

## IMF Practice Questions

CW/HW

Name: KEY Date: \_\_\_\_\_ Per \_\_\_\_\_

B 1. Order the intermolecular forces (dipole-dipole, London Dispersion, ionic, and hydrogen-bonding) from weakest to strongest.

- A) dipole-dipole, London Dispersion, ionic, and hydrogen-bonding
- B) London Dispersion, dipole-dipole, hydrogen-bonding, ionic
- C) hydrogen-bonding, dipole-dipole, London Dispersion, and ionic
- D) dipole-dipole, ionic, London Dispersion, and hydrogen-bonding
- E) London Dispersion, ionic, dipole-dipole, and hydrogen-bonding

E 2. Hydrogen bonds account for which of the following observation?

- A) Hydrogen naturally exists as a diatomic molecule. → cov bond
- B) Hydrogen is easily combustible with oxygen.
- C) Water molecules are bent or "V-shaped". → lone pairs
- D) Air is more dense than hydrogen gas. →
- \*E) For its molar mass, water has a high boiling point.

18g

m  
v

D 3. Which of the following would you expect to have the highest boiling point?

- A) F<sub>2</sub>
- B) Cl<sub>2</sub>
- C) Br<sub>2</sub>
- D) I<sub>2</sub> Strongest LDF → greater polarizability ↑#e<sup>-</sup>
- E) All of the above have the same boiling point.

A 4. Which of the following is most likely to be a solid at room temperature?

- A) Na<sub>2</sub>S → ionic
- B) HF
- C) NH<sub>3</sub>
- D) N<sub>2</sub>
- E) H<sub>2</sub>O

D 5. Which of the following should have the lowest boiling point?

- A) Na<sub>2</sub>S
- B) HF
- C) NH<sub>3</sub>
- D) N<sub>2</sub>
- E) H<sub>2</sub>O

C 6. On a relative basis, the weaker the intermolecular forces in a substance,

- A) the greater its heat of vaporization.
- B) the more it deviates from ideal gas behavior.
- C) the greater its vapor pressure at a particular temperature.
- D) the higher its melting point.
- E) none of these

D 7. Which of the species below would you expect to show the least hydrogen bonding?

- A)  $\text{NH}_3$
- B)  $\text{H}_2\text{O}$
- C)  $\text{HF}$
- D)  $\text{CH}_4$
- E) all the same



D 8. The molecules in a sample of solid  $\text{SO}_2$  are attracted to each other by a combination of

- A) London forces and H-bonding.
- B) H-bonding and ionic bonding.
- C) covalent bonding and dipole-dipole interactions.
- D) London forces and dipole-dipole interactions.
- E) none of these



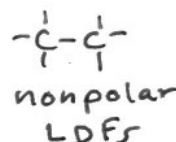
D 9. Which of the following is the correct order of boiling points for  $\text{KNO}_3$ ,  $\text{CH}_3\text{OH}$ ,  $\text{C}_2\text{H}_6$ ,  $\text{Ne}$ ?

- A)  $\text{Ne} < \text{CH}_3\text{OH} < \text{C}_2\text{H}_6 < \text{KNO}_3$
- B)  $\text{KNO}_3 < \text{CH}_3\text{OH} < \text{C}_2\text{H}_6 < \text{Ne}$
- C)  $\text{Ne} < \text{C}_2\text{H}_6 < \text{KNO}_3 < \text{CH}_3\text{OH}$
- D)  $\text{Ne} < \text{C}_2\text{H}_6 < \text{CH}_3\text{OH} < \text{KNO}_3$
- E)  $\text{C}_2\text{H}_6 < \text{Ne} < \text{CH}_3\text{OH} < \text{KNO}_3$

Strong IMFs → High BP

↓                      ↓  
Ionic                  H-bond  
Bonds

$\text{Ne} \rightarrow \text{LDFs}$



C 10. Which of the following statements about liquids is true?

- A) Droplet formation occurs because of the higher stability associated with increased surface area. ~~decreased~~
- B) Substances that can form hydrogen bonds will display lower melting points than predicted from periodic trends. higher
- T C) London dispersion forces arise from a distortion of the electron clouds within a molecule or atom.
- D) Liquid rise within a capillary tube because of the small size lowers the effective atmospheric pressure over the surface of the liquid.
- E) The boiling point of a solution is dependent solely on the atmospheric pressure over the solution. IMFs

E 11. Which statement regarding water is true?

- A) Energy must be given off in order to break down the crystal lattice of ice to a liquid. absorbed
- B) Hydrogen bonds are stronger than covalent bonds. NO!!
- C) Liquid water is less dense than solid water. more → ice floats!!
- D) Only covalent bonds are broken when ice melts. NO!!
- E) All of the statements (a-d) are false.

A 12. In which of the following groups of substances would dispersion forces be the only significant factors in determining boiling points?

- I.  $\text{Cl}_2$                   II.  $\text{HF}$                   III.  $\text{Ne}$                   IV.  $\text{KNO}_2$
- A) I, III, V
  - B) I, II, III
  - C) II, IV
  - D) II, V
  - E) III, IV, V



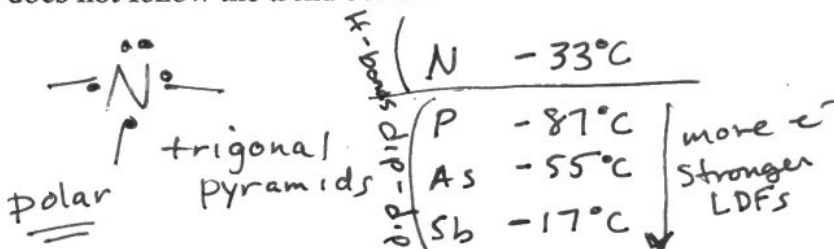
Ionic

- C 13. The elements of group 5A, the nitrogen family, form compounds with hydrogen having the boiling points listed below:

$\text{SbH}_3$   $-17^\circ\text{C}$ ,  $\text{AsH}_3$   $-55^\circ\text{C}$ ,  $\text{PH}_3$   $-87^\circ\text{C}$ ,  $\text{NH}_3$   $-33^\circ\text{C}$

The first three elements illustrate a trend where the boiling point decreases as the mass decreases; however, ammonia ( $\text{NH}_3$ ) does not follow the trend because of

- A) dipole-dipole attraction.  
 B) metallic bonding.  
 C) hydrogen bonding.  
 D) London dispersion forces.  
 E) ionic bonding.



- C 14. Which substance involves no bonding forces except London dispersion forces?

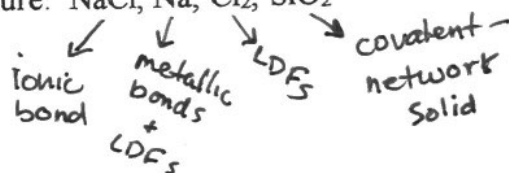
- A)  $\text{NaCl(l)} \rightarrow$  ionic bonds + LDFs  
 B)  $\text{HF(l)} \rightarrow$  d.pole-dipole + LDFs  
 C)  $\text{N}_2(\text{s}) \rightarrow$  LDFs  
 D)  $\text{H}_2\text{O(l)} \rightarrow$  H-bonding + LDFs  
 E)  $\text{K(s)} \rightarrow$  metallic bonds



- C 15. On the basis of your knowledge of bonding in liquids and solids, arrange the following substances in order of highest to lowest melting temperature:  $\text{NaCl}$ ,  $\text{Na}$ ,  $\text{Cl}_2$ ,  $\text{SiO}_2$

- A)  $\text{Cl}_2$ ,  $\text{Na}$ ,  $\text{NaCl}$ ,  $\text{SiO}_2$   
 B)  $\text{Na}$ ,  $\text{NaCl}$ ,  $\text{Cl}_2$ ,  $\text{SiO}_2$   
 C)  $\text{SiO}_2$ ,  $\text{NaCl}$ ,  $\text{Na}$ ,  $\text{Cl}_2$   
 D)  $\text{NaCl}$ ,  $\text{SiO}_2$ ,  $\text{Na}$ ,  $\text{Cl}_2$   
 E)  $\text{SiO}_2$ ,  $\text{Na}$ ,  $\text{NaCl}$ ,  $\text{Cl}_2$

$\text{NaCl}$   $1474^\circ\text{F}$   
 $\text{SiO}_2$   $3110^\circ\text{F}$



- B 16. Which of the following substances would you expect to have the lowest boiling point?

- A) diamond  
 B) methane,  $\text{CH}_4$   
 C) sodium nitrate,  $\text{NaNO}_3$   
 D) glycerine,  $\text{C}_3\text{H}_5(\text{OH})_3$   
 E) copper

- E 17. What is responsible for capillary action, a property of liquids?

- A) surface tension  
 → B) cohesive forces → same molecules  
 → C) adhesive forces → different molecules  
 D) viscosity → resistance to flow  
 (E) two of these



polar concave glass is polar

- B 18. When a nonpolar liquid displays a convex meniscus, which of the following explains this behavior?

- A) It has a low surface tension, and therefore clings to the glass.  
 B) The cohesive forces are stronger than the adhesive forces toward the glass.  
 C) The adhesive forces toward the glass are stronger than the cohesive forces.  
 D) The liquid's viscosity is low.  
 E) none of these

A 19. Which best explains the following trend?

| Element | b.p. (K) |
|---------|----------|
| He      | 4        |
| Ne      | 25       |
| Ar      | 95       |
| Kr      | 125      |
| Xe      | 170      |

IMFs getting stronger

- A) London dispersion forces
- B) dipole-dipole interaction
- C) hydrogen bonding
- D) Le Chatelier's principle
- E) none of these

A 20. Which of the following has the highest boiling point?

- A) chalk (calcium carbonate) ionic
- B) ice (water) H-bonds
- C) window cleaner (ammonia) H-bonds
- D) motor oil (hydrocarbon chains) nonpolar
- E) helium gas inside a party balloon nonpolar

D 21. Which of the following compounds has the highest viscosity?

- A)  $\text{CCl}_4(\text{l}) \rightarrow$  nonpolar  $\rightarrow$  LDFs
- B)  $\text{N}_2(\text{g}) \rightarrow$  nonpolar  $\rightarrow$  LDFs
- C)  $\text{H}_2\text{O}(\text{l}) \rightarrow$  H-bonds
- D)  $\text{CH}_3-(\text{CH}_2)_{25}-\text{CH}_3(\text{l}) \rightarrow$  27Cs in a chain !!
- E)  $\text{HCl}(\text{g})$

Strong IMFs entanglement

entangled

B 22. Hydrogen bonding is a type of London dispersion force.

- A) True
- B) False

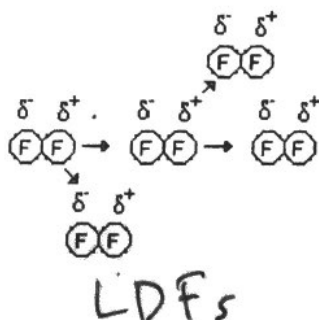
A 23. Intermolecular forces are weaker than intramolecular bonds.

- A) True
- B) False

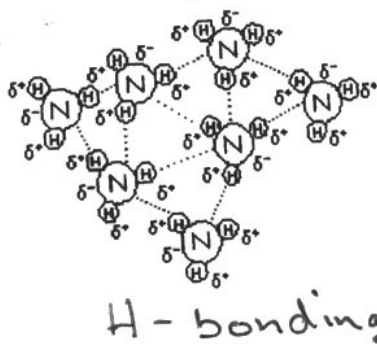
Use the following to answer questions 24-26:

Consider the representations below to answer the next three questions.

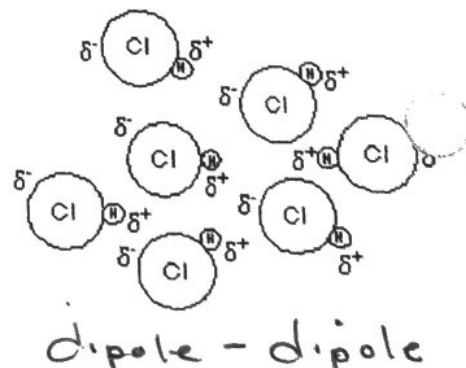
(I)



(II)

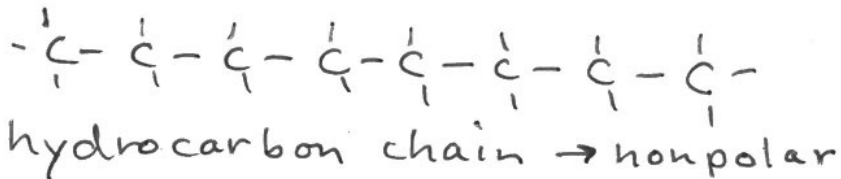


(III)



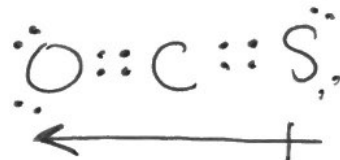
E 24. How many of the following statements are correct concerning drawing I?

- T I. Each molecule induces a dipole onto the next molecule in close proximity.
  - T II. The phenomenon shown is relatively weak and short-lived.
  - T III.  $C_8H_{18}$  contains this type of interaction.
  - T IV. The forces that exist in this phenomenon are London dispersion forces.
- A) 0  
B) 1  
C) 2  
D) 3  
E) 4



C 25. Which of the following statements are incorrect concerning drawing III?

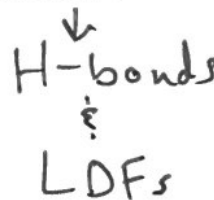
- T A) Electrostatic interactions exist between the molecules.
- T B) The molecules find the best compromise between attraction and repulsion.
- F C) These molecules exhibit ionic bonding.
- T D) OCS exhibits this type of interaction.
- E) Two of the above statements are incorrect.



strongest  
↑

B 26. Which drawing *best* represents the interactions between HF?

- A) I
- B) II
- C) III
- D) I, II
- E) All of the above



B 27. Methane ( $CH_4$ ) exhibits stronger hydrogen bond interactions than ammonia ( $NH_3$ ).

- A) True
- B) False  $\rightarrow$  nonpolar

A 28. Liquids with large intermolecular forces tend to have high surface tension.

- A) True
- B) False

29. The particularly strong dipole-dipole interaction between hydrogen and nitrogen is known as a H-bond

30. The relatively weak forces that exist among noble gas atoms are LDFs.

31. The resistance of a liquid to an increase in its surface area is the Surface tension of the liquid. *a sphere has less surface area per volume of liquid*
32. The meniscus of mercury curves downward at the edges. Explain using the concept of cohesion and adhesion. *Cohesive forces are stronger than the adhesive forces.*
33. If you have 10.0 moles of  $\text{BH}_3$  and 5.0 moles of  $\text{HF}$ , which amount exhibits the most hydrogen bonding? Explain.  *$\text{HF}$ ,  $\text{BH}_3$  does not H-bond!*
34. Make a sketch to show the hydrogen bonding between two acetic acid molecules ( $\text{HC}_2\text{H}_3\text{O}_2$ ).

