Page No.:
Date:
YOUVA

Class ⇒ B.Sc. Part II (Hons.)
Subject ⇒ Chemistry
Chapter ⇒ Thermodynamics
Topic ⇒ Statements, Cyclic process, Heat engine, Efficiency of a heat engine.

Name ⇒ Dr. Amarendra Kumar,
Deptt. of Chemistry,
Jain College, Ara.

Second Law of Thermodynamics Statements

Whenever a spontaneous process takes place, it is accompanied by an increase in the total energy of the universe.

We take the term 'universe' to mean the system and the surroundings. Thus,

$$\Delta S_{univ.} = \Delta S_{syst.} + \Delta S_{surr.}$$

When an irreversible spontaneous process occurs, the entropy of the system and the surroundings increases. i.e.

$$\Delta S_{univ.} > 0$$

When a reversible process occurs, the entropy of the system remains constant. i.e.

$$\Delta S_{univ.} = 0$$

Since, the entire universe is undergoing spontaneous change.

Thus second law of thermodynamics stated as –

"The entropy of the system is constantly increasing."

Date:

According to Kelvin

It is impossible to take heat from a hotter reservoir and convert it completely into work by a cyclic process without transferring a part of heat to a cooler reservoir.

According to Clausius

It is impossible for a cyclic process to transfer heat from a body at a lower temperature to one at higher temperature without at the same time converting some work to heat.

Cyclic process

When a system undergoes a series of changes and in the end returns to its original state, it is said to have completed a cycle. The entire process is called cyclic process.

Since, the internal energy of a system depends only upon its state, it follows that in a cyclic process, the net change of internal energy is zero.

i.e. $\Delta E = 0$

$\therefore$ According to first law of thermodynamics

$$\Delta E = 0 = q + w$$

or $q = -w$

If the series of changes in a cycle are conducted at constant temperature, the cycle is called an isothermal cycle.

If the ~~cycle is said to be a~~ changes are carried out reversibly, the cycle is called reversible cycle.

Heat engines

A machine which can do work by using heat that flows out spontaneously from a high temperature source to a low-temperature sink is called a heat engine.

A heat engine running on a periodic cyclic process can yield work continuously.

Efficiency of a Heat Engine

The ratio of the work obtained in a cyclic process (w) to the heat taken from the high-temperature reservoir (q) is called the efficiency of a heat engine.

Efficiency of a heat engine is given by

$$\eta = \frac{w}{q}$$

—x—