<u>Tutorial Sheet-8 (PHYSICS-2) 2019-2020</u>

Assignment 8: Calculate the Madelung constant in three dimensional NaCl crystal structure.

1. Define the terms: (a) Ionization energy, (b) Electron Affinity, (c) Lattice Energy and (d) Cohesive Energy. [CO1]
2. (a) When ice melts, which of the bonds is/are broken (Covalent, Hydrogen, Ionic)?
   (b) Out of electronegativity, charge, size, and number of atoms bound, which factor is used to determine a bond to be ionic? [CO1]
3. Explain why (a) Covalent bonds are directional and saturated; (b) ionic bonds are unsaturated and non-directional. [CO2]
4. The potential energy of a system of two atoms is given by $U(r) = -\alpha/r^4 + \beta/r^{12}$. Calculate the amount of energy released when the atoms form a stable bond and also determine the bond length. [CO3]
5. The potential energy of a system of two atoms is given by $U(r) = -A/r^2 + B/r^{10}$. A stable molecule is formed with the release of 8.0 eV of energy when the interatomic distance is 2.8 Å. Calculate A and B. Determine the force required to dissociate this molecule into atoms and the interatomic distance at which the dissociation occurs. [CO4]
6. The ionization energy of Hydrogen atom is 13.595 eV and its electron affinity is 0.754 eV. If these anion and cation are 5.1 Å apart, calculate the energy required to transfer an electron between them. [CO3]
7. The ionic radii of Cs and Br are 1.67 Å & 1.95 Å, respectively. Find the force of attraction between ions when they just touch each other. [CO3]
8. The potential energy of a diatomic molecule is given in terms of the interatomic distance r by the expression, $U(r) = \frac{-a}{r^m} + \frac{b}{r^n}$
   (a) Calculate the equilibrium spacing of two atoms (r_o). Also prove that n > m.
   (b) Show that the potential energy of the particles in the stable configuration is equal to $(1 - \frac{m}{n})\frac{a}{r_O^m}$.
   (c) If m=1 and n=8 show that if the particles are pulled apart, the molecule will break as soon as $r = \left(\frac{36b}{a}\right)^{1/7}$ and that the minimum force required to break the molecule is $\left(\frac{7}{9}\right)\frac{a^{9/7}}{(36b)^{2/7}}$.
   [CO4]