CHM 2045 Exam 2 (Instructors: Gower, Mitchell, Harrison. Ucak) **(Form Code A)** **October 20, 2009**

Instructions: On your scantron sheet enter your name, UF ID number (start on the first space and leave the last space blank), Discussion Section No. and Form Code (see above). This exam consists of 25 multiple choice questions each worth 10.0 points for a total maximum of 250 pts. You may retain your exam sheet (mark your answers on it and the scantron sheet). Turn in only the scantron. **Bubbling errors of any kind will count as an incorrect response or result in the loss of points.**

Rydberg constant $R = 1.097 \times 10^{7}\ m^{-1}$; $Rhc = 2.18 \times 10^{-18}$ J/atom; Planck's constant $h = 6.626 \times 10^{-34}$ Js; $c = 2.99 \times 10^{8}$ m/s;

1. Calculate the wavelength (in nm) of a photon emitted by hydrogen atom when an electron drops from n=5 to n=2 state.
1) 4.34×10^{-7} **nm** **2) 434 nm** **3) 1280 nm** **4)** 1280×10^{-7} **nm** **5)** 135×10^{-6} **nm**

2. Identify the atom or ion corresponding to an atom with ground state electronic configuration $[Kr]4d^{10}5s^{2}5p^{5}$
1) In **2)** In^{+} **3) Tl** **4) I** **5)** I^{+}

3. The wavelength of radiation used in a microwave oven is 2.10 cm. What is the energy of one photon of this microwave radiation?
1) 1.66×10^{-23} **J** **2)** 9.47×10^{-24} **J** **3)** 1.07×10^{-24} **J** **4)** 1.03×10^{-23} **J** **5)** 1.66×10^{-24} **J**

4. Which of the following sets of quantum numbers (n, *l*, m_l) are not allowed?
a) 3, 2, −1 **b) 2, 3, −1** **c) 3, 0, +1** **d) 6, 2, −1** **e) 4, 4, +4**
(1) a, b, c **2) b, c, e** **3) c, d** **4) a, b, e** **5) a, e**

5. Find the de Broglie wavelength of an electron (electron mass 9.11×10^{-31} **kg) with a speed of** 2.5×10^{6} **m/s.**
1) 1.27×10^{-9} **m** **2)** 2.91×10^{-10} **m** **3)** 7.27×10^{-10} **m** **4)** 7.27×10^{-11} **m** **5)** 5.27×10^{-10} **m**

6. An electron (electron mass 9.11×10^{-31} **kg) moving near an atomic nucleus has a speed of** $6 \times 10^{6} \pm 1\%$ **m/s. What is the uncertainty in its position?**
1) 1×10^{-9} **m** **2)** 2×10^{-9} **m** **3)** 1×10^{-11} **m** **4)** 2×10^{-11} **m** **5)** 3×10^{-11} **m**

7. Arrange the following elements, S, Ge, Cl, Rb, Ca in order of increasing first ionization energy, (IE_1).
1) Rb < Ca < Ge < S < Cl **2) Ca < Rb < S < Ge < Cl** **3) Rb < Ca <S < Ge < Cl**
4) Ca < Rb < Ge < Cl < S **5) Rb < Ca < Ge < Cl < S**

8. Arrange the following elements, S, Ga, P, Ba, Fr in order of decreasing atomic size.
1) Fr > Ba > P > Ga > S **2) Ba > Ga > P > S > Fr** **3) Fr > Ba > P > S > Ga**
4) Fr > Ba > Ga > P > S **5) Ba > Ga > P > S > Fr**

9. Arrange the following ions, Al^{3+}, F^{1-}, Na^{1+}, S^{2-} **in order of increasing ionic size.**
1) $Na^{1+} < Al^{3+} < F^{1-} < S^{2-}$ **2)** $Al^{3+} < Na^{1+} < F^{1-} < S^{2-}$ **3)** $Al^{3+} < F^{1-} < S^{2-} < Na^{1+}$
4) $Na^{1+} < Al^{3+} < S^{2-} < F^{1-}$ **5)** $Al^{3+} < Na^{1+} < S^{2-} < F^{1-}$

10. Which one of these is the most polar bond?
(1) C-Cl **(2) C-O** **(3) N-F** **(4) N-S** **(5) Si-O**

11. Which of the following molecules are polar? Cl_2, CO_2, BF_3, NO, SO_2, XeF_4
(1) Cl_2, CO_2 **(2) NO,** XeF_4 **(3)** BF_3, XeF_4 **(4)** CO_2, NO **(5) NO,** SO_2

12. Photodissociation of water, $H_2O(l) + h\nu \rightarrow H_2(g) + \frac{1}{2}O_2(g)$, **has been suggested as a source of hydrogen. The** ΔH^{o}_{rxn} **for the reaction is 285.8 kJ per mole of water decomposed. Calculate the maximum wavelength (in nm) that would provide the necessary energy for the photodissociation of one molecule of water.**
(1) 419 nm **(2) 47 nm** **(3) 93 nm** **(4) 279 nm** **(5) 838 nm**

13. What is the maximum number of electrons in an atom that can have the quantum numbers $n = 4$, $m_l = +1$ **?**
(1) 1 **(2) 2** **(3) 4** **(4) 6** **(5) 8**

14. The 2nd electron affinity (*EA*$_2$) for any atom is always a positive value, because:
(1) adding a negatively-charged electron to a negatively-charged anion is an endothermic process
(2) adding a negatively-charged electron to a positively-charged nucleus is an exothermic process
(3) Coulomb's Law states that electrostatic attraction is directly related to the distance between charged particles, and an anion is a larger particle than its parent atom
(4) a positively-charged cation is formed
(5) when the negative *EA*$_1$ of one atom bonds to the negative *EA*$_1$ of another atom, the result is always a positive *EA*$_2$

15. Element X has the following valence electron configuration: [core]ns^2np^4. Element M has the following valence electron configuration: [core]ns^2np^1. What ionic compound would most likely result from the reaction between ions of M and X?

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

16. Which of the following ionic compounds has the strongest (most negative) lattice energy?

(1) Mg_3N_2 (2) MgO (3) Na_2S (4) LiF (5) Cs_2Se

17. What is the formal charge on the nitrogen atom in the Lewis structure for the most significant resonance contributor for the thiocyanate ion (SCN^-)? (Hint: three resonance structures)

1) 0 2) –1 3) +1 4) –2 5) +2

18. Select the following species which is trigonal pyramidal.

1) BeF_3 2) Cl_3^{-1} 3) SO_4^{-2} 4) ClO_4^{-1} 5) ClO_3^{-1}

19. Select the following species which is square planar.

1) ICl_4^{-1} 2) BrF_5 3) $XeOF_4$ 4) $IOCl_5$ 5) IF_3

20. Identify the element of Period 2 that has the following successive ionization energies, in kJ/mol.

IE_1 = 1314 IE_2 = 3389 IE_3 = 5298 IE_4 = 7471 IE_5 = 10992 IE_6 = 13329 IE_7 = 71345 IE_8 = 84087

1) Li 2) B 3) O 4) Ne 5) None of these

21. Which of the following elements has the largest second ionization energy (IE_2)?

(1) Li 2) B 3) O 4) F 5) Na

22. Which of the following ground state ions is/are paramagnetic?

(1) Fe^{2+} (2) Zn^{2+} (3) Cu^{1+} (4) Ni^{2+} (5) V^{3+}

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

23. Oxygen difluoride is an unstable molecule that reacts readily with water. Calculate the bond energy of the O-F bond using the standard enthalpy of reaction and the bond energy data provided.

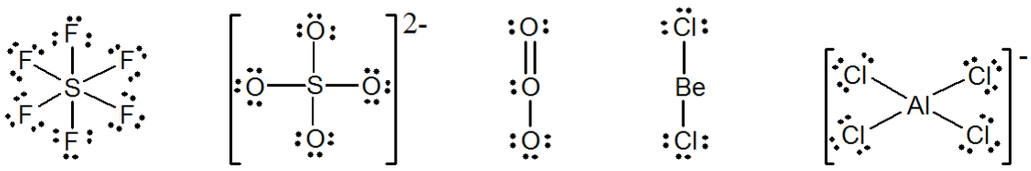
$OF_2(g) + H_2O(g) \rightarrow O_2(g) + 2HF(g)$ $\Delta H° = -318$ kJ

Bond:	**O-O**	**O-H**	**O=O**	**H-F**
Bond energy (kJ/mol):	**148**	**467**	**498**	**565**

(1) 188 kJ (2) 256 kJ (3) 275 kJ (4) 346 kJ (5) 388 kJ

24. In which one of the following structures, as drawn, does the central atom have a formal charge of +2?

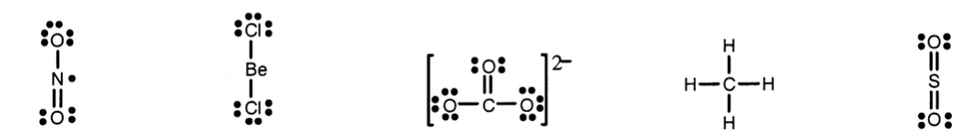
a. SF_6 b. SO_4^{2-} c. O_3 d. $BeCl_2$ e. $AlCl_4^-$



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

25. Which one of the following Lewis structures is definitely incorrect?

a. NO_2 b. $BeCl_2$ c. CO_3^{2-} d. CH_4 e. SO_2



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