

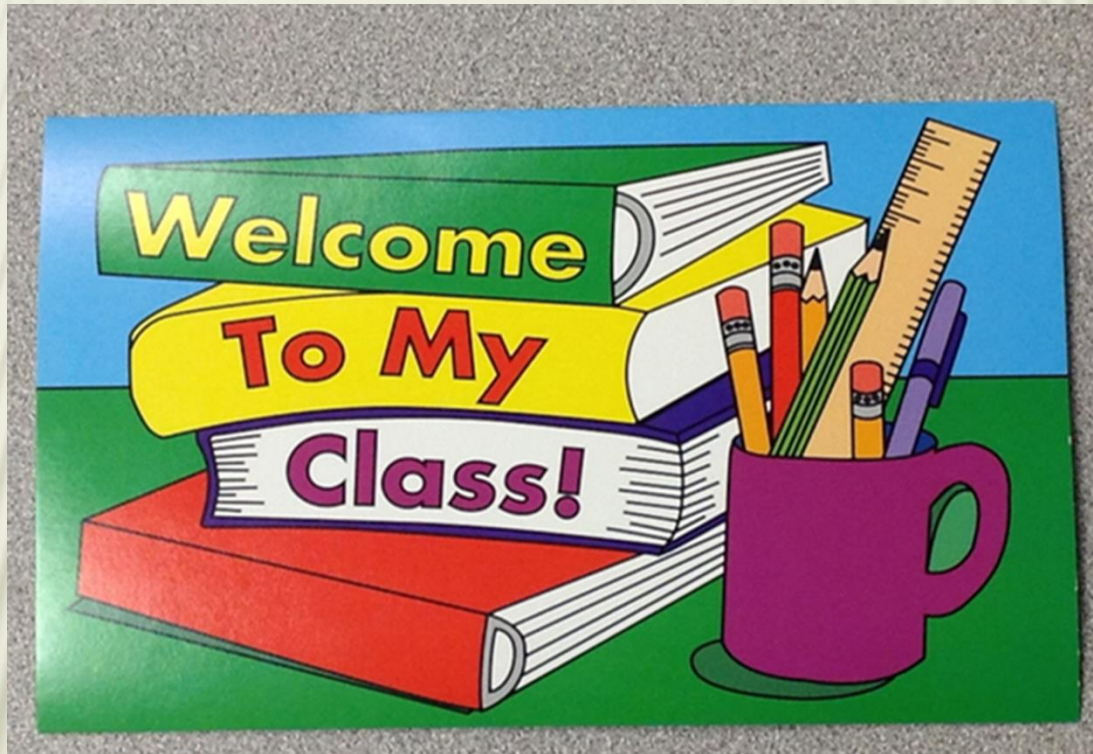


Pakistan School
Kingdom of Bahrain



CLASS 9

SUBJECT : PHYSICS



ENGAGING STARTER

- ✖ Identify conductors and insulators from the given pictures.



TOPIC

✖ Thermal conductivity

OBJECTIVE

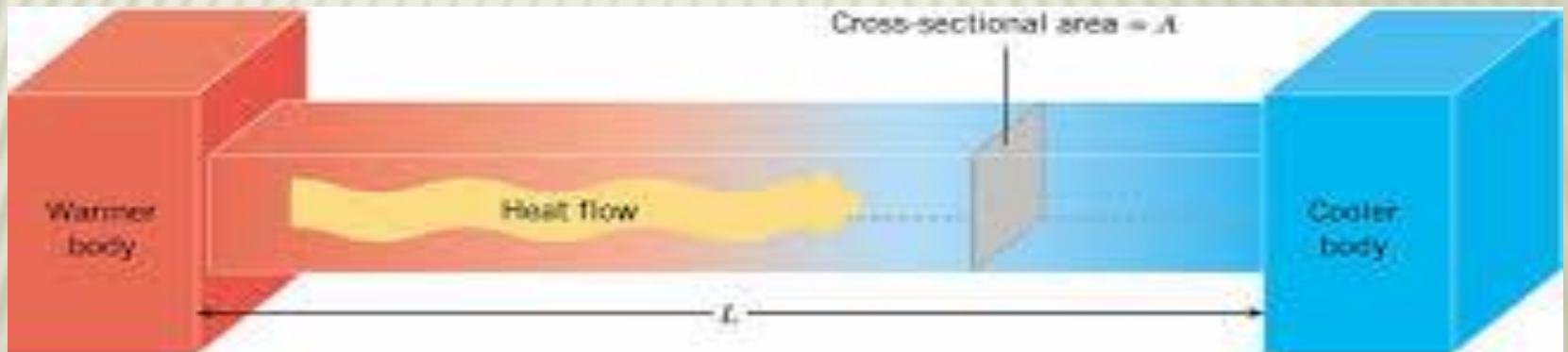
- ✖ At the end of this lesson students will be able to :
- ✖ Enlist the factors effecting thermal conductivity
- ✖ Solve the problems based on thermal conductivity of solid conductors.

- ✖ Conduction of heat occurs at different rates in different
- ✖ materials. In metals, heat flows rapidly as compared to insulators
- ✖ such as wood or rubber.



RATE OF FLOW OF HEAT

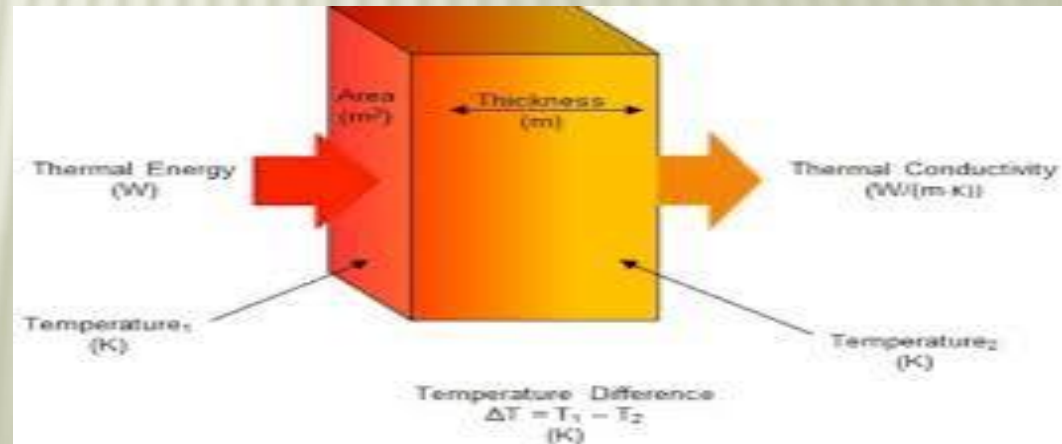
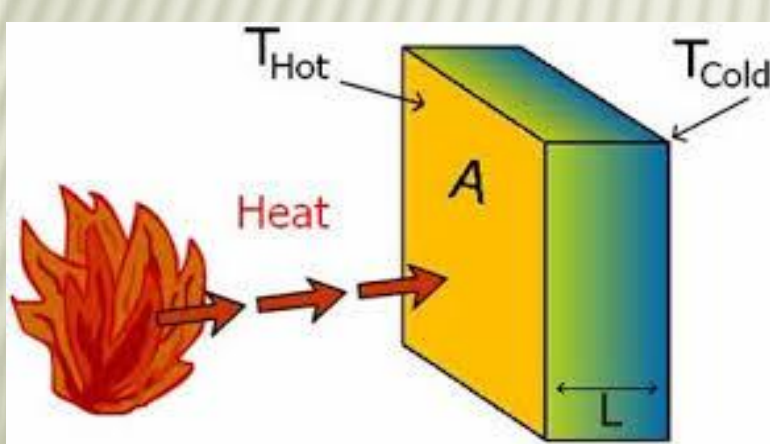
- ✖ “The amount of heat that flows in unit time is called the rate of flow of heat”.
- ✖ Mathematically : Q/t



$$P_{\text{cond}} = \frac{Q}{t} = kA \frac{T_H - T_C}{L}$$

DERIVATION OF THERMAL CONDUCTIVITY

- × Consider a solid block. One of its two opposite faces each of
- × cross-sectional area A is heated to a temperature T_1 Heat Q flows
- × along its length L to opposite face at temperature T_2 in t seconds.
- × Thus
- × Rate of flow of heat = Q/t (1)



FACTORS EFFECTING RATE OF FLOW OF HEAT

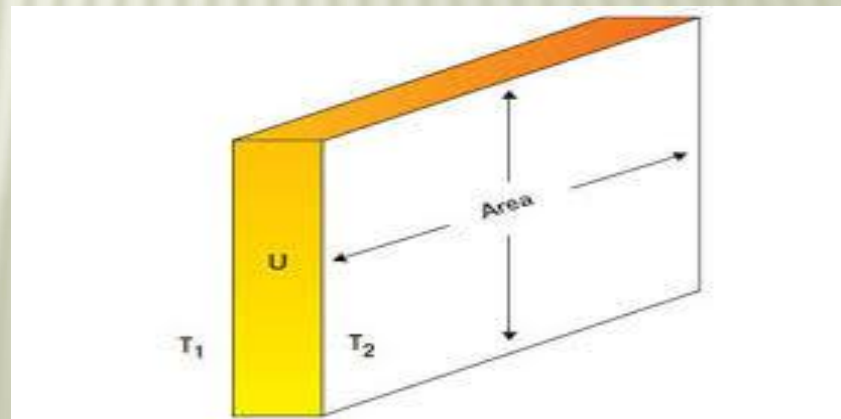
- ✖ It is observed that the rate at which heat flows through a solid object depends upon various factors.
- ✖ i. Cross-Sectional Area of the Solid:
- ✖ ii. Length of the Solid:
- ✖ iii. Temperature Difference between Ends:

I. CROSS-SECTIONAL AREA OF THE SOLID:

- ✖ Larger cross-sectional area A of a solid contains larger number of molecules and free
- ✖ electrons on each layer parallel to its cross-sectional area and hence greater will be the rate of flow of
- ✖ heat through the solid. Thus

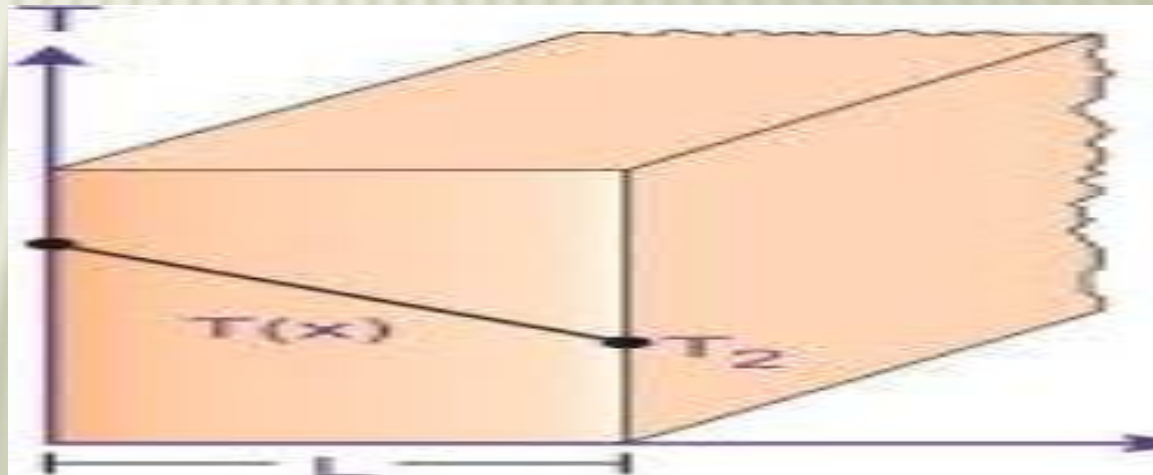
✖

✖ $Q/t \propto A$



II. LENGTH OF THE SOLID:

- ✖ Larger is the length between the hot and cold ends of the solid,
- ✖ more time it will take to conduct heat to the colder end and smaller will
- ✖ be the rate of flow of heat. Thus
- ✖ $Q/t \propto 1/L$



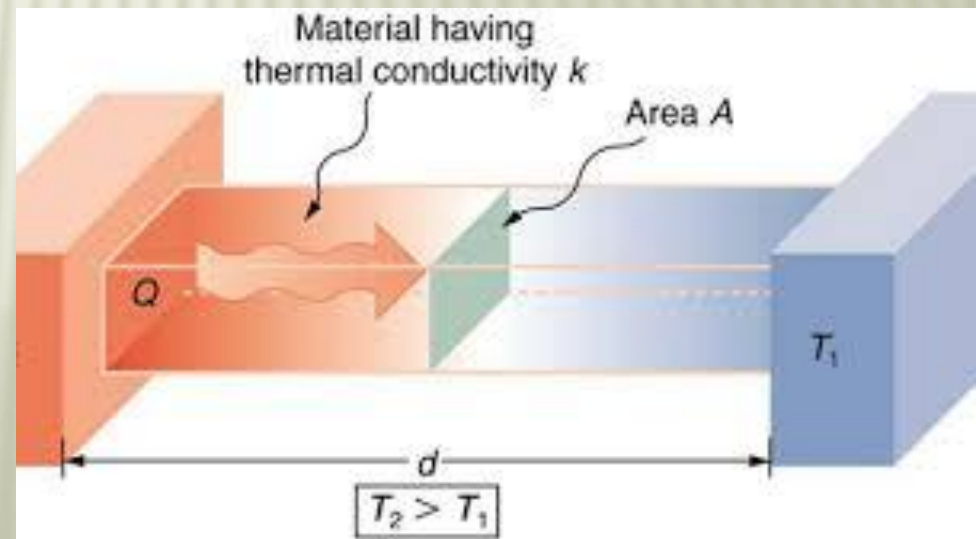
III. TEMPERATURE DIFFERENCE BETWEEN ENDS

- ✖ Greater is the temperature difference $T_1 - T_2$ between hot and cold faces of the solid, greater

- ✖ will be the rate of flow of heat.

Thus

- ✖ $Q/t \propto T_1 - T_2$



COMBINING THE 3 FACTORS :

✖ $Q/t \propto A \dots\dots\dots(1)$

✖ $Q/t \propto 1/L \dots\dots\dots(2)$

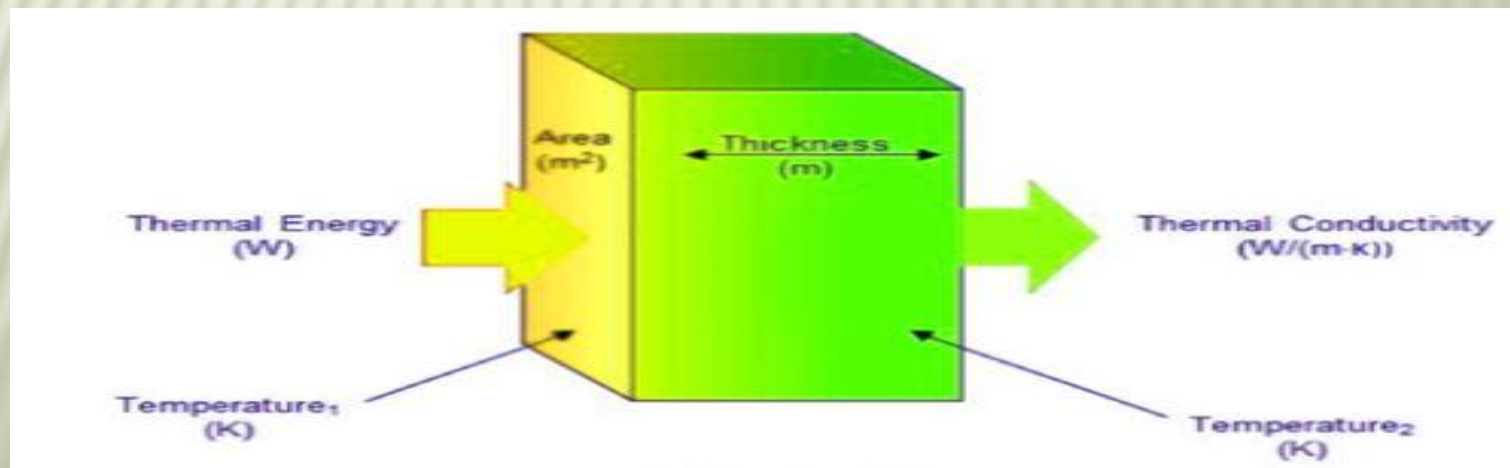
✖ $Q/t \propto T_1 - T_2 \dots\dots\dots(3)$

✖ Combining the above factors,
we get

✖ $Q/t \propto A (T_1 - T_2) / L$

✖ $Q/t = kA(T_1 - T_2) / L$
 $\dots\dots\dots(4)$

- ✖ $Q/t = kA(T_1 - T_2)/L$
- ✖ Here k is the proportionality constant called thermal conductivity of the solid.
- ✖ Its value depends:
- ✖ On the nature of the substance and is different for different materials.



DEFINITION OF THERMAL CONDUCTIVITY:

$$Q/t = kA(T_1 - T_2)/L$$

$$k = Q/t \times L/A (T_1 - T_2)$$

THERMAL CONDUCTIVITY:

Thermal conductivity of a substance can be defined as:

“The rate of flow of heat across the opposite faces of a meter cube of a substance maintained at a temperature difference of one Kelvin is called the thermal conductivity of that substance”.

EXAMPLES

✖ Thermal conductivity of some common substances are given below:

✖ Wood : 0.08 W/m K

✖ Iron : 85 W/m K

✖ Rubber : 0.2 W/m K

✖ Copper 400 W/m K



✖ Numerical problem : The concrete roof of a house of thickness 0.2 m has an area of 200m^2 . The temperature inside the house is 288K and outside is 308K. Find the rate at which thermal energy will be conducted through the roof .

The value of k for concrete is 0.65W/m K .

Given :

Thickness = 0.2m

Out side temperature = $T_1 = 308\text{K}$

Inside temperature = $T_2 = 288\text{K}$

Area = $A = 200\text{m}^2$

Value of $k = 0.65\text{W/m K}$.

To find

Rate of flow of heat = $Q/t = ?$

SOLUTION

✖ $Q/t = K A (T_1 - T_2) / L$

✖ Putting the values:

✖ $Q/t = 0.65 \times 200 (308 - 288) / 0.2$

✖ $Q/t = (0.65 \times 200 \times 20) / 0.2$

✖ $Q/t = \dots\dots\dots J/s$

PLENARY

- The rate of flow of heat is same for all the objects . T/F
- What are the factors on which rate of flow of heat depend?
- Rate of flow of heat isproportional to the temperature. (directly /inversely)
- The symbol of thermal conductivity is
- The formula for thermal conductivity is
- $k = Q/t \times L/A (T_1 - T_2)$ T/F
- Heat flowsin metals .
(rapidly /slowly).



HOME WORK

Chapter : 9

Transfer of heat

Page no : 208

Solve

Numerical 9.2 in note
book.



✕ Allah
Hafiz