UDAAN

2025

ELECTRICITY

PHYSICS

Lecture no - 08

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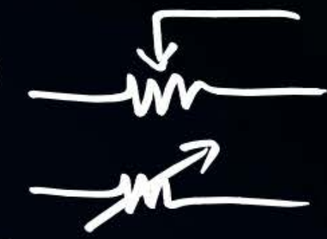
Topics to be covered

1. NCERT Discussion

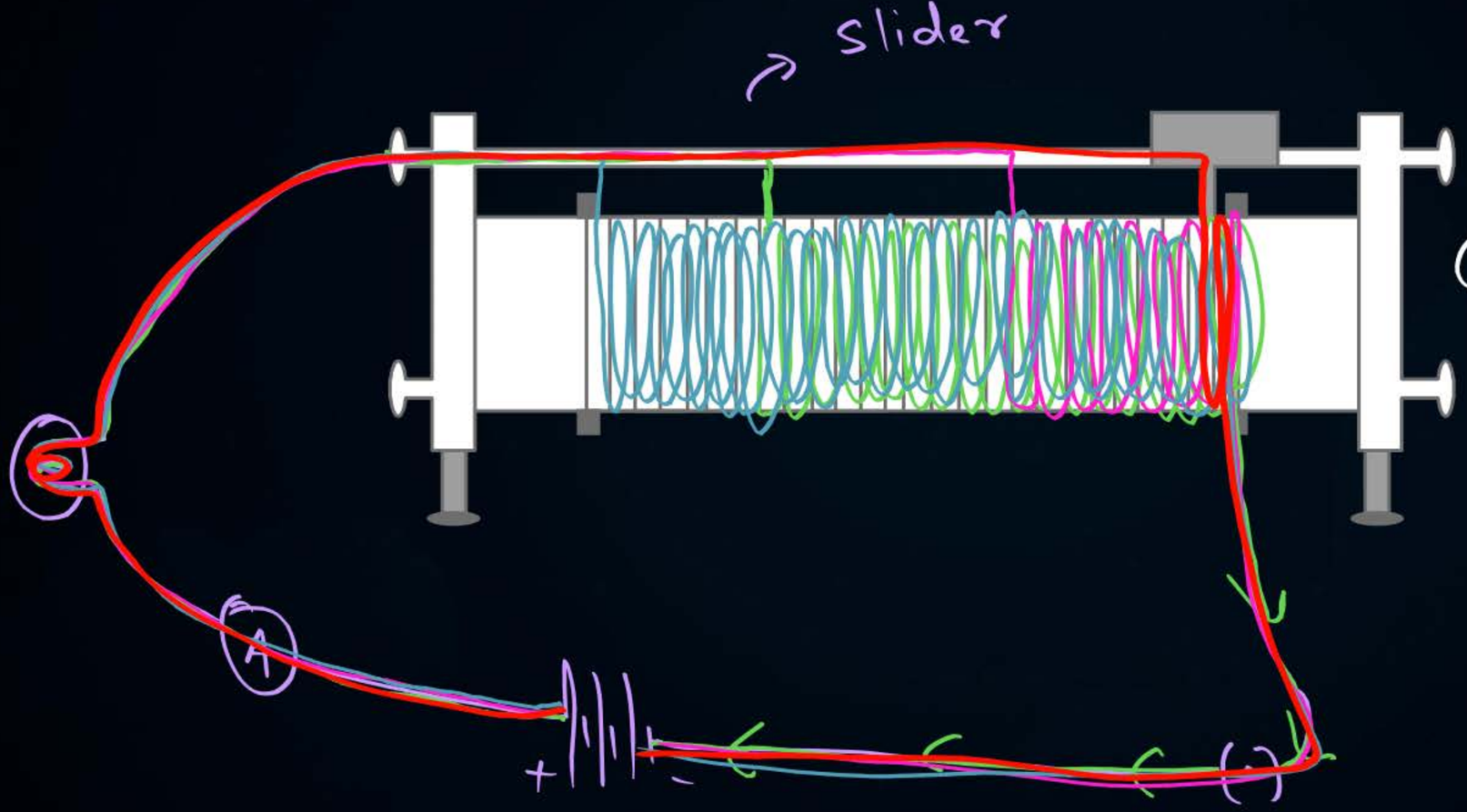
* Rheostat or Variable resistance → $R \propto \ell$

Changing



① Green → path ↑
→ length of wire ↑
→ $R \uparrow \propto \ell \uparrow$

② Magenta → path ↓
→ length ↓
$R \downarrow \propto \ell \downarrow$
→ Resistance ↓



Page No. 200 (INTEXT Q.1)

What does an electric circuit mean?

→ Define ✓

→ Simple circuit ✓

Page No. 200 (INTEXT Q.2)

Define the unit of current. ⟶ An Ampere of Current means one coulomb of charge passing in one second.

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

$$A = \frac{C}{s}$$

$$1A = \frac{1C}{1s}$$

Ampere or Coulomb per second.

Page No. 200 (INTEXT Q.3)

Calculate the number of electrons constituting one coulomb of charge.

$Q = ne$ → electronic charge $= 1.6 \times 10^{-19}$ C

Net charge

no of electrons

?

Page No. 202 (INTEXT Q.1)

Name a device that helps to maintain a potential difference across a conductor.

↳ Battery

Page No. 202 (INTEXT Q.2)

What is meant by saying that the potential difference between two points is 1 V?

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

↳ When 1 J of work is done on 1 C of charge, its potential difference is said to be 1 V.

$$1V = \frac{1J}{1C}$$

Page No. 202 (INTEXT Q.3)

$Q = 1C$

How much energy is given to each coulomb of charge passing through a 6 V battery?

or

Workdone

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

$$6 = \frac{W}{1}$$

$$W = 6J$$

Page No. 209 (INTEXT Q.1)

On what factors does the resistance of a conductor depend?

↳ $R = \rho \frac{l}{A}$

(1) $R \propto l$

(2) $R \propto \frac{1}{A}$

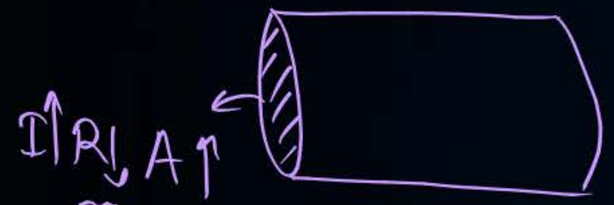
(3) $\rho \rightarrow$ Material

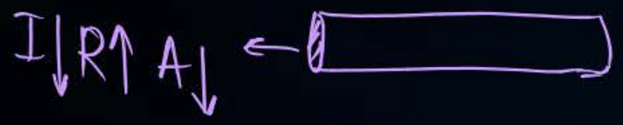
(4) Temperature

Page No. 209 (INTEXT Q.2)

Will current flow more easily through a thick wire or a thin wire of the same material, when connected to the same source? Why?

- $V \rightarrow$ same
- Resistance of the wire is inversely proportional to cross-sectional area. $\rightarrow$ Same
- Thick wire has more cross-sectional Area, which has low resistance, hence current will flow more easily.





Page No. 209 (INTEXT Q.3)

Let the resistance of an electrical component remains constant while the potential difference across the two ends of the component decreases to half of its former value. What change will occur in the current through it?

M-2

$V = IR$

$\frac{V}{2} \quad I'R$

$2 = \frac{I}{I'}$

$I' = \frac{I}{2}$

R

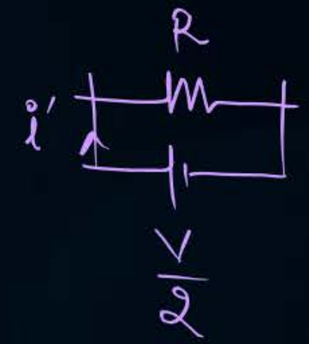
V

I

$V = IR \quad -(1)$

$\frac{V}{i} = R$

$\frac{V}{2} = i'R$



$\frac{V}{2} = i' \frac{V}{i}$

$\frac{i}{2} = i'$

Page No. 209 (INTEXT Q.4)

Why are coils of electric toasters and electric irons made of an alloy rather than a pure metal?

ρ ↑ R ↑ H ↑

ρ ↓ R ↓ H ↓

– Alloys have more resistivity as Compared to pure metal this implies that it must have high resistance which produces more heat as compared to pure Metal.

Page No. 209 (INTEXT Q.5)

Use the data in Table 12.2 to answer the following –

(a) Which among iron and mercury is a better conductor?

(b) Which material is the best conductor?

$\rho \downarrow$

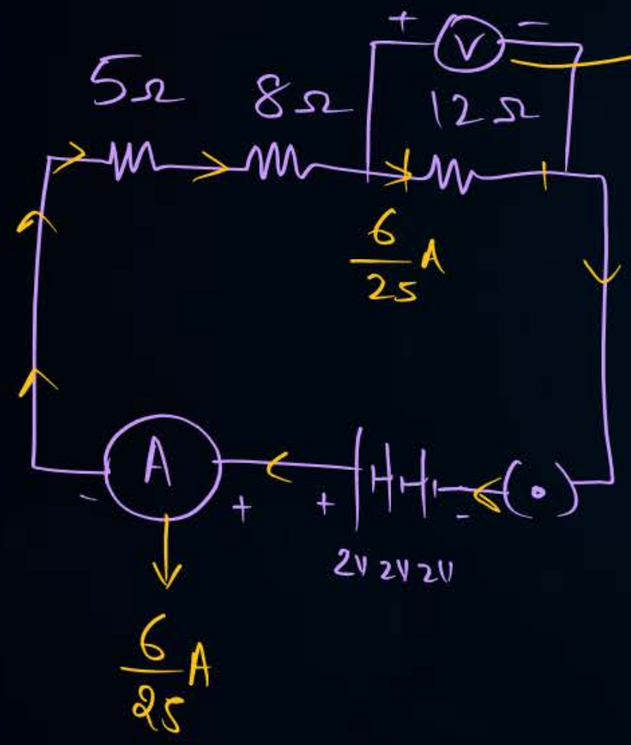
$\rho \rightarrow$ least

↓

'Silver'

Page No. 213 (INTEXT Q.1)

Draw a schematic diagram of a circuit consisting of a battery of three cells of 2 V each, a 5 Ω resistor, an 8 Ω resistor, and a 12 Ω resistor, and a plug key, all connected in series.



$V = 6\,V$

$R = 25\,\Omega$

$i = \frac{V}{R} = \frac{6}{25}\,A$

$V = IR$

$= \frac{6}{25} \times 12$

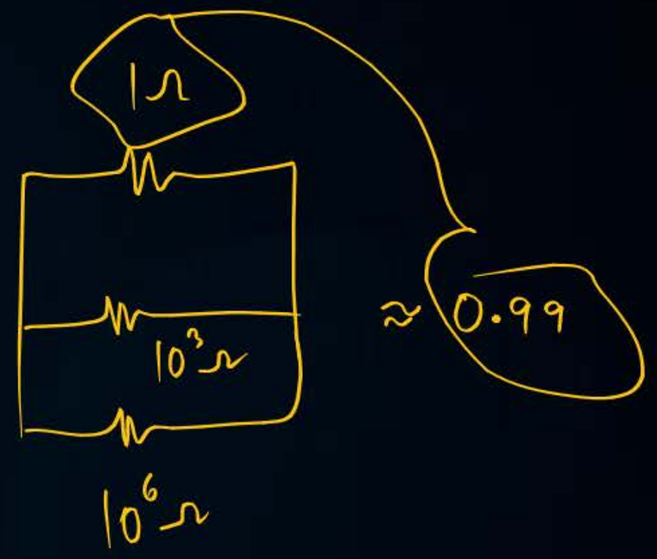
$V = \frac{72}{25}\,V$

Page No. 213 (INTEXT Q.2)

Redraw the circuit of Question 1, putting in an ammeter to measure the current through the resistors and a voltmeter to measure the potential difference across the 12 Ω resistor. What would be the readings in the ammeter and the voltmeter?

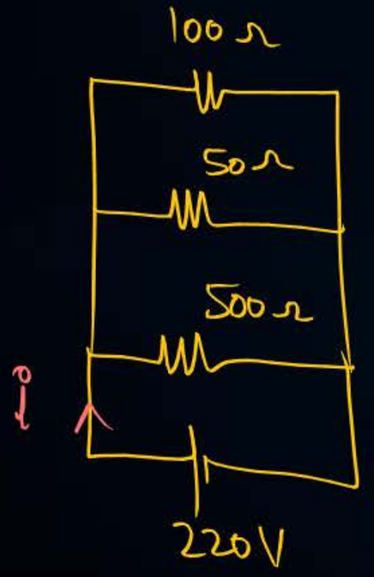
Page No. 216 (INTEXT Q.1)

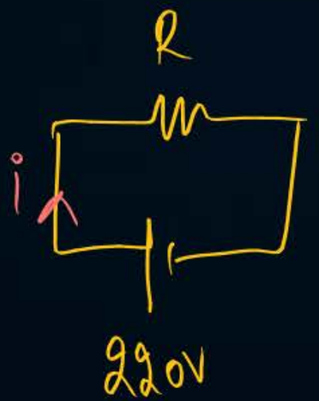
Judge the equivalent resistance when the following are connected in parallel – (a) 1 Ω and 10^6 Ω, (b) 1 Ω and 10^3 Ω, and 10^6 Ω.



Page No. 216 (INTEXT Q.2)

An electric lamp of 100 Ω, a toaster of resistance 50 Ω, and a water filter of resistance 500 Ω are connected in parallel to a 220 V source. What is the resistance of an electric iron connected to the same source that takes as much current as all three appliances, and what is the current through it?





$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

$$\frac{1}{R} = \frac{1}{100} + \frac{1}{50} + \frac{1}{500}$$

$$\frac{1}{R} = \frac{5+10+1}{500} = \frac{16}{500}$$

$$R = \frac{500}{16}\ \Omega$$

$$i = \frac{V}{R} = \frac{220}{\frac{500}{16}} = \frac{220 \times 16}{500}\ A$$

Page No. 216 (INTEXT Q.3)

What are the advantages of connecting electrical devices in parallel with the battery instead of connecting them in series?

① In a parallel ckt, each appliance gets same voltage.

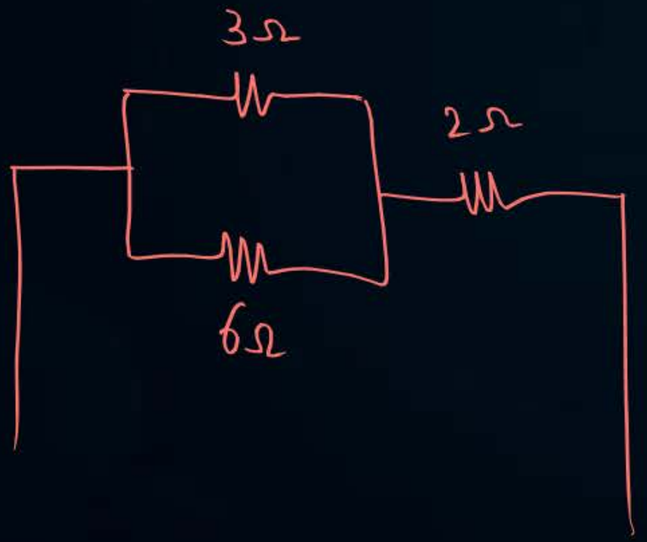
② If one appliance gets damaged, others work unaltered.

③ Each appliance gets separate switch.

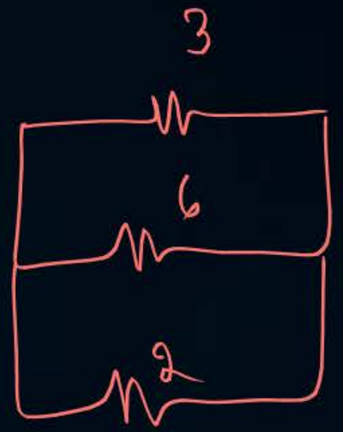
Page No. 216 (INTEXT Q.4)

How can three resistors of resistances 2 Ω, 3 Ω, and 6 Ω be connected to give a total resistance of (a) 4 Ω, (b) 1 Ω?

a) 4Ω



b)



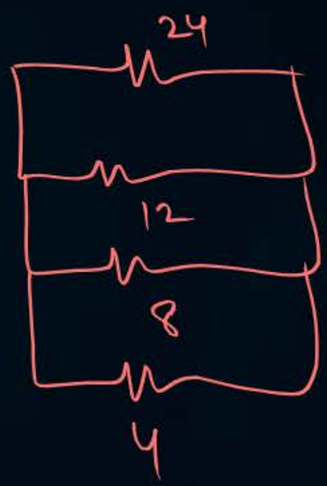
≡ 1Ω

Page No. 216 (INTEXT Q.5)

What is (a) the highest, (b) the lowest total resistance that can be secured by combinations of four coils of resistance 4 Ω, 8 Ω, 12 Ω, 24 Ω?

(2Ω) (4Ω) (48Ω)

a) Highest : Pure Series



$$\equiv \quad \frac{1}{R_p} = \frac{1}{4} + \frac{1}{8} + \frac{1}{12} + \frac{1}{24}$$

$$\frac{1}{R_p} = \frac{6+3+2+1}{24}$$

$$\frac{1}{R_p} = \frac{12}{24}$$

$$\frac{1}{R_p} = \frac{1}{2}$$

$$R_p = 2\Omega$$

Page No. 218 (INTEXT Q.1)

Why does the cord of an electric heater not glow while the heating element does?

↳ refer Notes.

Page No. 218 (INTEXT Q.2)

Compute the heat generated while transferring 96000 coulomb of charge in one hour through a potential difference of 50 V.

Heat = ε = W = ?

Q = 96000 C

x t = 1h x

V = 50 V

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

$W = 50 \times 96000$ J

$50 = \frac{W}{96000}$

Page No. 218 (INTEXT Q.3)

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

$H = I^2 R t$

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

$=$ ⌊_____⌋ J

Page No. 220 (INTEXT Q.1)

What determines the rate at which energy is delivered by a current?

↳ 'Electric Power'

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

Page No. 220 (INTEXT Q.2)

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

An electric motor takes 5 A from a 220 V line. Determine the power of the motor and the energy consumed in 2 h.

$I = 5A$

$V = 220\,V$

$P = VI$

$= 220 \times 5$

$\boxed{P = 1100\,W}$

$E = P \times t$

$= \frac{1100}{1000}\,kW \times 2h$

$E = 2.2\,kWh$

Page No. 221 (INTEXT Q.1)

Class notes

A piece of wire of resistance R is cut into five equal parts. These parts are then connected in parallel. If the equivalent resistance of this combination is R', then the ratio R/R' is –

A 1/25

B 1/5

C 5

D 25

Page No. 221 (INTEXT Q.2)

Which of the following terms does not represent electrical power in a circuit?

A I^2R

B IR^2

C VI

D V^2/R

$P = VI$

$P = I^2R$

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

Page No. 221 (INTEXT Q.3)

V.I.P.

$P = VI$ × $P = \frac{V^2}{R}$ $P = I^2R$ ×

An electric bulb is rated 220 V and 100 W. When it is operated on 110 V, the power consumed will be –

A 100 W

B 75 W

C 50 W

D 25 W

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

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

$$100 = \frac{(220)^2}{R} \Rightarrow R = \frac{(220)^2}{100}\ \Omega$$

$$P' = \frac{(110)^2}{\frac{(220)^2}{100}}$$

$$P' = \frac{110 \times 110 \times 100}{220 \times 220} = 25\ W$$

Page No. 221 (INTEXT Q.4)

V.I.P. $H = I^2Rt$, $H = VIt$, $H = \frac{V^2}{R}t$ ✓

ρ $\quad$ ℓ $\quad$ ℓ/A

Two conducting wires of the same material and of equal lengths and equal diameters are first connected in series and then parallel in a circuit across the same potential difference. The ratio of heat produced in series and parallel combinations would be –

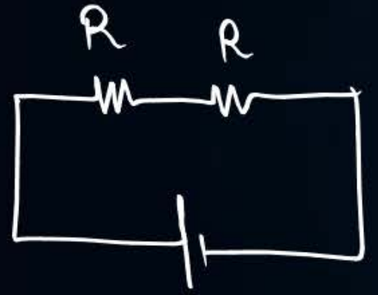
A 1 : 2

B 2 : 1

C 1 : 4

D 4 : 1

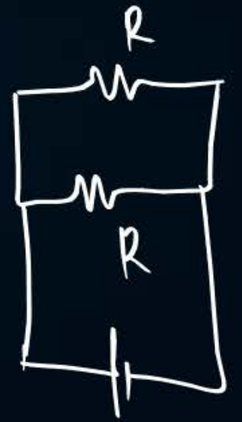
Series



$\equiv 2R$

$H_s = \frac{V^2}{2R}t$

Parallel



$\equiv \frac{R}{2}$

$H_p = \frac{V^2}{\frac{R}{2}} \times t$

V = const.

$H_s : H_p = 1 : 4$

$\frac{H_s}{H_p} = \frac{\frac{V^2}{2R} \times t}{\frac{V^2}{\frac{R}{2}} \times t} = \frac{V^2 \times t \times R}{2R \times V^2 \times t \times 2}$

$\frac{H_s}{H_p} = \frac{1}{4}$

THANK YOU