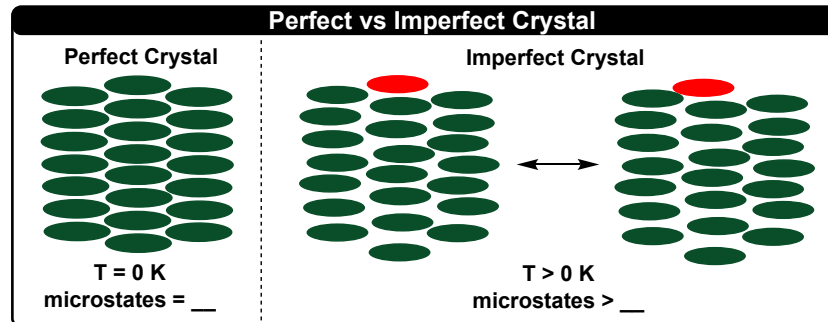


CONCEPT: THIRD LAW OF THERMODYNAMICS

- States that the _____ of a *perfect crystal* is _____ at absolute zero (_____).
 - Perfect crystal:** a solid with regular and _____ internal atomic arrangement.



- Microstates:** number of possible energetic ways to _____ components (atoms, molecules, ions) of a system.

EXAMPLE: All the statements are correct **except**:

- greater number of molecular motion, greater number of possible microstates
- a perfectly ordered system has more than 1 microstate
- any system at a temperature above 0 K has a positive ΔS
- perfect crystal exhibits no molecular motion

The Boltzmann Equation

- Austrian physicist Ludwig Boltzmann, related entropy (S) to number of _____ (W).

Boltzmann Equation

$$S_{\text{sys}} = k \ln W$$

- k = Boltzmann constant = 1.38×10^{-23} _____
- W = microstates

- _____ microstates, _____ entropy; microstates = 1, entropy = 0

EXAMPLE: Consider a system with a total of 3×10^{26} number of microstates, what is the entropy of such a system?

PRACTICE: A brand new deck of cards which hasn't been shuffled yet, possesses only one arrangement. Another, older deck has been shuffled and possesses 8×10^{67} arrangements. Calculate and compare entropies of each deck.