UDAAN

2025

ELECTRICITY

PHYSICS

Lecture no - 09

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Topics to be covered

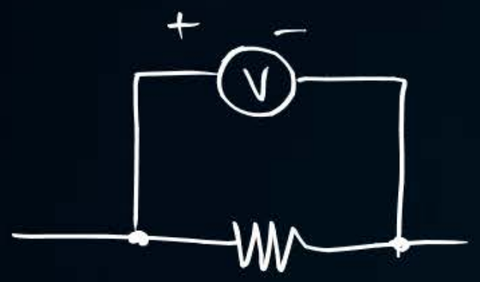
1. NCERT Discussion (Part - 2)

Page No. ~~221 (INTEXT Q.5)~~

How is a voltmeter connected in the circuit to measure the potential difference between two points?

↓

Parallel across the two points on either side of the device



Page No. 221 (INTEXT Q.6)

A copper wire has diameter 0.5 mm and resistivity of 1.6×10^{-8} Ω m. What will be the length of this wire to make its resistance 10 Ω? How much does the resistance change if the diameter is doubled?

$A = \pi r^2$ $\quad d = 0.5\ mm = \frac{0.5}{1000}\ m$

$= 3.14 \times \frac{0.5}{2} \times \frac{0.5}{2} \times 10^{-6}\ m^2$ $\quad r = \frac{0.5}{2} \times 10^{-3}\ m$

$\rho = 1.6 \times 10^{-8}\ \Omega m$

$R = 10\ \Omega$

$l = ?$

$$R = \rho \frac{l}{A}$$

$$10 = \frac{1.6 \times 10^{-8} \times l}{3.14 \times \frac{0.5}{2} \times \frac{0.5}{2} \times 10^{-6}}$$

$$l = \frac{10 \times 3.14 \times \frac{0.5}{2} \times \frac{0.5}{2} \times 10^{-6}}{1.6 \times 10^{-8}}$$

$l =$ ☐ m

$d \to 2d$

$r \to 2r$

$A \to$

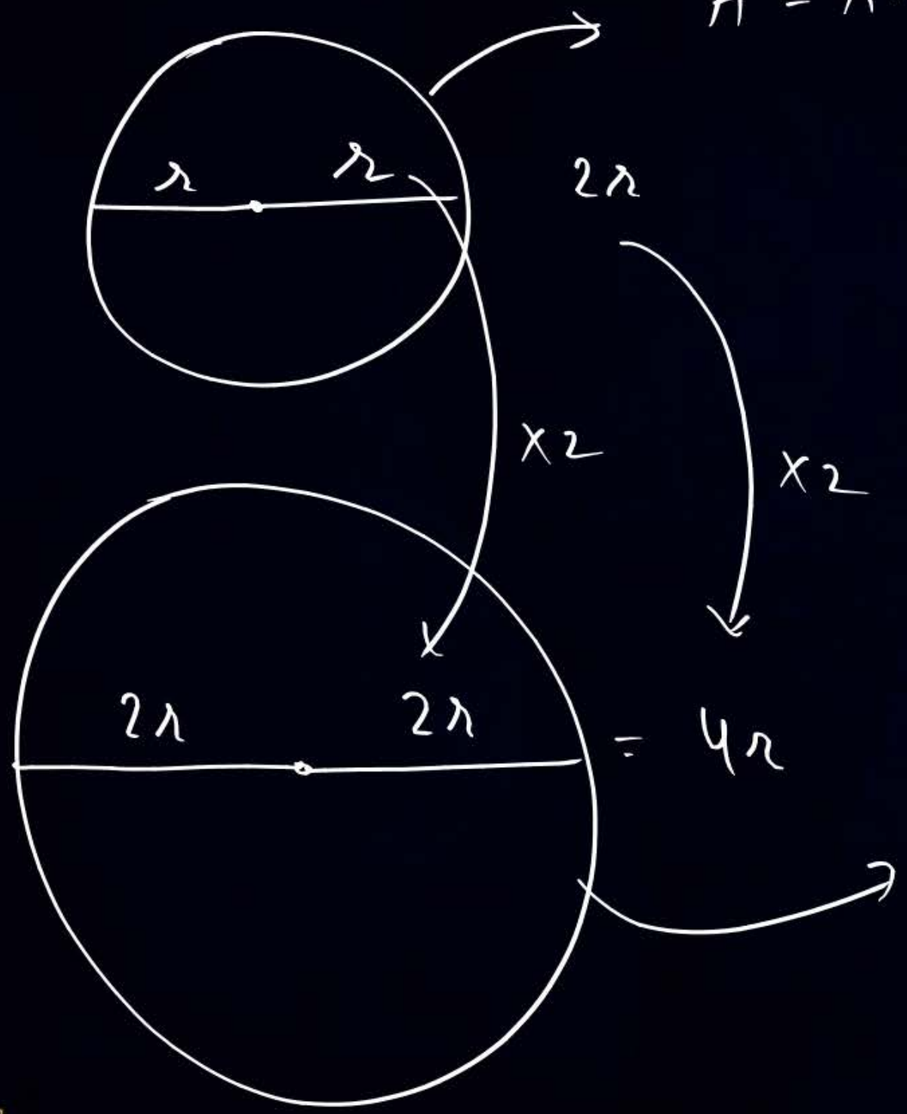
$d = 2r$

$2d \propto 2r$

$A = \pi r^2$

$A \propto r^2$

6th Maths



$A = \pi r^2$

$A' = \pi (2r)^2$

$= \pi 4r^2$

$A' = 4(\pi r^2) = 4A$

$d \rightarrow 2d$

$r \rightarrow 2r$

$A \rightarrow 4A$

$R = \rho \frac{l}{A}$; $R' = \frac{\rho l}{4A}$

$\frac{R'}{R} = \frac{\frac{\rho l}{4A}}{\frac{\rho l}{A}} = \frac{1}{4}$

$R' = \frac{R}{4}$

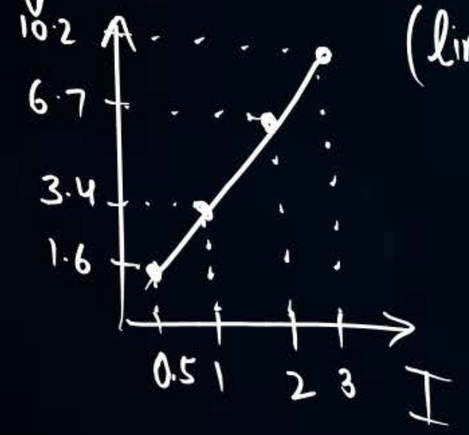
Slide 7

Page No. 221 (INTEXT Q.7)

The values of current I flowing in a given resistor for the corresponding values of potential difference V across the resistor are given below –

I (amperes)	0.5	1.0	2.0	3.0	4.0
V (volts)	1.6	3.4	6.7	10.2	13.2

Plot a graph between V and I and calculate the resistance of that resistor.



$V \propto I$ (linear)

Slope (V-I) $= \frac{\Delta V}{\Delta I} = R$

$= \frac{V_2 - V_1}{I_2 - I_1} = \frac{13.2 - 1.6}{4 - 0.5} =$ — Ω

Page No. 221 (INTEXT Q.8)

$R = ?$

When a 12 V battery is connected across an unknown resistor, there is a current of 2.5 mA in the circuit. Find the value of the resistance of the resistor.

$V = 12\,V$

$i = 2.5\,mA = 2.5 \times 10^{-3}\,A$

$R = ?$

$V = iR$

$R = \frac{V}{i} = \frac{12}{2.5 \times 10^{-3}}$

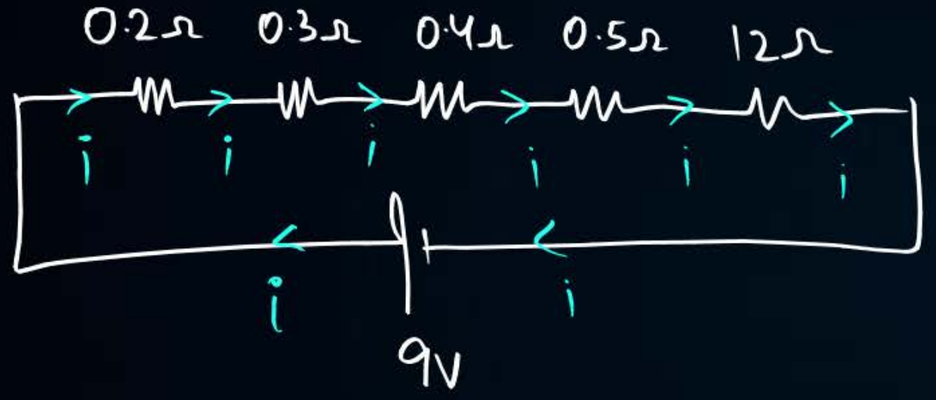
$= \frac{12 \times 10^3 \times 10}{2.5}$

$= \frac{12 \times 100 \times 10^2}{25}$

$= \quad \Omega$

Page No. 221 (INTEXT Q.9)

A battery of 9 V is connected in series with resistors of 0.2 Ω, 0.3 Ω, 0.4 Ω, 0.5 Ω and 12 Ω, respectively. How much current would flow through the 12 Ω resistor?



$$R_t = R_1 + R_2 + R_3 \cdots$$

$$R_t = 0.2 + 0.3 + 0.4 + 0.5 + 12$$

$$R_t = 13.4\,\Omega$$

$$V = iR$$

$$i = \frac{V}{R} = \frac{9}{13.4}\,A$$

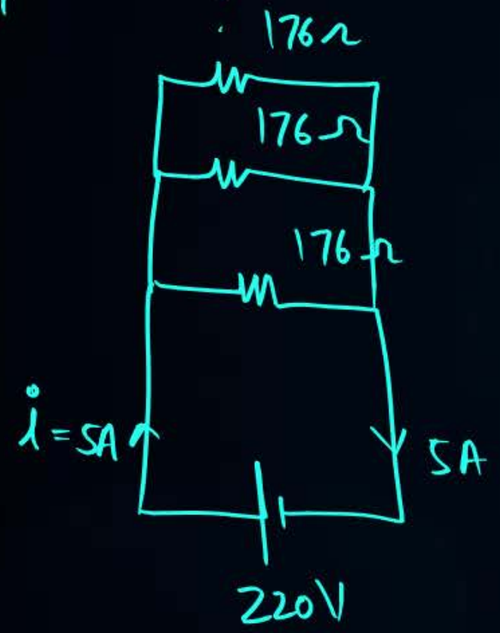
Page No. 221 (INTEXT Q.10)

Imp.

How many 176 Ω resistors (in parallel) are required to carry 5 A on a 220 V line?

n

'n'



$V_t = 220\,V$

$i_t = 5A$

$R_t = ?$

$V = iR$

$220 = 5 \times R_p$

$R_p = 44\,\Omega$

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \cdots$$

$$\frac{1}{44} = \frac{1}{176} + \frac{1}{176} + \frac{1}{176} \cdots \; n \text{ times}$$

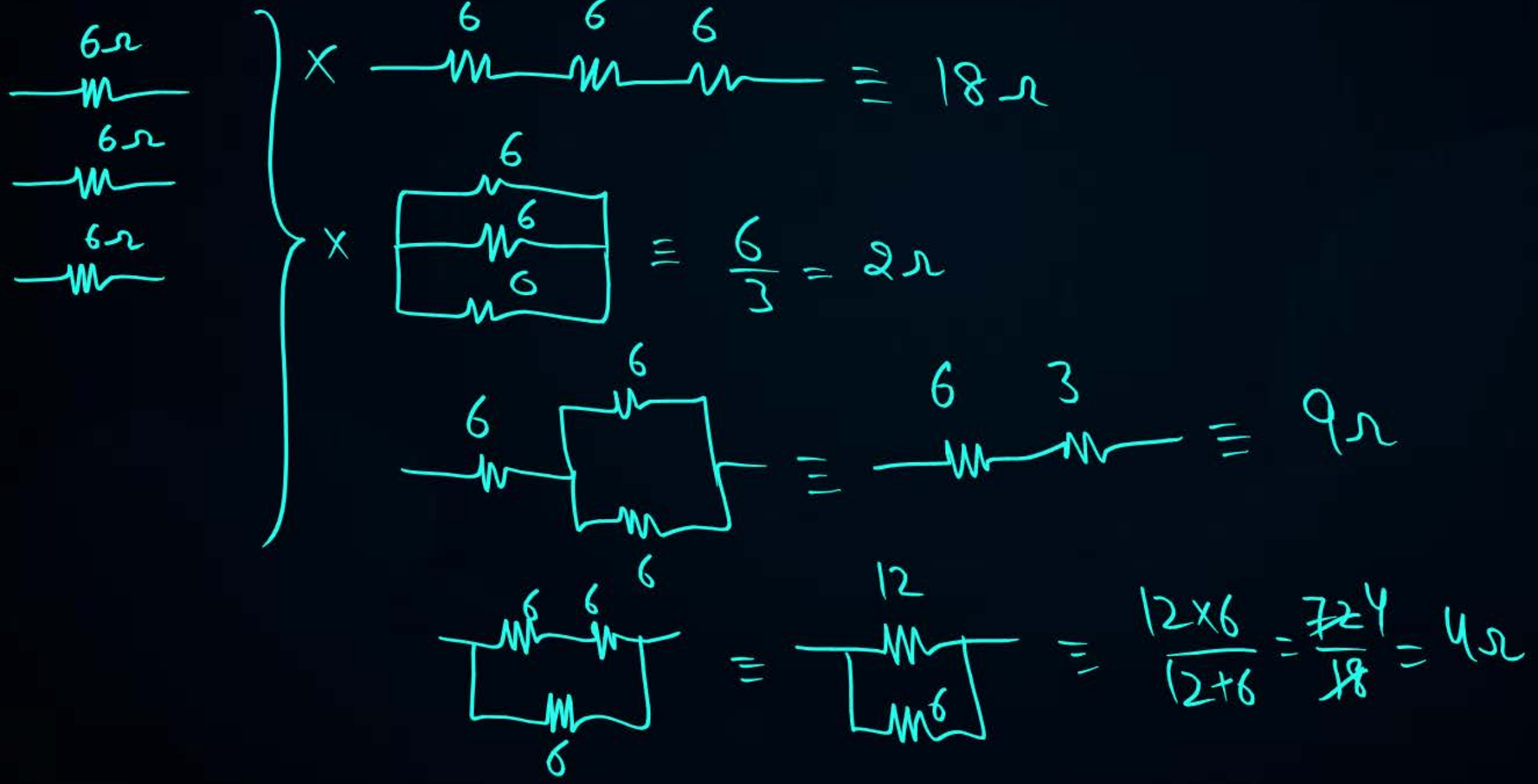
$$\frac{1}{44} = \frac{n}{176}$$

$$\frac{176}{44} = n$$

$n = 4$

Page No. 221 (INTEXT Q.11)

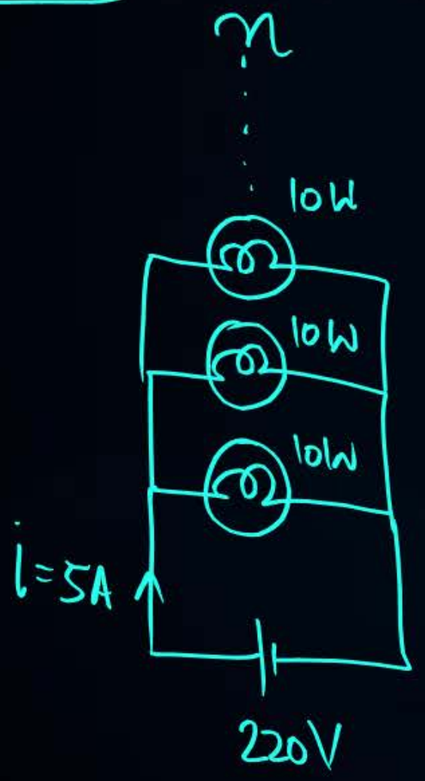
Show how you would connect three resistors, each of resistance 6 Ω, so that the combination has a resistance of (i) 9 Ω, (ii) 4 Ω.



Page No. 221 (INTEXT Q.12)

Imp.

Several electric bulbs designed to be used on a 220 V electric supply line, are rated 10 W. How many lamps can be connected in parallel with each other across the two wires of 220 V line if the maximum allowable current is 5 A?



$P_t = V \times I$

$= 220 \times 5$

$= 1100\ W$

$P_{total} = P_1 + P_2 + P_3 + P_4 \ldots\ldots n$

$1100 = 10 + 10 + 10 + 10 + \ldots\ldots n$

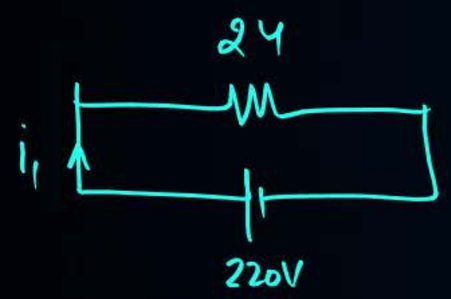
$110\phi = 10n$

$n = 110$ Bulbs

Page No. 221 (INTEXT Q.13)

A hot plate of an electric oven connected to a 220 V line has two resistance coils A and B, each of 24 Ω resistance, which may be used separately, in series, or in parallel. What are the currents in the three cases?

Separate



$V = iR$

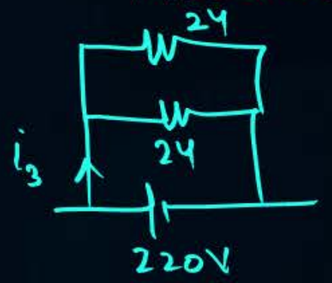
$i_1 = \frac{V}{R} = \frac{220}{24}\ A$

Series

$V = iR_s$

$i_2 = \frac{V}{R_s} = \frac{220}{48}\ A$

Parallel



$V = i_3 R_p$

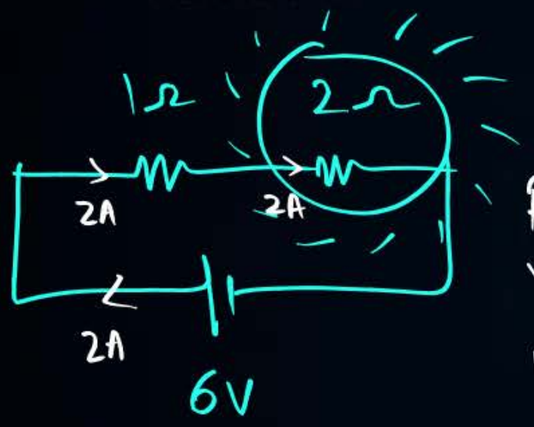
$i_3 = \frac{V}{R_p} = \frac{220}{12}\ A$

Page No. 221 (INTEXT Q.14)

Imp.

Compare the power used in the 2 Ω resistor in each of the following circuits: (i) a 6 V battery in series with 1 Ω and 2 Ω resistors, and (ii) a 4 V battery in parallel with 12 Ω and 2 Ω resistors.

i)



$R_t = 3\Omega$

$V = 6V$

$i = \frac{V}{R} = \frac{6}{3} = 2A$

$i = 2A$

$P = i^2R$

$= 2^2 \times 2$

$P = 8W$

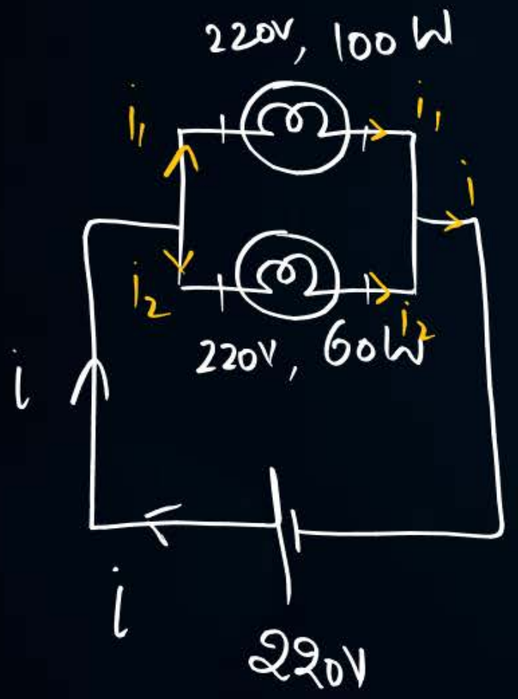
ii)

$P = \frac{V^2}{R} = \frac{(4)^2}{2} = \frac{16}{2} = 8W$

Page No. 221 (INTEXT Q.15)

Imp.

Two lamps, one rated 100 W at 220 V, and the other 60 W at 220 V, are connected in parallel to electric mains supply. What current is drawn from the line if the supply voltage is 220 V?



M-I

$P_{total} = P_1 + P_2$

$= 100 + 60$

$= 160\,W$

$P = V \times i$

$160 = 220 \times i$

$i = \frac{160}{220}\,A$ ✓

M-2

$P = Vi$ $\quad$ $P = Vi$ $\quad$ $i = i_1 + i_2$

$60 = 220 \times i_2$ $\quad$ $100 = 220 \times i_1$ $\quad$ $= \frac{60}{220} + \frac{100}{220}$

$\frac{60}{220}\,A = i_2$ $\quad$ $\frac{100}{220}\,A = i_1$ $\quad$ $i = \frac{160}{220}\,A$ ✓

Page No. 221 (INTEXT Q.16)

Which uses more energy, a 250 W TV set in 1 hr, or a 1200 W toaster in 10 minutes?

TV

$P = 250\ W = \frac{250}{1000}\ kw$

$t = 1\ h$

$E = P \times t$

$= \frac{250}{1000} \times 1$

$= 0.25\ Kwh$

Toaster

$P = 1200\ W = \frac{1200}{1000}\ kw$

$t = 10\ min = \frac{10}{60}\ h$

$E = P \times t$

$= \frac{1200}{1000} \times \frac{10}{60}$

$= \frac{12}{60} = 0.2\ Kwh$

TV > Toaster

Page No. 221 (INTEXT Q.17)

An electric heater of resistance 8 Ω draws 15 A from the service mains 2 hours. Calculate the rate at which heat is developed in the heater.

$\times 60$
$\times 60$

$$\text{Power} = I^2R$$
$$= (15)^2 \times 8$$
$$= 15 \times 15 \times 8 \text{ Watt}$$

Page No. 221 (INTEXT Q.18)

MP ↑ → 3380°C → heat retain → glow
R ↑

Explain the following.

(a) Why is the tungsten used almost exclusively for filament of electric lamps?

(b) Why are the conductors of electric heating devices, such as bread-toasters and electric irons, made of an alloy rather than a pure metal? → Notes

ρ ↑ R ↑ H ↑ ρ ↓ R ↓ H ↓

(c) Why is the series arrangement not used for domestic circuits? → Parallel ✓ Series ×

(d) How does the resistance of a wire vary with its area of cross-section? → $R \propto \frac{1}{A}$

(e) Why are copper and aluminium wires usually employed for electricity transmission?

ρ ↓ → Good Conductor

① Cheap
② Light

THANK YOU