Entropy

by

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P4.3C Explain why all mechanical systems require an external energy source to maintain their motion.

Items:

1- Entropy.

2- Entropy and Second Law of Thermodynamics.

3- Third Law of Thermodynamics.

Entropy

Everything in this universe always moves from an ordered state to a more disordered state. In other words, randomness is always increasing.

Order and disorder can be explained by the term *Entropy (s)*. Entropy is a measure of the disorder of the system.

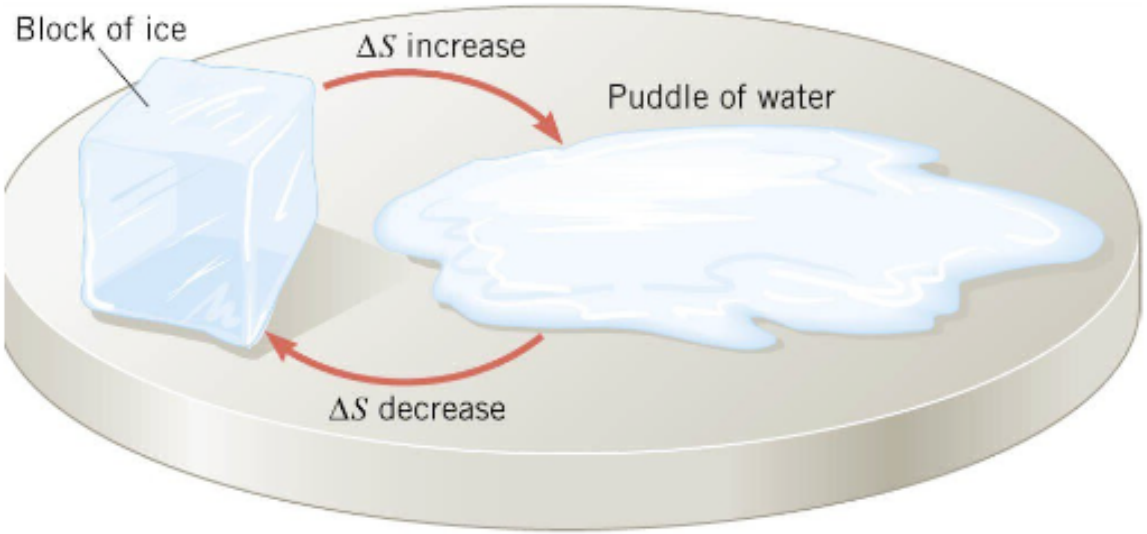
Increased entropy is associated with a greater degree of disorder (less order).
Decreased entropy is associated with a lesser degree of disorder (more order).

So, the entropy increases while going from an ordered state to a disordered state.

Entropy has the symbol S and the unit Joule/Kelvin (J/K)

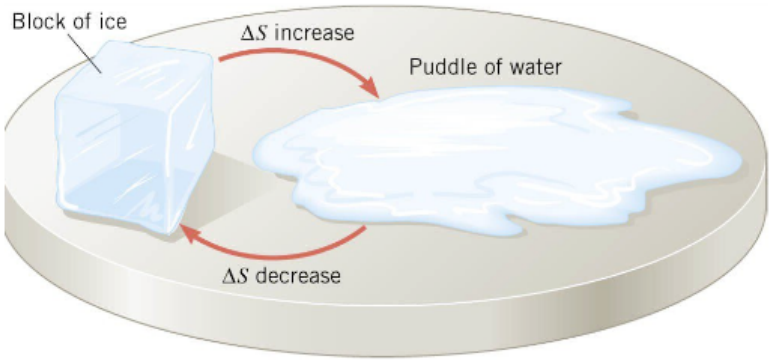
Example 1: *A block of ice relative to a water puddle*.

A block of ice is an example of an ordered system relative to a water puddle.



The molecules of water in the block of ice are ordered rigidly (solid structure).

Because of the order, the entropy is low.



On the other hand, the molecules of water in the puddle are moving with disorder (liquid state). Because of the disorder, the entropy is higher.

The entropy increases going from the solid state (order) to the liquid state (disorder). In other words, the change of entropy (ΔS) increases.

The entropy (S) decreases going from the liquid state (puddle) to the solid state (ice) of water. Going to a more ordered state the change of entropy (ΔS) decreases.

Example 2: *Building Demolition*

Demolition experts are causing this building to go from an ordered state (lower entropy) to a disordered state (higher entropy)

The Second Law of Thermodynamics Stated in Terms of Entropy

The total entropy of the universe does not change when a reversible process occurs ($\Delta S_{universe} = 0$) and increases when an irreversible process occurs ($\Delta S_{universe} > 0$).

A natural process always takes place in such a direction as to cause an increase in the entropy of the universe. The available energy of the universe is diminishing.

The second law of thermodynamics predicts that heat flows spontaneously only from hot body to a cold body. The entropy of the final state is larger than that of the initial state.

The Third Law of Thermodynamics

It is not possible to lower the temperature of any system to absolute zero in a finite number of steps.

Absolute zero is defined as 0 Kelvin or -273.15 degree celsius.

The third law is needed to explain a number of experimental observations that cannot be explained by the other laws of thermodynamics.

References:

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The edition was dedicated to the memory of Stella Kupferberg, Director of the Photo Department:"We miss you, Stella, and shall always remember that a well-chosen photograph should speak for itself, without the need for a lengthy explanation"

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