

## 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:

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

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

$m_l=0, \mp 1, \mp 2, \mp 3, \dots (2l+1)$

$m_s= \mp 1/2$

- (a) Write the four quantum numbers for all of the electrons in the L shell in the form of ' $n l m_l m_s$ ' 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;  $Fe^{3+}$ , Al;  $Al^{3+}$ , Cu;  $Cu^+$ , S<sup>2-</sup>, Mn;  $Mn^{2+}$

(b) Calcium oxide (CaO) exhibits predominantly ionic bonding. The  $Ca^{2+}$  and  $O^{2-}$  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  $E_o$

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;

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

$X_A$  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,  $H_2O$