P-151/002 Chap 13 Random Graded HWK

Total Pts = 40

{13-5} We have: $T(^\circ F) = \frac{9}{5} T(^\circ C) + 32$,

10 (a) $T = -15^\circ C$

$\Rightarrow T(^\circ F) = \frac{9}{5}(-15^\circ C) + 32 = (-27 + 32)^\circ F$

$\hookrightarrow = 5^\circ F$ (5)

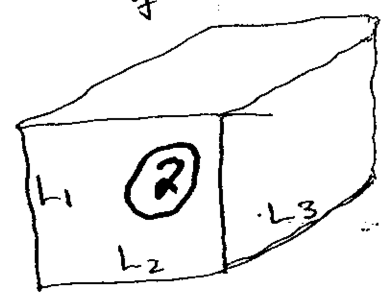
(b) $T = -15^\circ F$ and $T(^\circ C) = [T(^\circ F) - 32]\frac{5}{9}$

$\Rightarrow T(^\circ C) = (-15 - 32)\frac{5}{9}\,^\circ C = -\frac{47 \times 5}{9}\,^\circ C = -26.1^\circ C$

{13-76} By ideal gas law, $PV = \mathcal{N}RT = \frac{N}{N_A}RT = NkT$ (2)

↑ Total number of molecules

15 $L_3 = 6.5\,m$, $L_2 = 3.1\,m$, $L_1 = 2.5\,m$



$V \equiv$ volume of the room $= L_3 L_2 L_1$

$\hookrightarrow = 6.5\,m \times 3.1\,m \times 2.5\,m = 50.38\,m^3$

$p = 1.013 \times 10^5\,\frac{N}{m^2}$

$T = 273 + 22 = 295\,K$ (1)

$k = 1.38 \times 10^{-23}\,\frac{J}{K}\left(\equiv \frac{Nm}{K}\right)$

$\Rightarrow N = \frac{PV}{kT}$

$\hookrightarrow = \frac{1.013 \times 10^5\,\frac{N}{m^2}(50.38\,m^3)}{1.38 \times 10^{-23}\,\frac{Nm}{K}(295\,K)}$

$\hookrightarrow = \frac{1.013 \times 50.38}{1.38 \times 295} \times 10^{5+23}$ molecules (5)

$\hookrightarrow = 12.54 \times 10^{26}$ molecules

$\Rightarrow \mathcal{N}$ = number of moles of air molecules $= \frac{N}{N_A} = \frac{12.54 \times 10^{26}\text{ molecules}}{6.02 \times 10^{23}\,\frac{\text{molecules}}{\text{mole}}}$

$\hookrightarrow = 2.08 \times 10^3$ moles (5)

13-94 $h = 14\,m$, T is constant

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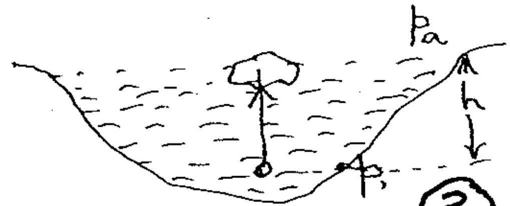
From Boyle's Law, we have



(3)

$$PV = \text{Const} \quad \text{—— (1)}$$

From manometer equation

$$p = p_a + \rho_{H_2O}\, g\, h = 1.013 \times 10^5 \frac{N}{m^2} + 10^3 \frac{kg}{m^3}\left(9.8 \frac{m}{s^2}\right) 14\,m$$

$$\Rightarrow = \left(1.013 \times 10^5 + 1.37 \times 10^5\right) \frac{N}{m^2}$$

$$\Rightarrow = 2.5 \times 10^5 \frac{N}{m^2}$$ (4)

Also, we must have from (1) above,

$$p_a V_a = p V, \quad V = \frac{4\pi}{3} r^3, \quad r = \frac{3}{2}\,cm$$

$$\Rightarrow V_a = \frac{pV}{p_a} = \frac{2.5 \times 10^5 \left(\frac{N}{m^2}\right)}{1.013 \times 10^5\, N/m^2} \frac{4\pi}{3} r^3$$

$$\Rightarrow = 2.35 \left(\frac{4\pi}{3} r^3\right)$$

$$\Rightarrow \frac{4\pi}{3} r_a^3 = 2.35 \left(\frac{4\pi}{3} r^3\right)$$

$$\Rightarrow r_a^3 = 2.35 \times \frac{27}{8}\,cm^3$$ (6)

$$\Rightarrow r_a \simeq (8\,cm^3)^{1/3}$$

$$\Rightarrow = 2\,cm$$

$\Rightarrow$ Bubble diameter at the lake surface $= 4\,cm$ (2)