Exam 980114

Name_____

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

1) What is the appropriate VSEPR notation for the central atom NH_3?

A) AX_2E_2 B) AX_3E C) AX_2 D) AX_2E E) AX_3E_2

Answer: B

2) The electron-group geometry around the central nitrogen in NH_3 is

A) linear.
B) tetrahedral.
C) trigonal bypyramidal.
D) octohedral.
E) none of these

Answer: B

3) According to VSEPR theory, the molecular geometry of NH_3 is described as

A) square pyramidal.
B) tetrahedral.
C) octohedral.
D) trigonal pyramidal.
E) square planar.

Answer: D

4) The hybrid orbitals used by nitrogen in NH_3 are

A) sp^2. B) sp^3. C) sp. D) sp^3d. E) sp^3d^2.

Answer: B

5) Which of the following molecules would you expect to have the largest dipole moment (μ)?

A) CS_2 B) COF_2 C) NOF_2 D) NO E) SO_3

Answer: C

6) Which of the following molecules contains polar bonds but is nonpolar?

A) H_2O B) CH_2Cl_2 C) Cl_2 D) CO_2 E) NH_3

Answer: D

7) What is the proper order of decreasing Cl-A-Cl angle?

1) PCl_3 2) $SiCl_4$ 3) BCl_3

A) 2 > 3 > 1 B) 3 > 1 > 2 C) 2 > 1 > 3 D) 3 > 2 > 1 E) 1 > 2 > 3

Answer: D

8) Which series correctly identifies the hybridization of the central atom in the following species?

CO_2 CH_4 H_2CO

A) sp^2 sp^3 sp^3
B) sp sp^3 sp
C) sp sp^2 sp^2
D) sp sp sp^3
E) sp sp^3 sp^2

Answer: E

9) Which of the following compounds can exist as cis-trans isomers?

A) $CH_3C(CH_3)=CHCH_3$
B) $CH_3CH=CHCH_3$
C) $CH_2=CHCH_2CH_3$
D) $CCl_2=CH_2$
E) $CH_3-C\equiv C-CH_3$

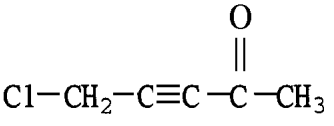
Answer: B

10) Which orbitals overlap in forming the C-C sigma bond of $NC-CH_3$?

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

Answer: B

11) How many π bonds are there in the following structure?



A) 1 B) 3 C) 5 D) 7 E) 9

Answer: B

12) When two atomic orbitals (AO) are combined to form molecular orbitals (MO), which of the following descriptions of the energy of the resulting molecular orbital is most accurate?

A) The MOs are the same energy as the AO.
B) One MO is higher and one MO is lower than the AO.
C) The MOs are of lower energy than the AO.
D) The MOs are of higher energy than the AO.
E) none of these

Answer: B

13) Use MO theory to predict which of the following species would exist?

A) H_2^- B) He_2 C) Li_2^{2+} D) F_2^{2-} E) Ne_2

Answer: A

14) Use MO theory to predict the strength of bond energies of the following pairs.

A) N_2 > N_2^+ and O_2^+ > O_2

B) N_2^+ > N_2 and O_2^+ > O_2

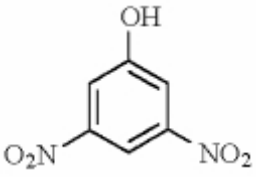
C) N_2^+ > N_2 and O_2 > O_2^+

D) N_2 > N_2^+ and O_2 > O_2^+

E) N_2^+ = N_2 and O_2^+ = O_2

Answer: A

15) Name the following compound by the IUPAC system.



A) 3,5-dinitrophenol

B) 2,4-dinitrotoluene

C) 2,4-dinitrophenol

D) hydroxydinitrobenzene

E) 1,3,5-dinitrophenol

Answer: A

16) How much heat, in kilojoules, is required to vaporize 350 g methanol, CH_3OH, at 25 °C? (At 25 °C, ΔH_{vap} = 38.0 kJ/mol)

A) 416 B) 312 C) 208 D) 192 E) 35

Answer: A

17) Which statement is not correct?

A) The boiling point of a liquid is the temperature at which its vapor pressure is equal to the external pressure.

B) The stronger the intermolecular forces, the higher the boiling point.

C) The equilibrium vapor pressure above a liquid is independent of the volume of liquid present and the volume of vapor present.

D) A volatile liquid has a high boiling point.

E) The vapor pressure above a liquid increases with temperature.

Answer: D

18) The vapor pressure of water is 28.3 mm Hg at 28°C. What mass of water vapor would be present in a 500 mL water vapor at 28°C ? (Gas constant R = 62.364 LTorr mol^{-1} K^{-1} = 0.0821 L atm mol^{-1} K^{-1})

A) 1.63 mg B) 3.58 mg C) 10.5 mg D) 13.6 mg E) 31.2 mg

Answer: D

19) Which of the following compounds is predicted to have the highest enthalpy of vaporization (ΔH_{vap}) at room temperature?

A) H_2O B) CO_2 C) CH_4 D) CCl_4 E) C_6H_{14}

Answer: A

20) Which of the following quantities would be largest (most positive)?

A) $\Delta H_{sublimation}$

B) $\Delta H_{melting}$

C) $\Delta H_{condensation}$

D) ΔH_{fusion}

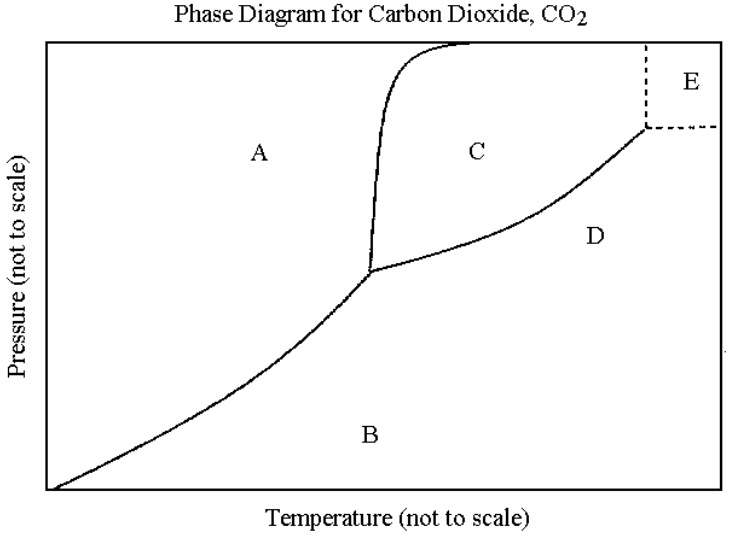
E) $\Delta H_{vaporization}$

Answer: A

21) A closed flask of water (H_2O) at the triple point for water contains which of the following phases?

A) liquid
B) solid
C) gas
D) all of the above
E) none of the above

Answer: D



22) Consider the phase diagram for CO_2. In going from phase A to phase B,

A) gaseous CO_2 becomes solid.

B) solid CO_2 becomes gaseous.

C) solid CO_2 becomes liquid.

D) liquid CO_2 becomes solid.

E) liquid CO_2 becomes gaseous.

Answer: B

23) Consider the phase diagram for CO_2. The point on the graph labelled E represents CO_2 as a

A) liquid.
B) gas.
C) supercritical fluid.
D) solid.
E) CO_2 cannot exist at that temperature and pressure.

Answer: C

24) Consider the phase diagram for CO_2. The letters indicate specific points in the phase diagram. In going from point A to B to C, what phase transitions does CO_2 undergo?

A) evaporation followed by fusion
B) sublimation followed by condensation
C) fusion followed by sublimation
D) fusion followed by evaporation
E) condensation followed by fusion

Answer: B

25) Which would have the lowest boiling point?

A) H_2O B) H_2S C) H_2Se D) H_2Te E) HI

Answer: B

26) Which of the following substances would exhibit dipole-dipole intermolecular forces?

A) NH_3 B) BCl_2 C) CF_4 D) Cl_2 E) CO_2

Answer: A

27) Which group contains elements in all three states of matter at room temperature?

A) 6A B) 3A C) 7A D) 1A E) 5A

Answer: C

28) The boiling points of the halogens increase going down the group. What type of intermolecular force best accounts for this fact?

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

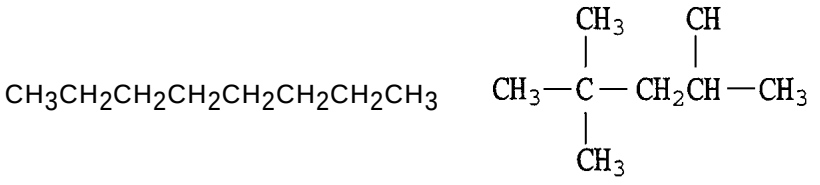
Answer: D

29) Which pair is mismatched?

A) N-H or O-H bonds - hydrogen bonding
B) polarity - dipole moment
C) polarizability - dispersion forces
D) polar - low boiling point
E) dipole moment - dipole-dipole forces

Answer: D

30) What factor that best explains the difference in boiling points between octane and isooctane?



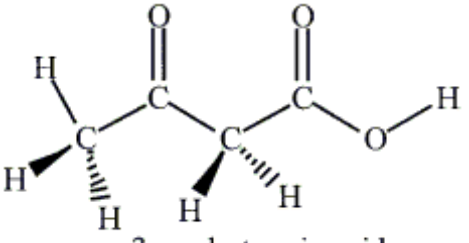
octane
b.p. 125.7°C

isooctane
b.p. 99.2°C

A) number of C-H bonds
B) molecular weight
C) polarity
D) polarizability - molecular shape
E) hydrogen bonding

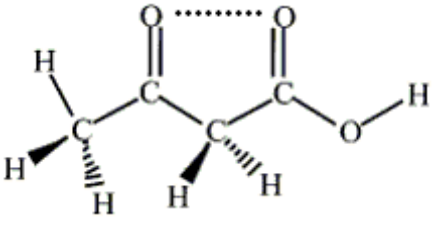
Answer: D

31) Which of the following structures correctly illustrates the intramolecular hydrogen bond in acetoacetic acid (3-oxobutanoic acid)?

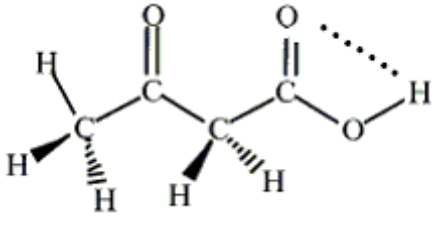


3-oxobutanoic acid

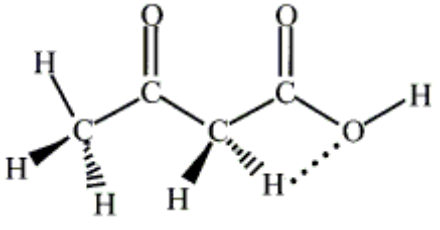
A)



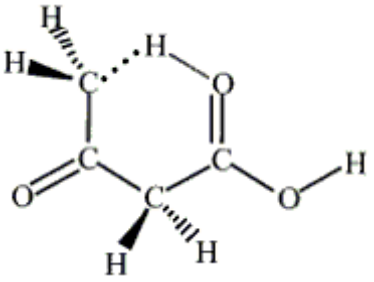
B)



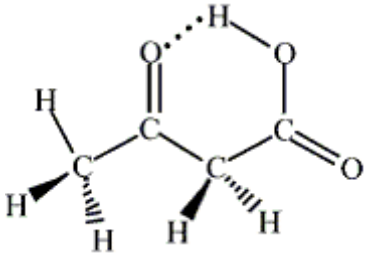
C)



D)



E)

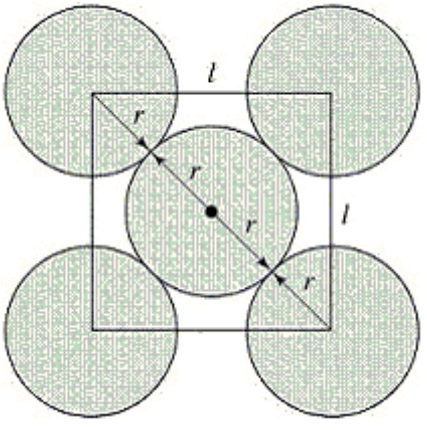


Answer: E

32) Which of the following is not an example of a network covalent solid?
A) diamond B) graphite C) SiC D) SiO_2 (sand) E) iron

Answer: E

33) Copper crystallizes in the cubic close-packed arrangement. The atomic (metallic) radius (labeled r in figure) of a Cu atom is 127.8 pm. Which of the following statement is correct?



A) The equivalent numbers of atoms in the unit cell is 5
B) The volume of that unit cell is 9.3×10^{-23} cm^3
C) The density of metallic copper is 8.935 g/cm^3
D) The length (labeled l in figure) of the unit cell is 255.6 pm

Answer: C

34) What mass of NaOH is present in 2.30 L of 5.40 *m* NaOH aolution (d = 1.15 g/mL)?
A) 497 g B) 571 g C) 516 g D) 216 g E) 470 g

Answer: B

35) What is the total number of moles of ions in 1.00 L of 0.391 M Na_2CO_3?

A) 0.293 B) 0.391 C) 0.0978 D) 1.173 E) 0.587

Answer: D

36) How many grams of Fe^{3+} are required to make 1.0 L of an aqueous solution of 100 ppm (mg/L) Fe^{3+}?

A) 1.0 g B) 1×10^{-6} g C) 0.01 g D) 1000 g E) 0.1 g

Answer: E

37) Which of the following concentration has the approximate concentration for an aqueous solution in 0.01 M CH_3OH?

A) 0.01 % CH_3OH (mass/volume)

B) 0.01 % CH_3OH (mass/mass)

C) 0.01 ppm CH_3OH

D) 0.01 m CH_3OH

E) $x_{CH_3OH} = 0.01$

Answer: D

38) Which of the following concentration units is independent of temperature?

A) molality (m)

B) volumw/volume percent

C) mass/volume percent

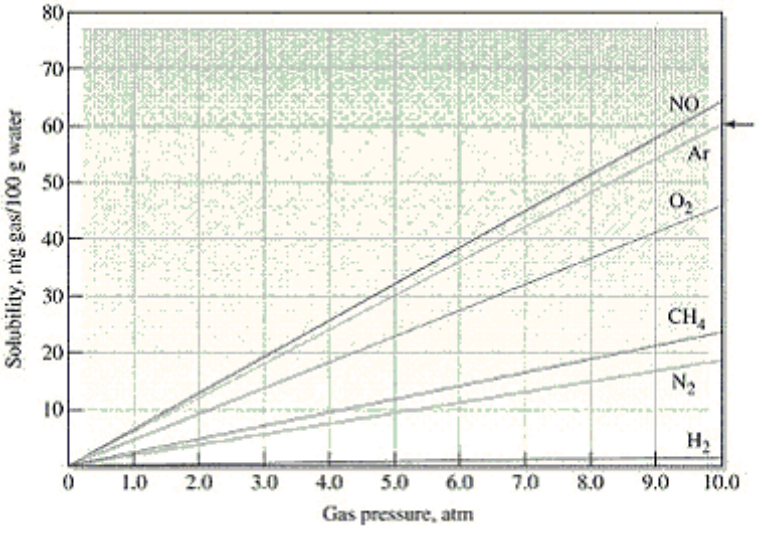
D) molarity (M)

E) None of the above units are independent of temperature.

Answer: A

39) A 450 g sample of pure water is shaken with air under a pressure of 0.95 atm at 20 °C. How many milligrams of $Ar_{(g)}$ will be present in the water when solubility equilibrium is reached? (the mole fraction of Ar in air is 0.00934)

Figure 1. The effect of gas pressure on aqueous solubilities of gases at 20°C



A) 0.12 mg B) 0.36 mg C) 0.48 mg D) 0.24 mg

Answer: D

40) Which of the following pairs is most likely to be heterogeneous?
A) methanol, CH_3OH, and water, H_2O
B) acetic acid, CH_3COOH, and water, H_2O
C) hexane, $CH_3(CH_2)_4$, and octane, $CH_3(CH_2)_6CH_3$
D) iodine, I_2, and benzene, C_6H_6
E) potassium chloride, KCl, and carbon tetrachloride, CCl_4

Answer: E

41) When an ionic salt dissolves in water, the solute-solvent interaction is
A) ion-ion forces.
B) ion-dipole.
C) dipole-dipole.
D) hydrogen bonding.
E) London forces.

Answer: B

42) Which of the following is not an example of a dynamic equilibrium? (assume that the situation doesn't change with time)
A) solute gas and liquid solvent in a closed container
B) a supersaturated solution
C) liquid and vapor in a closed container
D) liquid and vapor at the normal boiling point
E) solid solute in saturated solution

Answer: B

43) The vapor pressure of pure benzene (C_6H_6) and toluene (C_7H_8) at 25°C are 95.1 and 28.4 mm Hg, respectively. A solution is prepared with a mole fraction of toluene of 0.750. Assume the solution to be ideal and determine the total vapor pressure above the solution, in mm Hg.
A) 66.7 B) 61.8 C) 123.5 D) 45.1 E) 78.4

Answer: D

44) What is the freezing point, in °C, of a 0.10 *m* of NaCl? (K_f H_2O = 1.86°C m^{-1})
A) -1.86 B) -0.19 C) +0.37 D) -0.37 E) +0.19

Answer: D

45) What mass of glucose, $C_6H_{12}O_6$, in grams, should be added to 50.0 g H_2O to raise the boiling point to 100.45°C? (K_b = 0.512°C m^{-1})
A) 160 B) 50 C) 16.0 D) 0.88 E) 7.9

Answer: E

46) Which solution would have the largest osmotic pressure?
A) 0.1 M NH_4NO_3 at 25°C
B) 0.1 M $C_6H_{12}O_6$ at 30°C
C) 0.1 M $CO(NH)_2$ at 25°C
D) 0.05 M $CaCl_2$ at 25°C
E) 0.05 M KBr at 25°C

Answer: A

47) Given: freezing point of benzene 5.53 °C; K_f of benzene 5.12 °Cm^{-1}. A 1.065-g sample of an unknown substance is dissolved in 30.00 g of benzene; the freezing point of the solution is now 4.25 °C. The compound is 50.69% C, 4.23% H, and 45.08% O by mass. Determine the molecular formula of the substance.

A) $C_3H_3O_2$ B) $C_6H_6O_4$ C) $C_6H_8O_2$ D) $C_3H_6O_3$ E) $C_4H_6O_2$

Answer: B

48) Calculate the energy, in kilojoules, of one mole of photons of yellow laser light of wavelength 570 nm. (Planck's constant: 6.626×10^{-34} J· s)

A) 2.10×10^{5} B) 2.27×10^{-16} C) 3.49×10^{-22} D) 2.10×10^{2} E) 3.48×10^{-16}

Answer: D

49) How many pairs of electrons are there around the central atom in the Lewis structure of the following species?

ICl_2^-

A) 2 B) 3 C) 4 D) 5 E) 6

Answer: D

50) Which of the following is not a true statement concerning the energy of orbitals?

A) In a multielectron atom, the various subshells of a principal shell are at different energy levels.
B) In the hydrogen atom, all subshells of a principal shell are at the same energy level.
C) In high numbered principal shells of a multielectron atom, some subshells of different principal shells have nearly identical energies.
D) All orbitals within a subshell of a multielectron atom are at the same energy level.
E) Orbital energies are higher in multielectron atoms than in the hydrogen atom.

Answer: E