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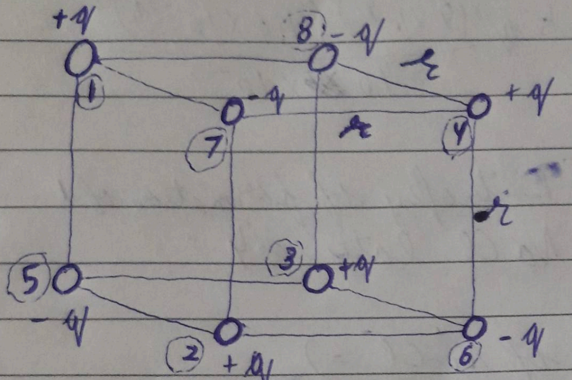
Q) finding entropy of formation of 1 mole of Na^+Cl^-.

1 mole = $N_A = 6 \times 10^{23}$

~~So~~, in a NaCl lattice there are 4 Na^+ and 4 Cl^-. So, No of lattice in 1 mole NaCl

$\Rightarrow \frac{6 \times 10^{23}}{4} = 1.5 \times 10^{23}$



$q = 1e^{-} = 1.6 \times 10^{-19}$ C

$r = 5.406$ A° $= 540.6$ pm

Potential Energy = $V q$
(charged bringed ~~to~~ in the field ~~of~~ of another charges)

$$PE_{(\text{for } 1^{st})} = 0$$

$$PE_{(\text{for } 2^{nd})} = \frac{k q q}{\sqrt{2} r} = \frac{k q^2}{\sqrt{2} r}$$

$$PE_{(\text{for } 3^{rd})} = \frac{k q q}{\sqrt{2} r} + \frac{k q q}{\sqrt{2} r} = \frac{2 k q^2}{\sqrt{2} r}$$

$$PE_{(\text{for } 4^{th})} = \frac{k q q}{\sqrt{2} r} + \frac{k q q}{\sqrt{2} r} + \frac{k q q}{\sqrt{2} r} = \frac{3 k q^2}{\sqrt{2} r}$$

$$PE_{(\text{for } 5^{th})} = -\frac{3 k q^2}{r} - \frac{k q^2}{\sqrt{3} r}$$

$$PE_{(\text{for } 6^{th})} = -\frac{3 k q^2}{r} - \frac{k q^2}{\sqrt{3} r} + \frac{k q^2}{\sqrt{2} r}$$

$$PE_{(\text{for } 7^{th})} = -\frac{3 k q^2}{r} - \frac{k q^2}{\sqrt{3} r} + \frac{2 k q^2}{\sqrt{2} r}$$

$$PE_{(\text{for } 8^{th})} = -\frac{3 k q^2}{r} - \frac{k q^2}{\sqrt{3} r} + \frac{3 k q^2}{\sqrt{2} r}$$

Date ..../..../.........

$$PE_{(Total)} = -12\frac{kq^2}{r} - \frac{4kq^2}{\sqrt{3}r} + \frac{12kq^2}{\sqrt{2}r}$$

$$PE_{(total)} = \left(\frac{+12}{\sqrt{2}} - \frac{4}{\sqrt{3}} - 12\right)\frac{kq^2}{r}$$

$$= \left(\frac{+12}{\sqrt{2}} - \frac{4}{\sqrt{3}} - 12\right)\frac{(9\times10^9)(1.6\times10^{-19})^2}{540\times10^{-12}}$$

$$= -2.48\times10^{-18}\ J$$ {Entropy of formation of 1 NaCl lattice}

=) Entropy of formation of 1 mole of Na^+Cl^- =)

$$(1.5\times10^{23})\times(-2.48\times10^{-18}) =$$

$$PE = -372\times10^{3}\ J/mole$$

or

$$-372\ KJ/mole$$

Spiral