

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

**Instructions: Answer the following questions. Show ALL work for problems to receive full credit. Make sure to include proper units and significant figures for all answers.**

[3 pt] 1. Complete the table below illustrating the differences between chemical bonds and intermolecular forces.

Property	Chemical Bonds	IMF Forces
Strength of Attraction		
Properties (Chemical or Physical)		
Represented by (in drawings):		

[12 pt] 2. For each of the IMF discussed in class, define them **AND** draw an example illustrating the attraction between **TWO** molecules. Properly label each picture.

(a) London Dispersion Forces (LDF)

(c) Hydrogen Bonding (HB)

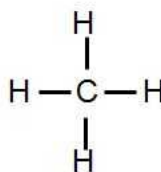
(b) Dipole-Dipole Forces (DD)

(d) Ion-Dipole Forces (ID)

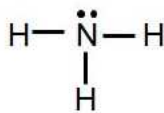
3. Which intermolecular force [Dipole-Dipole (DD), Hydrogen Bonding (HB), London Dispersion (LDF), or Ionic (I)] is best described by each of the following statements. If the statement describes more than one force, put down all the forces it applies to. If no force is described by the statement place NONE in the answer blank.

- (a) Attractive force between polar and nonpolar molecules. 3(a) \_\_\_\_\_
- (b) Primarily electrostatic in nature (opposites attract). 3(b) \_\_\_\_\_
- (c) Attractive force between nonpolar molecules. 3(c) \_\_\_\_\_
- (d) Result of a temporarily (or instantaneous) dipoles in atoms or molecules. 3(d) \_\_\_\_\_
- (e) Increases in strength depending on size of molecule. 3(e) \_\_\_\_\_
- (f) Is present in between all molecules. 3(f) \_\_\_\_\_
- (g) The strongest attractive force. 3(g) \_\_\_\_\_
- (h) Primarily between Metal and Nonmetals 3(h) \_\_\_\_\_
- (i) Attractive force between polar molecules. 3(i) \_\_\_\_\_
- (j) The weakest attractive force. 3(j) \_\_\_\_\_

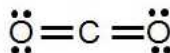
- [10 pt] 4. Answer the following questions about the pair of molecules pictured below. **Explain.**



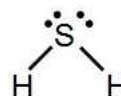
(A)



(B)



(C)



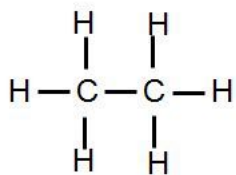
(D)



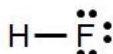
(E)

- (a) Which molecule has the lower Boiling Point? 4(a) \_\_\_\_\_
- (b) Which molecule has the lower Vapor Pressure? 4(b) \_\_\_\_\_
- (c) If 100 g of each molecule was added to separate beakers of water would lower the freezing point the most? 4(c) \_\_\_\_\_
- (d) Which molecule is more likely to dissolve in water? 4(d) \_\_\_\_\_
- (e) Which molecule has the strongest attractive forces between the molecules? 4(e) \_\_\_\_\_

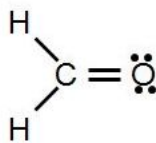
- [5 pt] 5. For each of the molecules below, list which IMF are present between the molecules. Order the molecules (A<B<C etc) from lowest  $B_p$  to Highest  $B_p$  Explain.



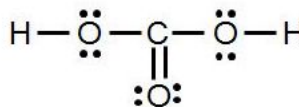
(A)



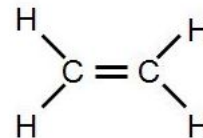
(B)



(C)



(D)



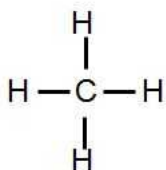
(E)

- [4 pt] 6. Using the molecules in the previous question:

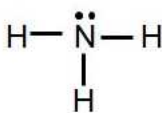
(a) Which molecule(s) are more likely to dissolve in water? Explain

(b) Which molecules are more likely to dissolve in pentane ( $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-CH}_3$ ). Explain.

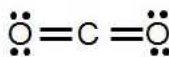
- [6 pt] 7. For each of the molecules below, list which IMF are present between the molecules. Order the molecules (A<B<C etc) from lowest  $B_p$  to Highest  $B_p$  Explain.



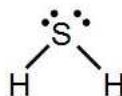
(A)



(B)



(C)



(D)

KCl

(E)

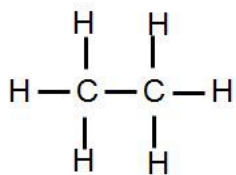
- [5 pt] 8. Using the molecules in the previous question:

(a) Which molecule(s) are more likely to dissolve in water? Explain.

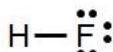
8(a) \_\_\_\_\_

(b) Which molecule(s) are more likely to dissolve in pentane 8(b) \_\_\_\_\_  
( $\text{CH}_3\text{CHCH}_2\text{CH}_2\text{CH}_3$ ). Explain.

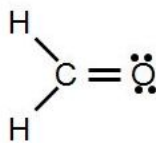
- [6 pt] 9. For each of the molecules below, list which IMF are present between the molecules. Order the molecules ( $A < B < C$  or label one end low, one end high) from lowest  $B_p$  to highest  $B_p$ . Explain.



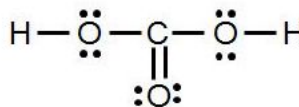
(A)



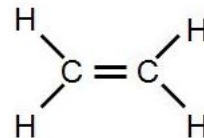
(B)



(C)



(D)



(E)

- [4 pt] 10. Using the molecules in the previous question:

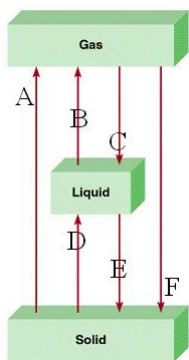
(a) Which molecule(s) are more likely to dissolve in water? Explain.

10(a) \_\_\_\_\_

(b) Which molecule(s) are more likely to dissolve in pentane 10(b) \_\_\_\_\_  
( $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$ ). Explain.

- [6 pt] 11. Sketch a picture showing how  $\text{AlCl}_3$  will dissolve in water. What is the attractive force between the ions and water molecules?

[6 pt] 12. Name each phase change shown below:



(a)

(b)

(c)

(d)

(e)

(f)

[5 pt] 13. For each of the following properties indicate whether they are (D)irectly proportional, (I)nversly proportional, or (N)ot related.

(a) Vapor Pressure and mols of solute in a solution 13(a) \_\_\_\_\_

(b) Vapor Pressure and Amount of Liquid in a flask 13(b) \_\_\_\_\_

(c) Vapor Pressure and Boiling Point 13(c) \_\_\_\_\_

(d) Vapor Pressure and Intermolecular Forces (IMF) 13(d) \_\_\_\_\_

(e) Atmospheric Pressure and Vapor Pressure 13(e) \_\_\_\_\_

[5 pt] 14. Answer the following questions about solubility: (D)ecrease, (I)ncrease, or (N)o change.

(a) If temperature is increased the solubility of a solid in a liquid will? 14(a) \_\_\_\_\_

(b) If the temperature is decreased the solubility of a gas in a liquid will? 14(b) \_\_\_\_\_

(c) If the pressure is decreased the solubility of a solid in a liquid will? 14(c) \_\_\_\_\_

(d) If the pressure is decreased the solubility of a gas in a liquid will? 14(d) \_\_\_\_\_

(e) If the particle size is increased the rate of dissolving a solid in a liquid will? 14(e) \_\_\_\_\_

[10 pt] 15. For each of the following properties indicate whether they are (D)irectly proportional, (I)nversly proportional, or (N)ot related.

- |  |             |
|--|-------------|
| (a) Vapor Pressure and Boiling Point                           | 15(a) _____ |
| (b) Vapor Pressure and Intermolecular Forces (IMF)             | 15(b) _____ |
| (c) Vapor Pressure and mols of solute in a solution            | 15(c) _____ |
| (d) Intermolecular Forces (IMF) and Melting Point              | 15(d) _____ |
| (e) Vapor Pressure and Amount of Liquid in a flask             | 15(e) _____ |
| (f) Boiling Point and the mols of solute in a solution         | 15(f) _____ |
| (g) Atmospheric Pressure and Vapor Pressure                    | 15(g) _____ |
| (h) Rate at which Solids dissolve in Liquids and Particle Size | 15(h) _____ |
| (i) Solubility of Solids in Liquids and Temperature            | 15(i) _____ |
| (j) Solubility of Gasses in Liquids and Pressure               | 15(j) _____ |

[5 pt] 16. Sketch a picture showing how  $\text{BaCl}_2$  will dissolve in water. Label all IMF's present.

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- [3 pt] 17. Is a solution consisting of 55.0 grams of  $\text{KClO}_3$  in 135 mL of water (U)nsaturated, (S)aturated or (SS)upersaturated at  $60^\circ\text{C}$ ? Explain. 17. \_\_\_\_\_
- [3 pt] 18. If you start with a saturated solution of  $\text{KClO}_3$  at  $90^\circ\text{C}$ , and cool it to  $50^\circ\text{C}$ , how many grams of  $\text{KClO}_3$  will precipitate out? Explain. 18. \_\_\_\_\_
- [5 pt] 19. What is the **boiling point** of a solution made from 25.0 grams of  $\text{C}_6\text{H}_{12}\text{O}_6$  dissolved in 250 g of benzene. 19. \_\_\_\_\_
- [3 pt] 20. Is a solution consisting of 25.0 grams of  $\text{KClO}_3$  in 100. mL of water (U)nsaturated, (S)aturated or (SS)upersaturated at  $40.0^\circ\text{C}$ ? Explain. 20. \_\_\_\_\_
- [3 pt] 21. If you want to make a saturated solution of  $\text{BaCl}_2$  and the current solutions is 20.0 grams of  $\text{BaCl}_2$  in 100. mL of water at  $50.0^\circ\text{C}$  how much solute will (circle one - dissolve / precipitate)? 21. \_\_\_\_\_
- [3 pt] 22. If you have 100 mL of a saturated solution of  $\text{BaCl}_2$  at  $70.0^\circ\text{C}$  and cool it to  $20.0^\circ\text{C}$  how much solute will precipitate out? 22. \_\_\_\_\_

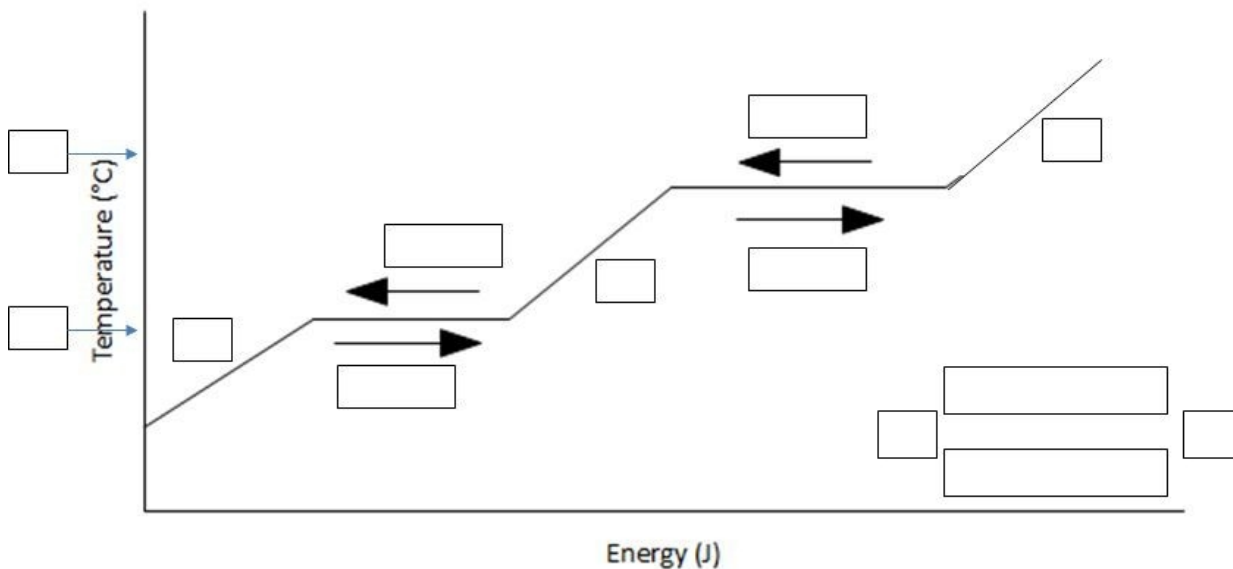
**CHE 101 - EP - Ch 9**

- [3 pt] 23. If you have of a saturated solution of  $\text{BaCl}_2$  in 175 g of water at  $30.0^\circ\text{C}$  and heat it to  $90.0^\circ\text{C}$  how much additional solute will dissolve? 23. \_\_\_\_\_
- [3 pt] 24. Is a solution consisting of 55.0 grams of  $\text{KClO}_3$  in 135 mL of water 24. \_\_\_\_\_  
(U)nsaturated, (S)aturated or (SS)upersaturated at  $60^\circ\text{C}$ ? Explain.
- [3 pt] 25. What is the final concentration of a dilute solution made from 150.mL of 2.35 M 25. \_\_\_\_\_  
 $\text{NaOH}$  diluted to a final volume of 500.0 mL
- [3 pt] 26. What is the final concentration of a dilute solution made from 150.mL of 2.35 M 26. \_\_\_\_\_  
 $\text{NaOH}$  diluted to a final volume of 500.0 mL
- [5 pt] 27. How much energy (in kJ) does it take to make a melt a 125.0 gram ice-cube and 27. \_\_\_\_\_  
then heat the resulting water to  $75.0^\circ\text{C}$ ?
- [3 pt] 28. If you have of a saturated solution of  $\text{BaCl}_2$  in 175 g of water at  $30.0^\circ\text{C}$  and heat it 28. \_\_\_\_\_  
to  $90.0^\circ\text{C}$  how much additional solute will dissolve?



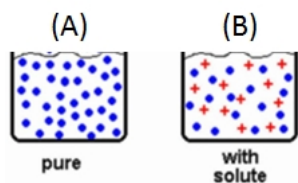
- [3 pt] 29. You work at a secret government research lab to which you were brought blindfolded. 29. \_\_\_\_\_  
One night while cooking dinner you notice that water boils at 105 °C. Where is the lab most likely located: (A) Space station, (B) A lonely mountain top, (C) Rangely CO - a great place to live, (D) a submarine floating in the middle of the ocean (E) or in a deep dark cave in Greenland? Explain.
- [5 pt] 30. How much energy (in kJ) does it take to make a super hot cup of coffee containing 30. \_\_\_\_\_  
250 mL of water that starts at room temperature (20. °C and liquid) and finishes at 100. °C as a gas.
- [3 pt] 31. Is a solution consisting of 55.0 grams of  $\text{KClO}_3$  in 135 mL of water 31. \_\_\_\_\_  
(U)nsaturated, (S)aturated or (SS)upersaturated at 60 °C? Explain.
- [3 pt] 32. If you start with a saturated solution of  $\text{KClO}_3$  at 90 °C, and cool it to 50 °C, how 32. \_\_\_\_\_  
many grams of  $\text{KClO}_3$  will precipitate out? Explain.
- [3 pt] 33. What is the molarity of a solution made by diluting 50.0 mL of 1.35 M  $\text{HNO}_3$  to a 33. \_\_\_\_\_  
final volume of 175 mL. Explain.

- [10 pt] 34. Complete the following heating curve by filling in the boxes with the **NAME** of the appropriate phase transition, temperature, or state of matter. Include the two missing phase transitions in the boxes in the lower right.



- [3 pt] 35. Which container will have the **LOWER** vapor pressure? Explain.

35. \_\_\_\_\_



- [3 pt] 36. Assuming equal amounts (by mass) which will dissolve **FASTER**? Explain?

36. \_\_\_\_\_

