CE 319 F

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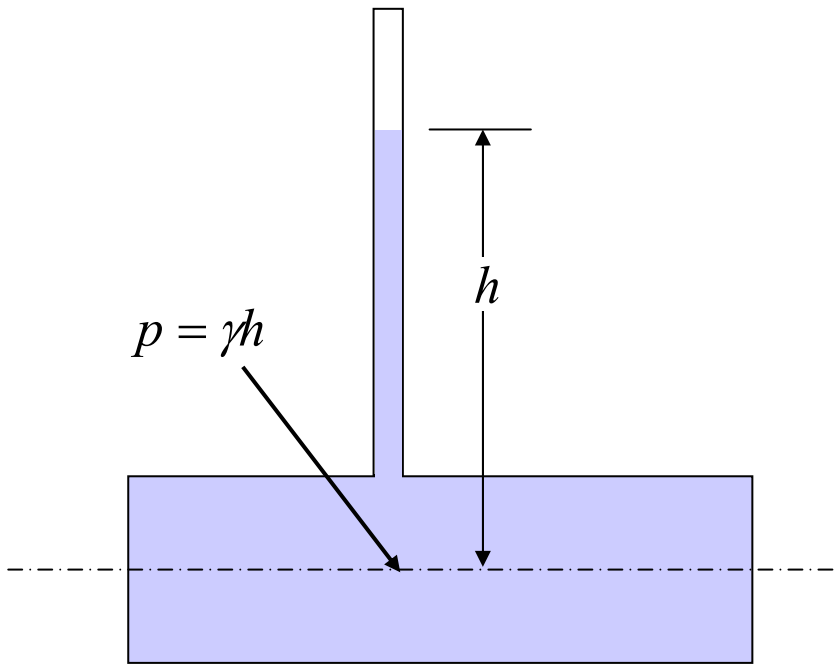
Elementary Mechanics of Fluids

Manometry

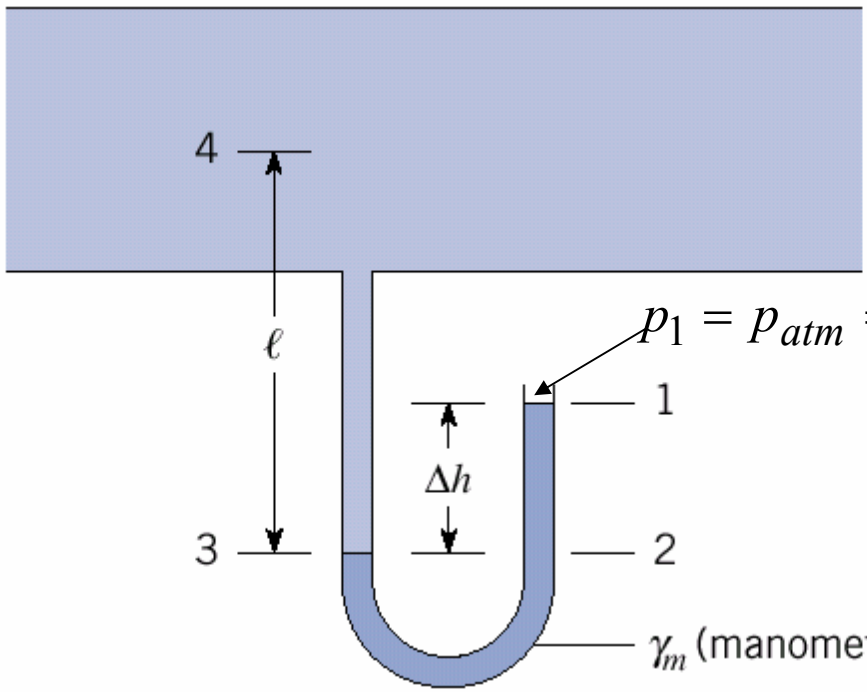
Manometry

- Pressure can be estimated by measuring fluid elevation



U-tube Manometer

$$p_1 - \gamma_m \Delta h + l\gamma = p_4$$



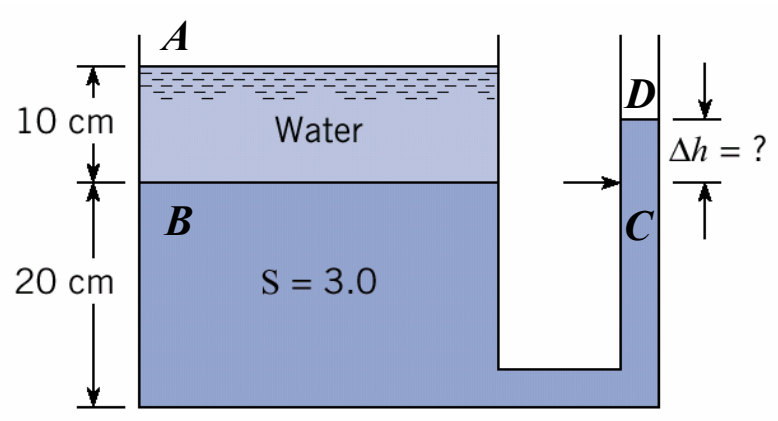
$p_1 = p_{atm} = 0\,(gage)$

$$p_4 = \gamma_m \Delta h - \gamma l$$
$$= 133{,}000(0.6) - 9810(1.8)$$
$$p_4 = 62.1\,kPa$$

Example (3.19)

Find the location of the surface in the manometer

The distance Δh is the height of the liquid in the manomoter above the heavier liquid in the tank.



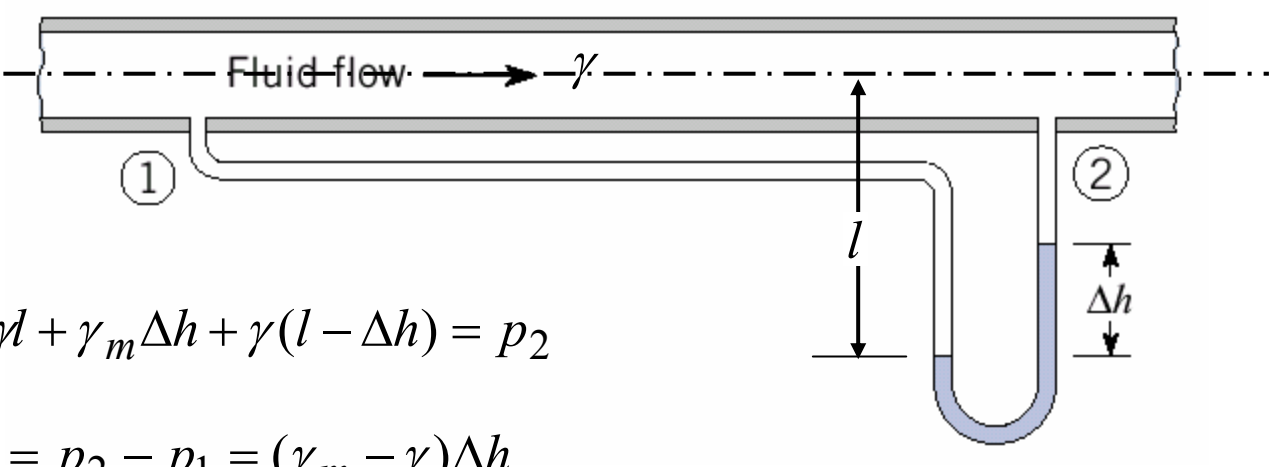
$$p_A + 0.1 * \gamma_w - \Delta h * \gamma_m = p_D$$

$$p_A = P_D = 0$$

$$\Delta h = 0.1 * \frac{\gamma_w}{\gamma_m}$$

$$\Delta h = 0.1 * \frac{1}{3} = 3.33\,cm$$

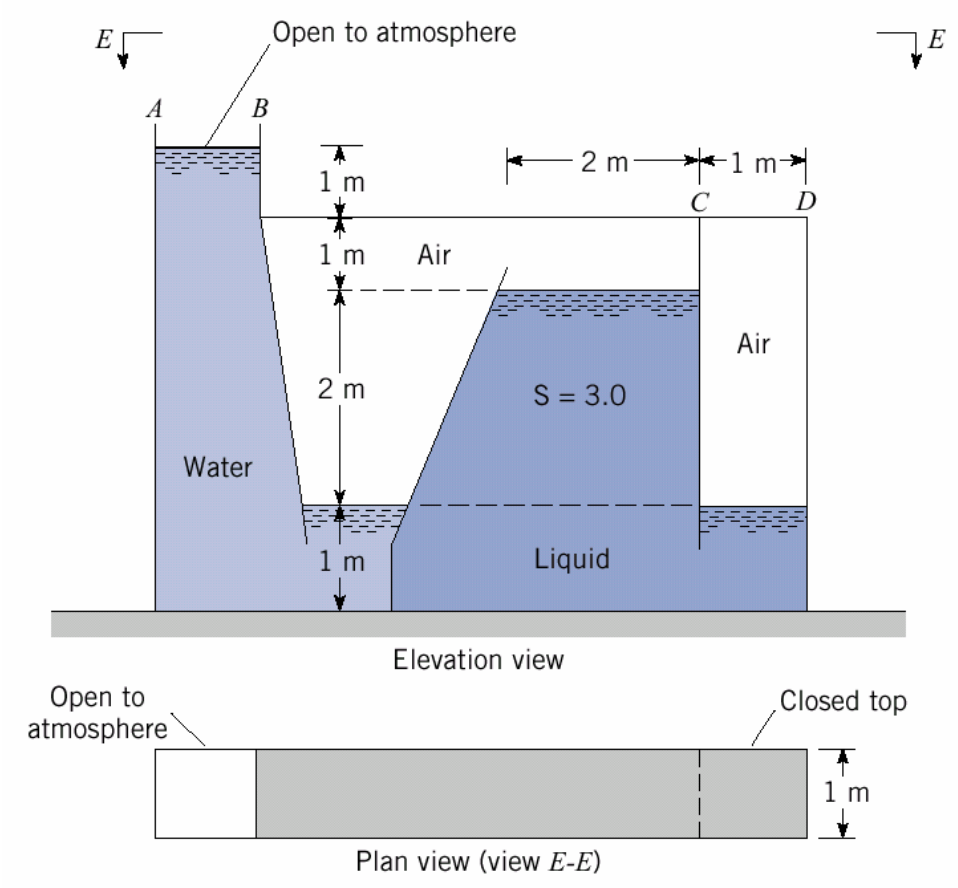
Differential Manometer



$$p_1 - \gamma l + \gamma_m \Delta h + \gamma (l - \Delta h) = p_2$$

$$\Delta p = p_2 - p_1 = (\gamma_m - \gamma)\Delta h$$

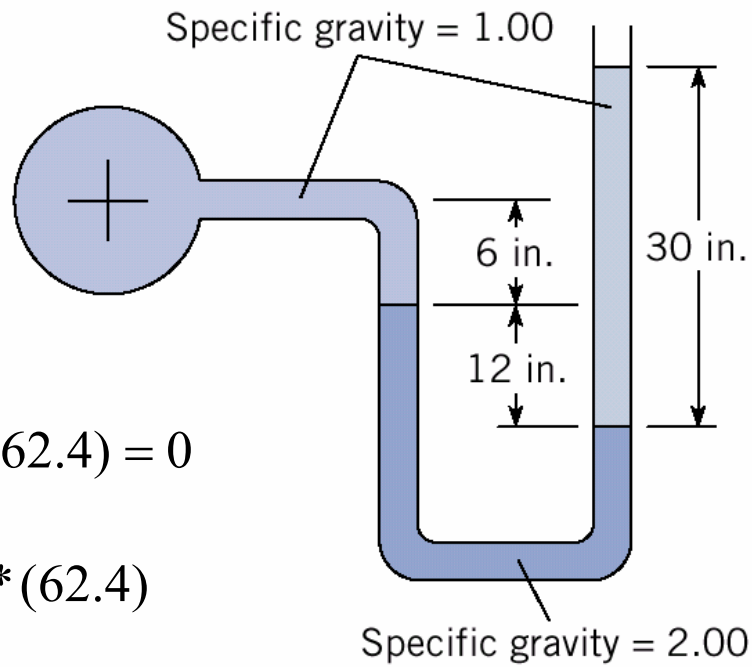
HW (3.20)


E
Open to atmosphere
E
A
B
1 m
2 m
1 m
C
D
1 m
Air
Air
2 m
S = 3.0
Water
1 m
Liquid
Elevation view
Open to atmosphere
Closed top
1 m
Plan view (view E-E)

Example (3.25)

Find: the gage pressure at the pipe center

Manometer equation from the pipe center to the open end of the manometer



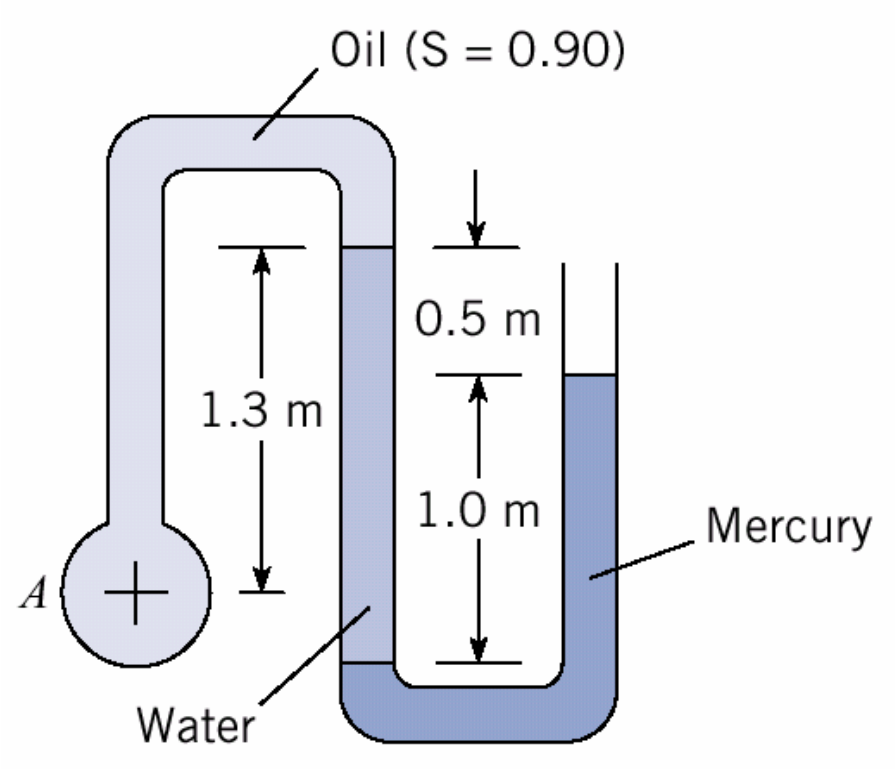
$$p_{pipe} + (0.5) * \gamma + (1) * 2\gamma - (2.5)\gamma = 0$$

$$p_{pipe} + (0.5) * (62.4) + 2 * (62.4) - (2.5) * (62.4) = 0$$

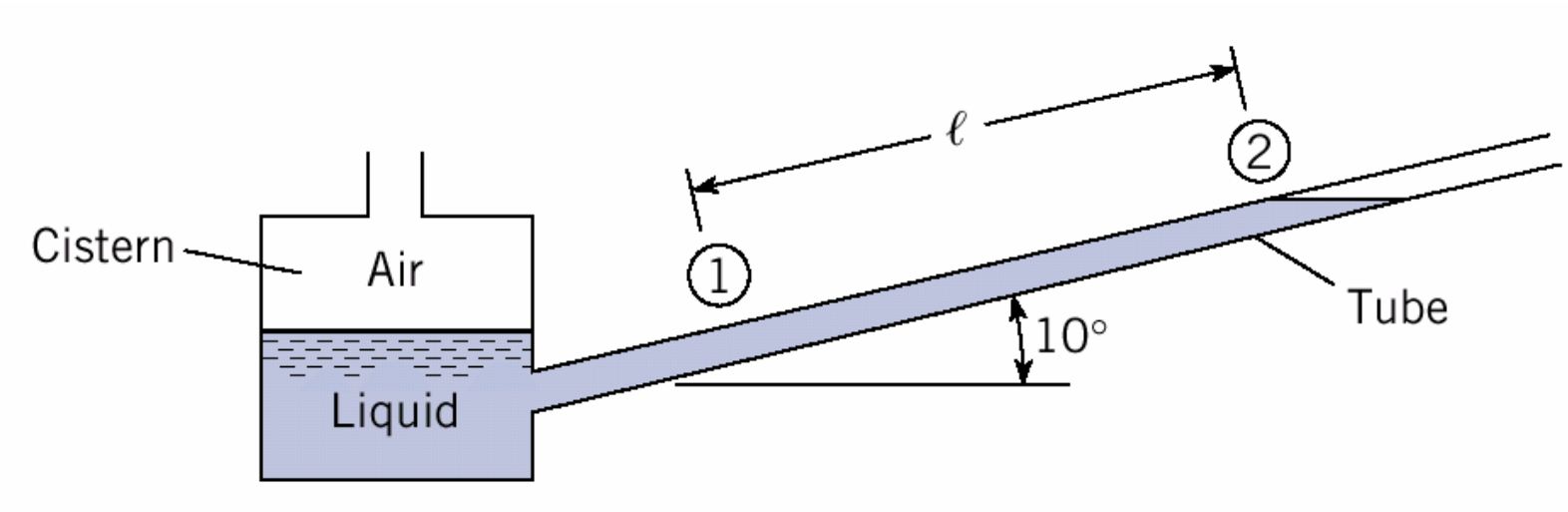
$$p_{pipe} = -(0.5) * (62.4) - 2 * (62.4) + (2.5) * (62.4)$$

$$\boxed{p_{pipe} = 0}$$

HW (3.28)



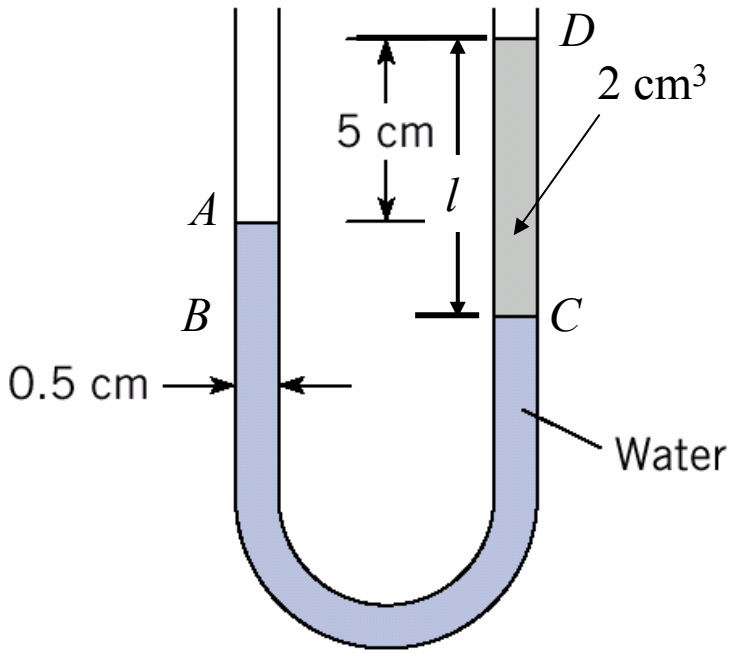
HW (3.32)



Example (3.35)

Find: Specific weight of fluid

Solution:



Solution:

$$V = \frac{\pi}{4} d^2 l$$

$$= \frac{\pi}{4}(0.5)^2 l = 2\,cm^3$$

$$l = 10.186\,cm$$

Manometer Equation

$$p_A + (l - 0.05)\gamma - l\gamma_{liq} = p_D$$

$$\gamma_{liq} = \frac{(l - 0.05)}{l}\gamma$$

$$= \frac{(0.10186 - 0.05)}{0.10186}(9810)$$

$$\gamma_{liq} = 4{,}995\,N/m^3$$

HW (3.51)