

13 • IMF's, Liquids, and Solids

PRACTICE TEST

1. Surface tension in a liquid is due to the fact that
- a) surface molecules are pulled toward the interior
 - b) liquids tend toward lowest energy
 - c) PE is increased for molecules at the surface
 - d) interior molecules are attracted in all directions
 - e) all of the above

E

2. In which one of the following will dipole-dipole attractions play the most significant role as the intermolecular attraction?

A

- a) HCl
- b) NaCl ion
- c) Kr LD
- d) H₂O H bond
- e) NH₃ H bond

3. With which type of substances do London dispersion forces play the most significant role?

D

- a) polar molecules
- b) metals
- c) ionic compounds
- d) non-polar molecules
- e) network compounds

4. The heat of vaporization of H₂S, at its boiling point (-61°C) is 18.8 kJ/mol. What mass of H₂S can be vaporized (at its boiling point) with 100 kJ of energy?

CLASSIC P MC

E

- a) $100 \times \frac{61}{18.8}$
- b) $34.1 \times \frac{18.8}{100}$
- c) $61 \times 18.8 \times 100 \times 34.1$
- d) $18.8 \times \frac{61}{34.1}$
- e) $100 \times \frac{34.1}{18.8}$

$\frac{100 \text{ kJ}}{18.8 \text{ kJ/mol}} \times 34.1$

5. Which one of the following substances exhibits the strongest intermolecular forces of attraction?

D

- a) CH₄ NP:LD
- b) C₂H₆ NP:LD
- c) C₃H₈ NP:LD
- d) CH₃OH H bond
- e) CH₃Cl DPDP

6. For which substance would you predict the highest heat of vaporization?

D

- a) F₂
 - b) H₂O
 - c) HF
 - d) NaCl
 - e) Br₂
- NB HB HB Ionic NP LD LD

IONIC > H > DD > LD

7. Which of the following will change the equilibrium vapor pressure of a liquid?

A

- I. Heat up or cool down the liquid *change T*
- II. Increase the Volume of the container
- III. Change the pressure above the liquid *BP*

- a) I only
- b) I and II only
- c) I, II, and III
- d) I and III only
- e) II and III only

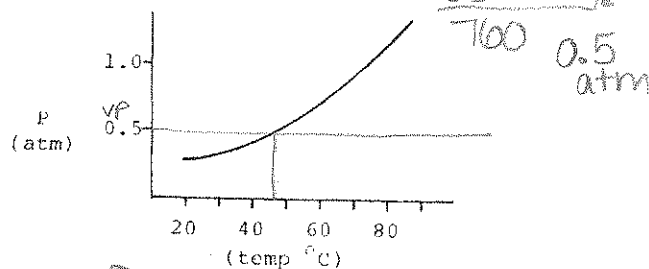
8. Which of the following statements describes a substance above its critical point?

B

- a) the substance can be liquefied
- b) the vapor and liquid phase become indistinguishable
- c) the substance experiences no intermolecular interactions
- d) there is a distinct phase boundary between the liquid and vapor
- e) all of the above

9. At what temperature will the liquid (whose vapor pressure is shown below) boil if the air pressure is reduced to 380 mmHg?

B



- a) 30°C
- b) 50°C
- c) 70°C
- d) 100°C
- e) the liquid will not boil at this pressure

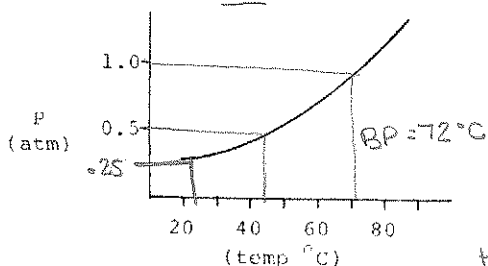
10. Which one of the following is linked with the correct intermolecular force of attraction?

B

- a) NH₃ ..HB.....dipole-dipole
- b) AlH₃London dispersion forces
- c) H₂ LD, NP.....hydrogen bonding
- d) C₂H₄ LD.....covalent bonding
- e) HCl DI, DI.....ionic

8 pts
7 Bonus

11. The vapor pressure graph of an unknown liquid is shown below. Which of the following statements about this liquid is/are true?



- I.** This liquid has weaker IMF's than water.
II. The liquid's normal boiling point is around 75°C. ~72°C
III. The liquid boils at room temperature when the pressure is dropped to about 0.25 atm. Room-temp ≈ 25°C
- a) II and III only d) I only
 b) II only e) I, II, and III
 c) I and III

12. How much energy does it require to melt 25.0 g benzene, C₆H₆? The heat of fusion of benzene is 2.37 kJ/mol. [molar mass = 78.0 g/mol]

- a) 8.25 kJ d) 0.759 kJ
 b) 59.3 kJ e) none of these
 c) 4625 kJ $\frac{25g}{78g} \times \frac{1mol}{1mol} \times 2.37 kJ$

13. What type of solid(s) can contain covalent bonds?

- a) molecular d) network
 b) metallic e) all but "b"
 c) ionic
 NaHCO₃

14. Which type of solid generally has the highest melting point?

- a) metallic c) molecular
 b) ionic d) network
 ≡ Diamond

15. Which substance below exhibits the weakest IMFs?

- a) IF₃ b) SO₂ c) CO₂ d) SiO₂ e) PH₃
- See back.

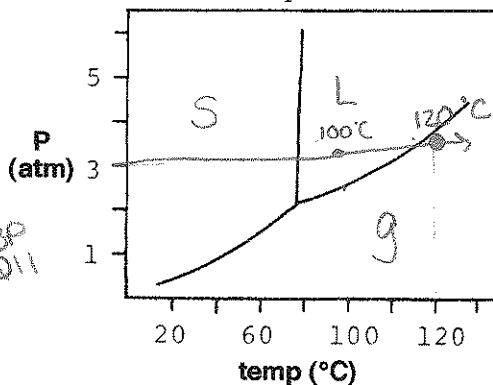
16. During the condensing of a liquid, the kinetic energy _____ and the potential energy _____.

- a) stays the same, increases
 b) increases, decreases
 c) increases, increases
 d) decreases, stays the same
 e) stays the same, decreases



Condensation
 gas → Liq
 ↓
 heat
 but no temp change
 ∴ KE stays same
 and PE ↓

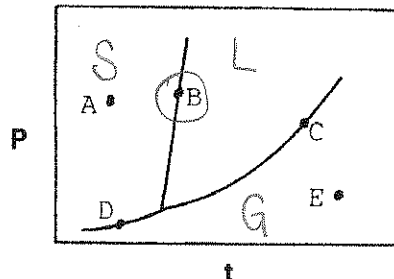
17. The phase diagram of a substance is given below. What occurs when the substance is heated from 100° C to 120° C at 3 atm pressure?



- a) it melts d) it freezes
 b) it sublimes e) no phase change occurs
 c) it boils

L → g

18. A typical phase diagram for a substance is given below. At what point on the diagram do solid and liquid exist at equilibrium?



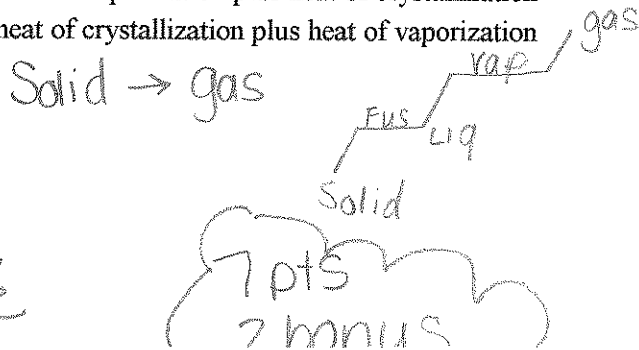
- a) A b) B c) C d) D e) E

19. Which one of the following as solids has a crystal structure containing discrete (separate) molecules?

- a) potassium d) carborundum, SiC
 b) glass e) hydrogen
 c) quartz

20. The heat of sublimation of a compound equals

- a) heat of fusion plus heat of vaporization
 b) heat of ionization plus heat of crystallization
 c) heat of vaporization minus heat of fusion
 d) heat of vaporization plus heat of crystallization
 e) heat of crystallization plus heat of vaporization



21. The normal boiling point of a liquid
- a) is 100 °C at 1 atm pressure. H_2O
 - b) is the temperature at which the vapor pressure is 1 atm.
 - c) is the temperature at which liquid and vapor are in equilibrium.
 - d) is the temperature at which the vapor pressure equals the external pressure.
 - e) is the temperature at which there is a continuous formation of gaseous bubbles in the liquid.

B

22. The vapor pressure of a liquid increases with an increase of temperature. Which of the following best explains this increase?

A

TVP
↑↑
↑EV

- a) The average kinetic energy of molecules is greater, thus more molecules can enter the gaseous state.
- b) The number of gaseous molecules above the liquid remains constant but these molecules have greater average kinetic energy.
- c) the faster moving molecules in the liquid exert a greater pressure.
- d) All the molecules have greater kinetic energies.
- e) The intermolecular forces between the molecules becomes less at higher temperatures.

D

slide 91

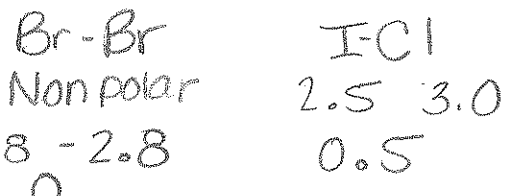
23. Which of the following indicates very strong intermolecular forces of attraction in a liquid?

- a) A very low boiling point.
- b) A very low critical temperature.
- c) A very low heat of vaporization.
- d) A very low vapor pressure.
- e) A very low surface tension.

D

24. The compounds Br_2 and ICl have almost identical molecular weights, yet ICl boils at 97°C and Br_2 boils at 59 °C. The best explanation for the difference is

- a) ICl is an ionic compound and Br_2 is covalent.
- b) ICl is a nonpolar molecule and Br_2 is polar.
- c) ICl has a longer bond than that in Br_2 .
- d) ICl has a measurable dipole moment (is polar) and Br_2 does not (is nonpolar).
- e) ICl has a stronger bond than that in Br_2 .



EN

25. In some compounds the hydrogen atom is covalently bonded to one atom and simultaneously attracted to another atom in another molecule by an electrostatic interaction. This interaction can occur when hydrogen is bonded to

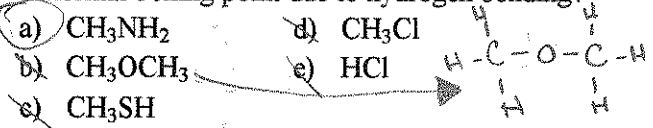
C

- a) Cl
- b) Si
- c) N
- d) C
- e) Br

Only possible H bond option

26. Which of the following compounds shows an abnormal boiling point due to hydrogen bonding?

A



Draw & look for H bond

27. Which of the following has the lowest boiling point?

B

- a) H_2O 18 (H bond)
- b) H_2S 18
- c) H_2Se 36
- d) H_2Te 54
- e) NH_3 17 (H bond)

Use mass ↓ mass ↓ BP

28. Which of the following would be expected to have the highest heat of vaporization? ↑ IMF ↑ MASS

A

- a) H_2O 18 ug
- b) NH_3 17
- c) HF 20 but always a gas.
- d) all three are the same

29. Which element is considered a covalent/network solid?

D

- a) Cr metal
- b) O
- c) Xe NG
- d) B
- e) Na metal

30. Which one of the following compounds has intermolecular forces different than the others?

- a) quartz, SiO_2
- b) $C_{(diamond)}$
- c) carbon dioxide, CO_2
- d) $C_{(graphite)}$
- e) silicon carbide, SiC

LD All the others are covalent network solids

Answers

1.	9.	17.	25.
2.	10.	18.	26.
3.	11.	19.	27.
4.	12.	20.	28.
5.	13.	21.	29.
6.	14.	22.	30.
7.	15.	23.	
8.	16.	24.	

7 pts
3 bonus