Name: ______________________ date: ____________ period: _____

ch. 11, 3, & 4 IMF, stochiometry, & reactions test 65 points AP chemistry

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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. Rationalize

compound	Boiling point
CS_2	318 K
COS	223 K

using concepts of the relative strength of various types of IMF and the relative strength of the total IMF between the above chemicals; clearly associate the type of IMF and the chemical. [10 points]

3 pt i) CS_2 : 6 + 32 = 38 e⁻ ; COS : 6 + 8 + 16 = 30 e⁻ } CS_2 have higher polarizability & higher London IMF

4 ii) S = C = S, Σ = 0 → nonpolar mol → London IMF; S = C = O, Σ ≠ 0 → polar mol → dipole-dipole IMF

3 iii) total IMF: CS_2 > COS b/c relative boiling pt

2. In the (redox) titration, the balanced net ionic equation is

$5\ Fe^{2+} + MnO_4^- + 8\ H^+ \rightarrow 5\ Fe^{3+} + Mn^{2+} + 4\ H_2O$

35 mL of 75 mM MnO_4^- was needed to titrate 125 mL aqueous solution of Fe^{2+}. What is the $[Fe^{2+}]$ prior to titration ? [10 points]

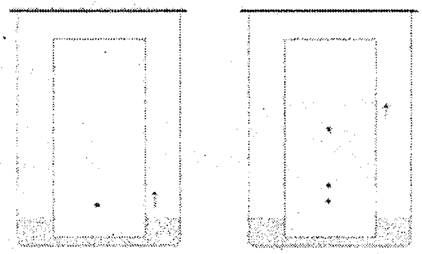
5 pt

$[Fe^{+2}]\ V_{Fe^{+2}} = 5\ [MnO_4^-]\ V_{MnO_4^-}$

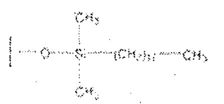
3 $[Fe^{+2}]\ 125\ mL = 5\ (75\ mM)\ 35\ mL$

2 $[Fe^{+2}] = 105\ mM$

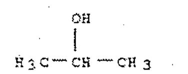
3. In a TLC (thin layer chromatography) laboratory activity



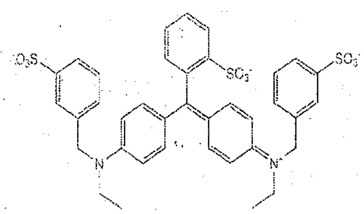
assume that the stationary phase is the same chemical as in your column chromatography lab and the mobile phase is 10% isopropyl alcohol, which was able to separate the red versus blue food dyes in your column chromatography lab. [15 points]

C18 

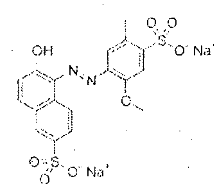
(source: stationary phase's surface)



(isopropyl alcohol - mobile phase)

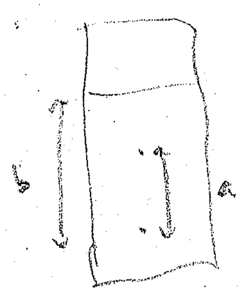


(source: blue dye)



(source: red dye)

a. Define / illustrate R_f in the context of a TLC lab.



• $R_f = \frac{a}{b} = \frac{\text{distance chemical move}}{\text{distance solvent move}}$

5pt@

b. What is the relative value of the R_f for the red versus blue dye ? Basis / rationale ?

• R_f(red) > R_f(blue) b/c

• as red · C18 IMF < blue · C18 IMF, so red travel more than blue
due to relative polarizability to blue dye

~~• ROH displace/competes with dye to bind C18~~

~~• ∃ dynamic binding/dissociation/rebinding~~

~~red, blue, & ROH with C18~~

C H O

4. The combustion of 2.78 mg of an ester produced 6.32 mg carbon dioxide and 2.58 mg of water. The molar mass is about 116 g / mol. What is the chemical formula of the ester ? [15 points]

i) % g C in CO_2 = # g C in CO_2 / # g CO_2 = # mg C in CO_2 / 6.32 mg = 12 / 44

g C in cpd = # g C in CO_2 = 1.724 mg C

ii) % H in H_2O = # g H in H_2O / # g H_2O = # mg H in H_2O / 2.58 mg = 2 / 18

mg H in cpd = # mg H in H_2O = 0.287 mg H

iii) # mg cpd = # mg C in cpd + # mg H in cpd + # mg O in cpd

2.78 mg = 1.724 mg + 0.287 mg + # mg O in cpd

mg O in cpd = 0.773 mg

2 pts +1

iv) 1.724 mg C × g / 10^3 mg × mol / 12 g = 0.0001437 mol C

0.287 mg H × g / 10^3 mg × 1 mol / 1 g = 0.000287 mol H

0.773 mg O × g / 10^3 mg × 1 mol / 16 g = 0.00004831 mol O

v) O : H : C

0.0000483 / : 0.000287 : 0.0001437

1 6 3

(vi) CF = (EF)n

n = CF / EF = 116 / 58 = 2

(vii) CF = $(C_3H_6O)_2$ = $C_6H_{12}O_2$

5. Write the net ionic equation; if there is no reaction, then write "no reaction". [15 points]

a. mix aqueous solutions of sodium acetate and silver nitrate

no RX

b. mix aqueous solutions of barium chloride and lithium phosphate

$Ba^{+2} + PO_4^{-3} \rightarrow Ba_3(PO_4)_2$

c. mix aqueous solutions of potassium hydroxide and hydrogen bromide

$H^+ + OH^- \rightarrow H_2O$

d. mix aqueous solutions of sodium carbonate and hydrogen chloride

$H^+ + CO_3^{-2} \rightarrow H_2O + CO_2$

e. add solid copper to aqueous solution of zinc nitrate

$Cu + Zn^{+2} \rightarrow Zn + Cu^+$ (or Cu^{+2})

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ch. 11, 3, & 4 IMF, stochiometry, & reactions retest 65 points (10 ec) AP chemistry

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1. Based on solubility rules and experimental observations, design an experiment to uniquely identify Na_2SO_4 from

$BaCl_2$	$CuCl_2$	Na_2CO_3	Na_2SO_4
$Ba(OH)_2$	$Cu(NO_3)_2$	NaI	
	$CuSO_4$	NaOH	

3+1 - Cu or other
4 - Ba or Na
8 - differentiate between various Na cmpd

using

NaOH	$AgNO_3$
Na_3PO_4	$Pb(NO_3)_2$
Na_2CO_3	$Fe(NO_3)_3$
NaI	$Cu(NO_3)_2$
Na_2SO_4	$Ba(NO_3)_2$

and description the expected observations and its interpretation in an organized manner. [15 points]

2. In the reaction: 5.0 g C_2H_6 + 5.0 g O_2 → CO_2 + H_2O, if the % yield = 85%, then how many grams of CO_2 would be produced in the reaction ? [20 points]

i) $2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$

5 g   5 g   # g ?

ii) 5 g C_2H_6 × mol C_2H_6 / 30 g C_2H_6 × 7 mol O_2 / 2 mol C_2H_6 × 32 g O_2 / mol O_2 = 18.6 g O_2 needed

5 pts all

have 5 g O_2

∴ O_2 is limiting

iii) 5 g O_2 × mol O_2 / 32 g O_2 × 4 mol CO_2 / 7 mol O_2 × 44 g CO_2 / 1 mol CO_2 = 3.9 g CO_2

iv) % yield = expt / calc

85% = expt / 3.93

expt = 3.3 g CO_2

3. Describe how to prepare 125 mL of 175 mM glucose, $C_6H_{12}O_6$ using …. [10 points]

a. Solid glucose and water

2 pts

2 pts

1

n = [ ] V = 175 mmol / L · 125 mL · L / 10^3 mL = 21.875 mmol

21.875 mmol · mol / 10^3 mmol · 180 g / mol = 3.94 g

∴ mix 3.94 g glucose + enough H_2O to make 125 mL soln

b. 225 mM glucose and water

1 pt

1

1

1

1 pt

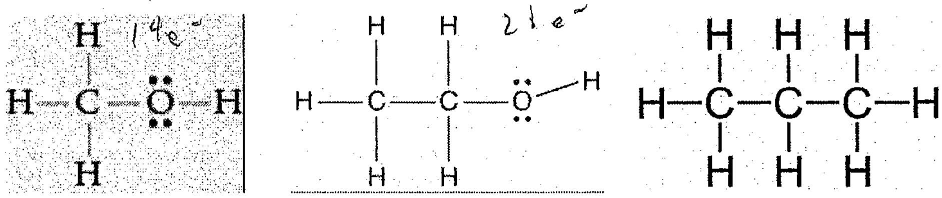
[dil] V_{dil} = [concd] V_{concd}

175 mM · 125 mL = 225 mM V_{concd}

V_{concd} = 97.2 mL

mix 97.2 mL concd soln & 27.8 mL H_2O

4. In regards to CH_3OH versus C_2H_5OH versus C_3H_8, _____ [15 points] 26 e⁻



Boiling point = 65 °C ? - 42 °C

a. What is the relative boiling point ? Basis / rationale of relative boiling point: using concepts of the relative strength of various types of IMF and the relative strength of the total IMF between the above chemicals; clearly associate the type of IMF and the chemical.

1 pt · BP : C_2H_5OH > CH_3OH > C_3H_8 b/c

1 pt · total IMF : C_2H_5OH > CH_3OH > C_3H_8

3 pts, 2 pts

MeOH: Σ ≠ 0 → polar → H-bond IMF + London

EtOH: Σ ≠ 0 → polar → H bond IMF + London

C_3H_8: Σ = 0 → nonpolar → London

· relative type IMF

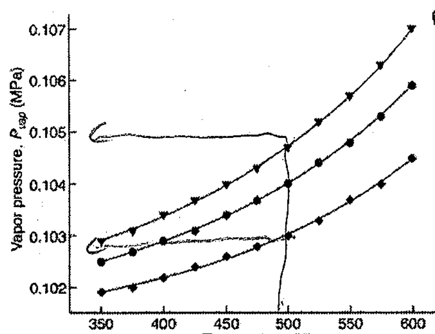
2 pt · EtOH > MeOH b/c EtOH has higher polarizability

1 · EtOH ≈ C_3H_8 for polarizability

2 · EtOH > C_3H_8 b/c EtOH has H bond IMF & C_3H_8 has only London

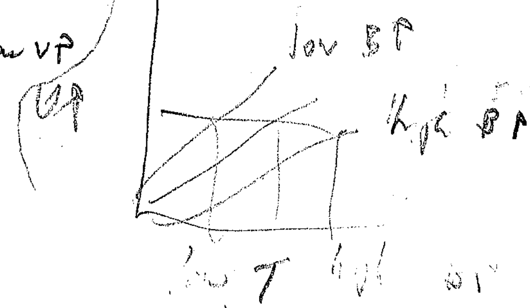
b. identify the above chemicals with the below graphs (ignore the numeric values on both axis). Basis / rationale = draw imaginary line(s) on the below graph, which is consistent with the preceding basis / rationale.

2 pt

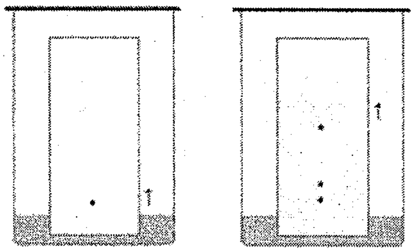


C_3H_8 = high VP

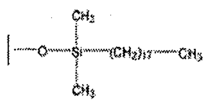
EtOH = low VP



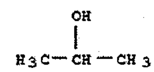
5. . In a TLC (thin layer chromatography) laboratory activity



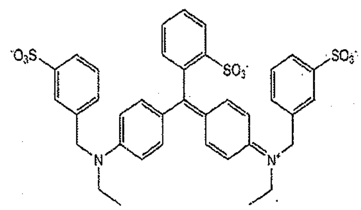
assume that the stationary phase is the same chemical as in your column chromatography lab and the mobile phase is 10% isopropyl alcohol, which was able to separate the red versus blue food dyes in your column chromatography lab. [15 points]



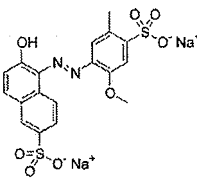
(source: stationary phase's surface)



(isopropyl alcohol - mobile phase)



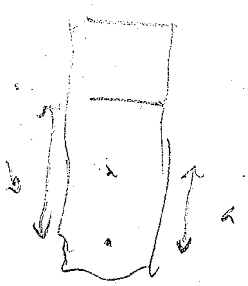
(source: blue dye)



(source: red dye)

b. Define / illustrate R_f in the context of a TLC lab.

6 pts
2 pts



$R_f = \frac{a}{b} = \frac{\text{distance cpd move}}{\text{distance solvent move}}$

b. What is the relative value of the R_f for the red versus blue dye ? Basis / rationale ?

4 pts
3 pts

- R_f (red) > R_f (blue) [or R_f (blue) < R_f (red)] b/c
- red weaker IMF with C18 than blue, due to difference in polarizability
  ↓
  red retarded less than blue
  ↓