

ATOMIC STRUCTURE AND INTERATOMIC BONDING

- 1) (a) Cite two important quantum mechanical concepts associated with the Bohr model of the atom
- (b) Cite two important additional refinements that resulted from the wave-mechanical atomic model

2) Allowed values for the quantum numbers of electrons are as follows:

$$n=1,2,3,\dots \text{ (K,L,M,...shells)}$$

$$l=0,1,2,3,\dots (n-1) \text{ (subshell, e.g. } l=1 \text{ corresponds to p subshell)}$$

$$m_l=0, \pm 1, \pm 2, \pm 3.. (2l+1)$$

$$m_s= \pm 1/2$$

- (a) Write the four quantum numbers for all of the electrons in the L shell in the form of 'nlm_lm_s' and note which corresponds to the s,p,d subshell
- (b) List the different ways to write the 4 quantum numbers of a 3p orbitals

3) (a) Give the electron configurations of Fe; Fe³⁺, Al; Al³⁺, Cu; Cu⁺, S²⁻, Mn; Mn²⁺

(b) Calcium oxide (CaO) exhibits predominantly ionic bonding. The Ca²⁺ and O²⁻ ions have electron structures that are identical to which inert gases?

(Atomic numbers(Z): Fe=26, Al=13, Cu=29, S=16, Mn=25, Ca=20, O=8)

4) The net potential energy between two adjacent ions, E_N, may be represented by;

$$E_N = -\left(\frac{A}{r}\right) + B/r^n$$

- a) Determine the equilibrium interionic spacing
- b) Determine the expression for E₀

- 5) Briefly cite the main differences between ionic, covalent and metallic bonding
- 6) The percent ionic character of a bond between elements A and B (A being the most electronegative) may be approximated by the expression;

$$\%ionic\ character = (1 - e^{-(0.25)(X_A - X_B)^2}) \times 100$$

X_A and X_B are the electronegativities for the respective elements.

Compute the percent ionic character of the interatomic bonds for the following compounds:

FeO and CsF

- 7) Determine the number of the covalent bonds that are possible for atoms of the following elements: Si, Ni, S, Br
- 8) (a) What type of bonding would be expected for each of the following materials and compounds:

Rubber: $(CH_2-C(CH_3)CH=CH_2)_n$, Solid xenon, bronze, nylon($nHOOC-(CH_2)_4-COOH + nH_2N-(CH_2)_6-NH_2 \rightarrow [-OC-(CH_2)_4-CO-NH-(CH_2)_6-NH-]_n + 2nH_2O$ and the part $-CO-NH-$ will stick together), BaS, AlP, MgO, LiF, KCl, H_2O , CO_2 , HCl

- (a) What type of intermolecular bonding would be expected for each of the compounds;

HF, HCl, H_2O