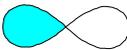


$$h = 6.63 \times 10^{-34} \text{ J sec} \quad c = 3.00 \times 10^8 \text{ m sec}^{-1} \quad N_A = 6.02 \times 10^{23} \text{ mol}^{-1} \quad E_n = -13.6 \text{ eV/n}^2$$

**Part 1.** Answer 7 of the following 8 questions. If you answer more than 7 cross out the one you wish not to be graded, otherwise only the first three will be graded. 6 points each.

1. As the number of nodes in a wave increases, the energy of the wave \_\_\_\_\_.
2. Give the  $n$  and  $l$  quantum numbers for the highest energy electron in B:  $n =$  \_\_\_\_\_,  $l =$  \_\_\_\_\_.  
What are the possible values of  $m_l$ ?  $m_l =$  \_\_\_\_\_.
3. Circle the correct answer in each of the following lists:
  - a. The largest electronegativity: Ge, P, O
  - b. The largest first ionization potential: K, Ga, Br
  - c. The largest atomic radius: As, P, N
4. Sketch the radial probability distribution ( $4\pi r^2 \Psi^2$ ) for a 3s orbital. Remember to label both axes.



5. Which of the following pairs of atoms is expected to have the **greatest** bond polarity and the **least** bond polarity?
  - a. N-O
  - b. B-N
  - c. K-F
  - d. Cl-Cl
6. Why does nitrogen have a greater first ionization potential than oxygen?.
7. What is the  $l$  quantum number for the atomic orbital shown at right? 
8. Circle the compound with the greatest lattice energy: KCl, CaCl<sub>2</sub>, MgO.

**Part 2.** Answer 3 of the following 4 questions. If you answer more than three cross out the one you wish not to be graded, otherwise only the first three will be graded. 9 points each.

9. Does F or Cl have a bigger difference between  $Z$  and  $Z_{\text{eff}}$  for the valence electrons. Remember to tell why  $Z$  and  $Z_{\text{eff}}$  are different.

10. Give the electron configuration for the following atoms or ions (include deviations from the aufbau principle, you can also simplify by using a noble gas core, eg [Ar]):

P:

Cu:

Ti<sup>2+</sup>:

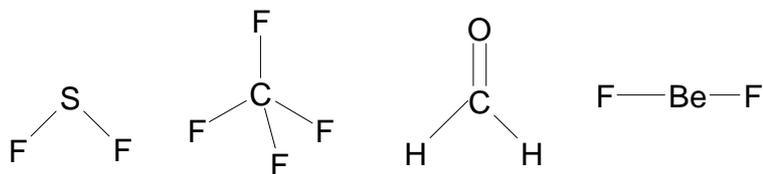
11. The wavelength of a photon is 500 nm. Calculate the frequency and the energy in kJ/mol.

12. What is the energy (in eV or J) of the photon that is emitted from a hydrogen atom that drops from the  $n=4$  level to the  $n=3$  level?

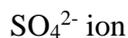
**Part 3.** Answer 3 of the following 4 questions. If you answer more than three cross out the one you wish not to be graded, otherwise only the first three will be graded. 10 points each.

13. Draw the Lewis dot resonance structures for the carbonate ion,  $\text{CO}_3^{2-}$ . Give the average bond order for the bonds. Don't forget to include the charge in your structures.

14. Which of the following are polar?



15. Use VSEPR theory to predict the shape of the following molecules. (Central atom listed first). Give the name of the shape and also draw the shape.



16. Give the Lewis dot formula and calculate the formal charge on each atom in the following two compounds:

