

Answer on Question #73584-Physics-Other

The interaction energy between two atoms is given by $e(r) = (-A/r + B/r^7)$ where r is the inter atomic separation. Show that for the particles to be in equilibrium $r = r_e = (7B/A)^{1/6}$ and show that for the equilibrium the energy of attraction is seven times the energy of repulsion.

Solution

For the equilibrium:

$$\frac{d}{dr} e(r) = 0 = -A \left(-\frac{1}{r^2} \right) + B \left(-7 \frac{1}{r^8} \right)$$

$$\frac{A}{r^2} = \frac{7B}{r^8}$$

$$r^6 = \frac{7B}{A}$$

$$r_{eq} = \sqrt[6]{\frac{7B}{A}}$$

The ratio of energies:

$$\frac{e_{at}}{e_{re}} = \frac{\frac{A}{r_{eq}}}{\frac{B}{r_{eq}^7}} = \frac{A}{B} r_{eq}^6 = \frac{A}{B} \frac{7B}{A} = 7.$$

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