EC-(13)

Subject : PHYSICS
Topic : Expression for Energy of two particles.
Class : I Sc - III, Papers - VI & Group - 'A'
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Ans. The energy of two particles in the field of each other at a separation r is given by

$$U = \frac{\alpha}{r} + \frac{\beta}{r^8}$$

They will form a stable compound at a separation r_0 such that at that separation the energy U is a minimum, *i.e.*,

$$\left|\frac{dU}{dr}\right|_{r=r_0} = 0$$

Now

$$\frac{dU}{dr} = -\frac{\alpha}{r^2} - \frac{8\beta}{r^9}$$

$$\therefore \quad \left|\frac{dU}{dr}\right|_{r=r_0} = -\frac{\alpha}{r_0^2} - \frac{8\beta}{r_0^9} = 0$$

or $$\frac{\alpha}{r_0^2} + \frac{8\beta}{r_0^9} = 0 \quad \text{or} \quad \alpha = \frac{8\beta}{r_0^7}$$

$$\therefore \quad r_0^7 = \frac{8\beta}{\alpha} \quad \text{Hence } r_0 = \left[\frac{8\beta}{\alpha}\right]^{1/7}$$

Q. 3.3. The energy of two particles in the field of each other is given by

$$U = -\frac{\alpha}{r^2} + \frac{\beta}{r^{10}}$$

where α and β are constants and r, the separation between the particles. Determine the separation between the particles for a stable compound and also determine the cohesive energy of the crystal.

(G.N.D.U. 2000)