# Worksheet

## (Chapter 3 Crystal Binding)

Q1. The potential energy of a diatomic molecule in terms of inter atomic distance $R$ is given by

$$U(R) = -\frac{A}{R^m} + \frac{B}{R^n},$$

where $A, B, m$ and $n$ are constants characteristics for the $MX$ -molecules. Attractive and repulsive exponents are related through:

(a) $n << m$ (b) $n < m$ (c) $n > m$ (d) $n >> m$

Q2. The potential energy of a diatomic molecule in terms inter atomic distance $R$ is given by

$$U(R) = -\frac{A}{R^m} + \frac{B}{R^n},$$

where $A, B, m$ and $n$ are constant characteristics for the $MX$ - molecules. The equilibrium separation $R_e$, is obtained as:

(a) $\left(\frac{nA}{mB}\right)^{\frac{1}{n-m}}$ (b) $\left(\frac{nA}{mB}\right)^{\frac{1}{m-n}}$ (c) $\left(\frac{nB}{mA}\right)^{\frac{1}{m-n}}$ (d) $\left(\frac{nB}{mA}\right)^{\frac{1}{n-m}}$

Q3. The potential energy of a diatomic molecule in terms of inter atomic separation $R$ is given by

$$U(R) = -\frac{\alpha}{R^4} + \frac{\beta}{R^{12}}$$

The equilibrium separation is obtained as:

(a) $(3\beta/\alpha)^{1/8}$ (b) $(3\beta/\alpha)^{1/6}$ (c) $(3\beta/\alpha)^{1/4}$ (d) $(3\beta/\alpha)^{1/2}$

Q4. The potential energy of a system of two atoms is given by

$$U = -\frac{A}{R^6} + \frac{B}{R^{12}}$$

If the atoms form a stable bond with bond length $3\overset{0}{A}$ and the bond energy $1.8eV$ the value of the constant $A$ is:

(a) $1.9\times10^{-76}\,Jm^6$ (b) $2.9\times10^{-76}\,Jm^6$ (c) $3.9\times10^{-76}\,Jm^6$ (d) $4.9\times10^{-76}\,Jm^6$

Q5. The potential energy of a system of two atoms is given by

$$U(R) = -\frac{A}{R^6} + \frac{B}{R^{12}}$$

If the atoms form a stable bond with bond length $3\overset{0}{A}$ and the bond energy $1.8eV$ the critical separation $R_c$ is obtained as:

(a) $1.33\overset{0}{A}$ (b) $2.33\overset{0}{A}$ (c) $3.33\overset{0}{A}$ (d) $4.33\overset{0}{A}$

Q6. If the equilibrium separation between cesium and chlorine atoms is $3.56\overset{0}{A}$, $A=1.76$ and $n=11.5$, the potential energy of $CsCl$ at equilibrium is:

(a) $-2.5eV$ (b) $-4.5eV$ (c) $-6.5eV$ (d) $-8.5eV$

Q7. A pair of $Li^+$ and $Cl^-$ ion with their radii $0.60\overset{0}{A}$ and $1.81\overset{0}{A}$ touch each other, the attractive force between them is:

(a) $1.96\times10^{-9}N$ (b) $2.96\times10^{-9}N$ (c) $3.96\times10^{-9}N$ (d) $4.96\times10^{-9}N$

Q8. Show that the Madelung constant A for an infinite linear chain of ions of alternating charge at an equilibrium separation $R_e$ is:

(a) 0.3863 (b) 1.3863 (c) 2.3863 (d) 3.3863

Q9. Show that the potential energy of two particles in stable configuration (at equilibrium) with $m=2$ and $n=10$ is equal to:

(a) $-\frac{1}{5}\left(\frac{A}{R_e^2}\right)$ (b) $-\frac{2}{5}\left(\frac{A}{R_e^2}\right)$ (c) $-\frac{3}{5}\left(\frac{A}{R_e^2}\right)$ (d) $-\frac{4}{5}\left(\frac{A}{R_e^2}\right)$

Q10. Assume a repulsive potential of the form $B/R^9$ acts between the neighboring ions of $NaCl$. If the nearest neighbor distance is $2.81\overset{0}{A}$ and the Madelung constant is $1.7476$, the compressibility $NaCl$ is

(a) $2.48\times10^{-11}m^2N$ (b) $3.48\times10^{-11}m^2N$ (c) $4.48\times10^{-11}m^2N$ (d) $5.48\times10^{-11}m^2N$