

Examrace

Thermodynamics: Laws of Thermodynamics and Heat Transfer Processes

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Thermodynamics

It is a branch of science which deals with changes in energy that accompany physical or chemical changes in matter.

Importance

- Establish feasibility of the reaction
- Extent of reaction after feasibility is established
- Deduce generalisations of physical chemistry

Limitations

- Applicable to only bulk process
- It predicts the possibility of process but not success
- It does not define the mechanism of process

Laws of Thermodynamics

First Law

- Stated by Mayer and Helmholtz
- Energy can neither be created nor destroyed by any physical or chemical change. It may change from one form to another.
- $\Delta U = q + w$
- Where, U = Energy of the system
- q = amount of heat
- w = Work done by the system

Second Law

According to Kelvin, it is impossible to take heat from a cold reservoir and convert it into work without at the same time transferring heat from a hot to cold reservoir.

Third Law

It is not possible to reduce the temperature of any system to absolute zero by any method involving finite number of operations, however, the ideal method may be.

Heat Transfer Processes

Planck's Law

Every object emits over the entire electromagnetic spectrum.

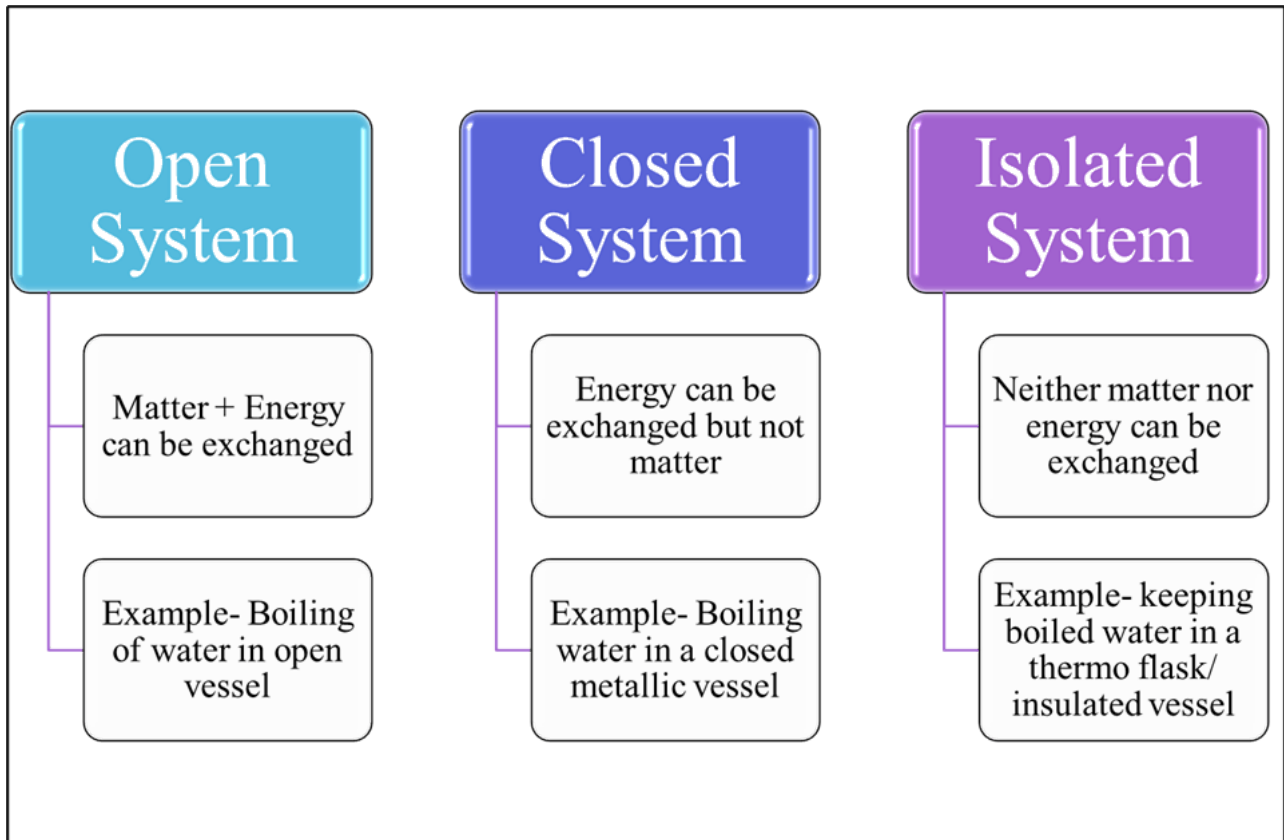
Stefan-Boltzmann Law

Total energy emitted by a black body is directly proportional to fourth power of its temperature.

Wien's Displacement Law

The product of peak wavelength and temperature of a blackbody radiator is constant.

Mass and Energy Transfer Across Various Interfaces



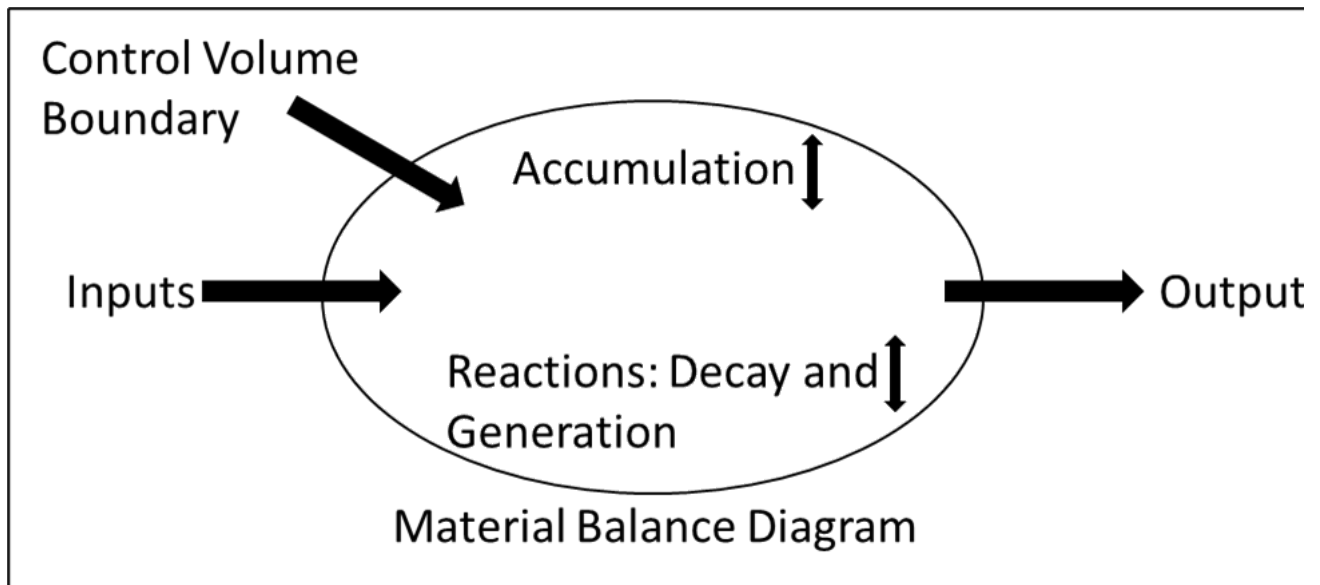
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Material Balance

- Also known as Mass balance.
- Used to find the accumulation of a contaminant/pollutant/substance in a particular region.
- Those particular regions are also called as control volume.

Mass Balance Equation

- Accumulation rate = Input rate – Output rate + Reaction rate
- For Steady-State conservation Systems
- Input rate = Output rate



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Multiple Choice Questions

1. Which among the following best explains the First Law of Thermodynamics?

1. Energy can neither be created nor be destroyed
2. Temperature of any system cannot be reduced to absolute zero
3. It is impossible to take heat from a cold reservoir and convert it into work
4. None of the above

Answer: a

2. Total energy emitted by a black body is directly proportional to fourth power of its temperature is given by

1. Planck's Law
2. Stefann-Boltzmann Law
3. Wien's Displacement Law
4. All of the above

Answer: b

3. In which of the following system matter and energy can be exchanged with the surrounding?

1. Open System
2. Close System
3. Isolated System
4. All of the above

Answer: c

4. For a Mass Balance Equation

1. Accumulation Rate = 0
2. Reaction Rate = 0
3. Input rate = Output rate
4. All of the above

Answer: d

#Thermodynamics

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#Thermodynamic process

#Mass and energy transfer across interfaces

#Material balance

✉ Mayank

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