

Electricity

Physics (Term–2)

Lecture-5

- **Electric power:**

Work done by an electric appliance per unit time, is called electric power.

Or

Energy consumed by electric appliance per unit time, is called electric power.

So, Electric Power = $\frac{\text{Work done}}{\text{time}}$ = $\frac{\text{Energy consumed}}{\text{time}}$

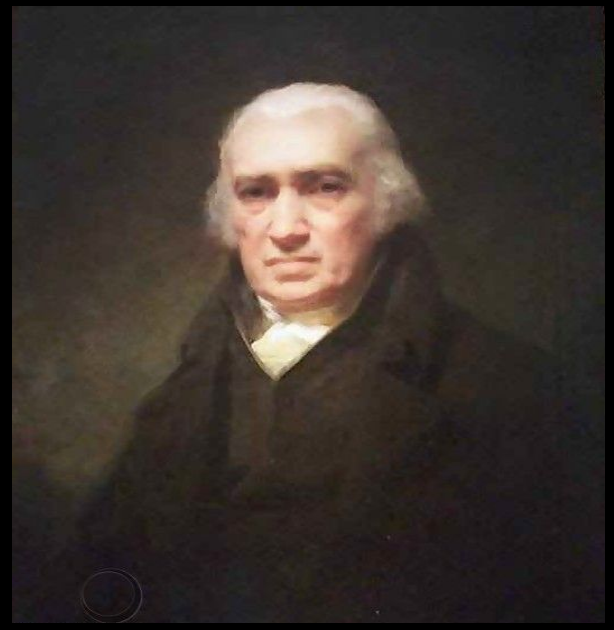
$$P = \frac{W}{t} = \frac{E}{t}$$

- **S.I unit of power:**

As, $\text{Power} = \frac{W}{t} = \frac{E}{t}$

$\text{S.I unit} = \frac{J}{sec} = J\,sec^{-1}$

$= \text{Watt (W)}$



Stud-5

- **Define 1 watt:**

when 1 joule of work is done or 1J of energy is consumed in 1 sec, power is said to be 1 watt.

$1W = \frac{1J}{1sec}$

- **Other formulae of power:** (Electronic)

① $\boxed{P = V \times I}$

As, $P = \frac{W}{t}$

$P = \frac{V \times Q}{t}$ $\left(\because V = \frac{W}{Q}\right)$

$P = V \times \left(\frac{Q}{t}\right)$

$\boxed{P = V \times I}$ $\left(\because \frac{Q}{t} = I\right)$

② $P = \frac{V^2}{R}$

As, $P = V \times I$

$P = V \times \frac{V}{R}$ $\left(\because I = \frac{V}{R}\right)$

$\boxed{P = \frac{V^2}{R}}$

③ $P = I^2 R$

As, $P = V \times I$

$= (IR) \times I$ $(\because V = IR)$

$\boxed{P = I^2 R}$

Ques What will be the power of a bulb, if it consumes 3.6×10^7 J of energy in 2 hours.

Ans $E = 3.6 \times 10^7$ J

$t = 2 \text{ hrs} = 2 \times 3600$

$= 7200$ sec

Now, $P = \frac{W}{t} = \frac{E}{t} = \frac{3.6 \times 10^7}{7.2 \times 10^3}$

$= \frac{1}{2} \times 10^4 = 0.5 \times 10^4$

$= 5000$ W

Ques A bulb of 60W and tube light of 40W is used for 10days. Find energy consumed in ~~watt~~? Joules ?

Ans Total Power = 60 + 40 = 100 W

time = 10 days = 10 × 24 × 3600 sec.

= (240 × 3600) sec.

$\therefore P = \frac{E}{t}$

$E = P \times t$

$= 100 \times 240 \times 3600$

$E = (24000 \times 3600)$ J

$= 864,00,000$ J

- **Commercial unit of energy:** (kWh or Unit)

"kWh" is the commercial unit of energy. "kWh" stands for kilowatt hour.

$$1\,kWh = 36,00,000\,J$$

Ques Show that 1kWh = 36,00,000 J.

Ans $1\,kWh = 1\,kilowatt \times 1\,hr$

$= 1000\,W \times 1\,hr$

$= \frac{1000\,J}{1\,sec} \times 3600\,sec$

$$1\,kWh = 36,00,000\,J$$

Ques An electric refrigerator rated 400W operates 8 hour / day. What is the cost of the energy to operate it for 30 days at Rs.3 per kWh?

Ans Power = 400 W

time = 8 × 30

= 240 hrs

= (240 × 3600) sec

∴ P = E / t

E = P × t

= (400 × 240 × 3600) J

∴ Energy in kWh = $\frac{(400 \times 24\cancel{0} \times \cancel{3600})}{\cancel{3,00,000}}$

= 4 × 24 = 96 kWh

∴ Electricity Cost = Rs 3 × 96

1 = Rs 288

- **Joules law of heating:**

According to Joules law of heating, whenever there is current in the conductor, there is heating effect which is directly proportional to **square of current**, directly proportional to **resistance** and directly proportional for the **time** which current is flowing.

As, $H \propto I^2$ — ①

$H \propto R$ — ②

$H \propto t$ — ③

Combining ①, ② and ③

$H \propto I^2 R t$

$H = K I^2 R t$

$H = I^2 R t$

↳ SI unit $t = J$

- **Application of heating effect of current:**

a) Electric bulb:

The electric heating is used to produce light, as in an electric bulb. The filament must retain as much of the heat generated as is possible, so that it gets very hot and emits light. A strong metal with high melting point such as tungsten (melting point 3380^{o}C) is used for making bulb filament.





① High M.P
② Glow on heating

Ques Why electric bulbs are filled with inert or non-reactive gases like Ne or Argon?

Ans In presence of O_2, tungsten metal reacts and it will metal oxide which will fuse the bulb in no time

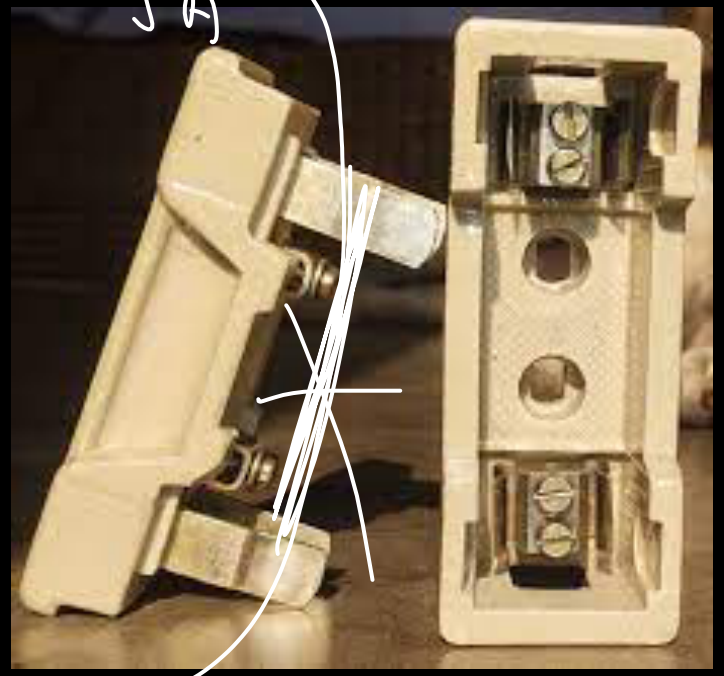
B) Electric fuse:

It is a safety device which breaks the circuit when excess current enters household circuit. Electric fuse is made up of copper wire, which melts when excess current flows through it, hence prevent household appliances from break down.

15A

20A

25A



C) Heating devices:

Heating effect is also used in heating devices, such as toaster, oven, kettle, laundry, iron etc.

We use Nichrome (Nickel + Chromium)

$H = I^2 R t$

