UDAAN

2025

ELECTRICITY

PHYSICS | Lecture - 04

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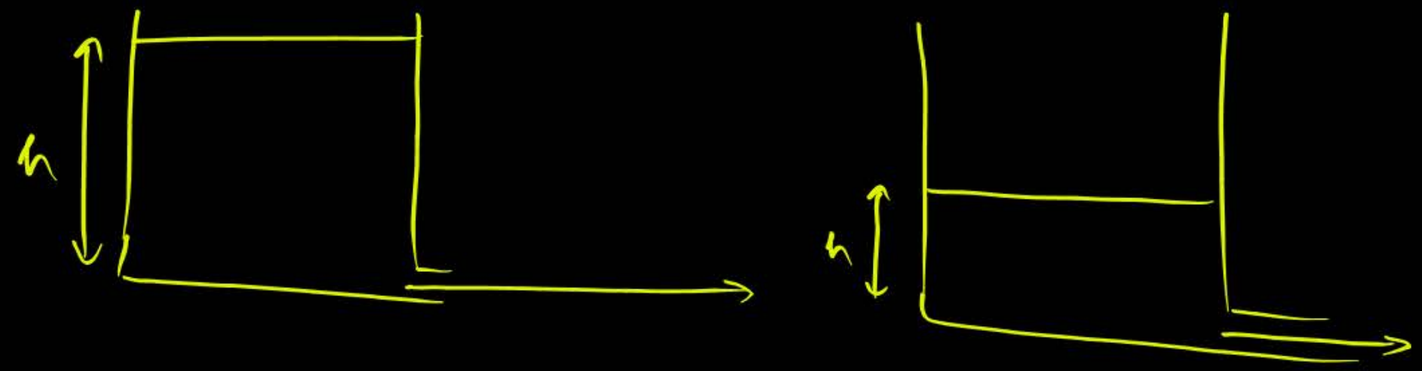
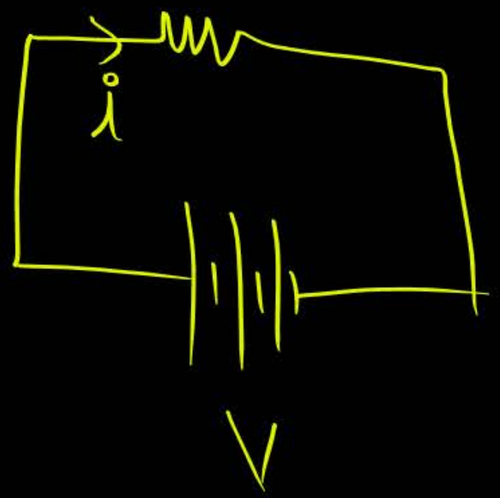
Topics to be covered

1. OHM'S LAW (Continued)
2. RESISTANCE
3. VERIFICATION OF OHM'S LAW
4. FACTORS AFFECTING RESISTANCE
5. DIFFERENCE BETWEEN R and ρ
6. RESISTIVITY OF ELECTRICAL SUBSTANCES

Revision





Ohm's law

$V \propto I$

$\boxed{V = IR}$

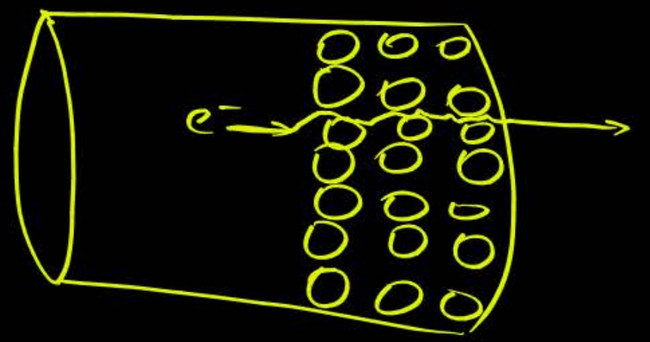
→ Constant

Revision contd.

$R \rightarrow$ Resistance

$V = IR$

ohm (Ω)



Ohm's Law (Validity)

1. Conductor ✓
2. Temperature Constant ✓

$$V = IR$$

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

VERIFICATION OF OHM'S LAW

BATTERY ELIMINATORS

RESISTANCE BOX (fixed)

VOLTMETER

AMMETER

PLUG KEY

RHEOSTAT (changing Resistance)

CONNECTING WIRE


Voltage
BATTERY ELIMINATOR
measure
I
DC MOVING COIL
RESISTANCE BOX
Key
(Switch
ON/OFF)
Measure
V

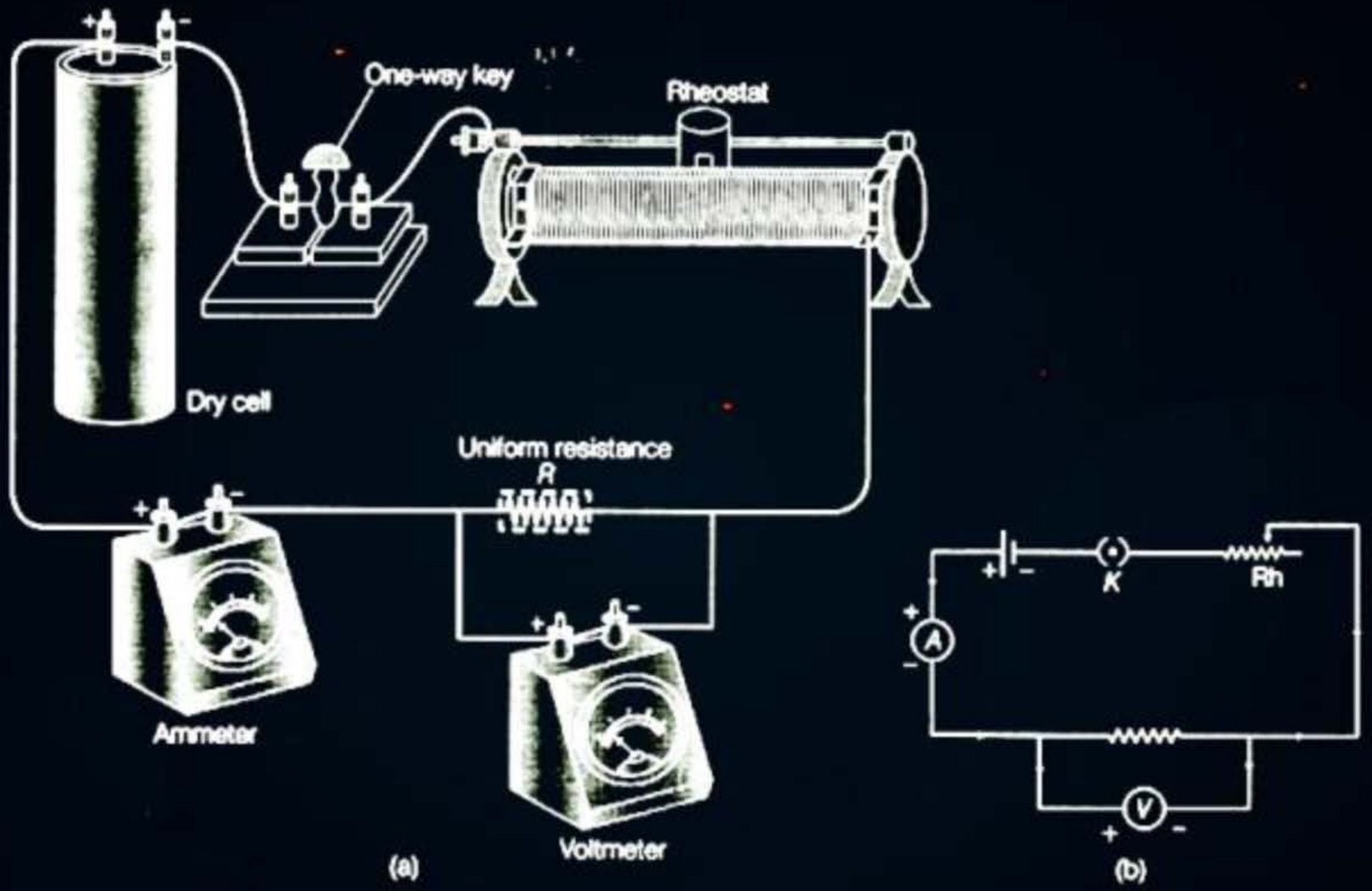
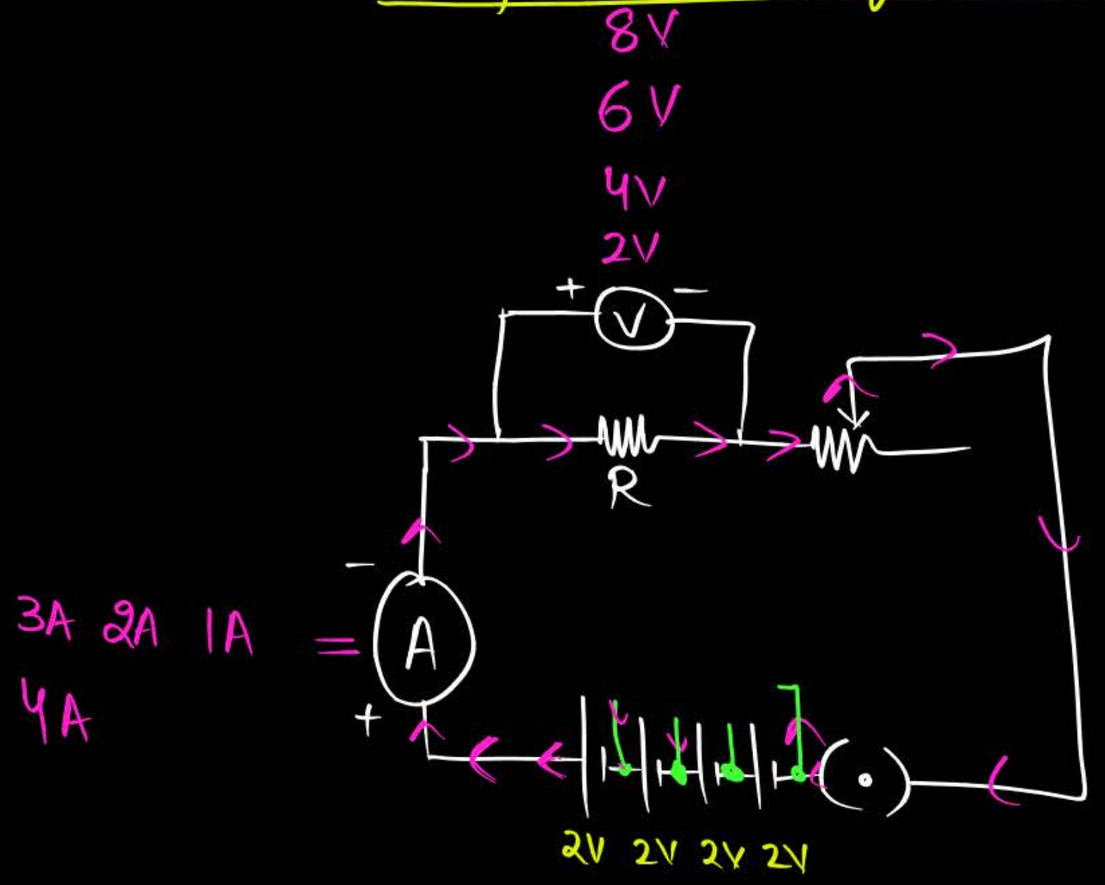
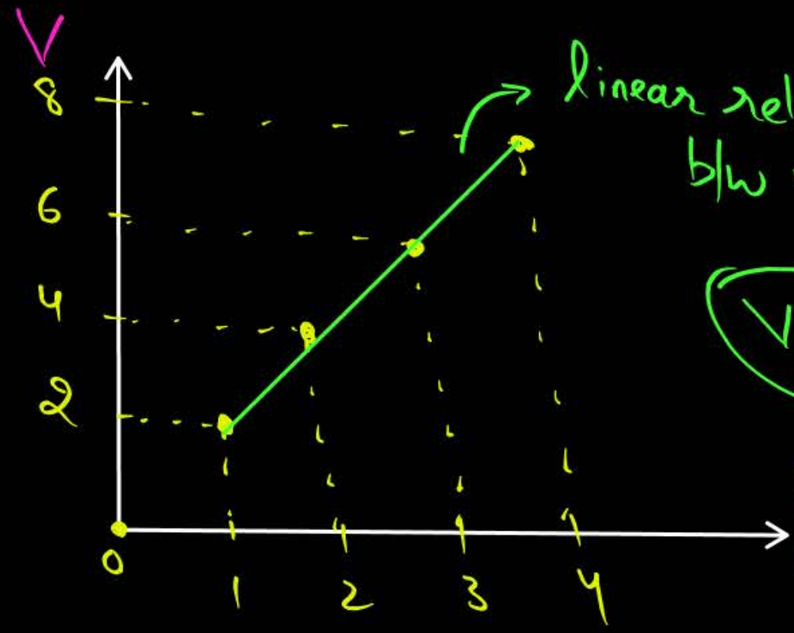


Fig. 1 (a) Arrangement diagram
(b) Circuit diagram

* Verification of ohm's Law ($V \propto I$)



V	2	4	6	8
I	1	2	3	4

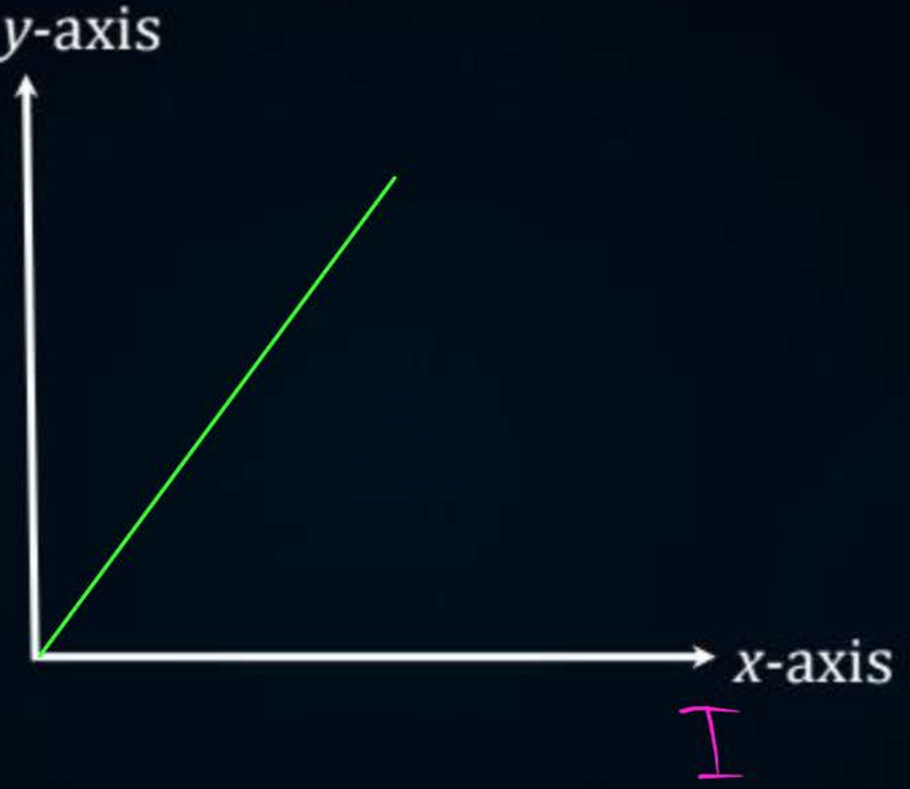


V-I CHARACTERISTIC CURVE/GRAPH

$$\text{Slope} = \frac{\Delta y}{\Delta x}$$

$$= \frac{\Delta V}{\Delta I} = R$$

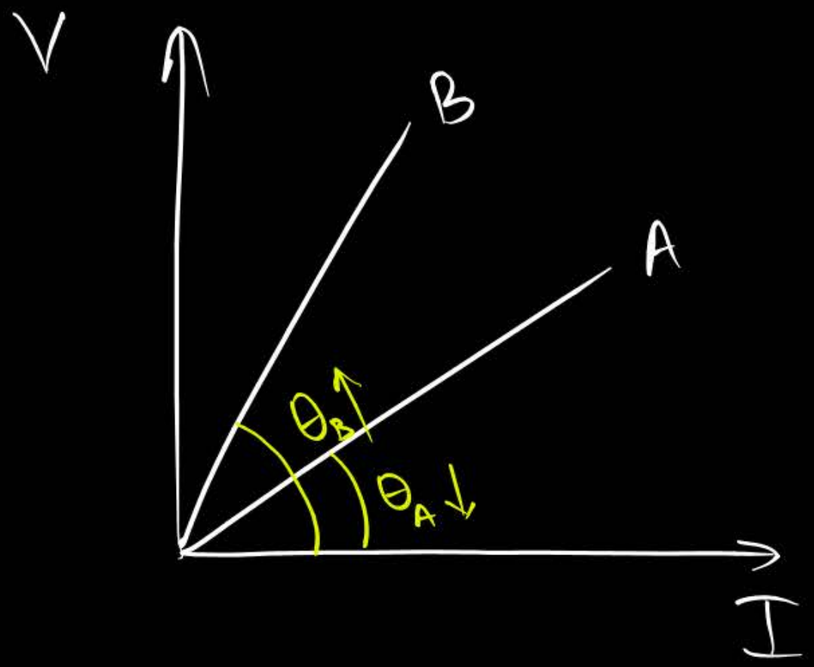
Slope = Resistance (V-I)



Class 9th

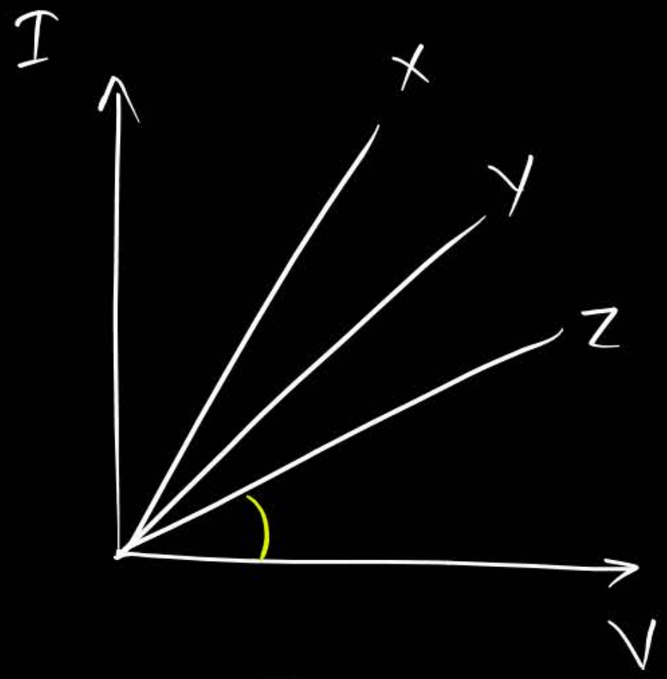
$$\text{Slope} = \frac{\Delta y}{\Delta x}$$

Practice PYQ



$R_B > R_A \rightarrow$ True

$R_A > R_B \rightarrow$ False



a) $R_x > R_y > R_z$

b) $R_z > R_y > R_x$

c) $R_y > R_z > R_x$

d) $R_x > R_z > R_y$

Slope (V-I) $= R$

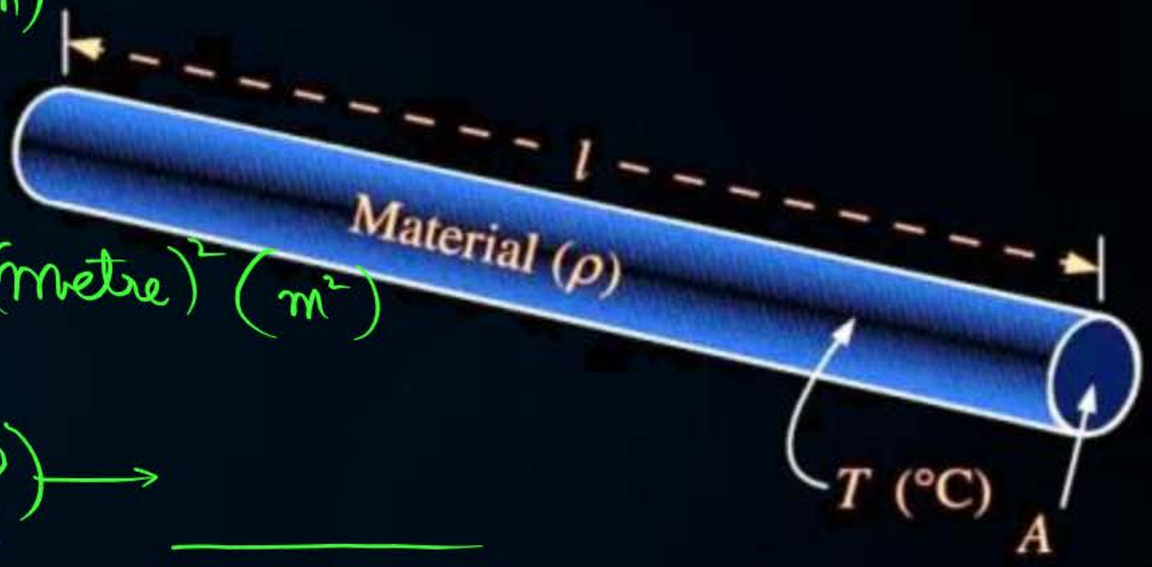
Slope (I-V) $\downarrow = \frac{1}{R} \uparrow$

Jugaad

Jo 'V' ke Paas Hoga, Uska 'R' Bada.

FACTORS AFFECTING RESISTANCE

1. length of the wire (l) ⟶ metre (m)
   (Lambai)
2. Cross-sectional Area of wire (A) ⟶ $(\text{metre})^2$ (m^2)
   (Motai)

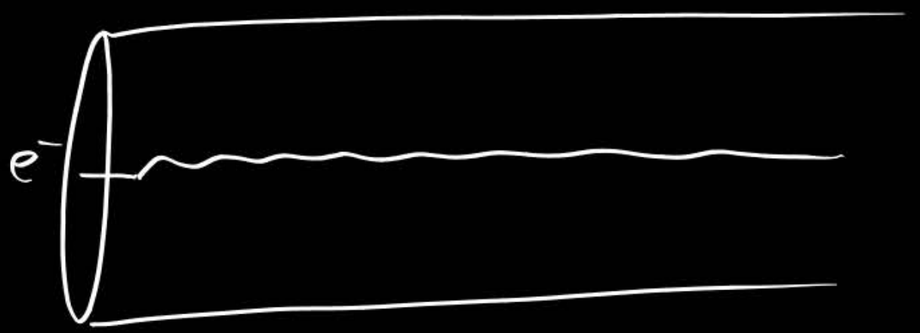


3. Material of the wire [Resistivity] (ρ) ⟶ _____
   (Konse chakki ka Atta khaya hai)

4. Temperature of the wire [T] ⟶ °C / K
   (Taapman)

① $R \uparrow \propto l \uparrow$

② $R \downarrow \propto \frac{1}{A} \uparrow$



Combining ② and ①

$$R \propto \frac{l}{A}$$

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

Personal formula (feel)

ρ = Constant

T = Constant

Feel of ρ

`Resistivity' (adverb)

↓

Rokne ki Kshmta

- Define - It is a property of material to oppose the flow of current through it.

`Resistance'

↓

Rukawat (Verb)

ρ →

- Very high — Insulator ($10^{14} - 10^{16}$ Ωm)
- Med — Alloys ($10^{1}, 10^{3}$ Ωm)
- Very low — Conductor ($\rho = 10^{-8}$ Ωm, 10^{-10} Ωm, 10^{-12} Ωm)

PYQ

Unit of 'ρ'

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

$$\Omega = \rho' \frac{m}{m^2}$$

$$\Omega m = \rho'$$

Ohm-metre = 'ρ'

DIFFERENCE BETWEEN

Summary

RESISTANCE (Rukawat)

→ Opposition offered by the atoms and particles of the Conductor in the path of Current.

→ SI unit ⟶ Ω (ohm)

→ denoted by 'R'

→ depends on l, A, ρ, T

RESISTIVITY (Rokne ki Kshmta)

→ It is the property of the material to offer opposition for the current to flow.

→ SI unit ⟶ Ωm (ohm-metre)

→ denoted by 'ρ'

→ depends on substance of the wire, Temperature.

RESISTIVITY OF ELECTRICAL SUBSTANCES

याद ×

feel

ρ ↑ R ↑

↓ ↓

Rokne Ki Kshamta → Rukawat Bhi Zyada Paida Karega

	Material	Resistivity (Ω m)
Conductors	Silver	1.60×10^{-8}
	Copper	1.62×10^{-8}
	Aluminium	2.63×10^{-8}
	Tungsten	5.20×10^{-8}
	Nickel	6.84×10^{-8}
	Iron	10.0×10^{-8}
	Chromium	12.9×10^{-8}
	Mercury	94.0×10^{-8}
	Manganese	1.84×10^{-6}
Alloys	Constantan (alloy of Cu and Ni)	49×10^{-6}
	Manganin (alloy of Cu, Mn and Ni)	44×10^{-6}
	Nichrome (alloy of Ni, Cr, Mn and Fe)	100×10^{-6}
Insulators	Glass	$10^{10} - 10^{14}$
	Hard rubber	$10^{13} - 10^{16}$
	Ebonite	$10^{15} - 10^{17}$
	Diamond	$10^{12} - 10^{13}$
	Paper (dry)	10^{12}

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

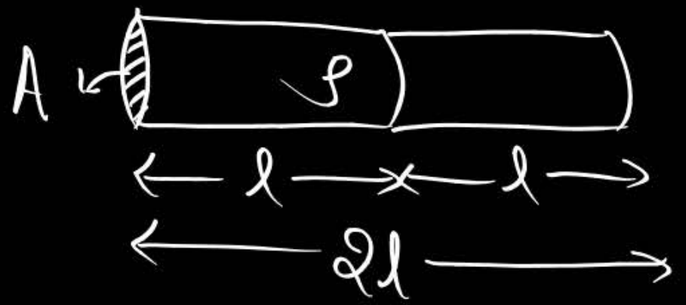
→ Comparitive Numerical

PYQ

eg - 

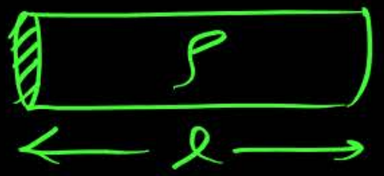
→ General Case : $R = \rho \frac{l}{A}$

Another identical Wire is joined, find the new $R' = ?$



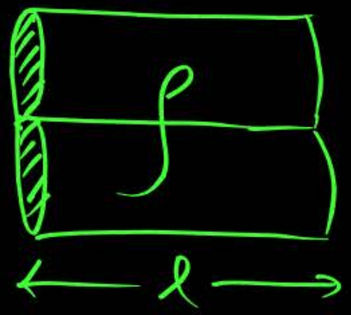
$\therefore R' = \rho \frac{2l}{A} = 2\left(\rho \frac{l}{A}\right)$

$R' = 2R$

Eg: 

$\therefore R = \rho \frac{\ell}{A}$

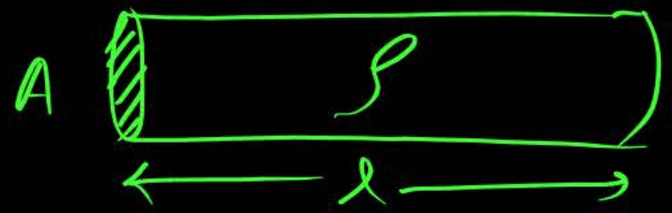
Another identical wire is fused parallelly.



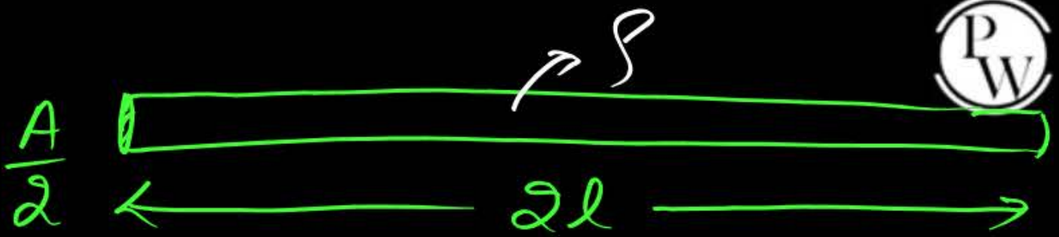
$\therefore R' = \rho \frac{\ell}{2A}$

$= \frac{1}{2}\left(\rho \frac{\ell}{A}\right)$

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



stretched to twice its length



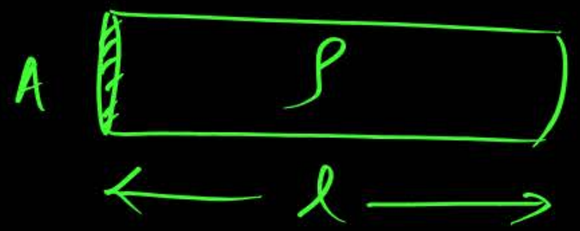
$$R = \rho \frac{\ell}{A}$$

$$R' = \rho \frac{2\ell}{\frac{A}{2}}$$

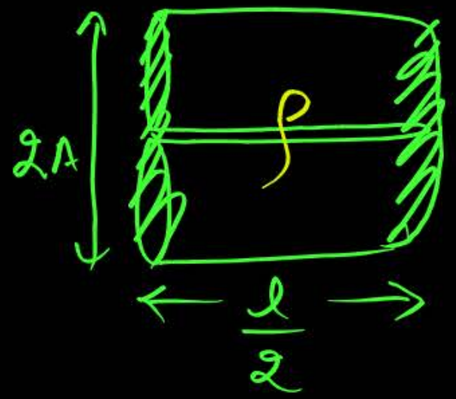
$$= 4\left(\rho \frac{\ell}{A}\right)$$

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

Eg.



folded on itself



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

$$R' = \rho \frac{\ell/2}{2 \times 2A}$$

$$= \frac{\rho \ell}{4A}$$

$$R' = \frac{1}{4}\left(\frac{\rho \ell}{A}\right) = \frac{R}{4}$$

QUESTION

H.W.

A wire of length L and resistance R is stretched so that its length is doubled and the area of cross-section is halved. How will it's

(1) resistance change (2) resistivity change.

QUESTION

H.W.

The resistance of a metallic wire becomes 8 times when:

A length is doubled

B length is tripled

C length is doubled and radius is halved

D length is halved and radius is doubled

THANK YOU