

Ideal Gases II - Answers

9.440

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 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.

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

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

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

$$71) P_{\text{total}} = P_{\text{H}_2\text{O}} + P_{\text{O}_2}$$

$$P_{\text{O}_2} = P_{\text{total}} - P_{\text{H}_2\text{O}}$$

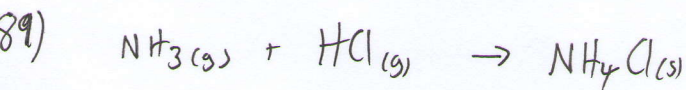
$$= 772 \text{ torr} - 26.7 \text{ torr}$$

$$P_{\text{O}_2} = 745.3 \text{ torr}$$

73) $P_{\text{total}} = P_{\text{H}_2\text{O}} + P_{\text{O}_2}$ $P_{\text{O}_2} V = n_{\text{O}_2} RT$
 $732 \text{ mmHg} = 23 \text{ mmHg} + P_{\text{O}_2}$ $n_{\text{O}_2} = \frac{P_{\text{O}_2} V}{RT} = \frac{(500 \times 10^{-3} \text{ L})(732 \text{ mmHg})}{(62.36 \frac{\text{L mmHg}}{\text{mol K}})(24 + 273 \text{ K})} = 0.0198 \text{ mol O}_2$
 $P_{\text{O}_2} = 732 \text{ mmHg}$

35) $1.25 \text{ g CaO} \times \frac{1 \text{ mol CaO}}{56.08 \text{ g CaO}} \times \frac{1 \text{ mol CO}_2}{1 \text{ mol CaO}} \times \frac{44.01 \text{ g CO}_2}{1 \text{ mol CO}_2} = 0.981 \text{ g CO}_2$

$P_{\text{CO}_2} V = n_{\text{CO}_2} RT$
 $V = \frac{n_{\text{CO}_2} RT}{P_{\text{CO}_2}} = \frac{(0.981 \text{ g CO}_2 \times \frac{1 \text{ mol CO}_2}{44.01 \text{ g CO}_2}) (0.0821 \frac{\text{L atm}}{\text{mol K}}) (273 \text{ K})}{(1 \text{ atm})} = 0.500 \text{ L}$



$P_{\text{NH}_3} V = n_{\text{NH}_3} RT$
 $n_{\text{NH}_3} = \frac{P_{\text{NH}_3} V}{RT} = \frac{(1.02 \text{ atm})(4.21 \text{ L})}{(0.0821 \frac{\text{L atm}}{\text{mol K}})(300 \text{ K})} = 0.174 \text{ mol NH}_3$

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

$0.174 \text{ mol NH}_3 \times \frac{1 \text{ mol NH}_4\text{Cl}}{1 \text{ mol NH}_3} \times \frac{53.49 \text{ g NH}_4\text{Cl}}{1 \text{ mol NH}_4\text{Cl}} = 9.31 \text{ g NH}_4\text{Cl}$ NH_3 is limiting reagent

$0.218 \text{ mol HCl} \times \frac{1 \text{ mol NH}_4\text{Cl}}{1 \text{ mol HCl}} \times \frac{53.49 \text{ g NH}_4\text{Cl}}{1 \text{ mol NH}_4\text{Cl}} = 11.66 \text{ g NH}_4\text{Cl}$ HCl is present in excess

101) $1.45 \text{ kg Fe} \times \frac{1 \text{ mol Fe}}{55.85 \times 10^{-3} \text{ kg Fe}} \times \frac{1 \text{ mol CO}}{1 \text{ mol Fe}} = 25.96 \text{ mol CO}$

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

$1.45 \text{ kg Fe} \times \frac{1 \text{ mol Fe}}{55.85 \times 10^{-3} \text{ kg Fe}} \times \frac{1 \text{ mol CO}_2}{1 \text{ mol Fe}} = 25.96 \text{ mol CO}_2$

$V = \frac{nRT}{P} = \frac{(25.96 \text{ mol})(0.0821 \frac{\text{L atm}}{\text{mol K}})(273 \text{ K})}{(1 \text{ atm})} = 581.85 \text{ L CO}_2 \text{ produced}$

same P, n, T
 \downarrow
 same \checkmark