

Name: _____

date: _____

ch. 11, 3, 4 IMF, stoichiometry, & chemical reactions test 75 points (7.ec) AP chemistry

Academic Honesty: The answers on this test are my own and I am using only the allowed set of notes as described in the syllabus. I have not discussed the test questions with anyone before or during the test nor have I seen the test questions prior to the exam. If you violate any of the preceding items or do not sign, your semester grade is a F.

Signature: _____

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. What is the relative vapor pressure for the isomers, dimethyl ether and ethyl alcohol? Basis / rationale? [10 points]

1 pt
4 pt
2
3

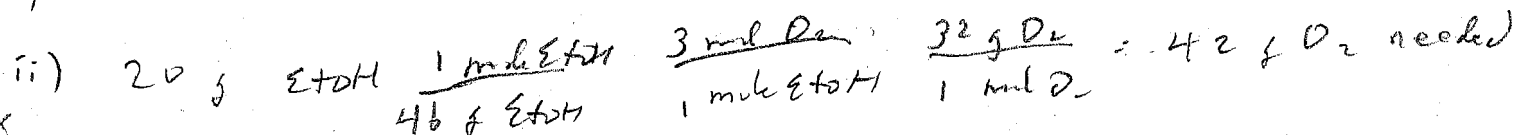
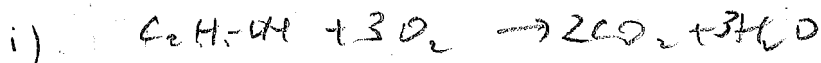
i) same polarizability b/c same e^-

ii) ether: dipole-dipole IMF b/c $H_3C-O-CH_3$
alcohol: H-bond IMF b/c CH_3CH_2-O-H

iii) relative IMF: ether < alcohol

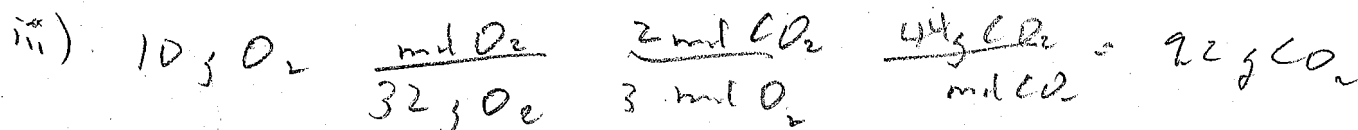
ether: \downarrow IMF \rightarrow easier to separate liquid molecules \rightarrow \uparrow evaporation \rightarrow \uparrow # gas molecules \rightarrow \uparrow V.P.

2. Solve: $20.0 \text{ g } C_2H_5OH + 10.0 \text{ g } O_2 \rightarrow \text{ ___ g } CO_2 + H_2O$, where the % yield = 85%. [20 points]



5 pt

have 10 g $O_2 \rightarrow O_2$ is limiting reactant



iv) $\% \text{ yield} = \frac{\text{expt yield}}{\text{calc yield}}$

$85\% = \frac{\text{expt yield}}{9.2 \text{ g}}$

expt yield = $7.8 \text{ g } CO_2$

3. In the redox titration: $3 A + 7 B \rightarrow \text{products}$; at the equivalence point, there is 75 mL B and 15 mL of 100 mM of A; what is the original [B]? [10 points]

$$3 \text{ pt} \left\{ [A] V_A = [B] V_B \quad \frac{3 \text{ ml A}}{7 \text{ ml B}}$$

$$3 \quad 7 [A] V_A = 3 [B] V_B$$

$$2 \quad 7 (100 \text{ mM}) 15 \text{ mL} = 3 [B] 75 \text{ mL}$$

$$2 \quad [B] = 46.7 \text{ mM}$$

4. The complete combustion of 1.0 g of a carboxylic acid with excess oxygen gas, produces 2.0 g carbon dioxide and 0.8182 g water. Based on the preceding information, ... [20 points]

a. What is the empirical formula of the carboxylic acid?

$$i) \quad \% \text{ C in } \text{CO}_2 = \frac{\# \text{ g C in } \text{CO}_2}{\# \text{ g } \text{CO}_2} = \frac{12}{44} = \frac{\# \text{ g C in } \text{CO}_2}{2 \text{ g}}$$

$$\# \text{ g C in } \text{CO}_2 = \# \text{ g C in } \text{CO}_2 = 0.5455 \text{ g C}$$

$$ii) \quad \% \text{ H in } \text{H}_2\text{O} = \frac{\# \text{ g H in } \text{H}_2\text{O}}{\# \text{ g } \text{H}_2\text{O}} = \frac{2}{18} = \frac{\# \text{ g H in } \text{H}_2\text{O}}{0.8182 \text{ g}}$$

$$\# \text{ g H in } \text{H}_2\text{O} = \# \text{ g H in } \text{H}_2\text{O} = 0.09091 \text{ g H}$$

$$iii) \quad \# \text{ g } \text{O} = \# \text{ g C} + \# \text{ g H} + \# \text{ g O}$$

$$1 = 0.5455 + 0.09091 + \# \text{ g O}$$

$$\# \text{ g O} = 0.3636$$

$$iv) \quad 0.3636 \text{ g O} \frac{\text{mol O}}{16 \text{ g O}} = 0.0227 \text{ mol O}$$

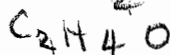
$$0.09091 \text{ g H} \frac{\text{mol H}}{1 \text{ g H}} = 0.09091 \text{ mol H}$$

$$0.5455 \text{ g C} \frac{\text{mol C}}{12 \text{ g C}} = 0.04546 \text{ mol C}$$

$$v) \quad \text{C} : \text{H} : \text{O}$$

$$0.04546 : 0.09091 : 0.0227$$

$$2 : 4 : 1$$



b. The molar mass of the carboxylic acid is about 88 g/mol; what is the chemical formula?

$$3 \text{ pt} \left\{ i) \quad \text{CF} = (\text{EF})_n$$

$$n = \frac{\text{CF}}{\text{EF}} = \frac{88}{44} = 2$$

$$2 \left\{ ii) \quad (\text{C}_2\text{H}_4\text{O})_2 \text{ or } \text{C}_4\text{H}_8\text{O}_2 = \text{CF}$$

5. Write the net ionic equations for ___ (hypothetical reaction ?); if there's no net ionic equation, then write "no net ionic equation". Need not "show your work". [12 points]

a. mix aqueous solutions of sodium carbonate and hydrogen chloride



b. mix aqueous solutions of potassium nitrate and sodium chloride

no NIE

c. mix aqueous solutions of lithium phosphate and barium bromide



d. mix aqueous solutions of potassium hydroxide and hydrogen sulfate



6. Describe how to prepare 175 mL of 725 mM calcium nitrate? [10 points]

- 5 pt
- i) $n = [i] V = 725 \frac{mmol}{L} \cdot 175 mL \cdot \frac{L}{10^3 mL} \cdot \frac{mol}{10^3 mmol} = 0.127 mol$
- 3 pt
- ii) $0.127 mol \cdot \frac{164 g Ca(NO_3)_2}{1 mol Ca(NO_3)_2} = 20.8 g$
- 2 pt
- iii) mix 20.8 g $Ca(NO_3)_2$ & enough H_2O to make 175 mL soln