5/1/03 *Typo*

Key

Error #1
Re calculate
w/ atm!
1.

1. D

2. A

3. E

4. D

5. D

AP Chemistry Quiz#7   Name(s)_____
Topic: Liquids, Solids, Solutions
Chapter 11 & 13 (20 points)   Date_____   Period_____

Directions: In the spaces provided to the left, write the answer that best completes each statement below. Calculators are allowed on Questions 1 and 2 on the Multiple Choice. (2 points each)

___D___ 1. The vapor pressure of pure water at 25 °C is 23.8 mm. Determine the vapor pressure, ~~in mm Hg~~, of water at 25 °C above a solution containing 35 g of urea(a nonvolatile, non electrolyte. MWt = 60.0 g/mol) dissolved in 75 g of water.

a) 0.88   b) 2.9   c) 3.3   d) 21   e) 27

$$P_A = X_A P_A^o \qquad X_{A\,(solvent)} = \frac{Moles\ Solvent}{total\ mols}$$

$$\frac{35g\ urea}{} \left| \frac{mol}{60g} \right| = .583\ mol$$

$$\frac{75g\ H_2O}{} \left| \frac{mol}{18g} \right| = 4.2\ mol$$

$$P_A = \left[\frac{4.16}{(.583 + 4.16)} \right] 23.8\ mm$$

$$= 21\ \cancel{atm}\ mm\ Hg$$

___A___ 2. A solution prepared by dissolving 0.60 g of nicotine(a nonelectrolyte) in water to make 12 mL of solution has an osmotic pressure of 7.55 atm at 25 °C . What is the molecular weight of nicotine in g/mol?

a) 160   b) 50   c) 43   d) 28   e) .60

$$\Pi = \frac{n}{V} RT = MRT \qquad 7.55\ atm = \left(\frac{n}{.012L} \right) \left(.0821\ \frac{L\,atm}{mol\,k} \right) 298K$$

$$n = .0037\ moles \quad ; \quad MM = \frac{.60g}{.0037\ mol} = 162\ g/mol$$

160g/mol (25.7)

(I.)   CH₄ has a lower boiling point than SiH₄. ⊕
II.   The predominant intermolecular force that is responsible for the fact that ice is less dense than liquid water is dipole-dipole. F
(III)   The shape of a liquid's meniscus is determined by the relative magnitudes of cohesive forces in the liquid and adhesive forces between the liquid and its container. T
(IV)   The strength of London dispersion forces between like-molecules depends on their molecular mass and polarizability. T
V.   Volatile liquids have low vapor pressures. F

___E___ 3. Which of the above statements are **correct**? Only...

a) I   b) I and III   c) I and V   d) I, II and V   e) I, III, and IV

$0.50 M\ Fe\ (NO_3)_3 = \underline{2.0\ M\ ions}$

$\boxed{0.75\ NaF = 1.50\ M\ ions}$
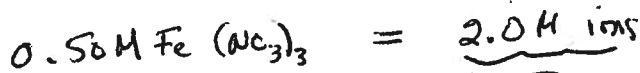
I. CH_3OH, CCl_4, and LiF, are listed in order of increasing solubility in water. F

II. KOH readily dissolves in water because of strong solute-solvent inter-actions. T

III. A 28% sulfuric acid solution by mass means that one liter of solution has a mass of 28 grams. F

IV. A 0.50 M iron(III) nitrate solution will have a higher boiling point than a 0.75 M sodium fluoride solution. T

V. Deviations from Raoult's law are encountered when the solute-solute and solvent-solvent interactions are weaker than solute-solvent interactions. T
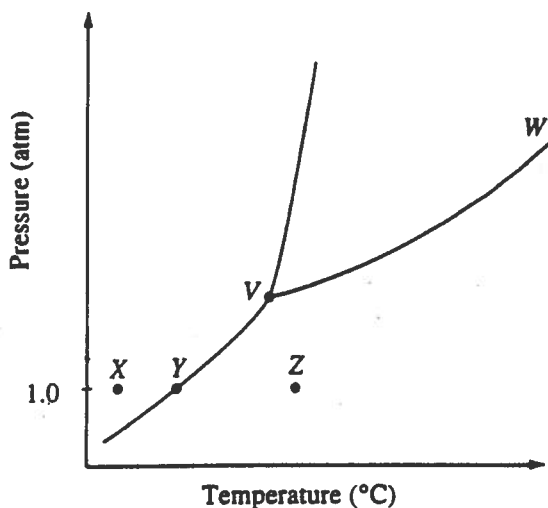
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D

_____4. Which of the above statements are **correct**? Only...

a) II   b) II and IV   c) III and V   d) II, IV and V   e) I, III, and IV

Lower U.P

Lower than what Raoult's law predicts

D _____5. Which one of the following statements is **incorrect** about the phase diagram of the pure substance below?

critical point

Vapor pressure curve ends
This is at the critical temp and pressure!
Beyond this point the L & G phase become indistinguishable

a. Boiling is occurring at each point on the curve between V and W. T
b. V represents the triple point where all three states of the substance coexist. T
c The solid and liquid have identical vapor pressures at point V. T
d. At point X the substance is a gas, at Y the substance is a liquid, and at point Z the substance is a solid. F
e. In a solid-liquid mixture of this substance, the solid will sink. T

II. Solve the following free response in the space provided below and on the back of this sheet. Calculators are allowed on this part.

An unknown compound contains only the three elements C, H, and O. A pure sample of the compound is analyzed and found to be 65.60 percent C and 9.44 percent H by mass.

(a) Determine the empirical formula of the compound. (3pts)

(b) A solution of 1.570 grams of the compound in 16.08 grams of camphor is observed to freeze at a temperature 15.2 Celsius degrees below the normal freezing point of pure camphor. Determine the molar mass and apparent molecular formula of the compound. (The molal freezing-point depression constant, K_f, for camphor is 40.0 kg-K-mol^{-1}.) (+3)

(c) When 1.570 grams of the compound is vaporized at 300°C and 1.00 atmosphere, the gas occupies a volume of 577 milliliters. What is the molar mass of the compound based on this result? (+2)   128 g/mole

(d) Briefly describes what occurs in solution that accounts for the difference between the results obtained in parts (b) and (c). {In other words, what do you notice about the molar masses obtained in parts b and c. And predict what is going on with the molecule.} (+2)

b is twice that of c $A(g) \rightarrow 2B(g)$ Must be a dimer!

(a) Assume 100 g sample   (+1)

$$\dfrac{65.69 \, C}{} \left| \dfrac{mol \, C}{12.01 g \, C} \right| = \dfrac{5.462 \, mol \, C}{1.560} = 3.5$$

$$\dfrac{9.44 \, g \, H}{} \left| \dfrac{mol \, H}{1.008 g \, H} \right| = \dfrac{9.366 \, mol \, H}{1.560} = 6$$

(+) $$\dfrac{24.96 g \, O}{} \left| \dfrac{mol \, O}{16.0 g \, O} \right| = \dfrac{1.560 \, mol \, O}{1.560} = 1$$

Mass oxygen!

$$100g - (65.60 + 9.44g)$$
$$= 24.96 g \, O \quad (+1)$$

(+1)

So $C_{3.5} H_6 O \rightarrow \boxed{C_7 H_{12} O_2}$
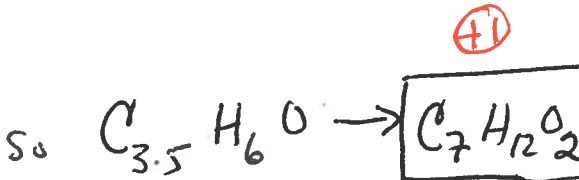
(b) $$m = \dfrac{\Delta T}{K_f} = \dfrac{15.2 °C}{40.0 \, kg \cdot K/mol} = \boxed{0.380 \, \dfrac{mol}{kg}}$$

$$\dfrac{.01608 \, kg}{} \left| \dfrac{.380 mol}{kg} \right| = \boxed{0.00611 \, mol} \qquad MM = \dfrac{1.520 g}{0.00611 mol}$$

$$= \boxed{257 g/mol}$$

So $$\dfrac{MM}{EM} = \dfrac{257 \, g/mol}{128 \, g/mol} = (2)$$

So $\therefore \boxed{C_{14} H_{24} O_4}$

2005 AP® CHEMISTRY FREE-RESPONSE QUESTIONS

Answer EITHER Question 7 below OR Question 8 printed on page 14. Only one of these two questions will be graded. If you start both questions, be sure to cross out the question you do not want graded. The Section II score weighting for the question you choose is 15 percent.

7. Use principles of atomic structure, bonding, and/or intermolecular forces to respond to each of the following. Your responses _must_ include specific information about _all_ substances referred to in each question.

(a) At a pressure of 1 atm, the boiling point of $NH_3(l)$ is 240 K, whereas the boiling point of $NF_3(l)$ is 144 K.

Between

(i) Identify the intermolecular force(s) in each substance. $\vee$ NH_3 molecule is H Bonding $\vee$ NF_3 is Dipole Dipole

(ii) Account for the difference in the boiling points of the substances.
H-Bonding is a "stronger" intermolecular force then Dipole Dip

(b) The melting point of $KCl(s)$ is 776°C, whereas the melting point of $NaCl(s)$ is 801°C.

(i) Identify the type of bonding in each substance. _Ionic_

(ii) Account for the difference in the melting points of the substances.
NaCl has a greater lattice energy due to the distance between the ionic

(c) As shown in the table below, the first ionization energies of Si, P, and Cl show a trend. Charg Na+ & Cl-

being closer

$LE = k \dfrac{QQ}{d}$

Element	First Ionization Energy (kJ mol⁻¹)
Si	786
P	1,012
Cl	1,251

(i) For each of the three elements, identify the quantum level (e.g., $n = 1$, $n = 2$, etc.) of the valence electrons in the atom. All three atoms the valence e⁻ are $n = 3$

(ii) Explain the reasons for the trend in first ionization energies.
Going Forva Si → Cl the effective nucleus increases √ atomic radius

(d) A certain element has two stable isotopes. The mass of one of the isotopes is 62.93 amu and the mass of the other isotope is 64.93 amu.

becomes smaller therefore require more energy to Remove th

(i) Identify the element. Justify your answer. Cu

(ii) Which isotope is more abundant? Justify your answer. outer most e⁻

$^{62.93}Cu$

Average A.M. of 63.54 is close to this

isotopes Mass

GO ON TO THE NEXT PAGE.