Chapter 10 Questions **NAME: _____**

1. The basic geometry for molecules in the set below which possesses the <u>smallest bond angles</u> is

   a. linear
   b. planar triangular
   c. tetrahedral
   d. trihedral
   ! e. octahedral

2. Based on the Lewis structure, the number of <u>total domains</u> in the valence shell of the arsenic atom in the $AsCl_3$ molecule is

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

3. Application of the concepts of VSEPR theory leads us to conclude that the shape of the SO_3 molecule is: (Recall that S can break the octet rule)

   a. trigonal pyramidal
   b. square planar
   c. regular tetrahedral
   ! d. triangular (or trigonal) planar
   e. distorted tetrahedron

4. Which one of the molecules below is a polar molecule?

   a. Br_2
   b. BF_3
   c. CO_2
   d. CS_2
   ! e. IBr

5. Draw a Lewis structure for the NH_3 molecule. What is the hybrid orbital set used by the nitrogen atom for bonding?

   a. sp^3d^2
   b. sp
   c. sp^3d
   ! d. sp^3
   e. sp^2

Chapter 11 Questions

6. A U.S. Weather Bureau forecast cited the atmospheric pressure at sea level as having a value of 768.2 mm Hg. Expressed in kilopascals (kPa) what would the value be? (1 atm = 101325 Pa = 760 torr = 760 mm Hg = 1.01325 bar = 1013.25mb)

   a. 778.4 kPa
   ! b. 102.4 kPa
   c. 100.3 kPa
   d. 91.62 kPa
   e. None of the above

7. A sample of a gas in a cylindrical chamber with a movable piston occupied a volume of 6.414 liters when the pressure was 850 torr and the temperature was 27.2 ^{o}C. The temperature was readjusted to 65.5 ^{o}C while the load on the piston was kept constant to keep the **pressure constant** in the system. What was the volume occupied by the sample at the new temperature?

   a. 2.66 liters
   b. 5.689 liters
   c. 7.21 liters
   ! d. 7.232 liters
   e. None of the above

8. A gas sample occupies a volume of 1.66 liters when the temperature is 150.0 ^{o}C and the pressure is 842 torr. How many molecules are there in the sample?

   a. 1.52×10^{22}
   b. 2.60×10^{22}
   ! c. 3.19×10^{22}
   d. 9.01×10^{22}
   e. None of the above

9. What is the mole fraction of methane in a gaseous mixture that consists of 8.00 g of methane and 12.00 g of ethane, C_2H_6, in a 3.50 liter container maintained at 35.20^{o}C?

   a. 0.400
   b. 0.434
   ! c. 0.555
   d. 0.800
   e. None of the above

Chapter 12 Questions

10. For a series of small molecules of comparable molecular weight, which one of the following choices lists the intermolecular forces in the correct increasing order?

a. hydrogen bonds < dipole-dipole forces < London forces
b. dipole-dipole forces < hydrogen bonds < London forces
c. London forces < hydrogen bonds < dipole-dipole forces
d. hydrogen bonds < London forces < dipole-dipole forces
! e. London forces < dipole-dipole forces < hydrogen bonds

11. Which one of the following listed compounds should have the lowest vapor pressure at a given temperature at which all these substances are in the liquid state?

a. $CH_3—CH_2—F$
b. $CH_3—CH_2—CH_3$
c. $CH_3—CH_2—CH_2—CH_3$
! d. $CH_3—CH_2—O—H$
e. $CH_3—O—CH_3$

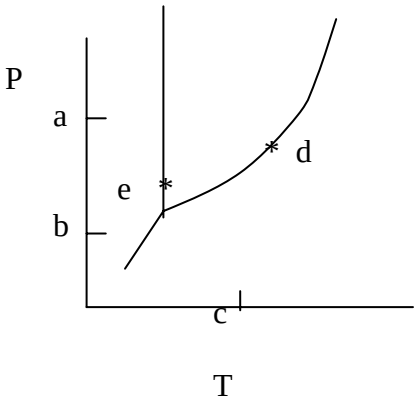
12. Given the following substances and their normal boiling points, in ^oC:

C: 43.8 ^oC D: 93.7 ^oC M: 56.7 ^oC T: 83.5 ^oC R: 63.6 ^oC

Which set below correctly lists some of these substances in order of **decreasing** vapor pressure at
20 ^oC?

! a. C > R > D
b. D > T > R
c. R > M > D
d. C > D > M
e. D > R > M

13.



At the temperature and pressure of point d, which statement below is true?

a. The substance will sublime.
b. There will be an equilibrium between the solid phase and the gaseous phase.
c. Vaporization and deposition will take place simultaneously.
! d. Condensation and evaporation will take place simultaneously.
e. The substance will be a superfluid.

Chapter 14 Questions

14. A solution is made by mixing 138.2 grams of ethanol, C_2H_6O, (46.069 g mol^{-1}), 103.6 grams of water (18.015 g mol^{-1}), and 80.11 grams of methanol, CH_4O (32.042 g mol^{-1}). What is the mole fraction of methanol in the mixture?

a. 0.02504
! b. 0.2222
c. 0.2493
d. 0.3333
e. 0.4490

15. A solution of sodium nitrite is prepared by mixing 3.25 g of $NaNO_2$ with 12.0 g of water. The percent, by mass, of $NaNO_2$ is

a. 28.0 %
b. 23.3 %
c. 27.0 %
! d. 21.3 %
e. 37.1 %

16. A glucose solution is prepared by dissolving 5.10 g of glucose, $C_6H_{12}O_6$, in 110.5 g of water. What is the molality of the glucose solution?

a. 0.283 *m*
b. 0.000256 *m*
c. 0.245 *m*
! d. 0.256 *m*
e. 0.351 *m*

18.The average speed at which a methane (CH_4) molecule effuses at 28.5 ^oC is 631 meters per second. The average speed at which an argon molecule effuses at this same temperature should therefore be

a. 253 m s^{-1}
b. 315 m s^{-1}
! c. 400 m s^{-1}
d. 502 m s^{-1}
e. 631 m s^{-1}

Chapter 15 Questions

19. A reaction has the rate law, rate = $k[A][B]^2$. What is the overall order of the reaction?

a. 2
b. 4
c. 1
! d. 3
e. 0

20. For the reaction, A + 2B $\rightarrow$ C + 2 D, some initial rate measurements were carried out

run #	[A]	[B]	rate, mol L^{-1} s^{-1}
1	0.100	0.200	0.000360
2	0.200	0.200	0.000720
3	0.100	0.400	0.000720

a. the rate law is therefore: rate = $k[A][B]^2$
b. the rate law is therefore: rate = k[B]
c. the rate law is therefore: rate = k[A]
! d. the rate law is therefore: rate = k[A][B]
e. the rate law is therefore: rate = $k[A]^2[B]$

21. In a first order reaction, what fraction of the material will remain after 4 half-lives?

! a. 1/16
b. 1/8
c. 1/9
d. 1/4
e. 1/3

22. For a first order reaction with a single reactant, after 230.0 seconds, 10.0% of the reactant remains. The rate constant for the reaction is therefore

a. $0.000640\ s^{-1}$
! b. $0.0100\ s^{-1}$
c. $100\ s^{-1}$
d. $0.0510\ s^{-1}$
e. $0.0915\ s^{-1}$

Chapter 16 Questions

23. Given the pair of reactions shown with the equilibrium constants,

$PCl_3(g) + Cl_2(g) \equiv PCl_5(g)$ K_1

$2\ NO(g) + Cl_2(g) \equiv 2\ NOCl(g)$ K_2

What is the equilibrium constant for the reaction,

$PCl_5(g + 2\ NO(g) \equiv PCl_3(g) + 2\ NOCl(g)$

a. K_1K_2
! b. K_2/K_1
c. K_1/K_2
d. $(K_1K_2)^{-1}$
e. K_2-K_1

24. For the reaction, $2\ SO_2(g) + O_2(g) \equiv 2\ SO_3(g)$, at 900.0 K the equilibrium constant, K_c, has a value of 13.0. Calculate the value of K_p at the same temperature.

a. $97.3 \times 10^3\ atm^{-1}$
! b. $0.176\ atm^{-1}$
c. $960\ atm^{-1}$
d. $0.00174\ atm^{-1}$
e. $0.077\ atm^{-1}$

25. A study of the system, $4\ NH_3(g) + 7\ O_2(g) \equiv 2\ N_2O_4(g) + 6\ H_2O(g)$, was carried out. A system was prepared with $[NH_3] = [O_2] = 3.60$ M as the only components initially. At equilibrium, $[N_2O_4]$ is 0.60 M. Calculate the equilibrium concentration of O_2.

a, 3.00 M
b. 2.40 M
! c. 1.50 M
d. 2.10 M
e. 3.30 M

26. The reaction, $2\ SO_3(g) \equiv 2\ SO_2(g) + O_2(g)$ is endothermic. Predict what will happen if the temperature is increased.

a. K_c remains the same
b. K_c decreases
c. the pressure decreases
d. more $SO_3(g)$ is produced
! e. K_c increases

27. A study of the system, $4\ NH_3(g) + 7\ O_2(g) \equiv 2\ N_2O_4(g) + 6\ H_2O(g)$, was carried out. A system was prepared with $[NH_3] = [O_2] = 3.60$ M as the only components initially. At equilibrium, $[N_2O_4]$ is 0.60 M. Calculate the equilibrium concentration of NH_3.

a. 3.00 M
b. 2.10 M
c. 3.30 M
d. 1.80 M
! e. 2.40 M

Chapter 17 Questions

28. The conjugate base of HPO_4^{2-} is

a. H_2PO_4
b. H_3PO_4
! c. PO_4^{3-}
d. PO_4^{2-}
e. $H_2PO_4^-$

29. Which one of the following four species is the least acidic substance?

a. HBr
b. HCl
! c. HF
d. HI

30. NH_3 can react directly with BF_3, forming NH_3—BF_3. In this reaction,

a. the NH_3 acts as a Brønsted base, accepting a proton from the BF_3 molecule
b. the NH_3 acts as a Lewis base, donating a proton to the BF_3 molecule
c. the NH_3 acts as a Brønsted acid, donating a proton to the BF_3 molecule
! d. the BF_3 molecule acts as a Lewis acid, accepting an electron pair from the NH_3 molecule to form a coordinate covalent bond

31. If the OH^- ion concentration in an aqueous solution at 25.0 ^oC is 6.6×10^{-4} M, then the H^+ concentration in moles per liter in the same solution is

a. 1.5×10^{-1}
b. 1.5×10^{-4}
c. 6.6×10^{-10}
! d. 1.5×10^{-11}
e. 6.6×10^{-11}

Chapter 18 and 20 Questions

32. The ionization constant, K_b, for ammonia has a value of 1.76×10^{-5}. What is the pK_b of this base?

a. +3.24
b. -4.75
! c. +4.75
d. -9.25
e. +9.25

33. A 0.100 M solution of an acid, HA, has a pH = 2.00. What is the value of the ionization constant, K_a for this acid?

a. 1.1×10^{-2}
! b. 1.1×10^{-3}
c. 1.1×10^{-4}
d. 1.0×10^{-3}
e. 1.0×10^{-4}

34. Formic acid, HCO_2H, has an ionization constant with the value: $K_a = 1.76 \times 10^{-4}$. Calculate the value of pK_b for the conjugate base of formic acid.

a. +3.75
b. +5.35
c. +8.65
! d. +10.25
e. +12.24

35. Here is a list of some weak acids and their pK's:

H*Mac*, $pK_a = 4.46$ H*Tern*, $pK_a = 3.50$ H*Brun*, $pK_a = 5.33$ H*Tharn*, $pK_a = 7.33$

H*Pen*, $pK_a = 8.24$ H*Fern*, $pK_a = 6.42$

Which one of the sets below would be the best choice to prepare a buffer with pH = 7.00

a. brunic acid (H*Brun*), and either sodium or potassium brunate
b. macnic acid (H*Mac*), and either sodium or potassium macnate
c. pentic acid (H*Pen*), and either sodium or potassium pentate
! d. tharnic acid (H*Tharn*), and either sodium or potassium tharnate
e. ternic acid (H*Tern*), and either sodium or potassium ternate

36. Which one of the processes below is the one which is accompanied by an increase in entropy?

a. setting up a stack of dominos
b. setting up decorations on a Christmas tree
c. filing correspondence in file folders and placing them in hanging file folders
! d. dropping a glass pane on the front walk of your residence
e. restocking a canned goods shelf display in a supermarket