

CHEM C0200 Inorganic Chemistry
Prof. Glen Kowach
Examination I
3/7/07

Name: _____

1. List all the possible quantum numbers for the $4d$ orbitals (n , l , m_l , m_s).

2. Draw the radial part of the wavefunction for a $3s$ orbital.

3. What orbital has the following angular part? _____

4. What is the trend in the atomic radii as you go across the periodic table from left to right? (circle your answer)

increases decreases

5. Which has the smallest radius?
 - a. Rb^+ with coordination number of 6 (CN=6)
 - a. Rb^+ with coordination number of 8 (CN=8)
 - a. Rb^+ with coordination number of 12 (CN=12)

6. Fill in the missing elements from the periodic table.

7. Draw a molecular orbital (MO) diagram for NO. (assume same order of MOs as O₂)

a. What is the bond order (BO) based on MO theory?

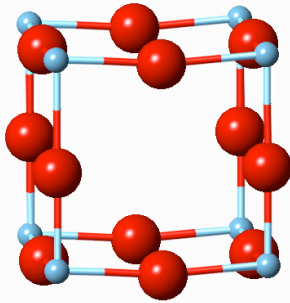
b. Draw the Lewis structure.

c. What is the BO based on the Lewis structure?

d. Is the molecule diamagnetic or paramagnetic?

e. Draw the shape of the highest occupied molecular orbital (HOMO)?

8. Below is the ReO_3 structure.



- a. What is the CN for Re?
- b. What is the CN for O?
- c. How many nearest neighbors does the Re have?
- d. What is the distance from the Re atom to the nearest neighbor as a fraction of a ?
- e. How many next nearest neighbors does the Re have?
- f. What is the distance from the Re atom to the next nearest neighbor as a fraction of a ?
- g. How many next next nearest neighbors does the Re have?
- h. What is the distance from the Re atom to the next next nearest neighbor as a fraction of a ?
- i. If $a = 5.2 \text{ \AA}$, then what is the density?

j. Draw a Born-Haber cycle for the formation of ReO_3 .

9. Draw the distribution diagram for H_2SO_4 . (label the points for $\text{pK}_{\text{a}1}$ and $\text{pK}_{\text{a}2}$)

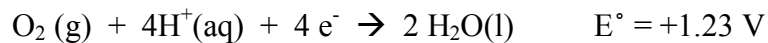
10. a. If your solvent is liquid ammonia, what is the chemical equation for autoprotolysis?

b. Write the expression for K_{ammonia} (K_{am})

c. What is the consequence for $\text{pK}_{\text{am}} = 33$ compared to pK_{w} ?

11. Arrange the oxides Al_2O_3 , B_2O_3 , BaO , CO_2 , Cl_2O_7 , and SO_3 in order from most acidic to most basic.

12. For zinc placed in an aqueous acidic solution:



a. What is the standard emf of the cell?

b. Is the reaction spontaneous?

c. What is K ?

given:

$$F = 9.649 \times 10^4 \text{ C/mol}$$

$$R = 8.314 \text{ J/molK}$$

At 298 K.