

1011_4th Exam_1020116

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

1) Which probably has the highest boiling point at 1.00 atm pressure?

- A) $\text{H}_2\text{NCH}_2\text{CH}_2\text{NH}_2$
- B) $(\text{CH}_3)_2\text{CHNH}_2$
- C) $(\text{CH}_3)_3\text{N}$
- D) $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$
- E) $\text{CH}_3\text{CH}_2\text{NHCH}_3$

Answer: A

2) Coordination number is:

- A) The number of atoms per unit cell
- B) The number of atoms in the holes of closest packed structures
- C) The number of layers in close packed structures
- D) The number of atoms in contact with a given atom
- E) The number of atoms in the corners of the unit cell

Answer: D

3) The solubility of CO in water at 0°C and 1 atm CO pressure is 0.0354 mg of CO in 1 mL of water. Calculate the molarity of aqueous CO solution at the normal partial pressure of CO of 0.00036 atm?

- A) $1.3 \times 10^{-5} \text{ M}$
- B) $2.9 \times 10^{-4} \text{ M}$
- C) $4.5 \times 10^{-7} \text{ M}$
- D) $3.2 \times 10^{-3} \text{ M}$
- E) $1.6 \times 10^{-3} \text{ M}$

Answer: C

4) Which statement is INCORRECT about molecular orbital theory?

- A) The bond order (BO) is $\frac{\#e^- \text{ in bonding} - \#e^- \text{ in antibonding}}{2}$.
- B) The number of molecular orbitals produced is equal to the number of atomic orbitals combined.
- C) The antibonding orbital is at a lower energy than the bonding orbital.
- D) Each pair of sigma molecular orbitals is a bonding orbital and an antibonding orbital.
- E) Hund's rule says that each orbital of identical energy has one electron before pairs are formed.

Answer: C

5) The vapor pressures of pure propyl alcohol and isopropyl alcohol are 21.0 mmHg and 45.2 mmHg, respectively, at 25°C. What is the composition of the vapor in equilibrium with a propyl alcohol - isopropyl alcohol solution in which the mole fraction of propyl alcohol is 0.250?

- A) $x_{\text{iso}} = 0.317$, $x_{\text{prop}} = 0.683$
- B) $x_{\text{iso}} = 0.750$, $x_{\text{prop}} = 0.250$
- C) $x_{\text{iso}} = 0.866$, $x_{\text{prop}} = 0.134$
- D) $x_{\text{iso}} = 0.512$, $x_{\text{prop}} = 0.488$

Answer: C

6) For BeCl_2 , the dipole moment of the molecule, hybridization on the central atom, and number of lone pairs on the central atom are:

- A) none, sp^3 , two
- B) away from Be, sp^2 , one
- C) none, sp , none
- D) toward Be, sp , one
- E) toward Be, sp^2 , none

Answer: C

7) The freezing point of pure benzene was measured as 5.49°C . With the same benzene and same equipment, the freezing point of a solution containing 6.582 g of an unknown (sold in the store as "moth crystals") in 100.203 grams of benzene was found to be 3.48°C . The cryoscopic constant, K_f , for benzene is $5.12^\circ\text{C}\cdot\text{kg}/\text{mole}$.

Calculate the mole weight of the unknown.

- A) 37.5 g/mol
- B) 172 g/mol
- C) 70.4 g/mol
- D) 16.7 g/mol
- E) 96.6 g/mol

Answer: B

8) A passage of substance directly from the vapor to the solid state is known as:

- A) sublimation
- B) fusion
- C) deposition
- D) decomposition
- E) solidification

Answer: C

9) A liquid has a normal boiling point of 78°C and its vapor pressure is 400 mmHg at 50°C . To compute the molar heat of vaporization, one needs: (R is constant)

- A) all information has been provided
- B) molarity
- C) the vapor pressure at another temperature
- D) the mole weight
- E) the specific heat

Answer: A

10) According to VB theory, sigma bonds are:

- A) formed only by s orbitals
- B) formed only by hybrid orbitals
- C) formed only by unhybridized orbitals
- D) always present in double bonds
- E) formed only by p orbitals

Answer: D

11) Which of the pairs of molecules below have the same hybridization on the central atom? (The central atom is underlined.)

- A) $\text{H}_3\text{C}\underline{\text{O}}\text{H}$, $\underline{\text{C}}\text{H}_2\text{O}$
- B) $\underline{\text{Be}}\text{H}_2$, $\underline{\text{N}}\text{H}_3$
- C) $\text{H}\underline{\text{O}}\text{Cl}$, $\underline{\text{C}}\text{IF}_3$
- D) $\text{H}_2\underline{\text{O}}$, $\text{H}\underline{\text{N}}\text{O}$
- E) $\text{H}\underline{\text{C}}\text{N}$, $\underline{\text{C}}\text{O}_2$

Answer: E

12) The enthalpy of fusion is:

- A) The quantity of heat released when a solid melts
- B) The quantity of heat when two elements are fused together to produce binary compound
- C) The quantity of heat released when an organic compound burns in an atmosphere of pure oxygen
- D) The quantity of heat required to melt a solid
- E) The quantity of heat required to fuse two atomic nuclei

Answer: D

13) Which of the following ionic compounds should have the highest melting point?

- A) MgO
- B) NaI
- C) CaS
- D) NaCl
- E) LiBr

Answer: A

14) According to MO theory, assuming that the molecular orbits are the same as a diatomic molecule, which is an INCORRECT statement for CN⁻?

- A) The BO is 2.
- B) The molecule is diamagnetic.
- C) There are no unpaired electrons.
- D) There are 10 electrons in the $n=2$ level orbitals.
- E) The σ_{2p} is the highest filled level.

Answer: A

15) Commercial nitric acid is 16.0 M HNO₃(aq) and has a density of 1.42 g/mL. What is the mole fraction of HNO₃ in this solution?

- A) 0.412
- B) 0.589
- C) 0.699
- D) 0.704

Answer: A

16) Choose the INCORRECT statement about H₃O⁺.

- A) The hybridization on O is sp^3 .
- B) There is one lone pair on O.
- C) There are 3 σ bonds.
- D) There is one π bond.
- E) The OH bonds are O(sp^3) - H(1s).

Answer: D

17) Which of the following is an example of a colloid?

- A) steel
- B) sucrose in water
- C) salt in water
- D) whipped cream

Answer: D

18) The phenomenon of supercooling refers to the existence of a metastable:

- A) liquid at a temperature below that of its sublimation point
- B) gas at a temperature below that of its critical point
- C) liquid at a temperature below that of its freezing point
- D) liquid at a temperature below that of its critical point
- E) two-phase liquid/solid mixture at the freezing point

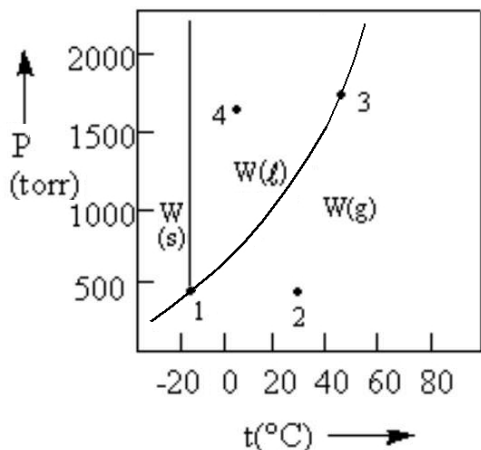
Answer: C

19) If one compares compound A, composed of nonpolar molecules, with compound B, composed of polar molecules, and both molecules have the same molecular formula, then it is true that:

- A) A boils at a lower temperature than B
- B) B boils at a lower temperature than A
- C) both compounds have the same boiling point
- D) B will not boil
- E) we have to know the structural formula to determine the differences in boiling points of A and B

Answer: A

20) According to the phase diagram given, which of the following statements is INCORRECT?



- A) If W is maintained at the pressure of point 4 while the temperature is increased to 80°C, the liquid will vaporize.
- B) At the temperature and pressure of point 1, W exists as a three-phase equilibrium system.
- C) If the system is maintained at the temperature of point 3 while pressure is decreased, more W will vaporize.
- D) The existence of liquid W at -40°C and 500 torr represents the metastable condition of "supercooling."
- E) At the temperature of point 2, a pressure of 500 torr will cause W to liquefy.

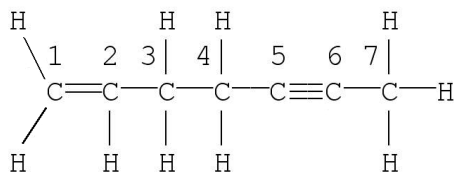
Answer: E

21) According to principles of VSEPR theory applied on AsCl_5^{2-} , which of the following is INCORRECT?

- A) VSEPR formula = AX_5E
- B) molecular geometry = square planar
- C) hybridization = sp^3d^2
- D) electron pair geometry = octahedral
- E) one lone pair and 5 bonding pairs

Answer: B

22) Which statement is correct for the structure shown?



- A) The molecule contains a total of five π bonds.
- B) Carbon no. 2 is described by sp^2 hybridization.
- C) Carbon no. 1 is described by sp^3 hybridization.
- D) Carbon no. 7 is described by sp hybridization.
- E) The molecule contains 19 σ bonds.

Answer: B

23) Which of the following does NOT involve any delocalized π bonds?

- A) ozone
- B) nitric acid
- C) acetate ion
- D) nitrous acid
- E) carbonate ion

Answer: D

24) A liquid will "wet" a surface if:

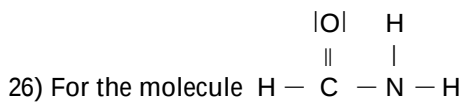
- A) the forces between the liquid molecules are weak
- B) The liquid has low viscosity and the surface is smooth
- C) the liquid has a low vapor pressure
- D) the liquid has a lesser density than the surface
- E) the forces between the molecules and the surface are greater than the forces between the molecules of the liquid

Answer: E

25) Which of the following is a true solution with particles less than 1 nm in size?

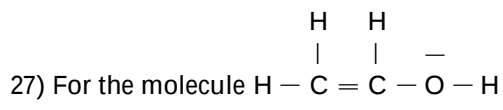
- A) milk.
- B) calcium chloride in water.
- C) oil in water.
- D) whipped cream.

Answer: B



- A) the hybridization for N is sp^2
- B) the hybridization for O is sp^3
- C) the hybridization for C is sp^2
- D) the hybridization for C is sp^3
- E) N is not hybridized

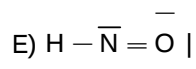
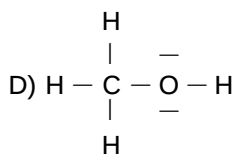
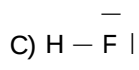
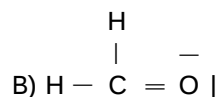
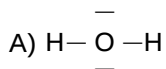
Answer: C



- A) O is not hybridized
- B) the hybridization on O is sp
- C) both carbons are sp^2 hybridized
- D) the geometry about O is linear
- E) there are two π bonds between the two carbons

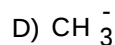
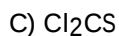
Answer: C

28) Below are given the Lewis structures of five molecules. Which one displays the LEAST hydrogen bonding?



Answer: B

29) Which of the following carbon molecules has sp hybridization?



Answer: E

30) Choose the INCORRECT statement about NH_2^- .

- A) There are two σ bonds.
- B) N is sp^3 hybridization.
- C) There is one lone pair on N.
- D) There are no π bonds.
- E) The molecule is bent.

Answer: C

31) Which of the following compounds has the highest solubility?



Answer: A

32) An atom at the corner of cubic unit cell is shared among:

- A) eight adjoining unit cells
- B) six adjoining unit cells
- C) ten adjoining unit cells
- D) four adjoining unit cells
- E) twelve adjoining unit cells

Answer: A

33) Choose the INCORRECT statement about NH_4^+ .

- A) There are no π bonds.
- B) The molecule is tetrahedral.
- C) The hybridization of N is sp^3 .
- D) There are four σ bonds.
- E) There is one lone pair of electrons on N.

Answer: E

34) Which of the following is a correct statement about azeotropes?

- A) The solution behaves as an ideal solution.
- B) The mixture cannot be separated by fractional distillation.
- C) The solution has the same pressure as the pure solvent.
- D) The components boil at distinct temperatures.
- E) The vapor has a different composition than the liquid.

Answer: B

35) Henry's Law constants for aqueous solutions at 25°C are 8.20×10^{-7} molal/mmHg for N_2 and 1.62×10^{-6} molal/mmHg for O_2 . Determine the solubility of nitrogen in water under an atmospheric pressure of 760 mmHg, assuming that air is 80% N_2 and 20% O_2 .

- A) 7.79×10^{-4} m
- B) 4.99×10^{-4} m
- C) 6.16×10^{-3} m
- D) 1.25×10^{-4} m
- E) 6.23×10^{-4} m

Answer: B

36) What is the mass/vol % ethanol in an ethanol-water solution with a density of 0.875 g/mL and containing 65.0% ethanol by volume? The density of pure ethanol is 0.789 g/mL.

- A) 51.3% ethanol (mass/vol)
- B) 90.2% ethanol (mass/vol)
- C) 56.9% ethanol (mass/vol)
- D) 74.5% ethanol (mass/vol)
- E) 58.6% ethanol (mass/vol)

Answer: A

37) If the HCOO^- ion is described using delocalized electrons, why can the oxygen atoms not have sp^3 hybrids?

- A) Molecular orbital theory does not include hybridization.
- B) The s orbital must be unhybridized to form the pi bond system.
- C) There must be an unhybridized p orbital to form the pi bond system.
- D) There is no hybridization in systems with delocalized electrons.
- E) The four lobes repel each other too strongly.

Answer: C

38) Which definition is INCORRECT?

- A) molarity = moles of solute/liter of solution
- B) mole fraction = moles of solute/moles of solution
- C) weight percent = grams of solute/100 grams of solution
- D) molality = moles of solute/kilogram of solvent
- E) volume percent = volume of solute/volume of solution

Answer: B

39) Which of the following describe the critical point of a liquid?

- I) the temperature and pressure at which a liquid's meniscus disappears
 - II) the point where the vapor pressure curve intersects the fusion temperature curve
 - III) the highest temperature and pressure at which a liquid can exist
 - IV) the highest temperature at which it is possible to obtain a liquid from its vapor by increasing pressure
- A) II), III), IV) B) I), IV) C) I), III), IV) D) I), II), III) E) II), III)

Answer: C

40) Choose the INCORRECT statement.

- A) Fullerenes are a recently discovered allotropic form of carbons.
- B) Graphite has sp hybridization.
- C) Nanotubes are an allotropic form of carbon.
- D) In a network covalent solid, covalent bonds extend throughout the crystalline solid.
- E) Diamond has sp³ hybridization.

Answer: B