Ideal Gases II - Answers

p. 440

65) The measured properties of a gas mixture depend only on the total number of moles of gas, not on the identity of the particles, because the the pressure exerted on the walls of the container is the sum of the partial pressures of each of the gases in the container, each of which depends only on the number of moles of each gas, not its identity. One of the assumptions of kinetic molecular theory is that gas molecules do not interact; the other is that their relative size is unimportant, since we neglect the volume of all gas molecules. Combined, these two assumptions allow us to neglect the specific chemical nature of each gas.

67) $P_{He} = \frac{n_{He}RT}{V} = \frac{\left(2.41g \times \frac{1 mol He}{4.0026g He}\right)\left(0.0821 \frac{L\,atm}{mol\,K}\right)(298\,K)}{(1.04\,L)} = 14.16$ atm He

$P_{Ne} = \frac{n_{Ne}RT}{V} = \frac{\left(2.79g\,Ne \times \frac{1 mol Ne}{20.179\,g\,Ne}\right)\left(0.0821 \frac{L\,atm}{mol\,K}\right)(298K)}{(1.04\,L)} = 3.25$ atm Ne

$P_{total} = P_{He} + P_{Ne} = 14.16$ atm $+ 3.25$ atm $= 17.41$ atm

71) $P_{total} = P_{H_2O} + P_{O_2}$

$P_{O_2} = P_{total} - P_{H_2O}$

$= 772$ torr $- 26.7$ torr

$P_{O_2} = 745.3$ torr

73) $P_{total} = P_{H_2O} + P_{O_2}$

$755\,mmHg = 23\,mmHg + P_{O_2}$

$P_{O_2} = 732\,mmHg$

$P_{O_2} V = n_{O_2} RT$

$$n_{O_2} = \frac{P_{O_2} V}{RT} = \frac{(500\times10^{-3}\,L)(732\,mmHg)}{(62.36\,\frac{L\,mmHg}{mol\,K})(24+273\,K)} = 0.0198\text{ mol } O_2$$

85) $$1.25\,g\ CaO \times \frac{1\,mol\ CaO}{56.08\,g\ CaO} \times \frac{1\,mol\ CO_2}{1\,mol\ CaO} \times \frac{44.011\,g\ CO_2}{1\,mol\ CO_2} = 0.981\,g\ CO_2$$

$P_{CO_2} V = n_{CO_2} RT$

$$V = \frac{n_{CO_2} RT}{P_{CO_2}} = \frac{\left(0.981\,g\ CO_2 \times \frac{1\,mol\ CO_2}{44.011\,g\ CO_2}\right)(0.0821\,\frac{L\,atm}{mol\,K})(273\,K)}{(1\,atm)} = 0.500\,L$$

89) $NH_{3(g)} + HCl_{(g)} \rightarrow NH_4Cl_{(s)}$

$P_{NH_3} V = n_{NH_3} RT$

$$n_{NH_3} = \frac{P_{NH_3} V}{RT} = \frac{(1.02\,atm)(4.21\,L)}{(0.0821\,\frac{L\,atm}{mol\,K})(300\,K)} = 0.174\text{ mol } NH_3$$

$$n_{HCl} = \frac{P_{HCl} V}{RT} = \frac{(0.998\,atm)(5.35\,L)}{(0.0821\,\frac{L\,atm}{mol\,K})(299\,K)} = 0.218\text{ mol } HCl$$

$$0.174\text{ mol } NH_3 \times \frac{1\,mol\ NH_4Cl}{1\,mol\ NH_3} \times \frac{53.49\,g\ NH_4Cl}{1\,mol\ NH_4Cl} = 9.31\,g\ NH_4Cl$$

<u>NH_3 is limiting reagent</u>

$$0.218\text{ mol } HCl \times \frac{1\,mol\ NH_4Cl}{1\,mol\ HCl} \times \frac{53.49\,g\ NH_4Cl}{1\,mol\ NH_4Cl} = 11.66\,g\ NH_4Cl$$

<u>HCl is present is excess</u>

101) $$1.45\,kg\ Fe \times \frac{1\,mol\ Fe}{55.85\times10^{-3}\,kg\ Fe} \times \frac{1\,mol\ CO}{1\,mol\ Fe} = 25.96\text{ mol CO}$$

$$V = \frac{nRT}{P} = \frac{(25.96\,mol)(0.0821\,\frac{L\,atm}{mol\,K})(273\,K)}{(1\,atm)} = 581.85\,L\ CO\text{ required}$$

$$1.45\,kg\ Fe \times \frac{1\,mol\ Fe}{55.85\times10^{-3}\,kg\ Fe} \times \frac{1\,mol\ CO_2}{1\,mol\ Fe} = 25.96\text{ mol } CO_2$$

$$V = \frac{nRT}{P} = \frac{(25.96\,mol)(0.0821\,\frac{L\,atm}{mol\,K})(273\,K)}{(1\,atm)} = 581.85\,L\ CO_2\text{ produced}$$

→ same P, n, T ⇓ same V