TRINITY COLLEGE FOR WOMEN NAMAKKAL

Department of Physics

HEAT,THERMODYNAMICS AND STATISTICAL PHYSICS

23UPH02 -EVEN Semester

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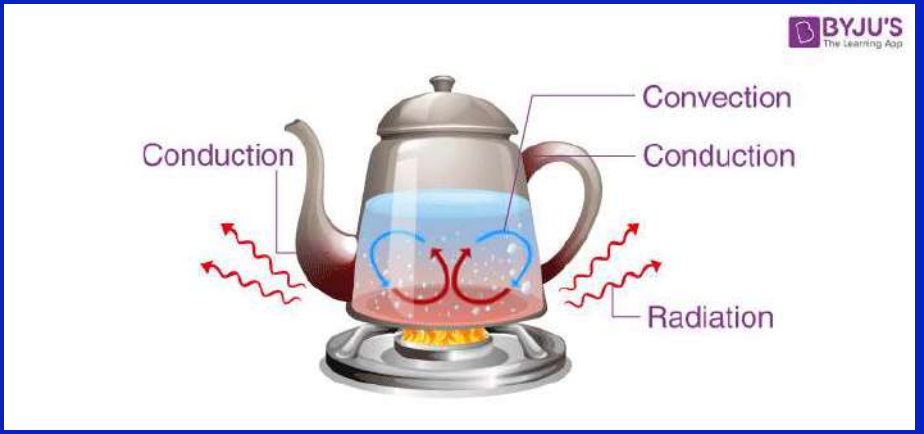
What is Heat Transfer?

According to thermodynamic systems, heat transfer is defined as
“The movement of heat across the border of the system due to a difference in temperature between the system and its surroundings.”

Interestingly, the difference in temperature is said to be a ‘potential’ that causes the transfer of heat from one point to another.

How is Heat Transferred?

- Heat can travel from one place to another in several ways. The different modes of heat transfer include:
- Conduction
- Convection
- Radiation
- Meanwhile, if the temperature difference exists between the two systems, heat will find a way to transfer from the higher to the lower system.



What is Conduction?

Conduction is defined as

The process of transmission of energy from one particle of the medium to another with the particles being in direct contact with each other.

An area of higher kinetic energy transfers thermal energy towards the lower kinetic energy area.

High-speed particles clash with particles moving at a slow speed, as a result, slow speed particles increase their kinetic energy. This is a typical form of heat transfer and takes place through physical contact. Conduction is also known as thermal conduction or heat conduction.

Conduction Equation

The rate of conduction can be calculated by the following equation:

$$Q = \frac{|K.A.(T_{hot} - T_{cold})|}{d}$$

Where,

Q is the transfer of heat per unit time

K is the thermal conductivity of the body

A is the area of heat transfer

T_{hot} is the temperature of the hot region

T_{cold} is the temperature of the cold region

d is the thickness of the body

The coefficient of thermal conductivity shows that a metal body conducts heat better when it comes to conduction.

Conduction Examples

Following are the examples of conduction:

Ironing of clothes is an example of conduction where the heat is conducted from the iron to the clothes.

Heat is transferred from hands to ice cube resulting in the melting of an ice cube when held in hands.

Heat conduction through the sand at the beaches. This can be experienced during summers. Sand is a good conductor of heat.

What is Convection?

Convection is defined as The movement of fluid molecules from higher temperature regions to lower temperature regions.

Convection Equation

As the temperature of the liquid increases, the liquid's volume also has to increase by the same factor and this effect is known as displacement.

$$Q = h_c \cdot A \cdot (T_s - T_f)$$

The equation to calculate the rate of convection is as follows:

Where,

Q is the heat transferred per unit time

h_c is the coefficient of convective heat transfer

A is the area of heat transfer

T_s is the surface temperature

T_f is the fluid temperature

Convection Examples

Examples of convection include:

Boiling of water, that is molecules that are denser move at the bottom while the molecules which are less dense move upwards resulting in the circular motion of the molecules so that water gets heated.

Warm water around the equator moves towards the poles while cooler water at the poles moves towards the equator.

Blood circulation in warm-blooded animals takes place with the help of convection, thereby regulating the body temperature.

What is Radiation?

Radiant heat is present in some or other form in our daily lives. Thermal radiations are referred to as radiant heat. Thermal radiation is generated by the emission of electromagnetic waves .

These waves carry away the energy from the emitting body. Radiation takes place through a vacuum or transparent medium which can be either solid or liquid.

Thermal radiation is the result of the random motion of molecules in matter. The movement of charged electrons and protons is responsible for the emission of electromagnetic radiation.

Radiation Equation

As temperature rises, the wavelength in the spectra of the radiation emitted decreases and shorter wavelengths radiations are emitted. ***Thermal radiation can be calculated by Stefan-Boltzmann law:***

$$P = e \cdot \sigma \cdot A \cdot (Tr - Tc)^4$$

Where,
P is the net power of radiation
A is the area of radiation
Tr is the radiator temperature
Tc is the surrounding temperature
e is emissivity and σ is Stefan's constant ($\sigma = 5.67 \times 10^{-8} Wm^{-2}K^{-4}$

Radiation Example

Following are the examples of radiation:
Microwave radiation emitted in the oven is an example of radiation.

UV rays coming from the sun is an example of radiation.
The release of alpha particles during the decaying of Uranium-238 into Thorium-234 is an example of radiation.

THANK YOU

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