

S.T.D.G.D. COLLEGE, SHAHPUR

Chemistry SM-3 (MIC-3)

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2nd Law of thermodynamics

The total entropy of an isolated system always increases during a spontaneous process.

For any spontaneous chemical reaction or physical change, the entropy change of the universe must be greater than zero ( $\Delta S_{\text{universe}} > 0$ ).

This law explains why certain reactions happen naturally on their own while others don't.

Entropy (S) :- A measure of molecular randomness or disorder. Gas molecules have higher entropy than solid because they move more freely.

The universe :- includes both the chemical system (the reaction) and its surroundings. even if a system's entropy decreases (like water freezing into ice), the heat released increases the entropy of the surroundings by greater amount, keeping the total change positive.

Spontaneity:- A chemical reaction happens naturally only if the total ~~entropy~~ entropy of universe goes up.

### examples

① cooling coffee:- A hot cup of coffee loses heat to the cooler surrounding air until both reach room temp. but it never spontaneously absorb heat from a cold room to get hotter.

② melting ice. - An ice cube in a warm drink absorb heat and melts, increasing the disorder of the molecules, but water never spontaneously freezes back into an ice cube in a warm room.

③ Diffusion of perfume:- perfume molecules spray from a bottle and spread out evenly to fill a room but they never spontaneously gather back into the bottle.

④ car engines:- A car engine converts fuel into movement, but it can't convert 100% of that energy into work, some energy always escape as waste heat