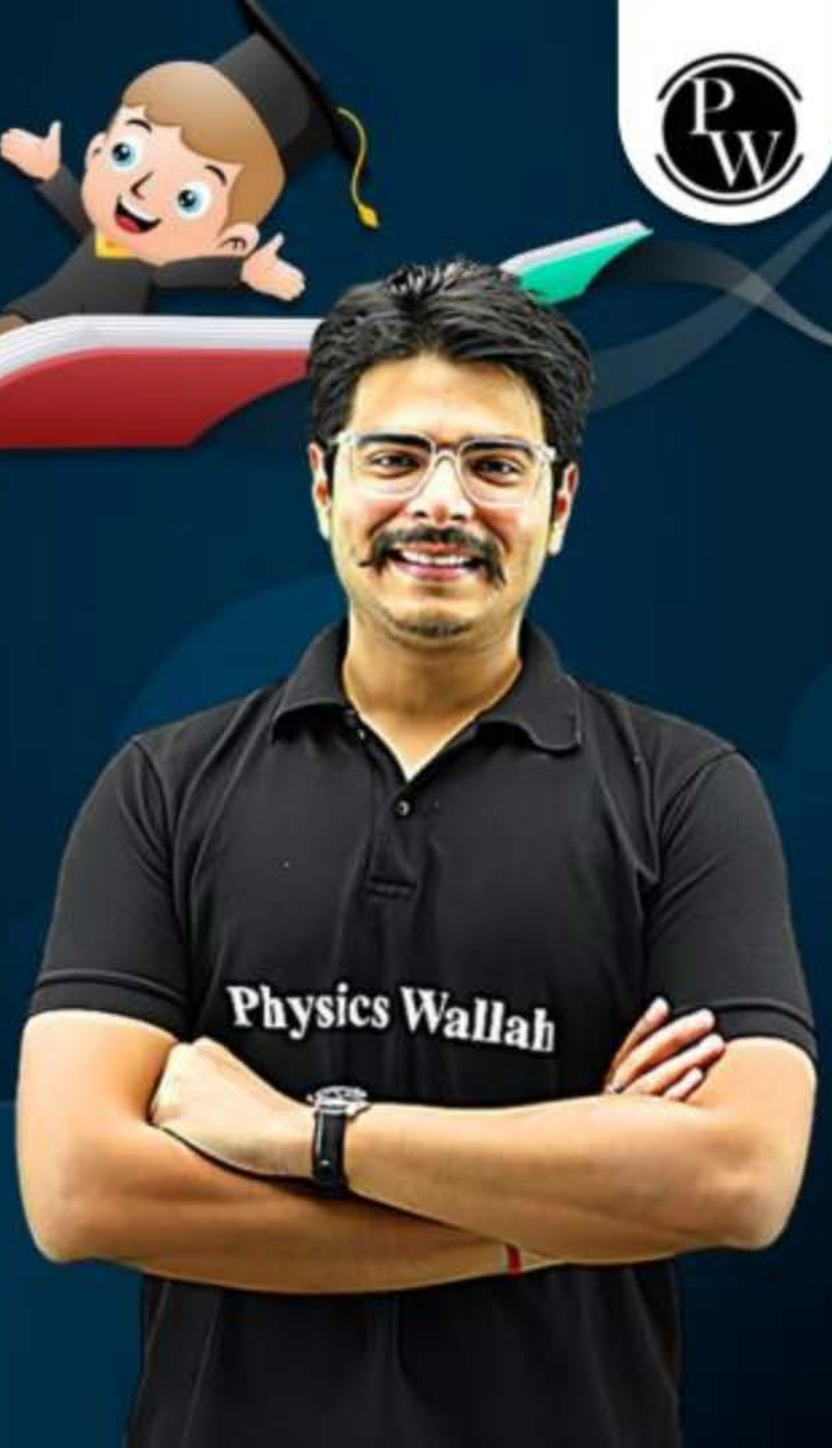
UDAAN

2025

ELECTRICITY

PHYSICS | Lecture - 07

By - ER. RAKSHAK SIR



Topics to be covered

1. THREE EFFECTS OF CURRENT
2. JOULE'S LAW OF HEATING
3. PRACTICAL APPLICATIONS OF HEATING EFFECTS
4. ELECTRICAL POWER
5. COMMERCIAL UNIT OF ENERGY

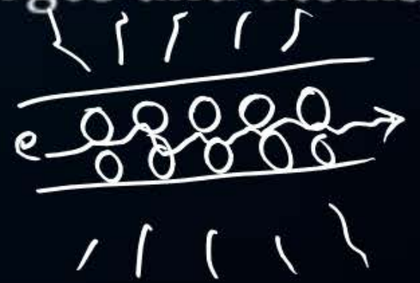
THREE EFFECTS OF CURRENT

1. **Chemical Effects of Current :** When Electric current is passed through the conducting solution, it causes chemical reactions to occur on cathode and anode. Example electroplating, Hydrolysis, Formation of Sodium Hydroxide (NaOH) (Class VIII and Class XII Electrochemistry)

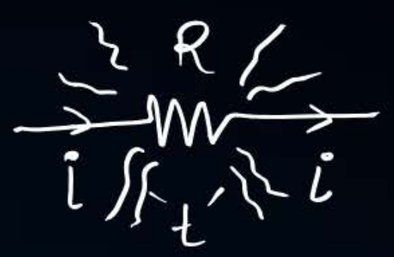
2. **Magnetic Effects of Current :** When electric current is passed through a conductor, magnetic field is produced in the area around the conductor (Class X, Chapter 13)

3. **Heating Effects of Current :** When current is passed through a conductor, due to repetitive collisions between moving charges and atoms, heat energy and power is dissipated. (Class X, Chapter 12)

→ Surrounding mein failna



JOULE'S LAW OF HEATING



$H \propto I^2$
$\propto R$
$\propto t$
$H \propto i^2 Rt$

It states that, "Heat produced in a conductor is directly proportional to the square the amount of Current flowing(I), Resistance(R) of the conductor, Time Period (T) of the flow of current".

$H = i^2RT$

Joule — Ampere — ohm — sec

* **Proof of Joule's Law:-**

$V = \frac{W}{Q}$

$W = VQ$

$W = IRIt$

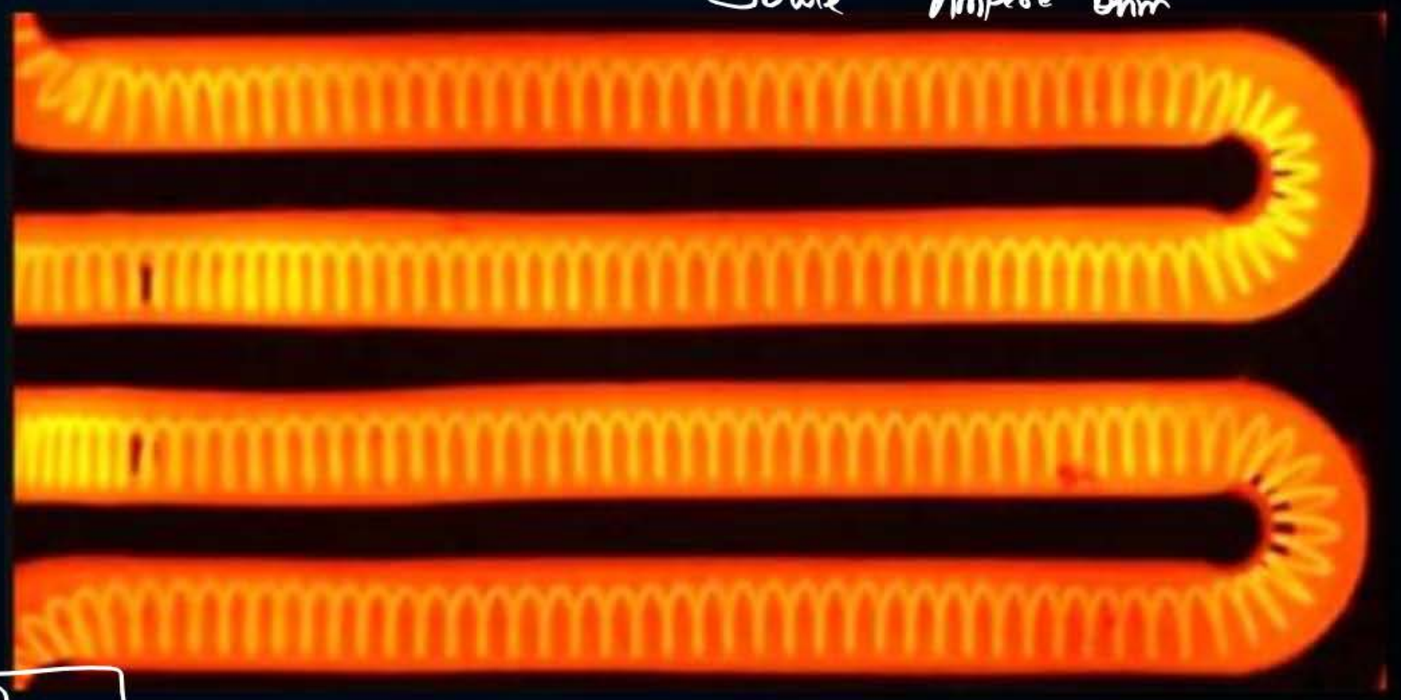
$\mathcal{E} = I^2Rt$

$V = IR$

$I = \frac{Q}{t}$

$Q = It$

$H = I^2RT$



QUESTION

An electric iron of resistance 20 Ω takes a current of 5 *A*. Calculate the heat developed in 30 s.

$R = 20\,\Omega$

$I = 5\,A$

$H = ?$

$t = 30\,s$

$H = I^2 R t$

$= 5^2 \times 20 \times 30$

$= 25 \times 2 \times 3 \times 100$

$H = 15000\,J$

PRACTICAL APPLICATIONS OF HEATING EFFECTS

1. Electric Bulb: → Tungsten (W)

→ filament
① Resistance ↑
② M.P. Very high ↑ 3380°C

"Glowing" effect ← Heat up

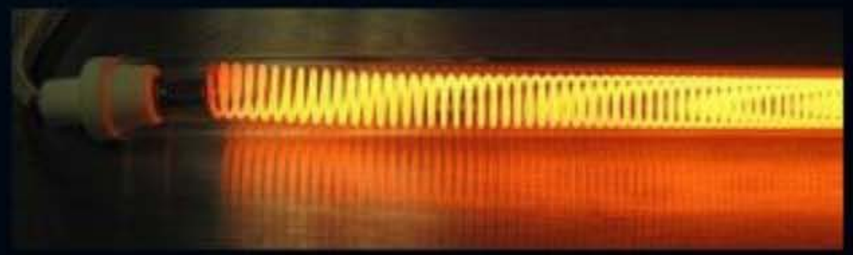
2. Electric Fuse:

→ Fuse Wire → Alloy (Sn-Pb) or (Cu-Ni) — Tin-Lead

① M.P. Low
② Resistance High

When i overloads → it melts and breaks ckt.

3. Heating Element:



Heating element

↓

Alloy

(Nichrome)

↓

$\rho \uparrow$

$R \uparrow$

$H \uparrow$

QUESTION

Which element is used to make:

A. Filament of the bulb → Tungsten (Pure Metal)

B. Connecting Wires → Copper (")

C. Heating Element → Nichrome (Alloy)

D. Fuse Wire → Sn-Pb (Alloy)

QUESTION

Wire (Copper)

Heating element (Nichrome Alloy)

Why does the cord of the electric heater does not glow but coil does ?

Cord is made up of pure metal like Copper which has low resistance hence the production of heat and glow is less as compared to coil which is made up of an Alloy like Nichrome which has more R, produces more H, hence it glows.

ELECTRICAL POWER

→ 9th Class

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

- SI unit → Watt (W)
- Scalar

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

$V = \frac{W}{Q}$

$W = QV$

$P = \frac{QV}{t}$

$I = \frac{Q}{t}$

$P = I \times V$

① General — $P = VI$

$V = IR$, $I = \frac{V}{R}$

$P = IRI$

② Series — $P = I^2R$

$P = V \cdot \frac{V}{R}$

③ Parallel — $P = \frac{V^2}{R}$

* Electrical Energy

$$P = \frac{E}{t} \rightarrow E = P \times t$$

① $P = VI$

② $P = I^2 R$

③ $P = \frac{V^2}{R}$

① $E = VIt$

② $E = I^2 R t$

③ $E = \frac{V^2}{R} t$

→ Joule's Law ke Formulae

COMMERCIAL UNIT OF ENERGY

IX, X } common

Energy Ki Units

1. SI unit → Joule (J)
2. CGS unit → ergs
3. Practical unit of heat → Calorie (cal)
4. Commercial unit → Kilowatt hour (kWh)

'Trade'

$1\ kWh = 3.6 \times 10^6$ Joule

1 Kilowatt hour = 1 unit

$E = P \times t$

Joule = Watt x seconds

J = Ws

Energy = Kilowatt hour

= (kWh)

QUESTION

An electric refrigerator rated 400 W operates 8 hour/day. What is the cost of the energy to operate it for 30 days at Rs 3.00 per kWh?

$P = 400\ W$

$t = 8\ h/day \times 30\ day = 240\ h$

$E = P \times t$

$= \frac{400\ kW}{1000} \times 240\ h$

$E = 96\ kWh$

$E = 96\ kWh = 96\ units$

$1\ unit \longrightarrow ₹\ 3$

$96\ units \longrightarrow ₹\ 96 \times 3$

$₹\ 288$

THANK YOU