Name: ______________________ date: __________ period: ______

ch. 12 & 14 stochimetry & gas test ~~55~~ 50 points honors chemistry

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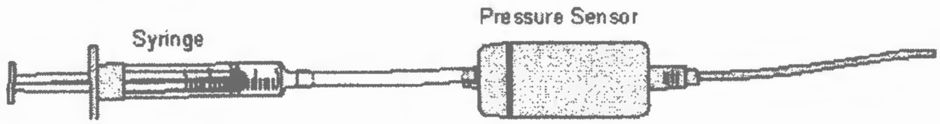
In problems involving any calculation, show your work in an organized manner, include (i) any relevant equation (or formula), (ii) conversion factor(s), (iii) put the proper units in your calculations and answer, and (iv) have the proper number of significant figures in your answer.

1. In regards to the Boyles' law lab, a schematic diagram of experimental setup



Describe the graphical analysis and its basis / rationale to estimate the volume of the tubing and the number of moles of gas in the system. [~~15~~ 10 points]

2 pt i) $V_{system} = V_{syringe} + V_{tubing}$ ①

$P V_{system} = nRT$ ②

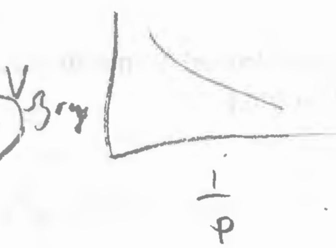
2 pt Subst ① into ②

$P (V_{syringe} + V_{tubing}) = nRT$

2 pt rearrange

$V_{syringe} = nRT \frac{1}{P} - V_{tubing}$

(ii) 2 pt



(iii) slope = $nRT \rightarrow n = \frac{slope}{RT}$

2 pt y-intercept = $-V_{tubing} \rightarrow V_{tubing} = -$y-int

2. The gas in a 125 mL container at 85 °C and 1.0 atm was condensed to 365.7 mg liquid. What is the molar mass of the gas ? [10 points]

2 pt i) $PV = nRT$

3

1 atm (0.125 L) = n $0.0821 \frac{L\,atm}{mol\,K}$ (85 + 273) K

n = 0.0043 mol

ii) molar mass = $\frac{\# g}{\# mol} \cdot \frac{0.3657 g}{0.0043 mol}$ = 85 g/mol

2 pt 3 pt

5 pts

3. Fill-in the blank: 5.0 g C_2H_5OH + 10.0 g O_2 → _____ g CO_2 + H_2O. [15 points]

3 pt i) 5 g C_2H_5OH × (1 mol C_2H_5OH / 46 g C_2H_5OH) × (3 mol O_2 / 1 mol EtOH) × (32 g O_2 / mol O_2) = 10.4 g O_2 needed

2 have 10 g → O_2 is limiting

ii) 10 g O_2 × (mol O_2 / 32 g O_2) × (2 mol CO_2 / 3 mol O_2) × (44 g CO_2 / 1 mol CO_2) = 9.2 g CO_2

1 1 1 2 pt

4. One gram of a hydrocarbon produced 3.0698 g carbon dioxide and 1.4651 g water. What is the empirical formula ? [15 points]

CH + O_2 → CO_2 + H_2O

1 g 3.0698 g 1.4651 g

3 pt

i) % C in CO_2 = 12/44 = # g C in CO_2 / # g CO_2 = # g C in CO_2 / 3.0698 g

g C in CO_2 = 0.8371 g

ii) # g in cpd = # g C in CO_2 = 0.8371 g

iii) # g cpd = # g C in cpd + # g H in cpd

1 g = 0.8371 g + # g H in cpd

g H in cpd = 0.1629 g

iv) 0.8371 g C × (mol C / 12 g C) = 0.06976 mol C

0.1629 g × (mol H / 1 g H) = 0.1629 mol H

v) C : H

0.06976 : 0.1629

1 : 2.335

1 : 2 1/3

1 : 7/3

3 : 7

EF = C_3H_7

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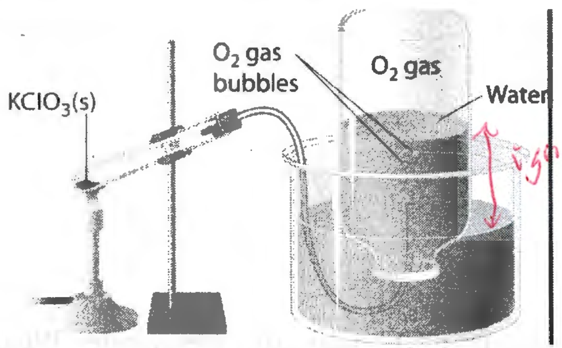
1. In a gas stoichiometry lab, a schematic diagram of the experimental setup is shown below.



Based on the hypothetical experimental data

Volume of gas = 275 mL
Temperature = 22 °C
Total pressure = 750 torr

regarding the reaction: $KClO_{3(s)} \rightarrow KCl_{(s)} + O_{2(g)}$

What is the mass of $KClO_3$? [~~15~~ 10 points]

2 i) $2KClO_3 \rightarrow 2KCl + 3O_2$

3 ii) $P_{total} = P_{O_2} + P_{H_2O}$

$750\ torr = P_{O_2} + 19.8\ torr$

$P_{O_2} = 730.2\ torr$

3 iii) $n_{O_2} = \frac{P_{O_2}V}{RT} = \frac{(730.2\ torr \cdot \frac{1\ atm}{760\ torr})\ 0.275\ L}{(0.0821\ \frac{L\ atm}{mol\ K})(22+273)\ K}$

$= 0.0109\ mol\ O_2$

2 iv) $0.0109\ mol\ O_2 \cdot \frac{2\ mol\ KClO_3}{3\ mol\ O_2} \cdot \frac{122.55\ g\ KClO_3}{mol\ KClO_3} = 0.89\ g$

2. What is the density of CCl_4 at 714 mm Hg and 125 °C ? [10 points]

(10/10)

- $PV = nRT$
- $P = \frac{g}{molar\ mass\ V} RT$
- $P \cdot molar\ mass = \frac{g}{V} RT$
- $= dRT$
- $d = \frac{P \cdot molar\ mass}{RT}$

$= \frac{(714\ mm\ Hg \cdot \frac{1\ atm}{760\ mm\ Hg})\ 154\ \frac{g}{mol}}{(0.0821\ \frac{L\ atm}{mol\ K})(125+273)\ K}$

$= 4.4\ g/L$

3. Fill-in the blank: 5.0 g C_3H_8 + 10.0 g O_2 → _____ g CO_2 + H_2O. [15 points]

i) $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

ii) $5\,g\,C_3H_8 \;\frac{mol\,C_3H_8}{44\,g\,C_3H_8}\;\frac{5\,mol\,O_2}{1\,mol\,C_3H_8}\;\frac{32\,g\,O_2}{mol\,O_2} = 18.2\,g\,O_2$ need

5pts

have 10 g O_2

∴ O_2 is limiting

iii) $10\,g\,O_2\;\frac{mol\,O_2}{32\,g\,O_2}\;\frac{3\,mol\,CO_2}{5\,mol\,O_2}\;\frac{44\,g\,CO_2}{1\,mol\,CO_2} = 8.25\,g\,CO_2$

4. Mixing one gram of copper chloride and excess silver nitrate form 2.13 grams of a precipitate. What is the empirical formula of the copper chloride ? [15 points]

$CuCl_x + AgNO_3 \rightarrow AgCl_{(s)} + Cu(NO_3)_?$

1.0 g ... 2.13 g

4pts i) % Cl in AgCl = $\frac{35.5}{143} = \frac{\#\,g\,Cl}{2.13}$; # g Cl = 0.5288 g Cl

4 ii) # g Cu = # g sample − # g Cl = 1 − 0.5288 = 0.4712 g Cu

4 iii) $0.4712\,g\,Cu\;\frac{mol\,Cu}{63.5\,g\,Cu} = 0.00742$ mol Cu

$0.5288\,g\,Cl\;\frac{mol\,Cl}{35.5\,g\,Cl} = 0.0149$ mol Cl

3 iv) Cu : Cl

0.00742 : 0.01349

1 : 1.2

$CuCl_2$

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ch. 12 & 14 stochimetry & gas retest 50 points (5 ec) honors chemistry

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1. A rigid 125 mL container has a pressure of 95 kPa and the temperature in the container is 22 °C; the container is heated to 58 °C; what is the pressure in the container ? [10 points]

2 pt 3

$PV = nRT$

$\frac{P}{T} = \frac{nR}{V} = k$

$\frac{P_1}{T_1} = \frac{P_2}{T_2}$

$\frac{95 kPa}{(22+273)K} = \frac{P}{(58+273)K}$

$P = \frac{95(58+273)}{22+273} = 107 kPa$

2 pt 3

2. The complete combustion of a 1.0 g carboxylic acid, which contains carbon, hydrogen, and oxygen, produced 1.4474g of carbon dioxide and 0.5921 g of water; what is the compound's empirical formula ? [15 points]

i) % of C in CO_2 = $\frac{12}{44} = \frac{\# g C}{\# g CO_2} = \frac{\# g C}{1.4474}$

\# g C = 0.3947 g

ii) % H in H_2O = $\frac{2}{18} = \frac{\# g H}{\# g H_2O} = \frac{\# g H}{0.5921}$

3 pt @

\# g H = 0.0658 g

iii) \# g cpd = \# g C + \# g H + \# g O

1 = 0.3947 + 0.0658 + \# g O

\# g O = 0.5395

iv) 0.3947 g C $\frac{mol}{12 g}$ = 0.03289 mol C

0.0658 g H $\frac{mol}{1 g}$ = 0.0658 mol H

0.5395 g O $\frac{mol}{16 g}$ = 0.0337 mol O

v) C : H : O

0.03289 : 0.0658 : 0.0337

1 2 1

CH_2O

$\rightarrow$ mw = 88 g/mol

3. What is the density of CF_4 at 714 mm Hg and 125 °C ? [10 points]

$PV = nRT$

$= \frac{\#g}{\text{molar mass}} RT$

$P = \frac{\#g}{V} \frac{RT}{\text{molar mass}}$

$= \frac{d RT}{\text{molar mass}}$

$d = \frac{P \cdot \text{molar mass}}{RT}$ (5 pt)

(5 pt) $= \frac{714 \text{ mm Hg} \frac{1 \text{ atm}}{760 \text{ mm Hg}} \frac{88 \text{ g}}{\text{mol}}}{\left(0.0821 \frac{\text{L atm}}{\text{mol K}}\right)(125+273)\text{ K}} = 2.5 \frac{\text{g}}{\text{L}}$

4. In regards to the reaction: $3\,H_{2(g)} + N_{2(g)} \rightarrow 2\,NH_{3(g)}$, the initial partial pressure of N_2 and H_2 is 5.0 atm and 12.0 atm, respectively, in a 125 L container at 137 °C. What is the total pressure in the container at the end of the reaction ? Assume % yield = 100%. [20 points]

i) $n_{N_2} = \frac{P_{N_2} V}{RT} = \frac{5 \text{ atm} (125 \text{ L})}{\left(0.0821 \frac{\text{L atm}}{\text{mol K}}\right)(137+273)\text{ K}} = 18.57 \text{ mol } N_2$

$n_{H_2} = \frac{P_{H_2} V}{RT} = \frac{12 \text{ atm} (125 \text{ L})}{0.0821 \frac{\text{L atm}}{\text{mol K}} (137+273)\text{ K}} = 44.56 \text{ mol } H_2$

ii) $44.56 \text{ mol } H_2 \frac{1 \text{ mol } N_2}{3 \text{ mol } H_2} = 14.85 \text{ mol } N_2$ need

have $18.57 \text{ mol } N_2$

$\therefore N_2$ is excess $\rightarrow H_2$ is limiting

& $18.57 - 14.85 = 3.72 \text{ mol } N_2$ remain

5 pt each

iii) $44.56 \text{ mol } H_2 \frac{2 \text{ mol } NH_3}{3 \text{ mol } H_2} = 29.7 \text{ mol } NH_3$ produced

iv) $P_{total} = \frac{n_{total} RT}{V}$

$= \frac{(n_{NH_3} + n_{N_2} + n_{H_2}) RT}{V}$

$= \frac{(29.7 + 3.72 + 0) \text{ mol} \; 0.0821 \text{ L atm/mol K} \; (137+273)\text{ K}}{125 \text{ L}}$

$= 9.0 \text{ atm}$