General and Structural Chemistry
Assignment 2-S-24
IIIT-Hyderabad

Q1. Explain why gold is extremely difficult to oxidize compared with Cu and Ag. **(4)**

Q2. A metalloid has no oxide of the formula R_2O_5 but has an acidic oxide of the formula R_2O_3. What could be the name of the element? Give reasons in support of your answer. **(4)**

Q3. Suppose that a metal forms an oxide of formula M_2O_3. Would you expect the metal oxide to be a solid, liquid, or gas at room temperature? Why? **(4)**

Q4. What additional information do we need to answer the question "Which ion has the electron configuration $1s^2 2s^2 2p^6 3s^2 3p^6$"? **(2)**

Q5. Give an example of an atom whose size is smaller than fluorine. **(2)**

Q6. Based on the knowledge of the electronic structure of the elements, arrange the following substances in the order of their increasing ability to act as oxidizing agents. He^+, Cl, P, Na, F^-. **(10)**

Q7. Sometimes one finds rearrangement of electrons due to extra stability of half-filled or completely filled orbitals. There is no case where an atom such as carbon is found with the ground-state configuration of $1s^2\ 2s^1\ 2p^3$ (half-filled p-orbital) instead of $1s^2\ 2s^2\ 2p^2$. Justify it. **(3)**

Q8. The electron affinity of nitrogen is very close to 0. The ionization potential for the oxygen atom is lower than that of nitrogen, even though the oxygen atom has a higher nuclear charge. Why is this so? **(4)**

Q9. Exciting Li $1s^2\ 2s^1$ to give $1s^2\ 2p^1$ requires 178 kJ mol^{-1}. However, exciting Be from $1s^2\ 2s^2$ to $1s^2\ 2s^1\ 2p^1$ requires 263 kJ mol^{-1}. Why are the energies so different? **(4)**

Q10. If 6 half-filled atomic p-orbitals combine to form pi-MOs (pi-molecular orbitals), how many pi-MOs will be formed? How many nodes are there in the respective frontier orbitals (HOMO and LUMO)? **(2,2,2)**

Q11. Use MOT to explain the following equilibrium bond lengths: N_2 (109.8 pm), N_2^+ (111.6 pm), and N_2^{2-} (122.4 pm). **(3)**

Q12. Suppose we supply enough energy to He_2^+ to remove its most weakly bound electron. Is the bond energy of the resulting ion larger or smaller than that of He_2^+? Is the bond length of the resulting ion larger or smaller than that of He_2? Refer to the proper MO correlation diagram. **(2,2,2)**

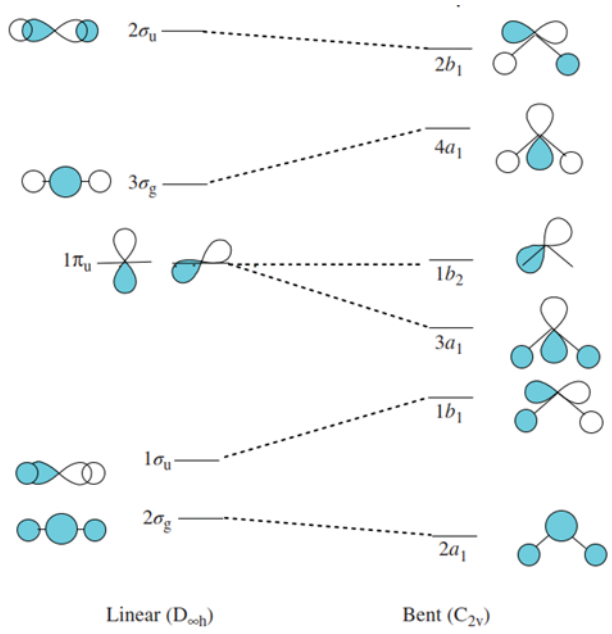
Q13. The ionization energy of molecular hydrogen (H_2) is greater than that of atomic hydrogen (H), but that of molecular oxygen (O_2) is lower than that of atomic oxygen (O). Briefly explain. **(4)**

Q14. In N_2, are the four π^b electrons ionized at lower or higher energies than the two σ^b ($2p_z$) electrons? **(2)**

Q15. By using photoelectron spectroscopy, what kind of information can one get regarding the molecular orbitals? (Give four points.) **(4)**

Q16. Walsh diagram is given below. The energy increases from bottom to top. What are the geometries you would predict for the ground and first electronic excited state configuration for BeH_2? **(3,3)**

Walsh Diagram:



Q17. The following data are given: CO bonds IR frequencies (ν (CO) stretching frequency): 2000 cm^{-1} and 2140 cm^{-1} and CO and $Cr(CO)_6$. Assign the IR frequencies to the respective molecules. Justify your answer. **(6)**

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