Gases APQs

1a) need pressure of just H_2 : 745 mmHg total − 23.8 mmHg H_2O

$P_{H_2} = 721.2$ mmHg

$$n = \frac{\left(\frac{721.2}{760}\text{atm}\right) \cdot 0.0900\,L}{0.08206 \frac{atm \cdot L}{mol \cdot K} \cdot 298.15\,K}$$

$$n = \boxed{3.49 \cdot 10^{-3} \text{ mol } H_2}$$

b) $$n = \frac{\left(\frac{23.8 \text{ mmHg}}{760 \text{ mmHg/atm}}\right) \cdot 0.0900\,L}{0.08206 \frac{atm \cdot L}{mol \cdot K} \cdot 298.15\,K} = \boxed{1.15 \cdot 10^{-4} \text{ mol } H_2O}$$

c) $$\frac{v_{H_2}}{v_{H_2O}} = \sqrt{\frac{18.016}{2.016}} = \boxed{2.99}$$

2) a) $$P_{H_2+O_2} = \frac{(2.50 + .500) \cdot 0.08206 \frac{atm \cdot L}{mol \cdot K} \cdot 400.15}{8.20\,L} = 12.0 \text{ atm}$$

$$12.0 \text{ atm} + 2.00 \text{ atm} = \boxed{14.0 \text{ atm total}}$$

b) need moles of Ar $$n_{Ar} = \frac{2.00 \cdot 8.20\,L}{0.08206 \frac{atm \cdot L}{mol \cdot K} \cdot 400.15} = 0.500 \text{ mol}$$

$$\frac{2.50 \text{ mol } H_2}{3.50 \text{ mol total}} = \boxed{0.714}$$

c) $$2.50 \text{ mol } H_2 \cdot \frac{2.016\,g}{1 \text{ mol}} = 5.04\,g$$

$$0.500 \text{ mol } O_2 \cdot \frac{32.00\,g}{1 \text{ mol}} = 16.00\,g$$

$$0.500 \text{ mol Ar} \cdot \frac{39.95\,g}{1 \text{ mol Ar}} = 19.975\,g$$

$$\frac{41.015\,g}{8.20\,L} = \boxed{5.00\,g/L}$$

2d) $0.500 \text{ mol } O_2 \cdot \frac{2 \text{ mol } H_2}{1 \text{ mol } O_2} = 1.00 \text{ mol } H_2$ used so $1.50 \text{ mol } H_2$ left

$0.500 \text{ mol } O_2 \cdot \frac{2 \text{ mol } H_2O}{1 \text{ mol } O_2} = 1.00 \text{ mol } H_2O$ created

assuming temp remains const then .500 mol Ar generates 2.00 atm

can also calculate with $PV=nRT$

eg: $P = \frac{nRT}{V} = \frac{1.00 \text{ mol} \cdot 0.08206 \cdot 400.15}{8.20 \text{ L}} = 4.00 \text{ atm}$

$P_{Ar} = 2.00 \text{ atm}$

$P_{H_2O} = 4.00 \text{ atm}$

$P_{H_2} = 6.00 \text{ atm}$

3) a) False, volume is irrevelant to the number of moles. All the ballons will have the same number of moles.

b) False, temperature is a measure of kinetic energy. If the temperatures are the same then the kinetic energies are the same.

c) False, the ballon with the lightest particles will have the greatest rate of shrinking. The rates of effusion depend on the mass of the particles.

4a) need moles of He and N_2

$3.22\,g\ He \cdot \frac{1\ mol\ He}{4.003\,g\ He} = 0.804\ mol\ He$ $\quad 11.56\,g\ N_2 \cdot \frac{1\ mol\ N_2}{28.02\,g\ N_2} = 0.413\ mol\ N_2$

$$P = \frac{n \cdot R \cdot T}{V} = \frac{(0.804+0.413) \cdot 0.08206 \cdot 288.15}{5.25\,L} = \boxed{5.48\ atm}$$

aii) $\frac{P_{N_2}}{P_{Total}} = \frac{n_{N_2}}{n_{Total}} = \frac{0.413\ mol}{1.217\ mol} = \boxed{0.339}$

bi) $D = \frac{9.62\,g}{1.50\,L} = \boxed{6.41\,g/L}$ $\quad$ bii) $M.M. = \frac{6.41\,g/L \cdot 0.08206 \cdot 303}{3.62\,atm}$

$M.M. = 43.96\ g/mol$

biii) max 3 C = 36.

$43.96 - 36.03 = \frac{7.93}{1.008} = 7.86\ H$ $\quad \boxed{C_3H_8}$

g H

5a) $6.19\,g\ PCl_5 \cdot \frac{1\ mol\ PCl_5}{208.22\,g\ PCl_5} = 0.0297\ mol\ PCl_5$

$$P = \frac{0.0297\ mol \cdot 0.08206 \frac{atm \cdot L}{mol \cdot K} \cdot 525.15}{2.00\,L} = 0.640\ atm$$

b) $P_{Total} = P_{PCl_3} + P_{Cl_2} + P_{PCl_5} = 1.00\ atm$

based on reaction $\quad$ leftover, so $= 0.640 - P_{Cl_2}$

Could also have been P_{PCl_3} ratio is 1:1

$P_{PCl_3} = P_{Cl_2}$ $\quad$ So solving in

$P_{Cl_2} + P_{Cl_2} + (0.640 - P_{Cl_2}) = 1.00$

$P_{Cl_2} = 0.360\ atm = P_{PCl_3}$

$P_{Cl_2} = 1.00 - 0.640 = 0.360\ atm$

$P_{PCl_5} = 0.640 - 0.360 = 0.280\ atm$