Exam 2  
CEM 151  
October, 20, 2010  

Name___________________  
Section__________________  
PID_____________________  

Multiple choice (6 points each).

1. The Oxidation number of the N in ammonium, the N in nitrate and the C in methane change by how much, respectively, in the following reaction:

\[ 2\text{NH}_4\text{NO}_3(s) + \text{CH}_4(g) \rightarrow \text{N}_2(g) + \text{CO}_2(g) + 6\text{H}_2\text{O}(l) \]

a. 0, 0, 0  c. -4, 4, 2  e. 2, -4, 2  g. -4, +4, +8  i. +4, -8  
b. 2, 2, -2  d. +4, -6, +8  f. -4, +6, +8  h. none of the above  j. Cannot be determined

2. Which of the following will result in a solution with higher conductivity?

a. Dissolving 100 g of glucose, C\textsubscript{6}H\textsubscript{12}O\textsubscript{6} in 1 L of water  
b. Dissolving 100 g of ammonium phosphate in 1 L of water  
c. Dissolving 100g of sodium chloride in 1 L of water  
d. Dissolving 100g of lithium fluoride in 1 L of water  
e. Dissolving 200g of acetic acid in 1 L of water  
f. All of the above solutions will have identical conductivity.

3. Which of the following are State Functions:

a. H  
b. \Delta H  
c. \Delta E  
d. work  
e. heat  
g. a, b, c  
h. a, b  
i. b, c  
j. all of the above  
k. none of the above

4. Which of the following reactions can directly do the most PV work on the surroundings:

a. \( \text{H}_2(g) + \frac{1}{2}\text{O}_2(g) \rightarrow \text{H}_2\text{O}(g) \)  
b. \( \text{HCl(aq)} + \text{NaOH(aq)} \rightarrow \text{???} \)  
c. \( \text{Na}_2(\text{CO}_3)(aq) + \text{HCl(aq)} \rightarrow \text{???} \)  
d. \( \text{P}_4 + 5\text{O}_2(g) \rightarrow 2\text{P}_2\text{O}_5(s) \)  
e. None of them can do any work.

5. 25 mL of a 0.25 M solution of sodium hydroxide is required to titrate 50. mL of a solution of hydrochloric acid. What was the concentration of hydrochloric acid?

a. 0.25 M  
b. 0.125 M  
c. 0.025 M  
d. 0.0050 M  
e. 0.050 M  
g. 0.10 M  
h. 0.50 M  
i. 0.0050 M  
j. 0.010 M
6. Given the following reactions, determine the missing enthalpy of reaction.

\[ \begin{align*}
A + B & \rightarrow C \quad 15 \text{ kJ} \\
B + F & \rightarrow G \quad 25 \text{ kJ} \\
C + E & \rightarrow G \quad ???
\end{align*} \]

\[ A + E \rightarrow F \quad -25 \text{ kJ} \]

\[ \begin{align*}
a. & \quad 15 \text{ kJ} \quad d. & \quad -65 \text{ kJ} \quad g. & \quad 25 \text{ kJ} \\
b. & \quad -15 \text{ kJ} \quad e. & \quad 10 \text{ kJ} \quad h. & \quad -25 \text{ kJ} \\
c. & \quad 65 \text{ kJ} \quad f. & \quad -10 \text{ kJ} \quad g. & \quad -250 \text{ kJ}
\end{align*} \]

7. What is the photoelectric effect?
   a. The release of light by gases in a discharge tube
   b. The observation that light is a wave that whose frequency corresponds to its energy.
   c. The observation that substances, especially metals glow different colors as they are heated.
   d. The observation that substances can produce an electric current when illuminated by light.
   e. None of the above.

8. A speaker is vibrating at a regular frequency of 150 Hz. What is the wavelength of the waves produced (the speed of sound is 344 m/s).
   a. 334 m  c. 1.8 x 10^{-4} m  e. 2.3 m
   b. none of the above  d. 2.4 J.  g. 82 cm

9. The frequency of orange light is approximately 5 x 10^{14} \text{ s}^{-1} and the frequency of violet light is approximately 7.5 x 10^{14} \text{ s}^{-1}. How many photons of orange light have the same total energy as 4 photons of violet light?
   a. 1  c. 2.5  g. 4  e. 5  i. 6
   b. 2  d. 3  f. 4.5  h. 5.5  j. 6.5

10. Potassium chloride reacts with lithium metal to produce lithium chloride and potassium, but will not react with barium metal to produce barium chloride and potassium. Put the three elements in their proper order in the activity series (in order of highest to lowest oxidation).
    a. Li, K, Ba  d. Ba, K, Li
    b. Li, Ba, K  e. K, Li, Ba
    c. Ba, K, Li  f. K, Ba, Li

11. What letters correspond to the following values of the secondary quantum number \( l \)?
    Choose the row where all of the choices are correct.
    \[ \begin{array}{llll}
    l = 2 & l = 0 & l = 3 & l = 1 \\
    a. & s & p & d & f \\
b. & s & f & d & p \\
c. & p & s & f & d \\
d. & d & s & f & p \\
e. & p & s & d & f
    \end{array} \]
12. According to the periodic table, which orbital is filled after the 4d orbital?
   a. 4s  c. 4p  e. 4d  g. 5p
   b. 3f  d. 4f  f. 5s  h. 3f

13. Which of the following types of electromagnetic radiation is highest in energy?
   a. microwaves  c. infrared  e. visible  g. radio
   b. X-rays  d. ultraviolet  f. laser  h. Cell phone

14. How many unpaired electrons are in an Iridium (Ir) atom?
   a. 0  c. 1  e. 2  g. 3
   b. 4  d. 5  f. 6  h. none of the above

15. There are _______ orbitals in the complete third shell.
   a. 25  c. 4  e. 14  g. 16
   b. 32  d. 8  f. 12  h. None of the above

16. The _______ quantum number is most responsible for defining the shape of an orbital.
   a. spin  c. $\Psi$  e. magnetic  g. Principle
   b. n  d. $m_s$  f. azimuthal

17. [Ar]4s$^2$3d$^{10}$4p$^1$ is the electron configuration for a(n) _________ atom.
   a. As  c. V  e. P  g. Ge
   b. Sb  d. Ga  f. Sn  h. None of the above.

18. Predict the atomic number of the next Noble gas (below Rn).
   a. 126  c. 11  e. 118  g. None of the above
   b. 96  d. 106  f. 136

19. The ground state electron configuration for a palladium (Pd) atom is:
   a. [Ar]4s$^2$4d$^9$  c. [Kr]5s$^2$3d$^8$  e. [Xe]5s$^2$5d$^{10}$
   b. [Kr]5s$^2$3d$^{10}$  d. [Kr]5s$^2$4d$^{10}$  f. [Xe]5s$^1$5d$^{11}$
   g. None of the above
Problems, show work ON THIS SHEET. Use additional paper if necessary
(12 points each)

20. Under constant-volume conditions, the heat of combustion of glucose (C\textsubscript{6}H\textsubscript{12}O\textsubscript{6}) is 15.57 kJ/g. A 25g sample of glucose is burned in a bomb calorimeter. The temperature increased from 20.5°C to 48.0 °C.
   a. What is the total heat capacity of the calorimeter?
   b. If the size of the glucose sample had been exactly twice as large, what would the final temperature of the calorimeter have been?

21. Calculate the standard enthalpy of formation of solid Mg(OH)\textsubscript{2}, given the following data:
   2Mg(s) + O\textsubscript{2}(g) \rightarrow 2MgO(s) \quad \Delta H^\circ = -1203.6 \text{ kJ}
   Mg(OH)\textsubscript{2}(s) \rightarrow MgO(s) + H\textsubscript{2}O(l) \quad \Delta H^\circ = 37.1 \text{ kJ}
   2H\textsubscript{2} + O\textsubscript{2} \rightarrow 2H\textsubscript{2}O(l) \quad \Delta H^\circ = -571.7 \text{ kJ}

22. Draw a figure that represents the following orbitals. Show any nodes or nodal planes:
   a. the 2s orbital
   b. The 3p orbitals
   c. The five 3d orbitals.