

## 1021\_4th Exam\_1030115

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

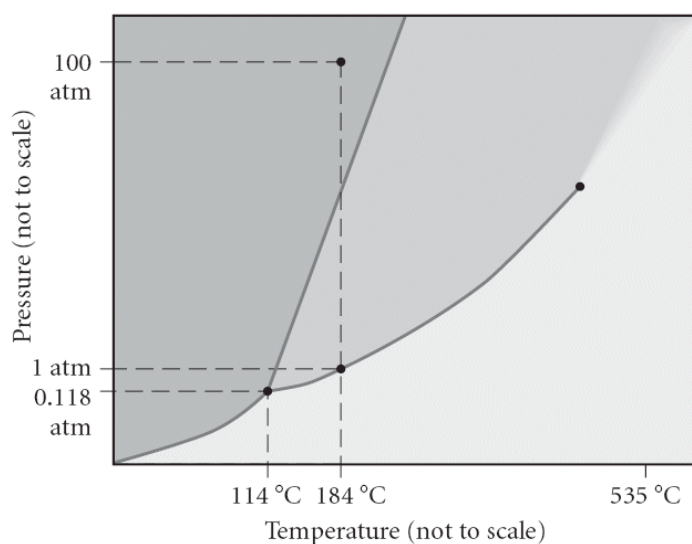
- 1) Place the following substances in order of increasing vapor pressure at a given temperature.

SF<sub>6</sub>      SiH<sub>4</sub>      SF<sub>4</sub>

- A) SiH<sub>4</sub> < SF<sub>4</sub> < SF<sub>6</sub>
- B) SF<sub>6</sub> < SF<sub>4</sub> < SiH<sub>4</sub>
- C) SiH<sub>4</sub> < SF<sub>6</sub> < SF<sub>4</sub>
- D) SF<sub>4</sub> < SF<sub>6</sub> < SiH<sub>4</sub>
- E) SF<sub>6</sub> < SiH<sub>4</sub> < SF<sub>4</sub>

Answer: D

- 2) Consider the phase diagram below. If the dashed line at 1 atm of pressure is followed from 100 to 500°C, what phase changes will occur (in order of increasing temperature)?



- A) sublimation, followed by deposition
- B) condensation, followed by vaporization
- C) fusion, followed by vaporization
- D) vaporization, followed by deposition
- E) No phase change will occur under the conditions specified.

Answer: C

- 3) A solution is prepared by dissolving 49.3 g of KBr in enough water to form 473 mL of solution. Calculate the mass % of KBr in the solution if the density is 1.12 g/mL.

- A) 8.57%
- B) 10.1%
- C) 10.4%
- D) 11.7%
- E) 9.31%

Answer: E

4) Give the electron geometry (eg), molecular geometry (mg), and hybridization for H<sub>2</sub>O.

- A) eg=trigonal pyramidal, mg=trigonal pyramidal, sp<sup>3</sup>
- B) eg=tetrahedral, mg=trigonal pyramidal, sp<sup>3</sup>
- C) eg=bent, mg=bent, sp<sup>2</sup>
- D) eg=trigonal planar, mg=trigonal planar, sp<sup>2</sup>
- E) eg=tetrahedral, mg=bent, sp<sup>3</sup>

Answer: E

5) Choose the situation below that would result in an exothermic  $\Delta H_{\text{solution}}$ .

- A) When  $|\Delta H_{\text{solute}}|$  is close to  $|\Delta H_{\text{hydration}}|$
- B) When  $|\Delta H_{\text{solute}}| > |\Delta H_{\text{hydration}}|$
- C) When  $|\Delta H_{\text{solute}}| \gg |\Delta H_{\text{hydration}}|$
- D) When  $|\Delta H_{\text{solute}}| < |\Delta H_{\text{hydration}}|$
- E) There isn't enough information to determine.

Answer: D

6) How much energy is required to heat 36.0 g H<sub>2</sub>O from a liquid at 65°C to a gas at 115°C? The following physical data may be useful.

$$\Delta H_{\text{vap}} = 40.7 \text{ kJ/mol}$$

$$C_{\text{liq}} = 4.18 \text{ J/g}^\circ\text{C}$$

$$C_{\text{gas}} = 2.01 \text{ J/g}^\circ\text{C}$$

$$C_{\text{sol}} = 2.09 \text{ J/g}^\circ\text{C}$$

$$T_{\text{melting}} = 0^\circ\text{C}$$

$$T_{\text{boiling}} = 100^\circ\text{C}$$

- A) 52.7 kJ                      B) 10.9 kJ                      C) 91.7 kJ                      D) 63.5 kJ                      E) 87.7 kJ

Answer: E

7) Determine the electron geometry (eg) and molecular geometry (mg) of the underlined atom CH<sub>3</sub>OCH<sub>3</sub>.

- A) eg=tetrahedral, mg=tetrahedral
- B) eg=octahedral, mg=octahedral
- C) eg=tetrahedral, mg=bent
- D) eg=trigonal bipyramidal, mg=tetrahedral
- E) eg=linear, mg=linear

Answer: C

8) Place the following in order of decreasing dipole moment.

I. cis-CHCl=CHCl

II. trans-CHCl=CHCl

III. cis-CHF=CHF

- A) III > I > II                      B) I = III > II                      C) II > III > I                      D) II > I > III                      E) I > III > II

Answer: A

- 9) Determine the vapor pressure of a solution at 25°C that contains 76.6 g of glucose (C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>) in 250.0 mL of water. The vapor pressure of pure water at 25°C is 23.8 torr.

A) 22.9 torr      B) 7.29 torr      C) 72.9 torr      D) 23.1 torr      E) 70.8 torr

Answer: D

- 10) Place the following compounds in order of decreasing strength of intermolecular forces.

I. CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub>      II. (CH<sub>3</sub>)<sub>3</sub>CCH<sub>3</sub>      III. (CH<sub>3</sub>)<sub>3</sub>CCH<sub>2</sub>CH<sub>3</sub>

A) II > III > I      B) III > I > II      C) I > III > II      D) III > II > I      E) I > II > III

Answer: C

- 11) Identify the colligative property.

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

Answer: E

- 12) Commercial grade HCl solutions are typically 39.0% (by mass) HCl in water. Determine the molarity of the HCl, if the solution has a density of 1.20 g/mL.

A) 10.7 M      B) 13.9 M      C) 9.35 M      D) 12.8 M      E) 7.79 M

Answer: D

- 13) Place the following substances in order of decreasing boiling point.

N<sub>2</sub>      O<sub>2</sub>      H<sub>2</sub>

A) N<sub>2</sub> > O<sub>2</sub> > H<sub>2</sub>  
B) O<sub>2</sub> > N<sub>2</sub> > H<sub>2</sub>  
C) N<sub>2</sub> > H<sub>2</sub> > O<sub>2</sub>  
D) O<sub>2</sub> > H<sub>2</sub> > N<sub>2</sub>  
E) H<sub>2</sub> > N<sub>2</sub> > O<sub>2</sub>

Answer: B

- 14) Determine ΔH<sub>vap</sub> for a compound that has a measured vapor pressure of 24.3 torr at 273 K and 135 torr at 325 K. [ Clausius-Clapeyron equation :  $\ln \frac{P_2}{P_1} = \frac{-\Delta H_{\text{vap}}}{R} \left( \frac{1}{T_2} - \frac{1}{T_1} \right)$  ; R = 8.314 J/mol·K ]

A) 79 kJ/mol      B) 24 kJ/mol      C) 34 kJ/mol      D) 13 kJ/mol      E) 41 kJ/mol

Answer: B

- 15) How much energy is required to vaporize 98.6 g of ethanol (C<sub>2</sub>H<sub>5</sub>OH) at its boiling point, if its ΔH<sub>vap</sub> is 40.5 kJ/mol?

A) 86.7 kJ      B) 52.8 kJ      C) 18.9 kJ      D) 11.5 kJ      E) 39.9 kJ

Answer: A

16) Which of the following substances would you predict to have the highest  $\Delta H_{\text{vap}}$ ?

- A) HCl
- B)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$
- C)  $\text{CH}_3\text{CH}_2\text{OH}$
- D)  $\text{HOCH}_2\text{CH}_2\text{OH}$
- E)  $\text{CH}_3\text{Cl}$

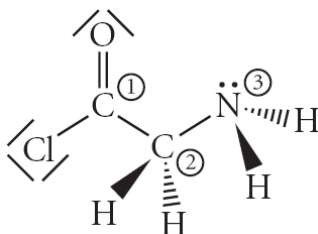
Answer: D

17) A solution containing more than the equilibrium amount is called \_\_\_\_\_.

- A) a dilute solution
- B) a concentrated solution
- C) an unsaturated solution
- D) a saturated solution
- E) a supersaturated solution

Answer: E

18) Consider the molecule below. Determine the molecular geometry at each of the 3 labeled atoms.



- A) 1=tetrahedral, 2=tetrahedral, 3=tetrahedral
- B) 1=trigonal planar, 2=tetrahedral, 3=trigonal pyramidal
- C) 1=trigonal planar, 2=tetrahedral, 3=tetrahedral
- D) 1=trigonal planar, 2=trigonal pyramidal, 3=trigonal pyramidal
- E) 1=tetrahedral, 2=tetrahedral, 3=trigonal planar

Answer: B

19) How many of the following molecules are polar?



- A) 4
- B) 0
- C) 1
- D) 3
- E) 2

Answer: C

20) Which of the following compounds is most soluble in hexane ( $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$ )?

- A) 1-pentanol
- B) 1-propanol
- C) methanol
- D) ethanol
- E) 1-butanol

Answer: A

21) Calculate the freezing point of a solution of 500.0 g of ethylene glycol ( $\text{C}_2\text{H}_6\text{O}_2$ ) dissolved in 500.0 g of water.

$K_f = 1.86^\circ\text{C}/m$  and  $K_b = 0.512^\circ\text{C}/m$ .

- A)  $70.2^\circ\text{C}$
- B)  $8.32^\circ\text{C}$
- C)  $-8.32^\circ\text{C}$
- D)  $-30.0^\circ\text{C}$
- E)  $30.0^\circ\text{C}$

Answer: D

22) The two strands in DNA are held together by \_\_\_\_\_.

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

Answer: C

23) Calculate the mass of oxygen (in mg) dissolved in a 5.00 L bucket of water exposed to a pressure of 1.13 atm of air. Assume the mole fraction of oxygen in air to be 0.21 and the Henry's law constant for oxygen in water at this temperature to be  $1.3 \times 10^{-3}$  M/atm. [Henry's law :  $S_{\text{gas}} = k_H P_{\text{gas}}$ ]

- A) 9.87 mg
- B) 27.3 mg
- C) 23.5 mg
- D) 49.4 mg
- E) 13.7 mg

Answer: D

24) Determine the electron geometry (eg) and molecular geometry (mg) of the underlined atom  $\text{H}_2\text{C}\underline{\text{O}}$ .

- A) eg=trigonal planar, mg=trigonal planar
- B) eg=tetrahedral, mg=bent
- C) eg=trigonal bipyramidal, mg=tetrahedral
- D) eg=tetrahedral, mg=tetrahedral
- E) eg=octahedral, mg=trigonal planar

Answer: A

25) Determine the electron geometry (eg) and molecular geometry (mg) of  $\text{XeF}_4$ .

- A) eg=linear, mg=linear
- B) eg=trigonal bipyramidal, mg=tetrahedral
- C) eg=tetrahedral, mg=tetrahedral
- D) eg=octahedral, mg=square planar
- E) eg=tetrahedral, mg=bent

Answer: D

26) How many moles of KF are contained in 347 g of water in a 0.175 *m* KF solution?

- A)  $3.22 \times 10^{-2}$  mol KF
- B)  $1.65 \times 10^{-2}$  mol KF
- C)  $1.98 \times 10^{-2}$  mol KF
- D)  $5.04 \times 10^{-2}$  mol KF
- E)  $6.07 \times 10^{-2}$  mol KF

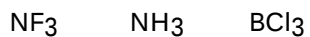
Answer: E

27) Determine the electron geometry (eg), molecular geometry (mg), and polarity of  $\text{PCl}_3$ .

- A) eg=linear, mg=linear, nonpolar
- B) eg=tetrahedral, mg=trigonal pyramidal, polar
- C) eg=trigonal pyramidal, mg=trigonal pyramidal, polar
- D) eg=trigonal planar, mg=trigonal planar, nonpolar
- E) eg=tetrahedral, mg=bent, polar

Answer: B

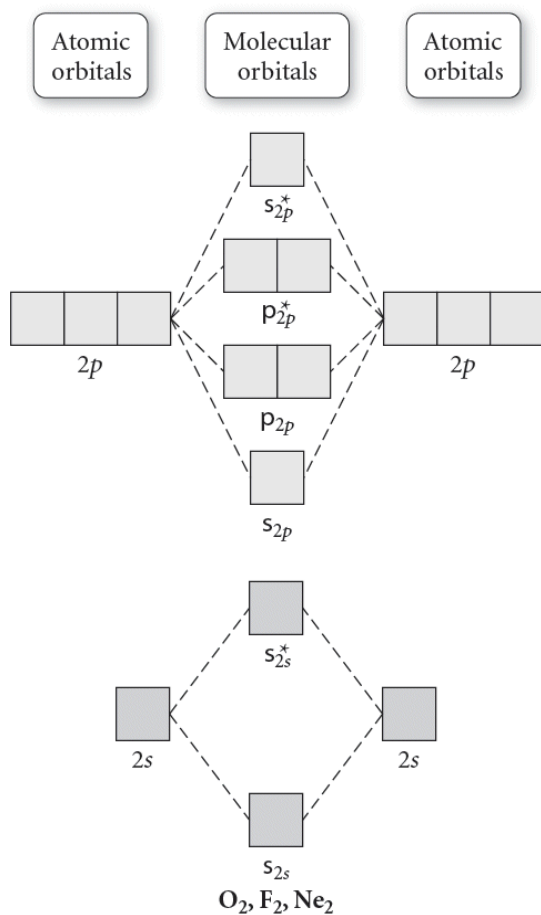
28) Place the following substances in order of increasing vapor pressure at a given temperature.



- A) NF<sub>3</sub> < NH<sub>3</sub> < BCl<sub>3</sub>
- B) BCl<sub>3</sub> < NH<sub>3</sub> < NF<sub>3</sub>
- C) NH<sub>3</sub> < NF<sub>3</sub> < BCl<sub>3</sub>
- D) BCl<sub>3</sub> < NF<sub>3</sub> < NH<sub>3</sub>
- E) NH<sub>3</sub> < BCl<sub>3</sub> < NF<sub>3</sub>

Answer: C

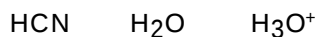
29) Use the molecular orbital diagram shown to determine which of the following are paramagnetic.



- A) Ne<sub>2</sub><sup>2+</sup>
- B) F<sub>2</sub><sup>2+</sup>
- C) O<sub>2</sub><sup>2-</sup>
- D) O<sub>2</sub><sup>2+</sup>
- E) None of the above are paramagnetic.

Answer: B

30) Place the following in order of increasing X-A-X bond angle, where A represents the central atom and X represents the outer atoms in each molecule.



- A) HCN < H<sub>3</sub>O<sup>+</sup> < H<sub>2</sub>O
- B) H<sub>2</sub>O < H<sub>3</sub>O<sup>+</sup> < HCN
- C) H<sub>3</sub>O<sup>+</sup> < H<sub>2</sub>O < HCN
- D) H<sub>2</sub>O < H<sub>3</sub>O<sup>+</sup> < HCN
- E) H<sub>2</sub>O < HCN < H<sub>3</sub>O<sup>+</sup>

Answer: B, D

31) Give the electron geometry (eg), molecular geometry (mg), and hybridization for NH<sub>3</sub>.

- A) eg=tetrahedral, mg=trigonal planar, sp<sup>2</sup>
- B) eg=trigonal pyramidal, mg=trigonal pyramidal, sp<sup>3</sup>
- C) eg=trigonal pyramidal, mg=tetrahedral, sp<sup>3</sup>
- D) eg=trigonal planar, mg=trigonal planar, sp<sup>2</sup>
- E) eg=tetrahedral, mg=trigonal pyramidal, sp<sup>3</sup>

Answer: E

32) Determine  $\Delta H_{\text{solute}}$  for KBr if the  $\Delta H_{\text{solution}}$  (KBr) = +19.9 kJ/mol and the  $\Delta H_{\text{hydration}}$ (KBr) = -670. kJ/mol.

- A) +650 kJ/mol      B) -710 kJ/mol      C) -650 kJ/mol      D) +690 kJ/mol      E) -690 kJ/mol

Answer: D

33) Give the hybridization for the C in HCN.

- A) sp<sup>3</sup>d<sup>2</sup>      B) sp      C) sp<sup>2</sup>      D) sp<sup>3</sup>d      E) sp<sup>3</sup>

Answer: B

34) Identify the place which has the lowest boiling point of water.

- A) Mt. Everest, 29,035 feet
- B) Death Valley, 282 feet below sea level
- C) Denver, Colorado, 5280 feet
- D) A pressurized passenger jet, 35,000 feet
- E) New Orleans, sea level

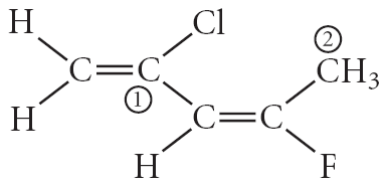
Answer: A

35) 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

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

Answer: E

36) Consider the molecule below. Determine the molecular geometry at each of the 2 labeled carbons.



- A) C1 = trigonal pyramidal, C2 = see-saw
- B) C1 = bent, C2 = trigonal planar
- C) C1 = trigonal planar, C2 = bent
- D) C1 = trigonal planar, C2 = tetrahedral
- E) C1 = tetrahedral, C2 = linear

Answer: D

37) Which substance below has the strongest intermolecular forces?

- A)  $A_2X$ ,  $\Delta H_{\text{vap}} = 39.6 \text{ kJ/mol}$
- B)  $C_3X_2$ ,  $\Delta H_{\text{vap}} = 36.4 \text{ kJ/mol}$
- C)  $EY_3$ ,  $\Delta H_{\text{vap}} = 21.5 \text{ kJ/mol}$
- D)  $BY_2$ ,  $\Delta H_{\text{vap}} = 26.7 \text{ kJ/mol}$
- E)  $DX_2$ ,  $\Delta H_{\text{vap}} = 23.3 \text{ kJ/mol}$

Answer: A

38) Determine the electron geometry (eg) and molecular geometry (mg) of  $ICl_2^-$ .

- A) eg=trigonal bipyramidal, mg=trigonal planar
- B) eg=tetrahedral, mg=bent
- C) eg=octahedral, mg=linear
- D) eg=tetrahedral, mg=trigonal pyramidal
- E) eg=trigonal bipyramidal, mg=linear

Answer: E

39) Why is water an extraordinary substance?

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

Answer: E

40) Determine the electron geometry (eg) and molecular geometry (mg) of  $NCI_3$ .

- A) eg=trigonal planar, mg=bent
- B) eg=linear, mg=trigonal planar
- C) eg=tetrahedral, mg=trigonal pyramidal
- D) eg=linear, mg=linear
- E) eg=tetrahedral, mg=tetrahedral

Answer: C