Name: __________________________________________, SSN ____________________________

LAST NAME, First
(Circle the alphabet segment of your LAST NAME): A-C D-H I-M N-R S-Z

Please answer the following questions:

Part I: Multiple Choices (60 pts: 15 @ 4 pts each). Circle the ONE best answer:

1. An Fe^{2+} ion is
   a) paramagnetic with four unpaired electrons
   b) diamagnetic with zero unpaired electrons
   c) paramagnetic with two unpaired electrons
   d) paramagnetic with one unpaired electron

2. The orbitals of 2p electrons are often represented as being
   a) elliptical                          b) tetrahedral
   c) dumbbell shaped                          d) spherical

3. Which of the following molecules is classified as predominantly ionic?
   a) SiO2                      b) ClO2  d) P_4O_{10}   d) CaO

4. Which set of quantum numbers is correct and consistent with n = 4?
   a) \( \ell = 3, m_\ell = -3, m_s = +\frac{1}{2} \)            b) \( \ell = 4, m_\ell = +2, m_s = -\frac{1}{2} \)
   c) \( \ell = 2, m_\ell = +3, m_s = +\frac{1}{2} \)            d) \( \ell = 3, m_\ell = -3, m_s = +1 \)

5. The ground state electron configuration of iridium, Ir (Z = 77) is
   a) [Xe] 5d^7 6s^2     b) [Xe] 4f^{14} 5d^7 6s^2
   c) [Xe] 4f^{14} 6d^7 6s^2    d) [Xe] 4f^{14} 5d^9

6. The maximum number of electrons that can occupy an orbital labeled 4p_x is
   a) 6                          b) 4
   c) 2                          d) 3

7. The ground state electron configuration of chromium atom, Cr (Z = 24) is
   a) 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^4
   b) 1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^5
   c) 1s^2 2s^2 2p^6 3s^2 3p^6 3d^6
   d) 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 4p^4

8. Which of the following has the highest ionization energy?
   a) Ar                 b) K                      c) Cl   d) S
9. When the three elements S, Se and Cl are arranged in order of increasing atomic radius, which is the correct order?
   a) Se < S < Cl  
   b) S < Cl < Se  
   c) S < Se < Cl  
   d) Cl < S < Se

10. Which of the following bonds is considered to be the most polar?
   a) O-F  
   b) C-F  
   c) N-F  
   d) Si-F

11. Which of the following electromagnetic radiation has the longest wavelength?
   a) X-ray  
   b) Visible light  
   c) Radio wave  
   d) Infrared

12. Which of the following isoelectronic species would have the largest radius?
   a) Mg$^{2+}$  
   b) Na$^+$  
   c) O$^{2-}$  
   d) F$^-$

13. Which compound has a triple bond?
   a) O$_2$  
   b) OF$_2$  
   c) BeF$_2$  
   d) N$_2$

14. Compact disc players use lasers that emit red light with a wavelength of 685 nm. What is the energy of a mole of photons in kilojoule?
   a) 175  
   b) $2.9 \times 10^{-19}$  
   c) $2.73 \times 10^{-13}$  
   d) no answer was given

15. In the BrCN molecule there are:
   a) 2 $\sigma$ and 1 $\pi$ bonds  
   b) 2 $\sigma$ and 2 $\pi$ bonds  
   c) 3 $\sigma$ and 1 $\pi$ bonds  
   d) 1$\sigma$ and 3 $\pi$ bonds
Part II. Calculations (12 pts) Show all work for full credit. Please express all answers with the proper units and correct number of significant figures.

1. a) Calculate the wavelength in nanometers in the H-atom spectrum that arises from the electron transition of \( n = 4 \) to \( n = 2 \).

\[ \lambda \text{ (nm)} \]

b) In what spectral region does this transition occur?

c) Is energy absorbed or emitted?

Part III. Bonding (28 pts):

1. (12 pts) Draw the Lewis structure for the nitrite ion, \( \text{NO}_2^+ \), draw the resonance structures, if there is any then: predict:

a) number \( \sigma \) and \( \pi \) bonds

b) The molecular shape of the ion

Lewis Structure & resonance structures (if any)

| a) Molecular shape: ------------------------- |
| b) \# of \( \sigma \) bonds \------ |
| and \# of \( \pi \) bonds \------ |
2. (16 pts) Draw the Lewis structure of the following molecules or ions?

a) SF$_4$  

b) SO$_3^{2-}$  

c) BeF$_2$  

d) PF$_5$
Exam 3 – Fall 2006

You will have **55 minutes** to complete this exam. The exam has **4 pages** plus the Periodic Table and Reference page.

When you are told to do so, **tear off** the Periodic Table cover sheet and use as required during the exam.

### Equations and Constants:

\[
\nu = \frac{R_H}{h} \left[ \frac{1}{\nu_{n_0}^2} - \frac{1}{\nu_{n_f}^2} \right] \\
E = h \nu \\
c = \lambda \nu \\
R_H = 2.180 \times 10^{-18} \text{ J} \\
h = 6.626 \times 10^{-34} \text{ J.s} \\
c = 3.00 \times 10^8 \text{ m/s}
\]

Avogadro’s Number = 6.022 x 10^23

### Periodic Table of the Elements

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