

1041_3rd Exam_1050106 (A)

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) Which compound has the highest magnitude of lattice energy?

- A) MgS B) CaS C) BaS D) SrS

Answer: A

2) Which pair of atoms forms the most polar bond?

- A) N and F B) C and O C) N and O D) C and F

Answer: D

3) Which of the following statements is TRUE?

- A) A pair of electrons involved in a covalent bond are sometimes referred to as "lone pairs."
B) It is not possible for two atoms to share more than two electrons.
C) Single bonds are shorter than double bonds.
D) A covalent bond has a lower potential energy than the two separate atoms.
E) A covalent bond is formed through the transfer of electrons from one atom to another.

Answer: D

4) Which of the following statements is TRUE?

- A) An ionic bond is much stronger than most covalent bonds.
B) An ionic bond is formed through the sharing of electrons.
C) Once dissolved in water, ionic compounds rarely conduct electricity.
D) Ionic compounds at room temperature typically conduct electricity.
E) None of the above are true.

Answer: A

5) Give the complete electronic configuration for S^{2-} .

- A) $1s^2 2s^2 2p^6 3s^2 4p^6$
B) $1s^2 2s^2 2p^6 3s^2 3p^6$
C) $1s^2 2s^2 3p^6 4s^2 5p^6$
D) $1s^2 2s^2 2p^6 3s^2 3p^6$
E) $1s^2 2s^2 2p^6 3s^2 3p^5$

Answer: D

6) Which of the following reactions is associated with the lattice energy of CaS ($\Delta H^\circ_{\text{latt}}$)?

- A) $\text{CaS(s)} \rightarrow \text{Ca}^{2+}(\text{aq}) + \text{S}^{2-}(\text{aq})$
B) $\text{CaS(s)} \rightarrow \text{Ca(s)} + \text{S(s)}$
C) $\text{Ca}^{2+}(\text{g}) + \text{S}^{2-}(\text{g}) \rightarrow \text{CaS(s)}$
D) $\text{Ca(s)} + \text{S(s)} \rightarrow \text{CaS(s)}$
E) $\text{Ca}^{2+}(\text{aq}) + \text{S}^{2-}(\text{aq}) \rightarrow \text{CaS(s)}$

Answer: C

7) Use the data given below to construct a Born-Haber cycle to determine the heat of formation of KCl.

	ΔH° (kJ)
$\text{K(s)} \rightarrow \text{K(g)}$	89
$\text{K(g)} \rightarrow \text{K}^+(\text{g}) + \text{e}^-$	418
$\text{Cl}_2(\text{g}) \rightarrow 2 \text{Cl}(\text{g})$	244
$\text{Cl}(\text{g}) + \text{e}^- \rightarrow \text{Cl}^-(\text{g})$	-349
$\text{KCl(s)} \rightarrow \text{K}^+(\text{g}) + \text{Cl}^-(\text{g})$	717

A) -437 kJ

B) -1119 kJ

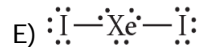
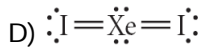
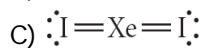
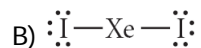
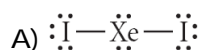
C) +158 kJ

D) -997 kJ

E) +631 kJ

Answer: A

8) Choose the best Lewis structure for XeI_2 .



Answer: E

9) Place the following in order of increasing magnitude of lattice energy.

CaO MgO SrS

A) $\text{CaO} < \text{MgO} < \text{SrS}$

B) $\text{MgO} < \text{CaO} < \text{SrS}$

C) $\text{CaO} < \text{SrS} < \text{MgO}$

D) $\text{SrS} < \text{MgO} < \text{CaO}$

E) $\text{SrS} < \text{CaO} < \text{MgO}$

Answer: E

10) Place the following in order of decreasing bond length.

H-F H-I H-Br

A) $\text{H-Br} > \text{H-F} > \text{H-I}$

B) $\text{H-I} > \text{H-F} > \text{H-Br}$

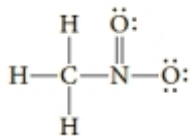
C) $\text{H-F} > \text{H-I} > \text{H-Br}$

D) $\text{H-F} > \text{H-Br} > \text{H-I}$

E) $\text{H-I} > \text{H-Br} > \text{H-F}$

Answer: E

11) Determine the formal charge of nitrogen in this structure.



A) -2

B) -1

C) +2

D) +1

Answer: D

12) Which of the following processes are exothermic?

A) $\text{Li(s)} \rightarrow \text{Li(g)}$

B) $\text{Br(g)} + \text{e}^- \rightarrow \text{Br}^-(\text{g})$

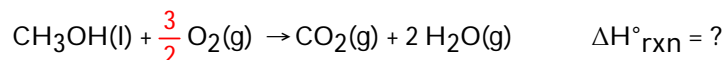
C) $\text{Cl}_2(\text{g}) \rightarrow 2\text{Cl}(\text{g})$

D) $\text{NaF(s)} \rightarrow \text{Na}^+(\text{g}) + \text{F}^-(\text{g})$

E) None of the above are exothermic.

Answer: B

13) Use the bond energies provided to estimate $\Delta H^\circ_{\text{rxn}}$ for the reaction below.



<u>Bond</u>	<u>Bond Energy (kJ/mol)</u>
C-H	414
C-O	360
C=O	799
O=O	498
O-H	464

A) -91 kJ

B) -392 kJ

C) +206 kJ

D) +473 kJ

E) -486 kJ

Answer: No Correct Answer Was Provided.

14) Which molecule geometry results when a central atom has five total electron groups, with three of those being bonding groups and two being lone pairs?

A) T-shaped

B) seesaw

C) bent

D) trigonal bipyramidal

Answer: A

15) Give the hybridization for the S in SF_6 .

A) sp

B) sp^3d

C) sp^2

D) sp^3d^2

E) sp^3

Answer: D

16) Give the electron geometry (eg), molecular geometry (mg), and hybridization for XeF_4 .

A) eg=octahedral, mg=square planar, sp^3d^2

B) eg=octahedral, mg=octahedral, sp^3d^2

C) eg=trigonal bipyramidal, mg=seesaw, sp^3d

D) eg=tetrahedral, mg=tetrahedral, sp^3

E) eg=trigonal pyramidal, mg=trigonal pyramidal, sp^3

Answer: A

17) Place the following in order of increasing dipole moment.

I. BCl_3 II. BIF_2 III. BClF_2

A) $\text{I} < \text{III} < \text{II}$

B) $\text{I} < \text{II} = \text{III}$

C) $\text{I} < \text{II} < \text{III}$

D) $\text{II} < \text{I} < \text{III}$

E) $\text{II} < \text{III} < \text{I}$

Answer: A

18) How many of the following molecules are polar?

BrCl_3 CS_2 SiF_4 SO_3

A) 2

B) 1

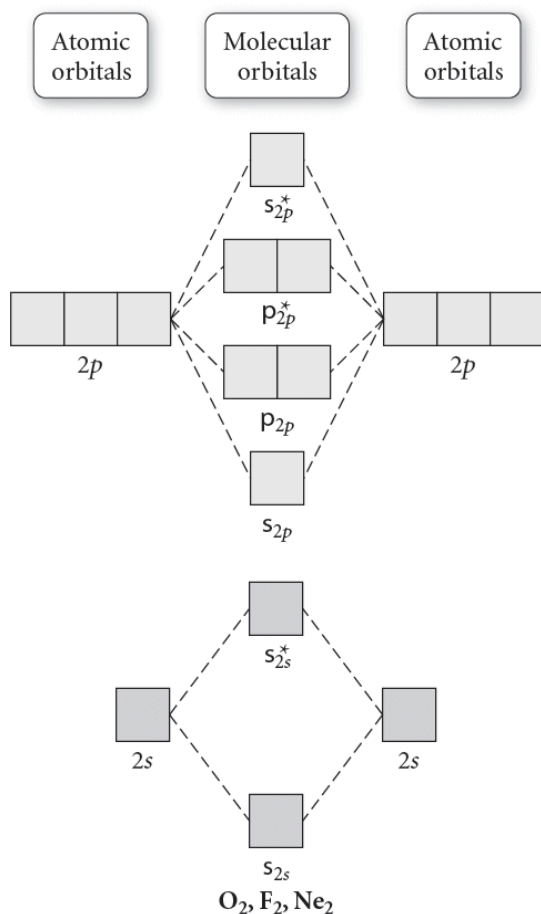
C) 3

D) 4

E) 0

Answer: B

19) Use the molecular orbital diagram shown to determine which of the following is paramagnetic.



A) Ne_2^{2+}

B) O_2^{2-}

C) F_2^{2+}

D) O_2^{2+}

E) F_2^{2-}

Answer: C

20) Use the molecular orbital diagram shown in Question 19 to determine which of the following is most stable.

A) F_2

B) Ne_2^{2+}

C) F_2^{2+}

D) F_2^{2-}

E) O_2^{2+}

Answer: E

21) Predict the relative bond angles in BF_3 and SO_2 .

- A) Relative bond angles cannot be predicted. B) SO_2 bond angle > BF_3 bond angles
C) BF_3 bond angles = SO_2 bond angle D) BF_3 bond angles > SO_2 bond angle

Answer: D

22) Give the electron geometry (eg), molecular geometry (mg), and hybridization for NH_3 .

- A) eg=trigonal planar, mg=trigonal planar, sp^2
B) eg=tetrahedral, mg=trigonal planar, sp^2
C) eg=trigonal pyramidal, mg=tetrahedral, sp^3
D) eg=tetrahedral, mg=trigonal pyramidal, sp^3
E) eg=trigonal pyramidal, mg=trigonal pyramidal, sp^3

Answer: D

23) Which of the following statements is TRUE?

- A) When two atomic orbitals come together to form two molecular orbitals, one molecular orbital will be lower in energy than the two separate atomic orbitals and one molecular orbital will be higher in energy than the separate atomic orbitals.
B) A bond order of 0 represents a stable chemical bond.
C) The total number of molecular orbitals formed doesn't always equal the number of atomic orbitals in the set.
D) Electrons placed in antibonding orbitals stabilize the ion/molecule.
E) All of the above are true.

Answer: A

24) According to valence bond theory, which kind of orbitals overlap to form the P—Cl bonds in PCl_5 ?

- A) $\text{P}(\text{sp}^3d) - \text{Cl}(p)$ B) $\text{P}(\text{sp}^3) - \text{Cl}(s)$ C) $\text{P}(\text{sp}^3) - \text{Cl}(p)$ D) $\text{P}(\text{sp}^3d) - \text{Cl}(s)$

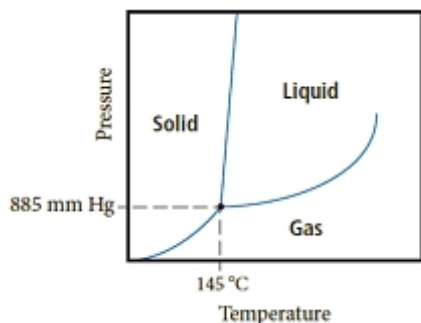
Answer: A

25) Determine the hybridization about O in CH_3OH .

- A) sp^2 B) sp C) sp^3d D) sp^3

Answer: D

26) Consider the phase diagram shown below. A sample of the substance in the phase diagram is initially at 175°C and 925 mmHg. What phase transition occurs when the pressure is decreased to 760 mmHg at constant temperature?



- A) liquid to gas B) solid to liquid C) solid to gas D) liquid to solid

Answer: A

- 27) Why is water an extraordinary substance?
- A) Water has an exceptionally high specific heat capacity.
 - B) Water is the main solvent within living organisms.
 - C) Water has strong hydrogen bonding.
 - D) Water has a low molar mass, yet it is a liquid at room temperature.
 - E) All of the above.

Answer: E

- 28) Based on the expected intermolecular forces, which halogen has the highest boiling point?
- A) Br₂
 - B) Cl₂
 - C) I₂
 - D) F₂

Answer: C

- 29) What is the strongest type of intermolecular force present in NH₂CH₃?
- A) ion-dipole
 - B) hydrogen bonding
 - C) dipole-dipole
 - D) dispersion
 - E) none of the above

Answer: B

- 30) How much energy is required to vaporize 48.7 g of dichloromethane (CH₂Cl₂) at its boiling point, if its ΔH_{vap} is 31.6 kJ/mol?
- A) 15.4 kJ
 - B) 31.2 kJ
 - C) 18.1 kJ
 - D) 6.49 kJ
 - E) 55.1 kJ

Answer: C

- 31) Which of the following statements is FALSE?
- A) The rate of vaporization increases with increasing surface area.
 - B) The rate of vaporization increases with increasing temperature.
 - C) Molecules with hydrogen bonding are more volatile than compounds with dipole-dipole forces.
 - D) The rate of vaporization increases with decreasing strength of intermolecular forces.
 - E) None of the above are false.

Answer: C

- 32) Which of the following statements is TRUE?
- A) Intermolecular forces are generally stronger than bonding forces.
 - B) Increasing the pressure on a solid usually causes it to become a liquid.
 - C) The potential energy of molecules decrease as they get closer to one another.
 - D) Energy is given off when the attraction between two molecules is broken.
 - E) None of the above are true.

Answer: C

- 33) Define triple point.
- A) The temperature that is unique for a substance.
 - B) The temperature at which the solid and liquid co-exist.
 - C) The temperature, pressure, and density for a gas.
 - D) The temperature at which the boiling point equals the melting point.
 - E) The temperature and pressure where liquid, solid, and gas are equally stable and are in equilibrium.

Answer: E

34) Acetic acid has a normal boiling point of 118°C and a ΔH_{vap} of 23.4 kJ/mol. What is the vapor pressure (in mmHg) of acetic acid at 25 °C? [$\ln \left(\frac{P_1}{P_2} \right) = \left(\frac{\Delta H_{\text{vap}}}{R} \right) \left(\frac{1}{T_2} - \frac{1}{T_1} \right)$, $R = 8.314 \text{ J/mol}$, $1 \text{ atm} = 760 \text{ mmHg}$]

A) 80.6 mmHg

B) 2.92×10^{-39} mmHg

C) 758 mmHg

D) 7.16×10^3 mmHg

Answer: A

35) How much energy must be removed from a 125 g sample of benzene (molar mass= 78.11 g/mol) at 425.0 K to liquify the sample and lower the temperature to 335.0 K? The following physical data may be useful.

$$\Delta H_{\text{vap}} = 33.9 \text{ kJ/mol}$$

$$\Delta H_{\text{fus}} = 9.8 \text{ kJ/mol}$$

$$C_{\text{liq}} = 1.73 \text{ J/g}^\circ\text{C}$$

$$C_{\text{gas}} = 1.06 \text{ J/g}^\circ\text{C}$$

$$C_{\text{sol}} = 1.51 \text{ J/g}^\circ\text{C}$$

$$T_{\text{melting}} = 279.0 \text{ K}$$

$$T_{\text{boiling}} = 353.0 \text{ K}$$

A) 95.4 kJ

B) 74.4 kJ

C) 67.7 kJ

D) 54.3 kJ

E) 38.9 kJ

Answer: C

36) Identify the type of solid for ice.

A) metallic atomic solid

B) ionic solid

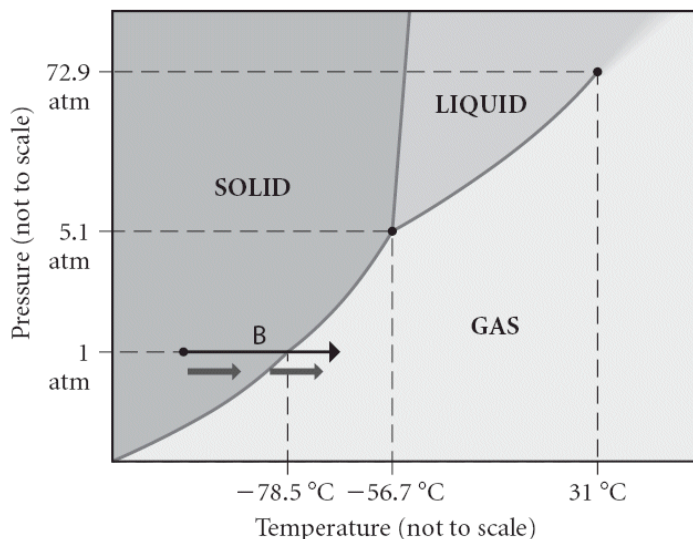
C) networking atomic solid

D) nonbonding atomic solid

E) molecular solid

Answer: E

37) Consider the phase diagram shown. Choose the statement below that is TRUE.



- A) The solid phase of this substance is higher in density than the liquid phase.
- B) The triple point of this substance occurs at a temperature of 31°C.
- C) The line separating the solid and liquid phases represents the ΔH_{vap} .
- D) At 10 atm of pressure, there is no temperature where the liquid phase of this substance would exist.
- E) None of the above are true.

Answer: A

38) Give the major force in seawater.

- A) dipole-dipole
- B) ion-dipole
- C) dispersion
- D) hydrogen bonding
- E) ion-ion

Answer: B

39) The osmotic pressure of a solution containing 22.7 mg of an unknown protein in 50.0 mL of solution is 2.88 mmHg at 25 °C. Determine the molar mass of the protein. [$\pi = C_M \times R \times T$, $R = 62.364 \text{ L}\cdot\text{mmHg} / \text{mol}\cdot\text{K}$]

- A) 3.85 g/mol
- B) 147 g/mol
- C) 2.93×10^3 g/mol
- D) 246 g/mol

Answer: C

40) Determine the vapor pressure of an aqueous ethylene glycol ($\text{C}_2\text{H}_6\text{O}_2$) solution that is 14.8% $\text{C}_2\text{H}_6\text{O}_2$ by mass. The vapor pressure of pure water at 25 °C is 23.8 torr [$\Delta P = i \times X_B \times P^\circ$]

- A) 1.14 torr
- B) 22.7 torr
- C) 20.3 torr
- D) 3.52 torr

Answer: B

41) Determine the vapor pressure of a solution at 55°C that contains 34.2 g NaCl in 375 mL of water. The vapor pressure of pure water at 55°C is 118.1 torr. The van't Hoff factor for NaCl is 1.9 [$\Delta P = i \times X_B \times P^\circ$]

- A) 112 torr
- B) 87.1 torr
- C) 115 torr
- D) 92.8 torr
- E) 108 torr

Answer: A

- 42) Calculate the boiling point of a solution of 500.0 g of ethylene glycol ($C_2H_6O_2$) dissolved in 500.0 g of water. $K_f = 1.86^\circ C/m$ and $K_b = 0.512^\circ C/m$. Use $100^\circ C$ as the boiling point of water. [$\Delta T = i \times K_b \times Cm$]
A) $92^\circ C$ B) $70^\circ C$ C) $-30.0^\circ C$ D) $108^\circ C$ E) $-8.32^\circ C$

Answer: D

- 43) Commercial grade HCl solutions are typically 39.0% (by mass) HCl in water. Determine the molality of the HCl, if the solution has a density of 1.20 g/mL.
A) 6.39 m B) 10.7 m C) 17.5 m D) 9.44 m E) 39.0 m

Answer: C

- 44) Which of the following concentration units are temperature dependent?

- A) molarity
- B) mole fraction
- C) mass percent
- D) molality
- E) none of the above.

Answer: A

- 45) Which of the following statements is generally TRUE?

- A) The solubility of a solid is highly dependent on pressure.
- B) The solubility of a solid is highly dependent on temperature.
- C) The solubility of a solid is highly dependent on both pressure and temperature.
- D) The solubility of a solid is not dependent on either temperature or pressure.
- E) None of the above.

Answer: B

- 46) Which of the following statements is TRUE?

- A) The solubility of an ionic solid in water decreases with increasing temperature.
- B) The solubility of a gas in water usually increases with decreasing pressure.
- C) In general, the solubility of a gas in water decreases with increasing temperature.
- D) In general, the solubility of a solid in water decreases with increasing temperature.
- E) None of the above statements are true.

Answer: C

- 47) An aqueous solution is saturated in both potassium chlorate and carbon dioxide gas at room temperature. What happens when the solution is warmed to $85^\circ C$?

- A) Potassium chlorate precipitates out of solution.
- B) Potassium chlorate precipitates out of solution and carbon dioxide bubbles out of solution.
- C) Nothing happens; all of the potassium chloride and the carbon dioxide remain dissolved in solution.
- D) Carbon dioxide bubbles out of solution.

Answer: D

- 48) Soap has an ionic and a polar end. It works well to remove oil by

- A) surrounding the oil and water with the nonpolar end.
- B) surrounding the oil and water with the polar end.
- C) surrounding the oil with the polar end, and the water interacts with the nonpolar end.
- D) surrounding the oil with the nonpolar end, and the water interacts with the polar end.

Answer: D

49) Identify the colligative property.

- A) vapor pressure lowering
- B) freezing point depression
- C) osmotic pressure
- D) boiling point elevation
- E) all of the above

Answer: E

50) The boiling point elevation of an aqueous sucrose solution is found to be 0.39°C . What mass of sucrose (molar mass = 342.30 g/mol) would be needed to dissolve in 500.0 g of water? $K_b(\text{water}) = 0.512^{\circ}\text{C}/m$.

$$[\Delta T = i \times K_b \times C_m]$$

- A) 130. g sucrose
- B) 528 g sucrose
- C) 223 g sucrose
- D) 261 g sucrose
- E) 762 g sucrose

Answer: A