CHE 112 - Practice Exam - Chapter 10-11 - ver 1 Score: _____/100

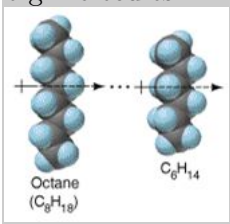
Name: _____ Class: _____ Date: _____

Question 1: C/D are double jeopardy. Question 3c: duplicate of 1b. Should just make 1b about MP or BP

[10 pt] 1. Define (using sentences) each of the following Intermolecular Forces (IMF's) including their relative strengths. In addition draw an example illustrating the attractive force between **TWO** molecules. Properly label all charges (+/-) and partial charges (δ^+/δ^-).

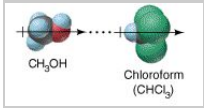
(a) London Dispersion Forces (LDF)

Between nonpolar molecules, due to instantaneous dipoles
Weakest force (0.05-20 kJ/mol) but...
Proportional to size therefore can be quite large for big molecules



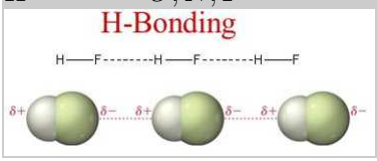
(b) Dipole-Dipole Forces (DD)

Electrostatic attraction (opposites attract)
Between Dipolar molecules - $\delta^+ - - - \delta^-$
Strength (3-20+ kJ/mol) proportional to difference in EN.



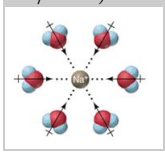
(c) Hydrogen Bonding (HB)

Electrostatic attraction (opposites attract)
H bonded to small highly EN element (O,N,F) resulting in an Extra Strong (10-40 kJ/mol) DD attraction
$H^{\delta+} - - - O, N, F^{\delta-}$



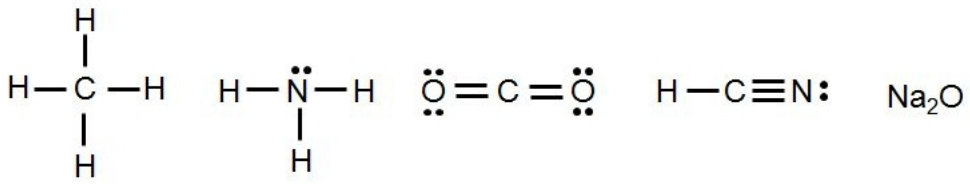
(d) Ion-Dipole (ID)

Electrostatic attraction (opposites attract)
Ion has full +/-, molecule has a dipole (δ^+/δ^-)
Stonger than HB because 1 full charge (30-100+ kJ/mol) Weaker than Ionic



[8 pt] 2. Answer the following question about the molecule below:

A B C D E



LDF (16 g/mol) HB LDF (44 g/mol) DD Ionic

(a) Below each molecule list the attractive forces present in each molecule.

(b) Order the molecules from lowest Vapor Pressure to Highest Vapor Pressure. Explain.

Vapor pressure is IP to the strength of the IMF
LDF (proportional to size) < DD < HB < ID < I
E < B < D < C < A

(c) Which molecule(s) are most likely to dissolve in water? Explain. 2(c) **B,D,E**

Like dissolves like (must state that it is IMF that must be alike)
Should also reference ±1 group rule

(d) Which molecule(s) are most likely to dissolve in hexane? Explain. 2(d) **A,E**

Like dissolves like (must state that it is IMF that must be alike)
Should also reference ± 1 group rule

[4 pt] 3. Complete the following with (D)irectly proportional, (I)nversly proportional, (N)o relationship or (F)thisIhavenoideawhattheansweris.

(a) Vapor Pressure to Temperature 3(a) **D**

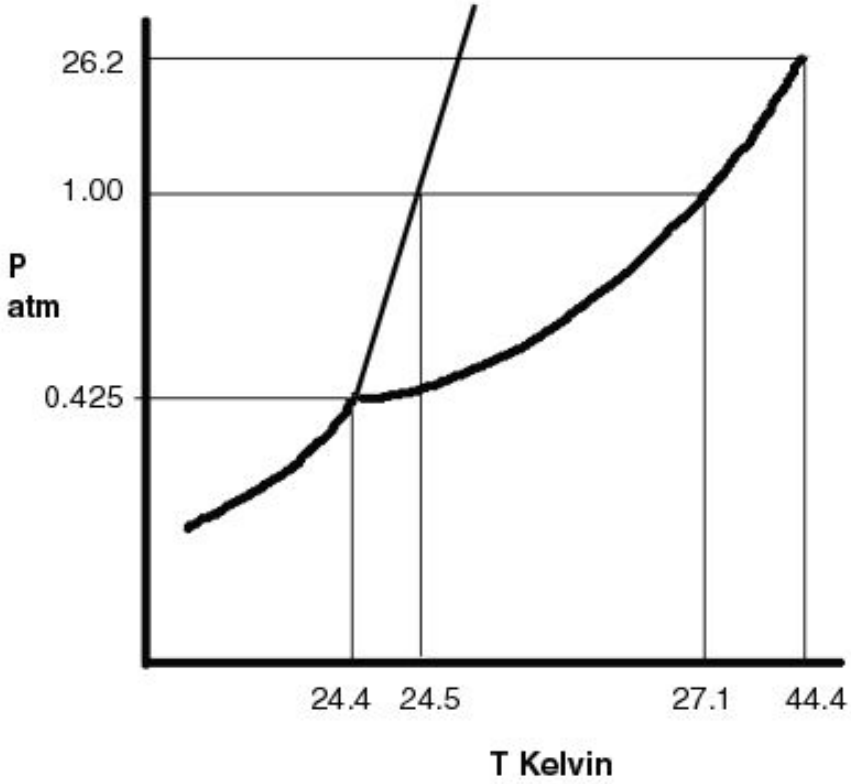
(b) Vapor Pressure to Size of the Container 3(b) **N**

(c) Vapor Pressure to IMF between molecules 3(c) **I**

(d) Vapor Pressure to the amount of liquid 3(d) **N**

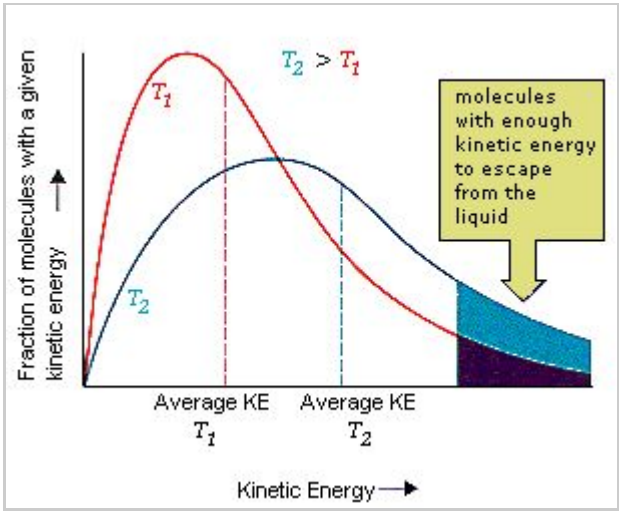
[10 pt] 4. Properly label all of the following points on the phase diagram, and answer the questions below.

(a) Solid Phase
(b) Liquid Phase
(c) Gas Phase
(d) Supercritial Fluid
(e) Triple Point
(f) Critical Point
(g) Where Vaporization occurs
(h) Where Condensation occurs
(i) Where Melting occurs
(j) Where Freezing occurs
(k) Where Sublimation occurs
(l) Where Deposition occurs
(m) Normal Boiling Point
(n) Normal Melting Point
(o) Melting Curve
(p) Vaporization Curve
(q) Sublimation Curve

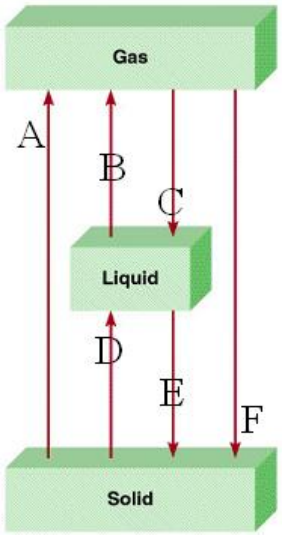


[5 pt] 5. Explain how a solution can evaporate (go from the liquid state to the gas state) when the temperature is below the boiling point of the liquid, and the atmospheric pressure is 760 mmHg. (For example, on a sunny day a puddle of water will evaporate even though the temperature is well below the boiling point of water.) A sketch might be useful too, so give me one!

Figure 11.24 on page 503
Evaporation occurs when a molecule has enough KE to break the IMF holding the molecules together. This can occur below the boiling point because temperature is a measure of the average KE, meaning that some molecules will have more energy (enough to escape the liquid) even though the temperature is below the boiling point. This concept is a review of the KM theory of gasses from Chapter 5.8 on page 229 in your book.


Fraction of molecules with a given kinetic energy
$T_2 > T_1$
T_1
T_2
molecules with enough kinetic energy to escape from the liquid
Average KE T_1
Average KE T_2
Kinetic Energy

[6 pt] 6. Identify each of the following phase transitions.



(a) Sublimation

(b) Evaporation or Vaporization

(c) Condensation

(d) Melting

(e) Fusion/Freezing

(f) Deposition

[5 pt] 7. Calculate the heat (in kJ) required to turn 2.5 kg of **ETHANOL** ice at -112℃ to ethanol liquid at 65℃ .

7. **1200 kJ**

3 step process:

(1) S (-112) to L (-112) - $q = m\Delta H = \frac{2.5\,\text{kg}}{} \times \frac{1000\,\text{g}}{1\,\text{kg}} \times \frac{104\,\text{J}}{1\,\text{g}} \times \frac{1\,\text{kJ}}{1000\,\text{J}} = 260\,\text{kJ}$

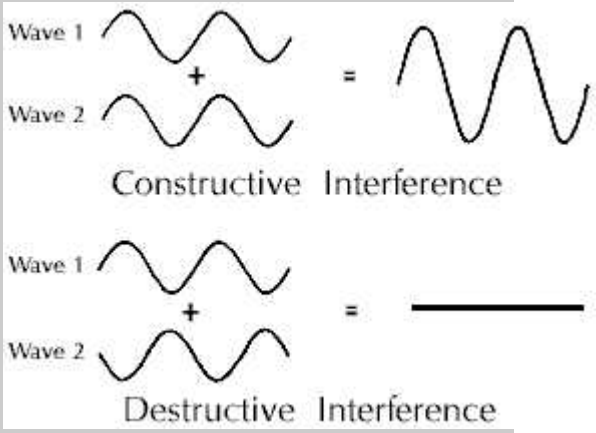
(2) L (-112 to L 65) - $q = mS\Delta T = \frac{2.5\,\text{kg}}{} \times \frac{1000\,\text{g}}{1\,\text{kg}} \times \frac{2.138\,\text{J}}{\text{g}\cdot\text{℃}} \times \frac{(177\,\text{℃}}{} \times \frac{1\,\text{kJ}}{1000\,\text{J}} = 946\,\text{kJ}$

[4 pt] 8. Define the terms 'Constructive' and 'Destructive' Interference and sketch a picture illustrating both. How is this phenomenon used in X-ray diffraction to determine the distance between atoms in a solid?

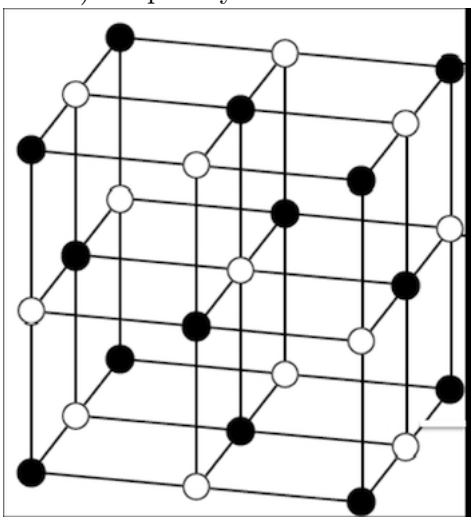
Constructive Interference - Waves in phase add together and increase in amplitude. In x-ray diffraction results in a bright spot.

Destructive Interference - Waves out of phase cancel. In x-ray diffraction results in a dark spot.

When two x-rays initially in phase interact with a solid if they travel the same distance (or an integer multiple of that distance) it will result in constructive interference. By changing the angle of incidence and to determine when constructive interference occurs one can determine the distance between atoms in the solid.



[6 pt] 9. A new mineral has been discovered containing an unknown metal X (black atoms) and oxygen (white atoms). Explain your answers in the space provided.



(a) What is the formula for the new mineral $X_{\#}O_{\#}$?

Black: 8 corner * 1/8 = 1 atom + 6 faces * 1/2 = 3 atoms (total = 4 atoms)
White: 12 edge * 1/4 = 3 atoms + 1 middle = 4 atoms total

(b) What is the charge on the unknown metal cation?

Oxidation Number = +2

[6 pt] 10. Answer the following questions using the graph given in class or the solubility table on your Cheat Sheet:

(a) Is a solution consisting of 25.0 grams of KBr in 43.0 mL of water (U)nsaturated, (S)aturated or (SS)upersaturated at 50.℃? Explain. 10(a) **U**

(1) Calculate the ratio $\frac{25\text{ g KBr}}{43\text{ g } H_2O} = \frac{x}{100\text{ g } H_2O}$.
(2) x = 58.1 g KBr / 100 g H_2O.
(3) This value is blow the line (80.1 g/100g) ∴ Unsaturated).

(b) If you start with a saturated solution of $BaCl_2$ at 40℃, and heat it to 90℃, how many more grams of $BaCl_2$ can be dissolved ? Explain. 10(b) **15.0 g $BaCl_2$**

(1) Estimate the value at 40℃ and 90℃. The difference between them is the amount that will dissolve.
(2) S(90℃) - S(40℃) = 55.7 - 40.7 = 15.0 g $BaCl_2$ will ppt. (The value is approximate)

[6 pt] 11. Sketch a picture showing now KBr would dissolve in water. Label any IMF between the solute-solute, solute-solvent and solvent-solvent.

[4 pt] 12. Complete the following with (D)irectly proportional, (I)nversly proportional, (N)o relationship or (F)thisIhavenoideawhattheansweris.

(a) Solubility of Solids in Liquids and Temperature 12(a) **D**

(b) Solubility of Gases in Liquids and Temperature 12(b) **I**

(c) Solubility of Solids in Liquids and Pressure 12(c) **N**

(d) Solubility of Gases in Liquids and Pressure 12(d) **D**

[4 pt] 13. Complete the following with (D)irectly proportional, (I)nversely proportional, (N)o relationship or (F)thisIhavenoideawhattheansweris.

(a) Mols solute and Boiling Point 13(a) **D**

(b) Mols solute and Freezing Point 13(b) **I**

(c) Mols solute and Osmotic Pressure 13(c) **D**

(d) Mols solute and Vapor Pressure 13(d) **I**

[3 pt] 14. What is the van't Hoff factor, and how does it effect Colligative Properties

Is the real/experimentally determined number of particles a compound produces in solution. It effects colligative properties because because they depend on the number of particles in solution not the type or chemical properties of the compound.

[4 pt] 15. Which solution will have a higher osmotic pressure. Solution A made by dissolving 25.0 g of KCl in 100.0 mL of water, or Solution B made by dissolving 15g of NaCl in 100.0 mL of water? Show work or Explain your answer to receive full credit.

15. **Solution A**

OP is DP to mols solute:

Solution A - $\frac{25\,\text{g}}{100\,\text{mL}} \times \frac{1\,\text{mol KCl}}{74.55\,\text{g KCl}} \times \frac{1\,\text{mL}}{0.001\,\text{L}} = 3.5M$

Solution B - $\frac{15\,\text{g NaCl}}{100\,\text{mL}} \times \frac{1\,\text{mol NaCl}}{58.44\,\text{g KCl}} \times \frac{1\,\text{mL}}{0.001\,\text{L}} = 2.6MM$

[5 pt] 16. 5.00 graphs of an unknown compound when dissolved in 125 mL of water resulted in an osmotic pressure of 10.0 atm at 25 °C. What is the molecular weight (MW) of the unknown compound?

16. **97.8632 g/mol**

M = 0.4087 M
mols = 0.05109
MW = 97.8632

[5 pt] 17. Explain why the **boiling point** of an impure solution is higher while the **freezing point** of an impure solution is lower than that of the pure solution. Include in your discussion a sketch of a phase diagram illustrating your explanation.

18. **Bonus:** Potassium crystallizes in a body-centered cubic lattice with a density of 0.856 g/cm^3 at 25°C.
    (a) How many atoms are there per unit cell? 18(a) _____
    (b) Determine the radius of a K atom. 18(b) _____

[5 pt] 19. Make sure to eat a rice crispy treat and have a great day! Oh yes, I should ask a question. What is your favorite food?