Chemistry 1212 Name____
February 6, 2020
Exam #1

Write very clearly and **show all of your work** for partial credit. A list of equations and constants as well as a periodic table are on the last two pages of your exam.

1.(20 points) Fill in the space with the correct response.

(a) What type of crystalline solid is a bucky ball? $\boxed{\text{atomic}}$

(b) What is the strongest intermolecular force present in methanol (CH_3OH)?

$\boxed{H-bonding}$

(c) A compound's $\boxed{\text{polarizability}}$ determines the strength of its induced dipole.

(d) Circle the species which is **least** miscible with water.

HBr $\boxed{He}$ $CaSO_4$ CH_3COCH_3 All the same

(e) Circle the gas which experiences the **weakest** intermolecular force.

$BaCl_2$ $\boxed{SiBr_4}$ Xe CH_3COCH_3 All the same

(f) Circle the species with the **highest** vapor pressure.

HCl $\boxed{F_2}$ H_2O BI_3 All the same

(g) Circle the species which is has the **lowest** viscosity.

$\boxed{CO_2}$ HI H_2S NH_3 All the same

(h) Circle the species which has the **lowest** melting point.

$\boxed{CH_4}$ CH_3CH_3 CH_3OH CH_3CH_2OH All the same

(i) Circle the species which has the **smallest** amount of hydrogen bonding.

H_2CO CH_3CH_3 CH_4 Xe $\boxed{\text{All the same}}$

(j) How many mg need to be added to 1L to make a 125 ppm solution? $\boxed{125\ mg}$

2. (20 points) Carbon disulfide had a vapor pressure of 100 mm Hg at -5.1°C and a normal boiling point of 46.5°C. What vapor pressure will the species have at 100°C?

Similar to Chapter 10 In Class Exercise #3

$$\ln\left(\frac{P_1}{P_2}\right)=\frac{\Delta H_{vap}}{R}\left(\frac{1}{T_2}-\frac{1}{T_1}\right)\rightarrow \Delta H_{vap}=R\ln\left(\frac{P_1}{P_2}\right)\Big/\left(\frac{1}{T_2}-\frac{1}{T_1}\right)\quad (2\,pts)$$

$$T_1=-5.1+273.15=268.05K\quad (2\,pts)$$

$$T_2=46.5+273.15=319.65K\quad (2\,pts)$$

$$\Delta H_{vap}=8.3145\frac{J}{mol\bullet K}\ln\left(\frac{100}{760}\right)\Big/\left(\frac{1}{319.65}-\frac{1}{268.05}\right)\quad (2\,pts)$$

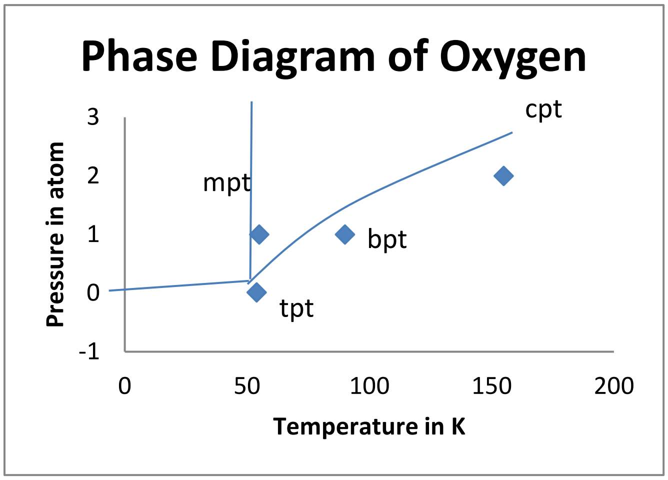
$$\Delta H_{vap}=28{,}001\tfrac{J}{mol}\rightarrow \boxed{28.0\tfrac{kJ}{mol}}\quad (3\,pts)$$

$$P_1=P_2\ mm\ Hg\times e^{\frac{\Delta H_{vap}}{R}\left(\frac{1}{T_2}-\frac{1}{T_1}\right)}\quad (3\,pts)$$

$$P_1=760.\ mm\ Hg\times e^{\frac{28{,}001\frac{J}{mol}}{8.3145\frac{J}{mol\bullet K}}\left(\frac{1}{319.65}-\frac{1}{373.15}\right)}\quad (3\,pts)$$

$$\boxed{P_1=3440\ mm\ Hg}\quad (3\,pts)$$

3. (20 points) Draw the phase diagram for oxygen. Label the axes, each phase, the triple point (54 K, 0.01 atm), the critical point (155 K, 2.0 atm), and the normal boiling and melting points are 90 K and 55 K, respectively.



2pts for each phase (*6pts* total), *2pts* for each axis label (*4pts* total), *2pts* ea. for bpt and fpt (*4pts* total), *2pts* ea. for cpt and tpt (*4pts* total), *2pts* for attempting to draw the figure to scale.

4. (24 points) The freezing points of 0.0935 m ammonium chloride and 0.0378 m ammonium sulfate in water were found to be -0.322°C and -0.173°C, respectively. What were the values of the van't Hoff factor for these salts? What is the percent dissociation for each salt? $K_{f,water} = 1.86\,^{o}C \bullet kg / mol$

Similar to Chapter 11 In Class Exercise #3

$$\Delta T_f = ik_f m \quad (3pts)$$

$$NH_4Cl \rightarrow NH_4^+ + Cl^- \quad i_{theoretical} = 2 \quad (3pts)$$

$$(NH_4)_2SO_4 \rightarrow 2NH_4^+ + SO_4^{2-} \quad i_{theoretical} = 3 \quad (3pts)$$

$$i_{NH_4Cl} = \frac{\Delta T_f}{k_f m} = \frac{3.22^{\circ}C}{1.86\frac{^{\circ}C \bullet kg}{mol} \bullet 0.0935\frac{mol}{kg}} = 1.85 \quad (3pts)$$

$$i_{(NH_4)_2SO_4} = \frac{\Delta T_f}{k_f m} = \frac{0.173^{\circ}C}{1.86\frac{^{\circ}C \bullet kg}{mol} \bullet 0.0378\frac{mol}{kg}} = 2.46 \quad (3pts)$$

$$\%\ dissociation = \frac{i_{actual}}{i_{theoretical}} \times 100\% \quad (3pts)$$

$$\%NH_4Cl\ dissociation = \frac{1.85}{2} \times 100\% = 92.6\% \quad (3pts)$$

$$\%(NH_4)_2SO_4\ dissociation = \frac{2.46}{3} \times 100\% = 82.0\% \quad (3pts)$$

5. (16 points) What is the molecular weight of camphor given it took 2.00 g to reduce the freezing point of 100.0 g of benzene (C_6H_6) by 0.674°C? $k_f = 5.12\frac{^{\circ}C \bullet kg}{mol}$

Similar to MW Lab & Hemoglobin example

$$k_f = 5.12\frac{^{\circ}C \bullet kg}{mol} \quad \Delta T_f = 0.674^{\circ}C \quad g_{camphor} = 2.00\ g \quad g_{C_6H_6} = 100.0\ g \quad (3pts)$$

$$MW_{camphor} = \frac{g_{camphor}}{n_{camphor}} \quad m = \frac{n_{camphor}}{kg_{C_6H_6}} \quad \Delta T_f = ik_f m \quad (3pts)$$

$$\Delta T_f = ik_f \rightarrow m = ik_f \frac{n_{camphor}}{kg_{C_6H_6}} \rightarrow n_{camphor} = \frac{\Delta T_f \bullet kg_{C_6H_6}}{ik_f} \quad (4pts)$$

$$n_{camphor} = \frac{0.674^{\circ}C \bullet 0.100\ kg_{C_6H_6}}{1 \bullet 5.12\frac{^{\circ}C \bullet kg}{mol}} = 0.0132\ moles\ camphor \quad (3pts)$$

$$MW_{camphor} = \frac{g_{camphor}}{n_{camphor}} = \frac{2.00\ g}{0.0132\ moles\ camphor} = 151.93\frac{g}{moles} \sim \boxed{152\frac{g}{moles}} \quad (3pts)$$