}}$$

1.63)

Given: Actuator ^{inside} diameter: 0.50 in
" " length: 42.0 in
filled w/ machine oil

Required: Stiffness in lb/in

Solution:

$$\text{Stiffness} = F/\delta = \frac{EA}{L}$$

$$\frac{189,000 (\pi 0.25^2)}{42} = \boxed{883.57 \text{ lb/in}}$$

1.76)

Given: 1.00 lbfRequired: mass in slugs, kg
Weight in NSolution:

$$1 \text{ lbf} = 1 \text{ lbm} \rightarrow 1 \text{ lbm} \times \frac{1 \text{ slug}}{32.174 \text{ lbm}} =$$

0.03108 slugs

$$1 \text{ Slug} = 14.5939 \text{ kg}$$

$$0.03108 \text{ slugs} \times \frac{14.5939 \text{ kg}}{1 \text{ slug}} = \boxed{0.4536 \text{ kg}}$$

$$0.4536 \text{ kg} \times 9.81 \text{ m/s}^2$$

4.45 N

1.92)

Given: Cylindrical container — 150 mm dia
2.25 N (empty)
35.4 N (w/ 200 mm oil)

Required: specific gravity of oil

Solution:

$$\text{Specific weight: } \gamma = \frac{W}{V} =$$

$$W = 33.15 \text{ N}$$

$$V = \pi r^2 h = \pi (0.075^2) (0.200 \text{ m})$$

$$V = 0.003534 \text{ m}^3$$

$$\gamma = \frac{33.15 \text{ N}}{0.003534 \text{ m}^3} = 9379.53 \frac{\text{N}}{\text{m}^3}$$

$$\text{Sp. gravity} = \frac{9379.53 \frac{\text{N}}{\text{m}^3}}{9810.00 \frac{\text{N}}{\text{m}^3}} = \boxed{0.9561}$$

1.107)

Given: Alcohol sp. gravity = 0.79Required: Density in slugs/ft³ + g/cm³

$$0.79 = \frac{\rho_{\text{Alch}}}{\rho_{\text{H}_2\text{O}}} = \frac{\rho_{\text{Alch}}}{1000 \text{ kg/m}^3} = 790 \text{ kg/m}^3$$

$$790 \frac{\cancel{\text{kg}}}{\text{m}^3} \times \frac{1000 \text{ g}}{1 \text{ kg}} \times \frac{1 \text{ m}^3}{1,000,000 \text{ cm}^3} = \boxed{0.79 \text{ g/cm}^3}$$

$$790 \frac{\cancel{\text{kg}}}{\text{m}^3} \times \frac{1 \text{ slug}}{14.5939 \cancel{\text{ kg}}} \times \frac{1 \text{ m}^3}{35.315 \text{ ft}^3} = \boxed{1.53 \text{ slugs/ft}^3}$$

2.17)

Non-newtonian fluids:

- Quicksand
- Asphalt
- Ketchup
- Paint

2.18) $6.2 \times 10^{-4} \text{ Pa} \cdot \text{s}$ 2.27) $1.8 \times 10^{-7} \frac{\text{lb} \cdot \text{s}}{\text{ft}^2}$ 2.35) $2.3 \times 10^{-4} \frac{\text{lb} \cdot \text{s}}{\text{ft}^2}$

2.61)

Given:Steel ball: 1.6 mm dia., 77 kN/m³ sp. weight (γ)

heavy fuel oil: S.g. = 0.94

ball falls 250 mm in 10.4 sec

Required: Oil viscositySolution:

$$\text{Specific gravity} = 0.94 = \frac{\rho_{\text{oil}}}{\rho_{\text{water}}}$$

$$0.94 = \frac{\rho_{\text{oil}}}{1000 \frac{\text{kg}}{\text{m}^3}} \rightarrow \rho_{\text{oil}} = 940 \frac{\text{kg}}{\text{m}^3}$$

Falling Ball Viscometer

$$\eta = \frac{(\gamma_{\text{ball}} - \gamma_{\text{oil}}) D^2}{18 v}$$

$$\gamma_{\text{oil}} = \rho g = (940 \frac{\text{kg}}{\text{m}^3})(9.81 \frac{\text{m}}{\text{s}^2})$$

$$\text{recall } 1 \text{ N} = 1 \frac{\text{kg} \cdot \text{m}}{\text{s}^2}$$

$$\gamma_{\text{oil}} = 9221.4 \frac{\text{N}}{\text{m}^3}$$

$$\frac{0.25 \text{ m}}{10.4 \text{ s}} = 0.024 \text{ m/s} = v$$

$$\rightarrow \frac{(77000 \frac{\text{N}}{\text{m}^3} - 9221.4 \frac{\text{N}}{\text{m}^3})(0.0016 \text{ m})^2}{18(0.024 \frac{\text{m}}{\text{s}})}$$

$$\boxed{0.41 \text{ Pa} \cdot \text{s}}$$