Form Code X NAME________________________________________

CHM 2045, Spring 2015, Exam 2 Review Packet (Broward Teaching Center)

Final Packet Instructions: Do your best and don’t be anxious. Read the question, re-read the question, write down all given or valuable information, and write down what you want to find. As on all graded events, the loving of moles applies.

1) A certain light bulb consumes 200 J of energy per second. If a light bulb converts all of this energy to 500 nm light, how many photons are produced each second?
   1) 5.0 x 10^20  2) 200  3) 5.0x10^-7  4) 5.0x10^-19  5) 5.0

2) Select the false statement:
   (1) Photons of green light have greater energy than photons of red light
   (2) Light emitted by an n = 4 to n = 2 transition will have greater energy than light from an n = 3 to n = 1 transition
   (3) The energy of a photon is directly related to its frequency and inversely related to its wavelength
   (4) There are only two subshells associated with the n = 2 shell of an atom
   (5) In accordance with Hund's rule, a ground-state phosphorus atom contains three unpaired electrons in its 3p subshell

3) A 3.58 g sample of benzene (C\textsubscript{6}H\textsubscript{6}, 78.11 g/mol) was burned in a bomb calorimeter with a heat capacity of 800 J/°C. The calorimeter contained 85g of water (4.18 J/g°C), and the temperature increased by 10°C. What is the molar enthalpy of combustion of benzene in kJ/mol?
   1) 3.27 kJ/mol  2) -19.70 kJ/mol  3) -5.52 kJ/mol  4) -116.98kJ/mol  5) -252 kJ/mol
4) Which choice contains a possible set of quantum numbers \((n, l, ml, ms)\) for the first electron removed from a ground-state vanadium atom?

(1) 4, 0, 0, \(\frac{1}{2}\)  (2) 4, 1, 0, \(-\frac{1}{2}\)  (3) 3, 2, 0, \(\frac{1}{2}\)  (4) 3, 1, 1, \(\frac{1}{2}\)  (5) 4, 2, 2, \(-\frac{1}{2}\)

5) Calculate \(\Delta H\) for this reaction: \(\text{CH}_4(g) + \text{NH}_3(g) \rightarrow \text{HCN}(g) + 3\text{H}_2(g)\) given:

\[
\begin{align*}
\text{N}_2(g) + 3 \text{H}_2(g) & \rightarrow 2 \text{NH}_3(g) \quad \Delta H = -91.8 \text{ kJ} \\
\text{C}(s) + 2 \text{H}_2(g) & \rightarrow \text{CH}_4(g) \quad \Delta H = -74.9 \text{ kJ} \\
\text{H}_2(g) + 2 \text{C}(s) + \text{N}_2(g) & \rightarrow 2 \text{HCN}(g) \quad \Delta H = +270.3 \text{ kJ}
\end{align*}
\]

\[
\begin{align*}
1) & \quad 200 \text{ kJ} \quad 2) 256 \text{ kJ} \quad 3) 125.15 \text{ kJ} \quad 4) 230 \text{ kJ} \quad 5) 250 \text{ kJ}
\end{align*}
\]

6) A certain element (X) has the following valence electron configuration: \([A]ns^2np^5\) and element M has the following valence electron configuration: \([B]ns^2\). Let \(A\) and \(B\) = the number of core electrons for \(Y\) and \(M\) respectively and \(n\) = the energy level. If an ionic compound was made between \(M\) and \(X\), what would the chemical formula most likely look like?

(1) \(MX\)  (2) \(M_2X\)  (3) \(MX_2\)  (4) \(M_2X_3\)  (5) \(M_3X_4\)

7) Which of the following is true?

P) Paramagnetic refers to an atom with one or more unpaired electrons
Q) Diamagnetic is refers to an atom that has only paired electrons.
R) Ca has an electron configuration of \([\text{Ar}] 4s^2\)
S) Cu has an electron configuration of \([\text{Ar}] 3d^{10} 4s^1\)

(1) Only P, Q, and S are true
(2) Only Q and R are true
(3) Only R and S are true
(4) Only Q is true
(5) All true
8) Enormous numbers of microwave photons are needed to warm household samples. A bowl of soup containing 400g of water is heated in a microwave oven from 20.0°C to 98.0°C using radiation with wavelength 122 mm. Assuming that the specific heat capacity of the soup is the same as that of water (4.184 J/g°C) and no heat loss to the bowl, which choice is closest to the number of photons absorbed?

1) $4.0 \times 10^{-6}$
2) $8.0 \times 10^{-20}$
3) $4.0 \times 10^6$
4) $8.0 \times 10^{28}$
5) None are right

9) Rank the following ions in order of increasing ionization energy: O$^{2-}$, Mg$^{2+}$, F$^-$, Na$^+$. 

1) O$^{2-}$ < Mg$^{2+}$ < F$^-$ < Na$^+$
2) Mg$^{2+}$ < O$^{2-}$ < Na$^+$ < F$^-$
3) Mg$^{2+}$ < Na$^+$ < F$^-$ < O$^{2-}$
4) O$^{2-}$ < F$^-$ < Na$^+$ < Mg$^{2+}$
5) O$^{2-}$ < F$^-$ < Mg$^{2+}$ < Na$^+$

10) Find the de Broglie wavelength of an electron (electron mass 9.11 x 10$^{-31}$ kg) with a speed of 1.0 x 10$^6$ m/s.

1) $1.27 \times 10^{-9}$ m
2) $7.27 \times 10^{-10}$ m
3) $2.91 \times 10^{-10}$ m
4) $6.27 \times 10^{-9}$ m
5) $9.27 \times 10^{-10}$ m
11) Identify the electron configuration of the metal iron in Fe(NO$_3$)$_3$

(1) [Ar] 4s$^2$3d$^6$ (2) 3d$^5$ (3) 3d$^6$ (4) 4s$^2$3d$^3$ (5) 4s$^2$3d$^4$

12) Which of the following ground-state electron configurations corresponds to an atom that has the most negative value of the electron affinity (the greatest affinity for electrons)?

a) 1s$^2$ 2s$^2$ 2p$^6$ 3s$^1$

b) 1s$^2$ 2s$^2$ 2p$^6$ 3s$^2$ 3p$^5$

c) 1s$^2$ 2s$^2$ 2p$^6$ 3s$^2$ 3p$^2$

d) 1s$^2$ 2s$^2$ 2p$^6$ 3s$^2$ 3p$^6$ 4s$^2$ 3d$^5$

e) 1s$^2$ 2s$^2$ 2p$^6$

13) A 100.0 mL sample of 1.020 M HCl is mixed with a 50.0 mL sample of 2.040 M NaOH in a Styrofoam cup. If both solutions were initially at 24.53°C, and the enthalpy of the neutralization reaction is $-57$ kJ/mole of H$_2$O formed, what is the final temperature of the mixture? Assume that the solution has a density of 1.00 g/mL and a specific heat of 4.184 J/g°C, and that the Styrofoam cup has an insignificant heat capacity.

1) 15.26 C  
2) 33.8 C  
3) 24.53 C  
4) 50 C  
5) 26.56 C
14) Consider the following components of the Born-Haber cycle for the formation of NaBr from solid Na and gaseous Br₂, and use these components to calculate the lattice energy (\(\Delta H_{\text{lattice}}\)) of solid NaBr.

- \(\Delta H_{\text{sublimation}}\) of Na = +107 kJ/mol
- \(\Delta H_{\text{first-ionization}}\) of Na = +496 kJ/mol
- \(\frac{1}{2} \Delta H_{\text{bond-energy}}\) of Br₂ = +97 kJ/mol
- \(\Delta H_{\text{first-electron-affinity}}\) of Br = −325 kJ/mol
- \(\Delta H_{\text{formation}}\) of NaBr = −367 kJ/mol

\[
\begin{align*}
(1) \quad -367 \text{ kJ/mol} &\quad (2) \quad -673 \text{ kJ/mol} &\quad (3) \quad -399 \text{ kJ/mol} &\quad (4) \quad -957 \text{ kJ/mol} &\quad (5) \quad -742 \text{ kJ/mol}
\end{align*}
\]

15) The overall reaction in the commercial heat pack can be represented as

\[4 \text{ Fe}(s) + 3 \text{ O}_2(g) \rightarrow 2 \text{ Fe}_2\text{O}_3(s) \quad \Delta H = -1652 \text{ kJ}\]

How much heat is released when 30.0 g Fe and 6.00 g O₂ are reacted?

\[
\begin{align*}
1) \quad -103.25 \text{ kJ} &\quad 2) \quad -0.2685 \text{ kJ} &\quad 3) \quad 0.125 \text{ kJ} &\quad 4) \quad -1652 \text{ kJ} &\quad 5) \quad 400 \text{ kJ}
\end{align*}
\]
16) Why does sodium always occur as a monovalent cation (Na\(^+\)) in compounds?
(1) Its electronegativity is too large
(2) Its ionization energy is too large
(3) 2nd ionization energy is too large
(4) Its 1st electron affinity is too large
(5) Its 2nd electron affinity is too large

17) A hot 312-g chunk of iron is plunged into 200. g of water in an insulated container. The temperature of the water increases from 24 to 75 °C. The specific heat capacity of the iron is 0.45 J/g°C and the specific heat capacity of the water is 4.184 J/g°C. The initial temperature of the iron was closest to…?

1) 378 °C  2) 450 °C  3) 303 °C  4) 760 °C  5) 266 °C

18) Which reaction is exothermic?

1) Na(g) → Na\(^+\)(g) + e\(^-\)
2) \(\frac{1}{2}\)F\(_2\)(g) → F(g)
3) K (s) + H\(_2\)O (l) → KOH (aq) + H\(_2\)(g)
4) N\(_2\) (g) + 3H\(_2\) (g) → 2 NH\(_3\)(g)
5) H\(_2\)O(l) → H\(_2\)O(g)
19) Name the Period 3 element with the following successive ionization energies (in kJ/mol)

<table>
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<th>IE1</th>
<th>IE2</th>
<th>IE3</th>
<th>IE4</th>
<th>IE5</th>
<th>IE6</th>
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<td>1903</td>
<td>2910</td>
<td>4956</td>
<td>6278</td>
<td>22,230</td>
</tr>
</tbody>
</table>

1) P   2) K   3) O   4) Ar   5) S

20) Which of the following ground state ions is/are paramagnetic?
(1) Fe^{2+}
(2) Zn^{2+}
(3) Cu^{+}
(4) Ni^{2+}
(5) V^{3+}

1) 1 and 4 only   2) only 1, 4, and 5   3) only 1   4) only 2 and 3   5) only 2, 4 and 5

GOOD LUCK and SMILE ON THE EXAM!!!