Chapter 5 − Problems 54, 56, 64, 86

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54. Rank the gases Xe, CH_4, F_2, and CH_2F_2 in order of (a) increasing speed of effusion through a pinhole (b) increasing time of effusion

    (a) Speed:

    Least Xe CH_2F_2 F_2 CH_4 Greatest

    (b) Time:

    Least CH_4 F_2 CH_2F_2 Xe Greatest

56. A balloon filled with nitrogen gas has a small leak. Another balloon filled with hydrogen gas has an identical leak. How much faster will the hydrogen balloon deflate? (1)

$$\begin{aligned} m_{H_2} &= 2\left[\frac{\text{g}}{\text{mol}}\right] \\ m_{N_2} &= 28\left[\frac{\text{g}}{\text{mol}}\right] \\ \frac{U_{H_2}}{U_{N_2}} &= \sqrt{\frac{28}{2}} \\ &= 3.742 \end{aligned} \tag{1}$$

64. A sample of methane gas (CH_4) is at 50[°C] and 20[ATM]. Would you expect it to behave more or less ideally if (a) the pressure were reduced to 1[ATM]? (b) the temperature were reduced to −50[°C]

    (a) More

    (b) Less

86. Each bulb contains argon gas with amounts proportional to the number of circles pictorially represented ($A \to 2$, $B \to 4$, $C \to 10$) in the chamber. All three bulbs are maintained at the same temperature. Unless otherwise stated, assume that the valves connecting the bulbs are closed and seal the gases in their respective chambers. Assume also that the volume between each bulb is negligible. (a) Which bulb has the highest pressure? (b) If the pressure in bulb A is .5[ATM], what is the pressure in bulb C? (c) If the pressure in bulb A is .5[ATM], what is the total pressure? (d) If the pressure in bulb A is .5[ATM], and the valve between bulbs A and B is opened, redraw the figure shown above to accurately represent the gas atoms in all three bulbs. What is $P_A + P_B + P_C$? Compare your answer in part (d) to part (c). (e) Follow the instructions in part (d) but now open only the valve between bulbs B and C.

(a) The bulb with the most particles (C)

(b) (2)

$$\begin{aligned} .5 &= \frac{2 \cdot .0821 \cdot T}{1} \\ T &= 3.05[\text{K}] \\ P_C &= \frac{10 \cdot .0821 \cdot 3.05}{1} \\ &= 2.5[\text{ATM}] \end{aligned} \tag{2}$$

(c) (3)

$$\begin{aligned} P_{total} &= P_A + P_B + P_C \\ P_A &= .5[\text{ATM}] \\ P_B = 2P_A &= 1[\text{ATM}] \\ P_C = 5P_A &= 2.5[\text{ATM}] \\ P_{total} &= .5 + 1 + 2.5 \\ &= 4[\text{ATM}] \end{aligned} \tag{3}$$

(d) Figure 1

(e) Figure 2

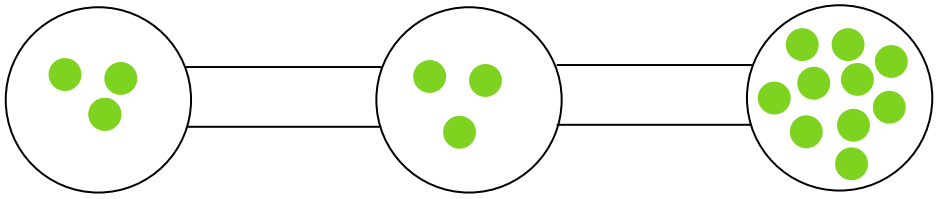

Figure 1: Result of Opening Valve AB. Total Pressure Remains 4[ATM]

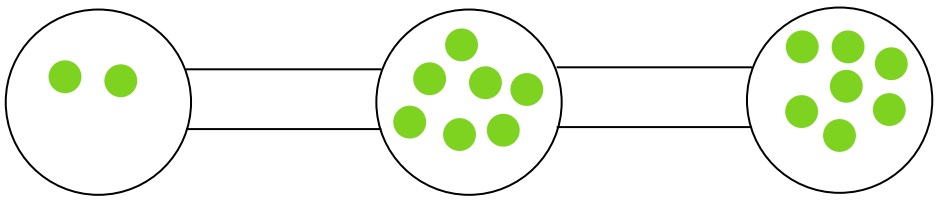

Figure 2: Result of Opening Valve BC. Total Pressure Remains 4[ATM]