L.S.F.

CHM201

EXAM 2

L.S.F.

ALWAYS READY TO HELP!

Multiple Choice Questions:

1. Which of the following statements is true?
    a. We can determine the exact location of an electron if we know its energy.
    b. An electron in a 2s orbital can have the same *n*, *l*, and *m* quantum numbers as an electron in a 3s orbital.
    c. Ni has 2 unpaired electrons in its 3d orbitals.
    d. In the building up of atoms, electrons occupy the 4f orbitals before the 6s orbitals.
    e. Only three quantum numbers are needed to uniquely describe an electron.
2. How many electrons can be described by knowing quantum numbers *n*=4, l =3, m=0?
    a. 0
    b. 2
    c. 6
    d. 10
    e. 14
3. An element E has the electron configuration $[Kr]4d^{10}5s^25p^3$. What is the formula for the fluoride of E most likely to be?
    a. EF_2
    b. EF_3
    c. EF
    d. EF_6
    e. EF_8
4. What is the electron configuration of Ti^{2+}?
    a. $[Ar]\ 2s^2$
    b. $[Ar]\ 4s^13d^1$
    c. $[Ar]\ 3d^2$
    d. $[Ar]\ 4s^23d^2$
    e. None of these
5. An element has the electron configuration $[Kr]\ 4d^{10}5s^25p^2$. The element is a(n)
    a. Nonmetal
    b. Transition element
    c. Metal
    d. Lanthanide
    e. Actinide
6. Sodium gaining an electron is an _______ process, and fluorine gaining an electron is an ________ process.
    a. Endothermic, exothermic
    b. Exothermic, endothermic
    c. Endothermic, endothermic
    d. Exothermic, exothermic

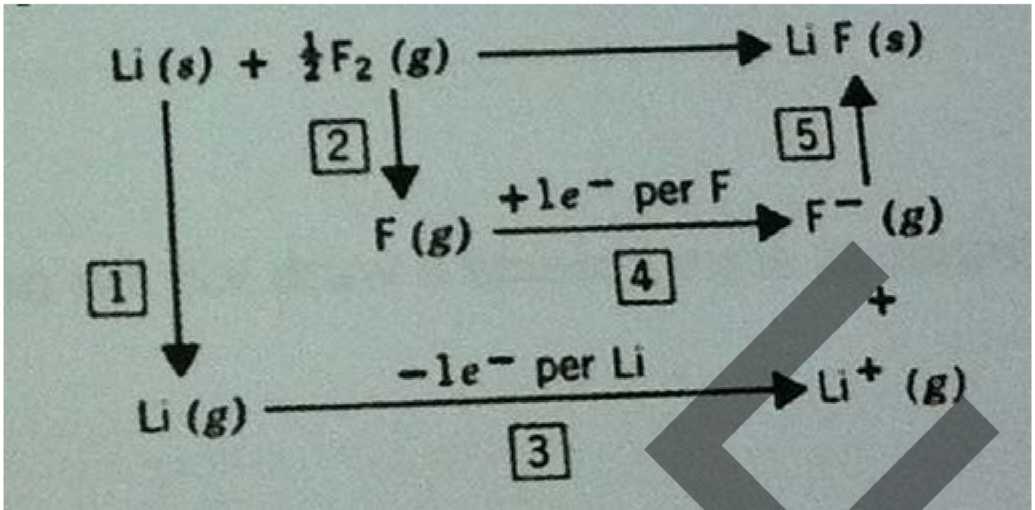
7. Which one of the following isoelectronic species has the smallest radius?
    a. Mg^{2+}
    b. Na^{+}
    c. Ne
    d. F^{-}
    e. O^{2-}
8. The successive ionization energies for one of the period three elements is listed below. Which element is referred to?

E1	577.4 kJ/mol
E2	1,816 kJ/mol
E3	2,744 kJ/mol
E4	11,580 kJ/mol
E5	15,030 kJ/mol

a) Na b) Mg c) Al d) Si e)P

9. Which of the following sets of quantum numbers is possible for a **3d** electron?
    a. $n = 3, l = 3, m_l = -2, m_s = +0.5$
    b. $n = 2, l = 1, m_l = +1, m_s = -0.5$
    c. $n = 3, l = 1, m_l = 0, m_s = -0.5$
    d. $n = 3, l = 2, m_l = -2, m_s = +0.5$
    e. $n = 4, l = 1, m_l = +1, m_s = +0.5$
10. calculate the wavelength of the fourth line in the Balmer series (the visible series) of the hydrogen spectrum (note that the electron is removed completely)
    a. 0.12334 m
    b. 24.373 m
    c. 2.7353×10^{-7} m
    d. 4.1029×10^{-7} m
    e. 36.559 m

11. Using the picture below, what process corresponds to the lattice energy?

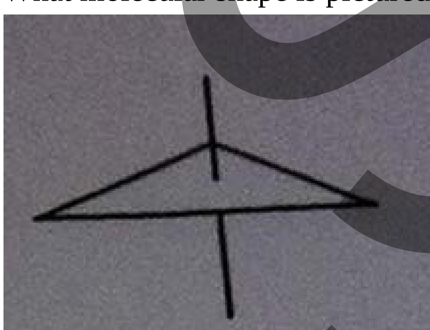


a. 1   b. 2   c. 3   d.4   e.5

12. What is the shape of the IF_4^- ion?

a. Square planar
b. Tetrahedral
c. Square pyramidal
d. Octahedral
e. T-shaped

13. What molecular shape is pictured below?



a. Linear
b. Tetrahedral
c. Octahedral
d. Planar triangular
e. Trigonal bipyramidal

14. In which case is the bond polarity *incorrect*?

a. δ+ H—F δ-
b. δ+ Na—O δ-
c. δ+ Mg—H δ-
d. δ+ Cl—Br δ-
e. δ+ C—O δ-

15. Which of the following molecules has a nonzero dipole moment?
    a. CCl_4
    b. SiF_4
    c. CS_2
    d. SO_3
    e. PBr_3
16. Which of the following series is isoelectronic?
    a. B, C, N, O
    b. S^{2-}, Cl^-, K^+, Ca^{2+}
    c. F^-, Cl^-, K^+, Rb^+
    d. Na, K, Rb, Cs
    e. Sn, As, S, F
17. In which of the following compounds does the **bond between the central atom and fluorine** have the greatest ionic character?
    a. OF_2
    b. SF_2
    c. SeF_2
    d. AsF_3
    e. SbF_3
18. For which of the following can we *not* draw a stable Lewis structure?
    a. PCl_5
    b. OCl_6
    c. SCl_6
    d. All of these have stable Lewis structures
    e. None of these have stable Lewis structures
19. Given the following information:

    N_2 bond energy = 941 kJ/mol

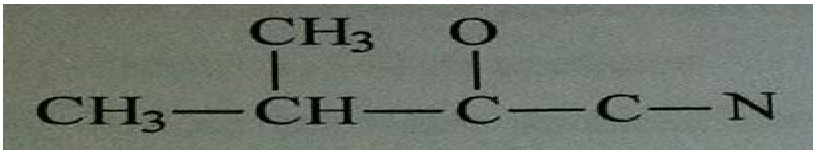
    F_2 bond energy = 154 kJ/mol

    ½ N_2 (g) + 3/2 F_2 (g) → NF_3 (g) $\Delta H°$ = -103kJ/mol

    Calculate the N—F bond energy.

    a. 113 kJ/mol
    b. 268 kJ/mol
    c. 317 kJ/mol
    d. 66 kJ/mol
    e. None of these

20. Complete the Lewis structure of the molecule



This molecule has ________ single bonds and _______ multiple bonds.

a. 4, 2
b. 6,3
c. 11, 5
d. 11, 2
e. 13, 0

21. For which compound is resonance required to describe the structure adequately?

a. PCl_3
b. O_3
c. HCN
d. NH_4^+
e. None of these

22. The molecule XCl_5^- has a square pyramidal shape. Which of the following atoms could be X?

a. O
b. P
c. Xe
d. S
e. At least two of these atoms could be X

23. Of the following, which molecule has the smallest bond angle?

a. CCl4
b. NH3
c. SO2
d. Cl2O

24. According to the VSEPR, the electron pairs around NH3 and those around CH4 are arranged

a. Differently, because in each case there are a different number of atoms around the central atom.
b. Differently, because in each case there are a different number of electron pairs around the central atom.
c. The same, because both nitrogen and carbon are in the second period
d. The same, because in each case there are the same number of electron pairs around the central atom
e. Differently or the same, depending on the conditions leading to maximum repulsion.

25. 0.200 mol NO is placed in a one liter flask at 2273K. After equilibrium is attained, 0.0863 mol N_2 and 0.0863 mol O_2 are present. What is the K_p for this reaction?

$$2NO(g) \leftarrow\rightarrow N_2(g) + O_2(g)$$

   a. 9.92
   b. 3.15
   c. 0.0372
   d. 0.576
   e. 39.7

26. For the reaction system, $N_2(g) + 3H_2(g) \leftarrow\rightarrow 2NH_3(g)$ + heat
   The conditions that would favor maximum conversion of the reactants to products would be
   a. High temperature and high pressure
   b. High temperature, pressure unimportant
   c. High temperature and low pressure
   d. low temperature and high pressure
   e. low temperature and low pressure

27. Solid HgO, liquid Hg, and gaseous O_2 are placed in a glass bulb and allowed to reach equilibrium at a given temperature. $2HgO(s) \leftarrow\rightarrow 2Hg(l) + O_2(g)$ ΔH = +43.4 kcal. The mass of HgO in the bulb could be increased by
   a. Adding more Hg
   b. Removing some O2
   c. Reducing the volume of the bulb
   d. Increasing the temperature
   e. Removing some Hg

28. Which of the following equilibrium constants indicate thereaction that gives the smallest amount of product?
   a. $K_c = 5 \times 10^{-10}$
   b. $K_c = 5 \times 10^{-1}$
   c. $K_c = 5 \times 10^{-0}$
   d. $K_c = 5 \times 10^{1}$

29. For the reaction below, K_p = 1.16 at 800°C. $CaCO_3(s) \leftarrow\rightarrow CaO(s) + CO_2(g)$
   If a 25.0-g sample of $CaCO_3$ is put into a 10.2-L container and heated to 800°C, what percent of the $CaCO_3$ will react to reach equilibrium?
   a. 23.7%
   b. 53.8%
   c. 13.4%
   d. 100.%
   e. 47.4%

30. A sample of solid NH_4NO_3 was placed in an evacuated container and then heated so that it decomposed explosively according to the following reaction:

$NH_4NO_3(s) \leftrightarrow N_2O(g) + 2H_2O(g)$

At equilibrium, the total pressure in the container was found to be 2.03 atm at a temperature of 500°C. Calculate $K_{p.}$

a. 33.5
b. 4.12
c. 1.83
d. 1.24
e. 2.03

31. Consider the following reaction:

$2NOCl(g) \leftrightarrow 2\ NO(g) + Cl_2(g)$

initially pure NOCl(g) is placed in a vessel at 3.00 atm. At equilibrium, 0.416% of the NOCl has decomposed. Determine the value for K_p.

a. 2.01×10^{-5}
b. 1.09×10^{-7}
c. 2.18×10^{-7}
d. 6.24×10^{-3}
e. 2.72×10^{-8}

Subjective Questions: Please show all work clearly.

A. Given the following information

$Li(s) \rightarrow Li(g)$	Heat of sublimation of Li(s) = 161kJ/mol
$HCl(g) \rightarrow H(g) + Cl(g)$	Bond energy of HCl = 427 kJ/mol
$Li(g) \rightarrow Li^+(g) + e^-$	Ionization energy of Li(g) = 520. kJ/mol
$Cl(g) + e^- \rightarrow Cl^-(g)$	Electron affinity of Cl(g) = 349 kJ/mol
$Li^+(g) + Cl^-(g) \rightarrow LiCl(s)$	Lattive energy of LiCl(s) = 829 kJ/mol
$H_2(g) \rightarrow 2H(g)$	Bond energy of H_2 = 432 kJ/mol

Calculate the net change in energy for the reaction

$2Li(s) + 2HCl(g) \rightarrow 2LiCl(s) + H_2(g)$

B. 3.0 moles each of carbon monoxide, hydrogen, and carbon are placed in a 2.0 Liter vessel and allowed to come to equilibrium according to the equation:

$CO(g) + H_2(g) \leftrightarrow C(s) + H_2O(g)$

If the equilibrium constant at the temperature of the expreminet is 4.0, what is the equilibrium concentration of water vapor?

C. Write the 3 resonance structures for OCN^- and calculate the formal charge in each.