

Multiple Choice (4 points each): Answer on blue form; be sure to code in your name and ID.

Answers

- | | |
|--|------|
| 1. What is the approximate O-C-O bond angle in CO_3^{2-} ? | 1. c |
| a. 90° | |
| b. 109° | |
| c. 120° | |
| d. 180° | |
| e. 270° | |
| 2. Which one of the following molecules and ions would <u>not</u> be expected to have a tetrahedral shape? | 2. e |
| a. SiF_4 | |
| b. BeF_4^{2-} | |
| c. BF_4^- | |
| d. NH_4^+ | |
| e. XeF_4 | |
| 3. All of the following molecules have polar bonds and are polar molecules <u>except</u> | 3. b |
| a. ICl_3 | |
| b. BCl_3 | |
| c. PCl_3 | |
| d. CH_2Cl_2 | |
| e. ICl | |
| 4. Which of the following molecules is non-polar? | 4. a |
| a. CO_2 | |
| b. HCl | |
| c. SO_2 | |
| d. H_2O | |
| e. NH_3 | |
| 5. The three molecular shapes that an sp^3 hybridized molecule can have are | 5. d |
| a. see-saw, T-shaped, linear | |
| b. octahedral, square pyramidal, square planar | |
| c. planar triangular, bent, T-shaped | |
| d. tetrahedral, trigonal pyramidal, bent | |
| e. tetrahedral, square planar, see-saw | |
| 6. Choose the molecule whose bonding can best be described using sp^2 hybrid orbitals. | 6. b |
| a. $\text{HC}\equiv\text{CH}$ | |
| b. $\text{H}_2\text{C}=\text{CH}_2$ | |
| c. $\text{H}_3\text{C}-\text{CH}_3$ | |
| d. $\text{H}_3\text{C}-\text{O}-\text{CH}_3$ | |
| e. H_2S | |

7. What type of orbital-orbital overlap occurs between O and F to form the O-F bonds in OF_2 ?

7. c

- a. $sp-2s$
- b. $sp-2p$
- c. sp^3-2p
- d. sp^3-2s
- e. sp^3-sp

8. Which of the following molecules or ions possesses two pi bonds and one sigma bond?

8. a

- a. CN^-
- b. F_2
- c. OH^-
- d. O_2
- e. SO_2

9. How many sigma bonds and pi bonds respectively are there in N_2O ?

9. c

- a. 2 and 0
- b. 2 and 1
- c. 2 and 2
- d. 3 and 1
- e. 2 and 3

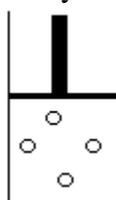
10. Equal volumes of nitrogen (N_2) and hydrogen sulfide (H_2S) gases under the same conditions of temperature and pressure have equal

10. a

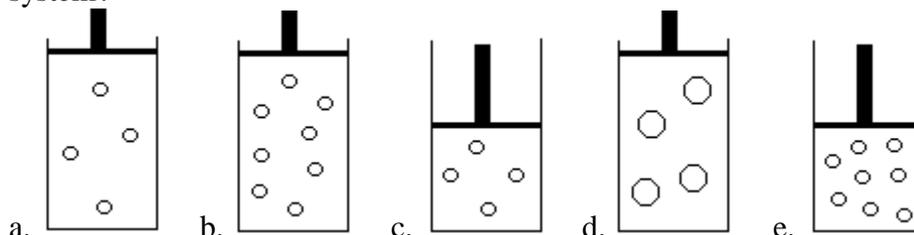
- a. numbers of molecules.
- b. masses.
- c. numbers of atoms.
- d. numbers of covalent bonds.
- e. average velocities.

11. Consider the following gaseous system at a temperature of 200K.

11. a



If the temperature is increased to 400 K, which diagram best represents the final system?



12. A weather balloon filled with hydrogen gas greatly increases in volume as it ascends to high altitudes. The expansion of the balloon is primarily due to
- a. a decrease in the average kinetic energy of the hydrogen molecules inside the balloon.
 - b. an increase in the average kinetic energy of the hydrogen molecules inside the balloon.
 - c. a decrease in the average kinetic energy of the surrounding atmosphere molecules.
 - d. an increase in the rate of collision of the hydrogen molecules against the inside walls of the balloon.
 - e. a decrease in the rate of collisions of the atmosphere molecules on the outside walls of the balloon.
13. Which characteristic does not describe an ideal gas?
- a. zero volume occupied by ideal gas molecules
 - b. no attractive forces between ideal gas molecules
 - c. obeys the equation $PV = nRT$
 - d. $PV/RT = \text{a constant}$
 - e. strong repulsions between molecules
14. A balloon contains a mixture of He(g) and Ne(g). If a small leak occurs, which statement is true?
- a. Both He(g) and Ne(g) leak from the balloon at the same rate.
 - b. All of the He(g) immediately leaks out, leaving all of the Ne(g) in the balloon.
 - c. Ne(g) leaks from the balloon 2 times faster than does He(g).
 - d. He(g) leaks from the balloon 2.5 times faster than does Ne(g).
 - e. Ne(g) leaks from the balloon 5 times faster than does He(g).
15. At 320 K and 16 atm pressure, the molar volume of ammonia (NH₃) is about 10% less than the molar volume of an ideal gas. The best explanation for the actual volume being less than the ideal volume is that
- a. the volume occupied by the NH₃ molecules themselves is significant at this high concentration.
 - b. the intermolecular forces of attraction become significant at this low temperature and this high pressure.
 - c. at this high temperature, a significant amount of NH₃ decomposes to N₂ and H₂.
 - d. ammonia is a real gas and not an ideal gas.
 - e. the critical temperature and pressure of NH₃ (405K and 112 atm) are too close to the actual temperature and pressure of the NH₃ as described.

16. Which one of the following compounds will have hydrogen bonds as one of its intermolecular forces? 16. a
- NH_3
 - H_2S
 - SiH_4
 - HCl
 - CH_2Cl_2
17. Which one of the following substances has London dispersion forces as its only intermolecular forces? 17. d
- CH_3OH
 - NH_3
 - H_2S
 - CH_4
 - SO_2
18. Compare two compounds: A, which is composed of polar molecules, and B, which is composed of non-polar molecules. The two compounds are isomers, that is, they have the same chemical formula, but with a different arrangement of atoms. Which of the following statements is true? 18. b
- A boils at a lower temperature than B.
 - B boils at a lower temperature than A.
 - Both compounds have the same boiling point.
 - A will not boil.
 - B will not exist as a liquid.
19. Which of the following compounds is expected to have the highest boiling point? 19. d
- CH_3OCH_3
 - $\text{CH}_3\text{CH}_2\text{CH}_3$
 - $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$
 - $\text{CH}_3\text{CH}_2\text{OH}$
 - $\text{CH}_3\text{CH}_2\text{F}$
20. The meniscus of alcohol in a glass capillary tube is concave because of 20. c
- the exertion of gravity on the surface of the liquid
 - impurities in the capillary tube
 - stronger interactions of alcohol with glass than with alcohol
 - weaker interaction of alcohol with glass than with alcohol
 - greater atmospheric pressure at the center of the column

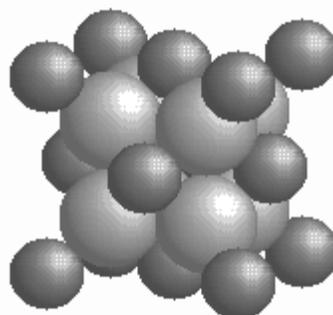
21. Solid nickel has a cubic unit cell. The edge of the cubic cell is 3.0×10^{-8} cm. Which of the cubic unit cells listed below would give nickel its highest density?
- a simple cubic unit cell
 - a body centered cubic unit cell
 - a face centered cubic unit cell
 - The density would be the same for all the cubic unit cells since the edge of all the cells is 3.0×10^{-8} cm.
 - Cannot determine this since the size of the nickel atom is not given.

21. c

22. Calcium fluoride crystallizes in a face-centered cubic lattice. The fluoride ions occupy the tetrahedral holes in the unit cell, and the calcium ions occupy the faces and corners of the unit cell. The total number of ions inside the unit cell is

22. e

- 22
- 3
- 6
- 8
- 12



23. What is the simplest formula of a solid containing A, B, and C atoms in a cubic lattice in which the A atoms occupy the corners, the B atoms the body-center position, and the C atom the faces of the unit cell?

23. b

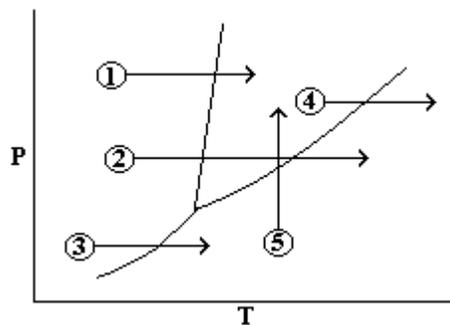
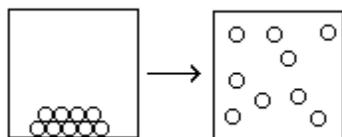
- ABC
- ABC₃
- ABC₆
- A₈BC₆
- A₄BC₃

24. The normal boiling point of a liquid is
- the only temperature at which there can be equilibrium between liquid and gas states.
 - the temperature above which the substance cannot exist as a liquid regardless of the pressure.
 - the temperature at which the gas molecules have more kinetic energy than molecules in the liquid.
 - the temperature at which the vapor pressure equals 760 torr.
 - any temperature at which a liquid boils.

24. d

25. Which arrow on the phase diagram corresponds to the phase change illustrated on the left?

25. c



- a. 1
- b. 2
- c. 3
- d. 4
- e. 5