

Fluid Mechanics HW

Group 1

Brady
semester
1/15/24

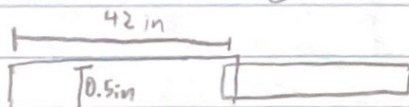
1.48.) $F = 18000 \text{ lb}$ $A = \pi r^2$ $r = 1.25 \text{ in}$
 $D = 2.5 \text{ in}$ $A = \pi (1.25 \text{ in})^2 = 4.91 \text{ in}^2$
 $P = \frac{F}{A} = \frac{18000 \text{ lb}}{4.91 \text{ in}^2} = \boxed{3665.99 \text{ lb/in}^2}$

1.58.) $E = \frac{-\Delta P}{\Delta V/V}$ $E_{\text{mercury}} = 3590000 \text{ psi} = 24750 \text{ MPa}$

$3590000 \text{ psi} \cdot 0.01 = -\Delta P = \boxed{-35900 \text{ psi} = \Delta P}$

$24750 \text{ MPa} \cdot 0.01 = -\Delta P = \boxed{247.5 \text{ MPa} = \Delta P}$

1.63.) $D = 0.5 \text{ in}$ $L = 42.0 \text{ in}$ machine oil



Assuming $\frac{\Delta V}{V} = 0.01 \Rightarrow E = 189000 \text{ psi}$

$V = \frac{\pi (0.5 \text{ in})^2}{4} \cdot 42.0 \text{ in} = 8.247 \text{ in}^3$

$\Delta V = V - V_x$ $V_x = \frac{\pi (0.5 \text{ in})^2}{4} \cdot x$ $-\frac{\Delta V}{V} = \frac{V - V_x}{V}$

$-\left(\frac{\Delta V}{V} \cdot V - V\right) = -\frac{\pi (0.5 \text{ in})^2}{4} \cdot x \Rightarrow x = -\left(\frac{\Delta V}{V} \cdot V - V\right) \cdot \frac{4}{\pi (0.5 \text{ in})^2}$

$x = -(-0.01 \cdot 8.247 \text{ in}^3 - 8.247 \text{ in}^3) \cdot \frac{4}{\pi (0.5 \text{ in})^2} \Rightarrow x = 41.58 \text{ in}$

$\Delta L = h - x$

$E = -\frac{\Delta P}{\frac{\Delta V}{V}} \Rightarrow -E \cdot \frac{\Delta V}{V} = \Delta P = 189000 \text{ psi} \cdot -0.01 = 1890 \text{ psi}$

$\Delta P \cdot A = 1890 \text{ psi} \cdot \frac{\pi (0.5 \text{ in})^2}{4} = 371.1 \text{ lb}$

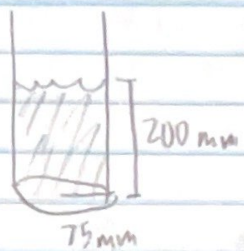
$C = \frac{F}{\Delta L} = \frac{371.1 \text{ lb}}{42.0 \text{ in} - 41.58 \text{ in}} = \boxed{883.57 \frac{\text{lb}}{\text{in}}}$

1.76.) $W = mg = 1 \text{ lb}$ $m = \frac{W}{g} = \frac{1 \text{ lb}}{32.2 \text{ ft/s}^2} = \boxed{0.031 \text{ slugs}}$

$1 \text{ lb} \left(\frac{0.4536 \text{ kg}}{1 \text{ lb}} \right) = \boxed{0.4536 \text{ kg}}$

$1 \text{ lb} = \boxed{4.45 \text{ N}}$

1.92.)



$$V = \pi r^2 \cdot h$$

$$V = \pi (0.075 \text{ m})^2 \cdot (0.2 \text{ m})$$

$$V = 0.00353 \text{ m}^3$$

$$W = 35.4 \text{ N} - 2.25 \text{ N} = 33.15 \text{ N}$$

$$\gamma_{oil} = \frac{33.15 \text{ N}}{0.00353 \text{ m}^3} = 9390.93 \frac{\text{N}}{\text{m}^3}$$

$$sg = \frac{9390.93 \frac{\text{N}}{\text{m}^3}}{9810 \frac{\text{N}}{\text{m}^3}} = \boxed{0.957} \quad \gamma_{w@4^\circ\text{C}} = 9810 \frac{\text{N}}{\text{m}^3}$$

1.107.) $sg = 0.79 \therefore \rho_o = 790 \frac{\text{kg}}{\text{m}^3} \left(\frac{1000 \text{ J}}{1 \text{ kg}} \right) \left(\frac{1 \text{ m}^3}{1000000 \text{ cm}^3} \right)$

$$= \boxed{0.79 \frac{\text{g}}{\text{cm}^3}}$$

$$790 \frac{\text{kg}}{\text{m}^3} \left(\frac{1 \text{ m}^3}{35.31 \text{ ft}^3} \right) \left(\frac{1 \text{ slug}}{14.59 \text{ kg}} \right) = \boxed{1.53 \frac{\text{slugs}}{\text{ft}^3}}$$