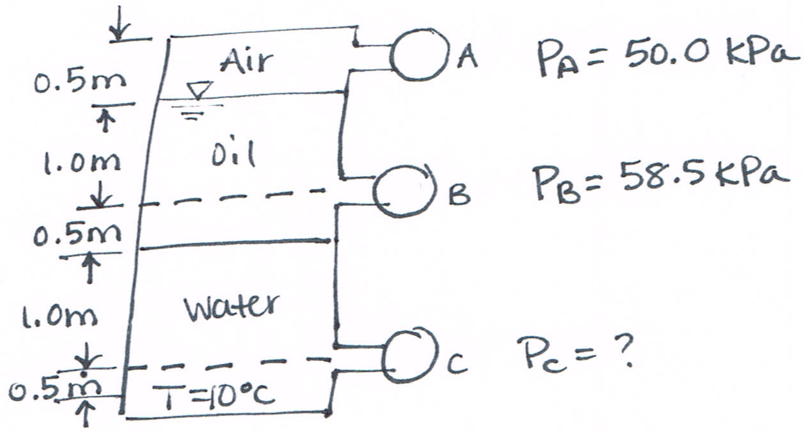
3.16) For the closed tank with Bourdon-tube gages tapped into it, what is the specific gravity of the oil and the pressure reading on gage C?

SKETCH:



KNOWN:

Closed tank

T= 10°C

$\gamma = 9810 \text{ N/m}^3 \Rightarrow$ Table A.5

UNKNOWN:

S.G. of oil

$P_C = ?$

SOLUTION:

Hydrostatic equation (from oil surface to elevation B).

$$P_A + \gamma z_A = P_B + \gamma z_B$$

$$50{,}000 \frac{N}{m^2} + \gamma_{oil}(1m) = 58{,}500 \frac{N}{m^2} + \gamma_{oil}(0m)$$

$$\gamma_{oil} = 8500 \text{ N/m}^3$$

Specific Gravity:

$$S.G. = \frac{\gamma_{oil}}{\gamma_{water}} = \frac{8500 \text{ N/m}^3}{9810 \text{ N/m}^3} = \boxed{0.87 = S.G.}$$

Hydrostatic equation (in water):

$$P_C = (P_{atm\ of\ oil}) + \gamma_{water}(1m)$$

Hydrostatic equation (in oil):

$$P_{btm\ of\ oil} = (58{,}500 \text{ Pa} + \gamma_{oil}(0.5m))$$

3.16 continued

$$P_C = 58{,}500\ \text{Pa} + \gamma_{oil}(0.5\text{m}) + \gamma_{water}(1\text{m})$$

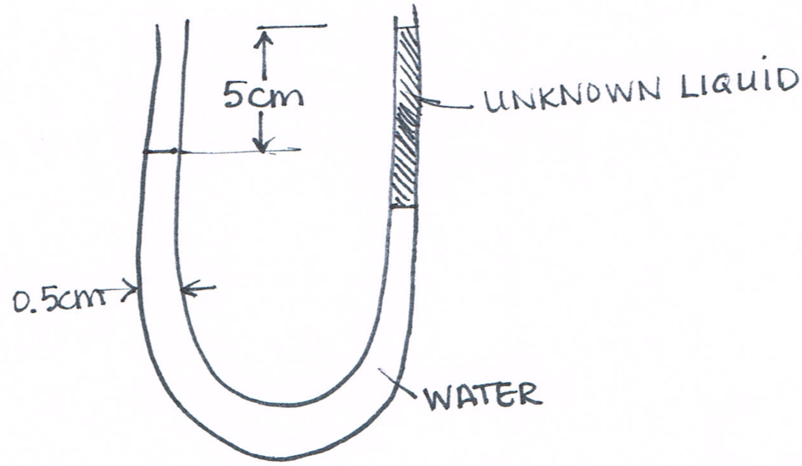
$$= (58{,}500\ \text{Pa} + 8500\ \text{N/m}^3(0.5\ \text{m})) + 9810\ \text{N/m}^3(1\text{m})$$

$$= 72{,}560\ \text{N/m}^2$$

$$\boxed{P_C = 72.56\ \text{kPa}}$$

3.54) A device for measuring the specific weight of a liquid consists of a U-tube manometer as shown. The manometer tube has an internal diameter of 0.5 cm and originally has water in it. Exactly 2 cm^3 of unknown liquid is then poured into one leg of the manometer, and a displacement of 5 cm is measured between the surfaces as shown. What is the specific weight of the unknown liquid?

SKETCH:



UNKNOWN:

γ of unknown liquid (N/m^3)

SOLUTION:

Find the length of the column of the unknown liquid

$$\forall = (\pi/4)(0.5\ cm)^2 \ell = 2 cm^3$$

$$\Rightarrow \ell = 10.186\ cm$$

manometer equation (from water surface in left leg to liquid surface in right leg)

$$0 + (10.186 cm - 5cm)(10^{-2} m/cm)(9810\ N/m^3) - \left[(10.186cm)(10^{-2} \tfrac{m}{cm}) \times \gamma_{liq}\right] = 0$$

$$\gamma_{liq.} \Rightarrow 508.7 Pa - 0.10186 \gamma_{liq.} = 0$$

$$\boxed{\gamma_{liquid} = 4995\ N/m^3}$$

3.66) Two cylindrical tanks have bottom areas A and 4A respectively, and are filled with water to the depths shown.

a) Which tank has the higher pressure at the bottom of the tank?

b) Which tank has the greater force acting downward on the bottom circular surface?

~~UNKNOWN~~

UNKNOWN:

a) ?

B) ?

GOVERNING EQNS:

$P = -\gamma \Delta z$

SOLUTION:

a) which tank has the higher pressure at the bottom?

Tank 1: $P_1 = \gamma h$ at the bottom

Tank 2: $P_2 = \gamma\left(\frac{1}{2}h\right) = \frac{1}{2}\gamma h$ at the bottom

$\boxed{\text{Tank 1 has the higher pressure @ the bottom}}$

b) which tank has the greater force acting downward at the bottom?

$F = PA$

Tank 1: $F_1 = PA = \gamma h A$

Tank 2: $F_2 = PA = \left(\frac{1}{2}\gamma h\right)(4A) = 2\gamma h A$

$\boxed{\text{Tank 2 has the greater force acting downward on the tank bottom}}$