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### Unit 13 Problem Set Key

1)

Given:

$$\text{Volume} = 2\text{L}$$

$$\text{Pressure} = 1\text{ atm}$$

$$\text{Temp.} = 85^\circ\text{C} + 273.15 = 358.15\text{K}$$

$$PV = nRT$$

$$n = \frac{PV}{RT} = \frac{(1\text{ atm})(2\text{L})}{(0.08206 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}})(358.15\text{K})}$$

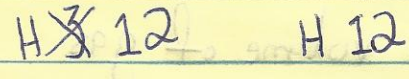
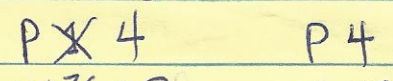
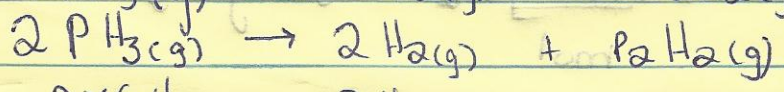
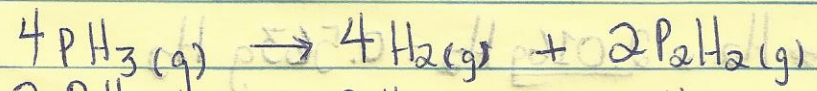
$$= 0.07\text{ mol}$$

2)

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \quad \frac{6.50\text{L}}{80.0^\circ\text{C}} = \frac{65.0\text{L}}{T_2}$$

$$T_2 = \frac{65.0\text{L} \times 80.0^\circ\text{C}}{6.50\text{L}} = 800^\circ\text{C}$$

3)



$$28.6\text{g PH}_3 \times \frac{\text{mol PH}_3}{33.994\text{g}} = 0.8413\text{ mol PH}_3$$

$$0.8413\text{ mol PH}_3 \times \frac{2\text{ mol H}_2}{2\text{ mol PH}_3} = 0.8413\text{ mol H}_2$$

$$0.8413\text{ mol PH}_3 \times \frac{1\text{ mol P}_2\text{H}_2}{2\text{ mol PH}_3} = 0.42065\text{ mol P}_2\text{H}_2$$

Sum of moles of gas products is 1.26195 mol

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# moles  $\times$  molar volume @ STP

$$1.26195 \text{ mol} \times 22.4 \text{ L} = 28.3 \text{ L}$$

4) Reaction  $\rightarrow$   $\text{H}_2$  (g)

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

$$685 \text{ mmHg} = P_{\text{H}_2} + 28.3 \text{ mmHg}$$

$$P_{\text{H}_2} = 656.7 \text{ mmHg} \times \frac{1 \text{ atm}}{760 \text{ mmHg}} = 0.86408 \text{ atm}$$

$$PV = nRT$$

$$n = \frac{PV}{RT} = \frac{(0.86408 \text{ atm})(7.80 \text{ L})}{(0.08206 \frac{\text{L} \cdot \text{atm}}{\text{mol} \cdot \text{K}})(294.15 \text{ K})} = 0.2792 \text{ moles of H}_2$$

$$0.2792 \text{ moles H}_2 \times 2.016 \text{ g H}_2 = 0.563 \text{ g H}_2$$

5) b is a correction for the volume of gas particles

6) Gas A:  $P_1 V_1 = P_2 V_2$   
 $(1.0 \text{ atm})(4.0 \text{ cm}^3) = P_2 (14.0 \text{ cm}^3)$

$$0.29 \text{ atm} = 0.2857 \text{ atm} = P_2$$

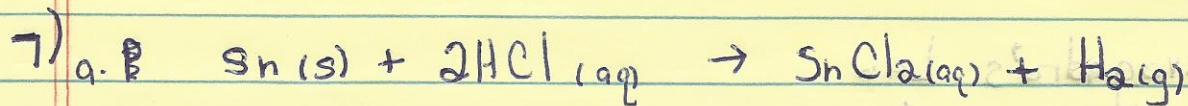
Gas B:  $P_1 V_1 = P_2 V_2$

$$(2.0 \text{ atm})(10.0 \text{ cm}^3) = P_2 (14.0 \text{ cm}^3)$$

$$1.4 \text{ atm} = 1.4286 \text{ atm} = P_2$$

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(3)



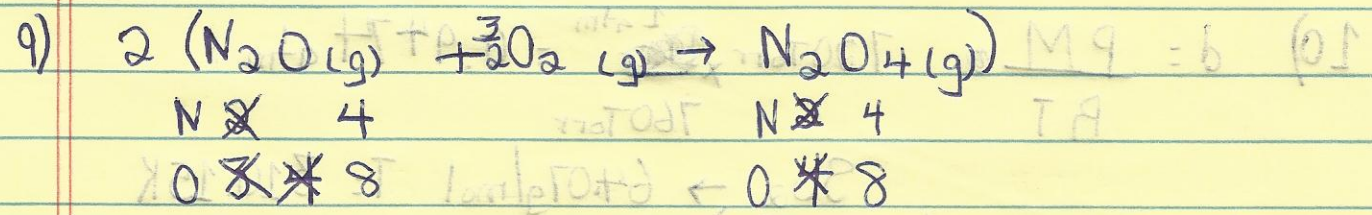
b.  $1.40 \text{ g Sn} \times \frac{\text{mol Sn}}{118.71 \text{ g}} = 0.01179 \text{ mol Sn}$ ;  $710 \text{ Torr} = 710 \text{ mmHg} \times \frac{1 \text{ atm}}{760 \text{ mmHg}} = 0.9342 \text{ atm}$

$PV = nRT$   
 $V = \frac{nRT}{P} = \frac{(0.01179 \text{ mol})(0.08206 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}})(300.15 \text{ K})}{0.9342 \text{ atm}}$   
 $= 0.311 \text{ L}$

8)  $PV = nRT$   
 $n = \frac{PV}{RT} = \frac{(1.00 \text{ atm})(2.54 \text{ L})}{0.08206 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}}(318.15 \text{ K})} = 0.09729 \text{ mol Br}_2$

$PV = nRT$   
 $P_{\text{final}} = \frac{nRT}{V} = \frac{(0.09729 \text{ mol})(0.08206 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}})(473.15 \text{ K})}{15.0 \text{ L}} = 0.2518 \text{ atm}$

$0.2518 \text{ atm} \times \frac{760 \text{ mmHg}}{1 \text{ atm}} = 190 \text{ mmHg}$

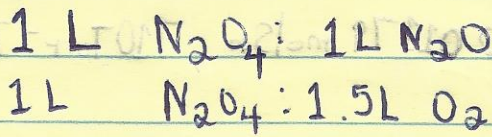


$2 \text{ N}_2\text{O}(g) + 3 \text{ O}_2(g) \rightarrow 2 \text{ N}_2\text{O}_4(g)$   
 1 mol  $\text{N}_2\text{O}_4$  : 1 mol  $\text{N}_2\text{O}$   
 1 mol  $\text{N}_2\text{O}_4$  : 1.5 mol  $\text{O}_2$

(4)

9. Avogadro's Law

$$V \propto n$$



$$3.6 \text{ L } \text{N}_2\text{O}_4 \times \frac{1 \text{ L } \text{N}_2\text{O}}{1 \text{ L } \text{N}_2\text{O}_4} = 3.6 \text{ L } \text{N}_2\text{O}$$

$$3.6 \text{ L } \text{N}_2\text{O}_4 \times \frac{1.5 \text{ L } \text{O}_2}{1 \text{ L } \text{N}_2\text{O}_4} = 5.4 \text{ L } \text{O}_2$$

$$\textcircled{a} 3.6 \text{ L } \text{N}_2\text{O}_4 \times \frac{1.5 \text{ L } \text{O}_2}{1 \text{ L } \text{N}_2\text{O}_4} = 5.4 \text{ L } \text{O}_2$$

b. The 4.0 L of  $\text{O}_2$  were @  $P = 2.00 \text{ atm}$ ;  $T = 20^\circ\text{C}$ 

$$PV = nRT$$

$$n = \frac{PV}{RT} = \frac{(2.00 \text{ atm})(4.0 \text{ L})}{(0.08206 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}})(293.15 \text{ K})} = 0.3326 \text{ mol } \text{O}_2$$

$$0.3326 \text{ mol } \text{O}_2 \times \frac{2 \text{ mol } \text{N}_2\text{O}_4}{3 \text{ mol } \text{O}_2} = 0.2217 \text{ mol } \text{N}_2\text{O}_4$$

@  $P = 1.0 \text{ atm}$ ,  $T = 20^\circ\text{C}$ 

$$PV = nRT$$

$$V = \frac{nRT}{P} = \frac{(0.2217 \text{ mol})(0.08206)(326.15)}{1.0 \text{ atm}} = 5.93 \text{ L of } \text{N}_2\text{O}_4$$

$$10) d = \frac{PM}{RT} = \frac{720 \text{ Torr} \times \frac{1 \text{ atm}}{760 \text{ Torr}}}{(0.08206 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}})(310.15 \text{ K})} = 0.9474 \text{ atm}$$

$$\text{SO}_2 \rightarrow 64.07 \text{ g/mol } T = 310.15 \text{ K}$$

$$d = \frac{0.9474 \text{ atm} (64.07 \frac{\text{g}}{\text{mol}})}{(0.08206 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}})(310.15 \text{ K})} = 2.38 \text{ g } \text{SO}_2$$

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Need to find the molecular mass.

11)

$$PV = nRT$$

$$n = \frac{PV}{RT} = \frac{3.75 \text{ atm} (1.0 \text{ L})}{(0.08206 \frac{\text{L} \cdot \text{atm}}{\text{mol} \cdot \text{K}}) (310.15 \text{ K})} = 0.1473 \text{ mol}$$

$$M = \frac{5.02 \text{ g}}{0.1473 \text{ mol}} = 34.1 \frac{\text{g}}{\text{mol}}$$

a. $\text{H}_2\text{O}$	b. $\text{HBr}$	c. $\text{HCN}$	d. $\text{H}_2\text{S}$	e. $\text{C}_2\text{H}_2$
18.016g	80.908g	27.028g	34.086g	26.036g
mol	mol	mol	mol	mol

12)

$$P_{\text{total}} = 1380 \text{ mmHg}$$

g: Ar

$$\chi_g = \frac{n_g}{n_{\text{total}}} = \frac{1.5 \text{ mol Ar}}{5.81 \text{ mol}} = 0.258$$

$$P_g = \chi_g P_{\text{total}} = 0.258 (1380 \text{ mmHg}) = 356 \text{ mmHg}$$