

The logo features the text 'UDAAN 3.0' in white, bold, sans-serif font inside a red, rounded rectangular banner with a dotted border. The banner is set against a dark blue background with a yellow sun and grey clouds at the bottom. Two white paper airplanes are shown in a circular path around the banner.

UDAAN 3.0

PHYSICS

ELECTRICITY

Lecture No.- 03

A portrait of a man with dark hair, a mustache, and glasses, wearing a black polo shirt. He is standing with his arms crossed against a yellow background. The text 'ER. RAKSHAK SIR' is written in black on a yellow banner at the bottom of the image.

ER. RAKSHAK SIR

Today's

Targets



- 1 OHM'S LAW ✓
- 2 RESISTANCE ✓
- 3 VERIFICATION OF OHM'S LAW ✓
- 4 FACTORS AFFECTING RESISTANCE ✓
- 5 DIFFERENCE BETWEEN R & ρ
- 6 RESISTIVITY OF ELECTRICAL SUBSTANCES ✓

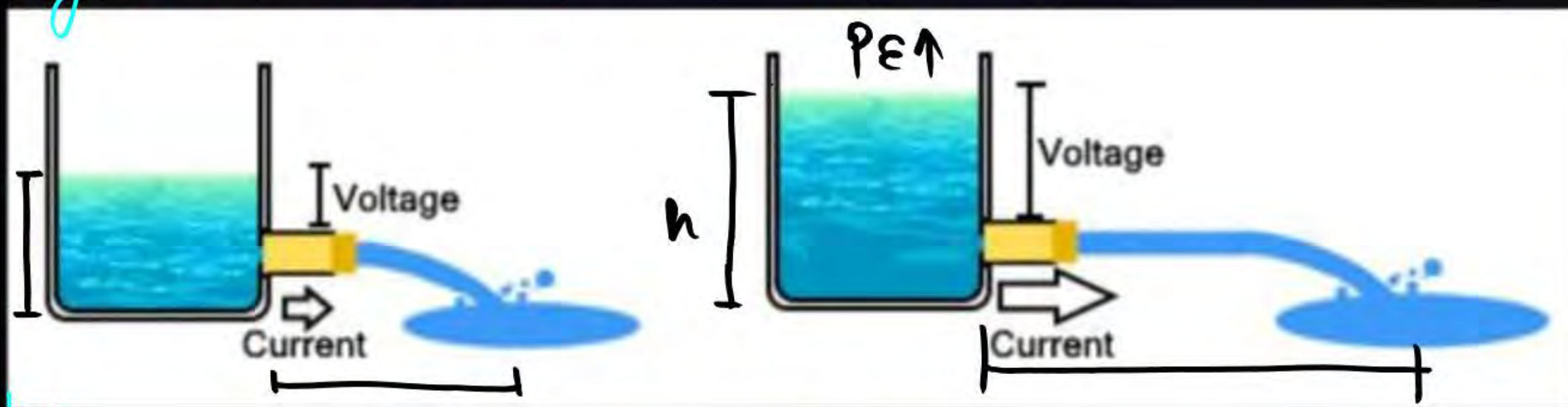


OHM'S LAW

Voltage \propto Current
 $V \propto I$

It states that,
Current flowing in a conductor is

directly
proportional
to potential
difference applied
across the
ends of
the conductor,
at constant temp.



$$V \propto I$$
$$* \boxed{V = IR}$$

Voltage \swarrow \searrow Current \rightarrow Constant \rightarrow Resistance



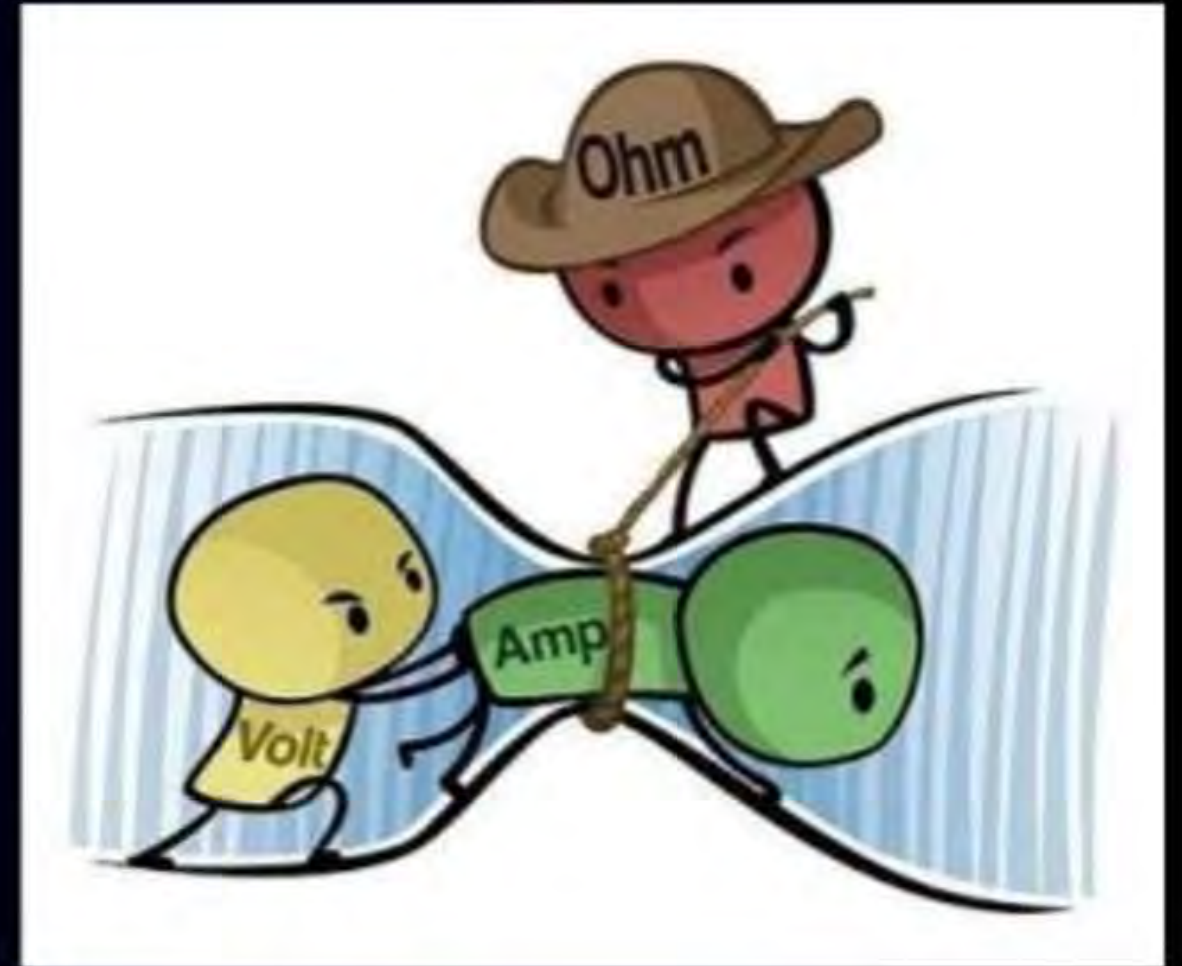
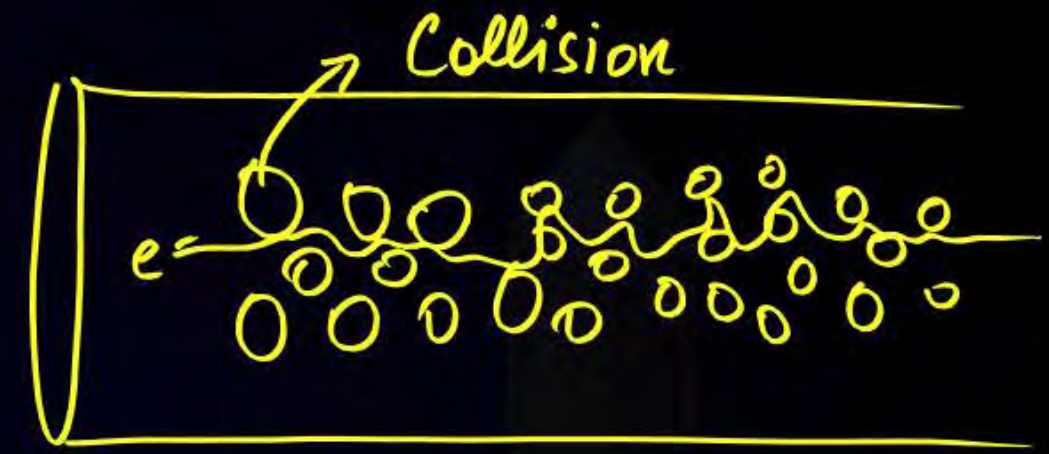
RESISTANCE

$$\Rightarrow \frac{V}{I}$$

→ It is the opposition offered by the conductor in the flow of current.

→ 'R'

→ Ohm or Ω





VERIFICATION OF OHM'S LAW



*BATTERY
ELIMINATORS*



*RESISTANCE
BOX*



VOLTMETER



AMMETER



PLUG KEY



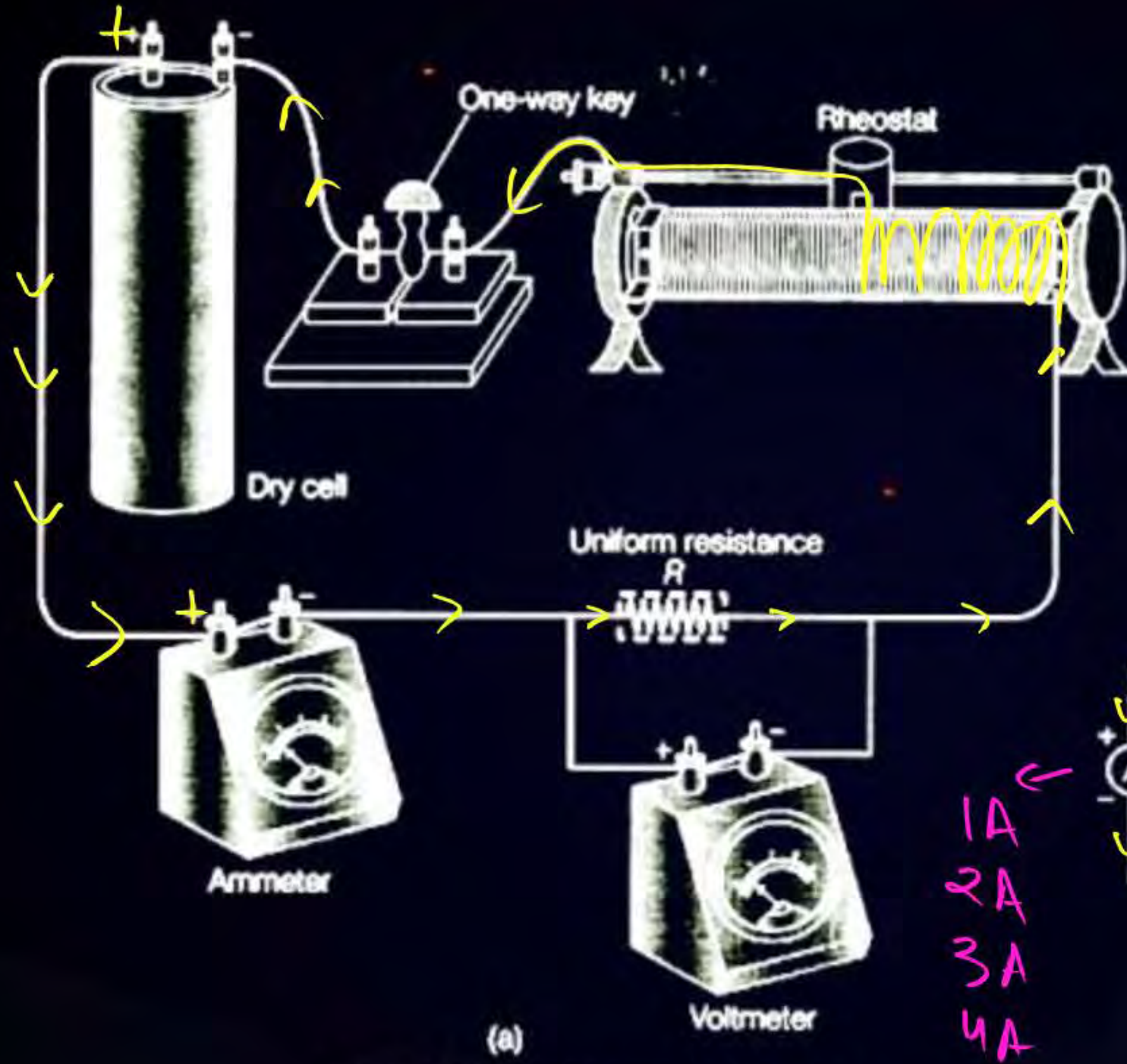
RHEOSTAT



*CONNECTING
WIRE*

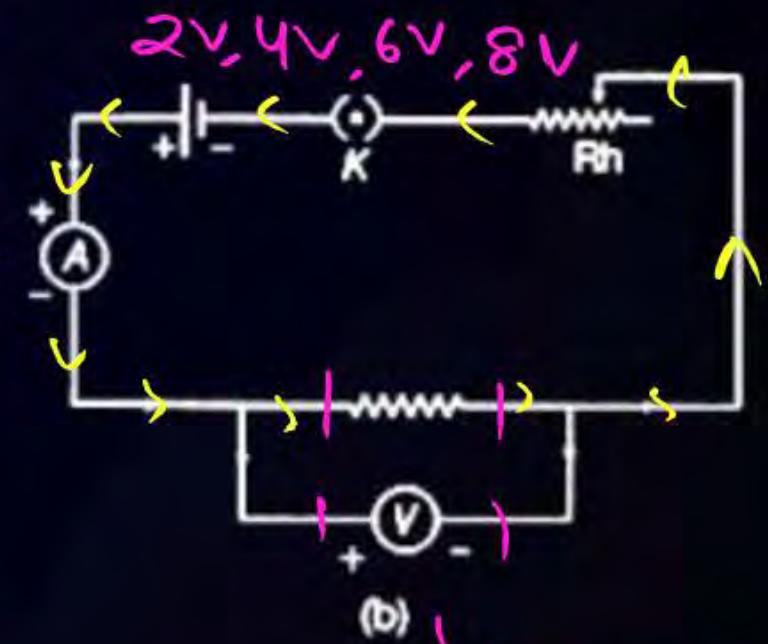
Simple





	V_1			V_2
V	2	4	6	8
I	1	2	3	4
	I_1			I_2

1A
2A
3A
4A



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

2V, 4V, 6V, 8V



V-I CHARACTERISTIC CURVE/GRAPH



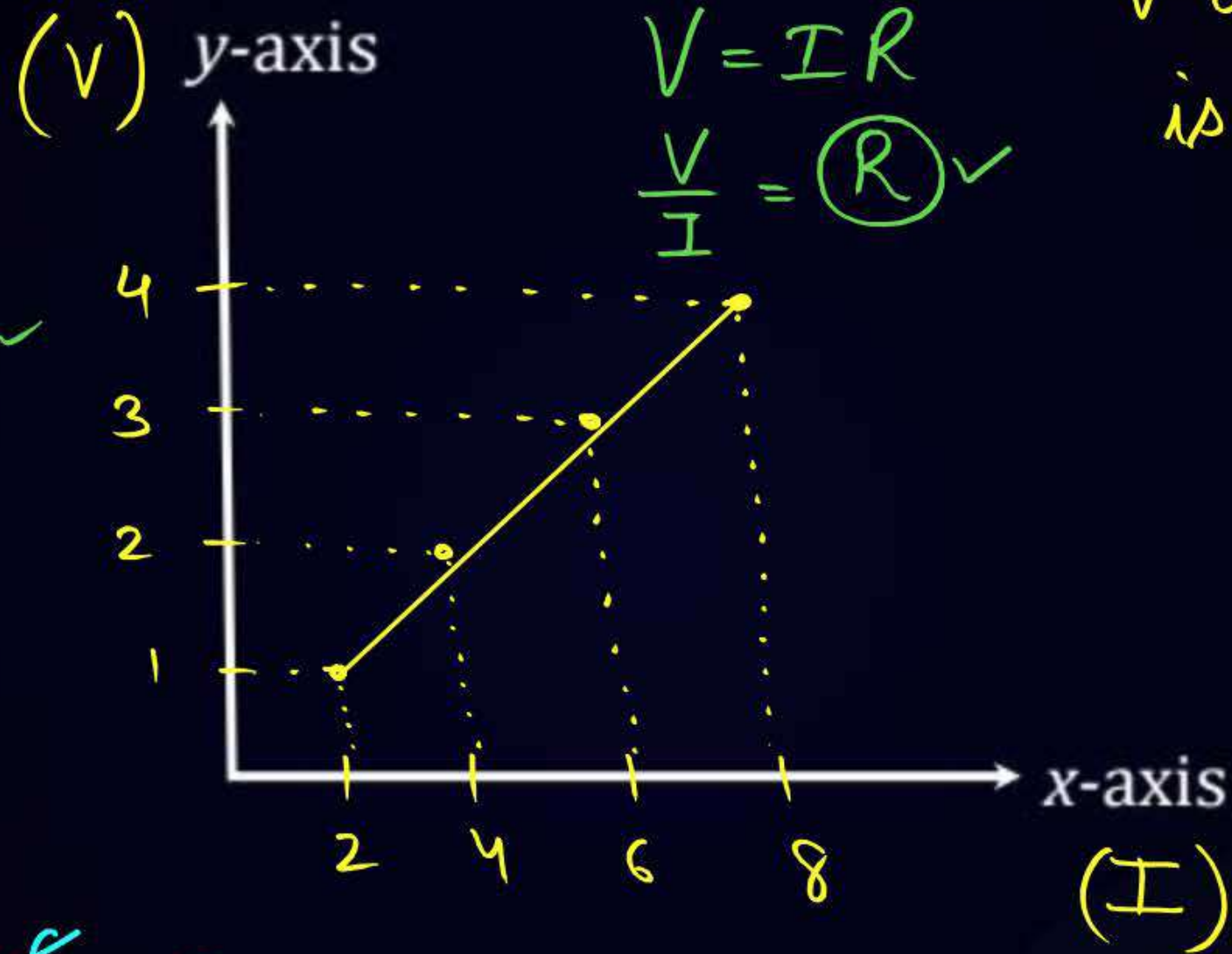
$$* \text{ slope } = \frac{\Delta y}{\Delta x}$$

(V-I)

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

$$= \frac{V_2 - V_1}{I_2 - I_1}$$

$$= \frac{8 - 2}{4 - 1} = \frac{6}{3} = 2 \Omega$$



V and I Graph

is a straight line

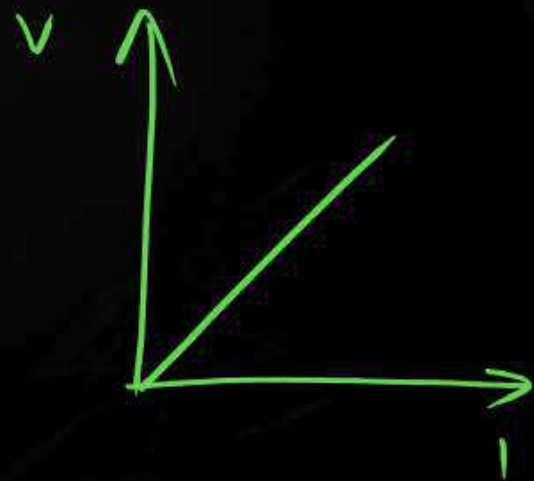
↓
"linear graph"

$$y \propto x$$

$$V \propto I$$

hence, ohm's law is
Verified.

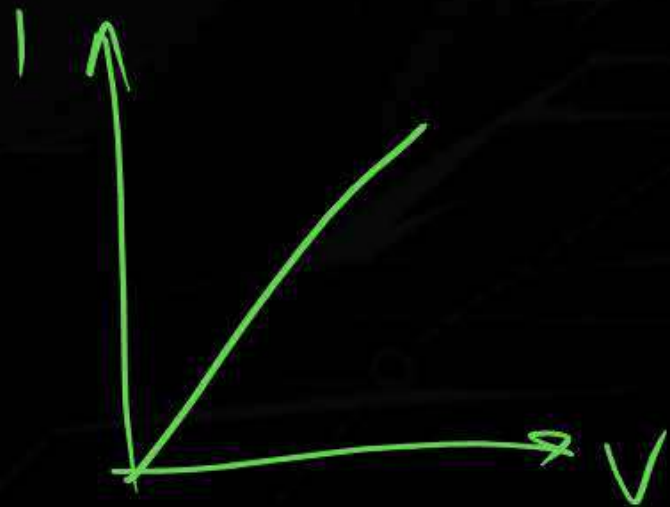
NOTE - Slope of 'V-I' graph gives 'R'



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

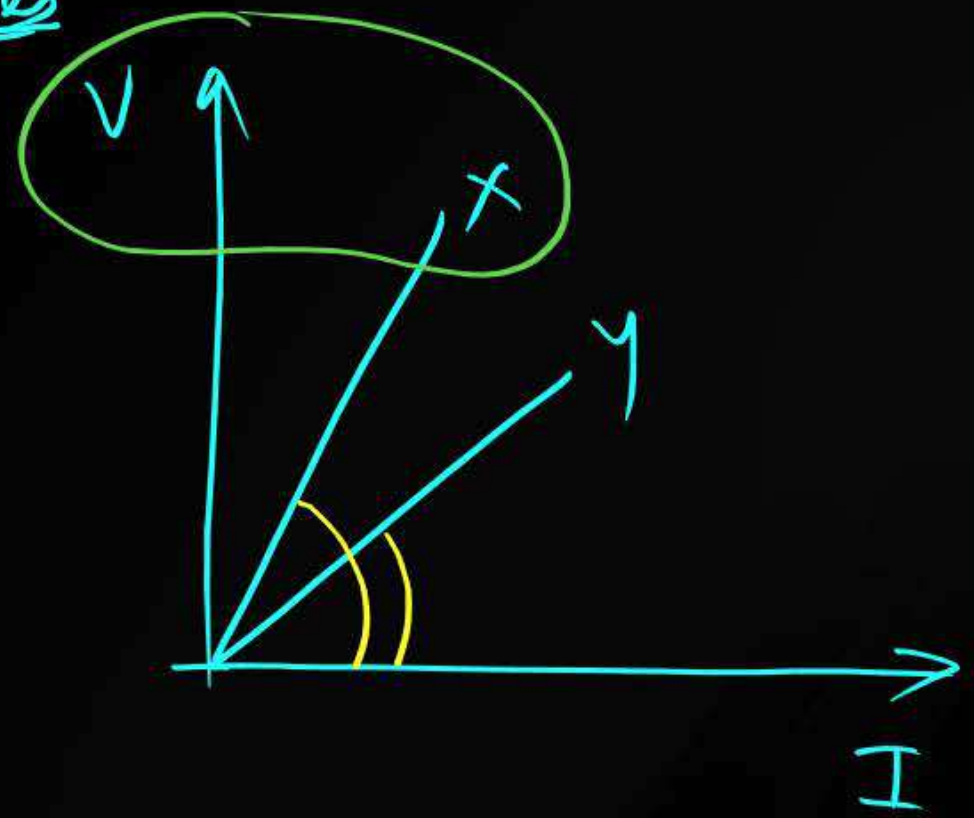
$$= \frac{\Delta V}{\Delta I} = 'R'$$

- Slope of 'I-V' graph gives ' $\frac{1}{R}$ '



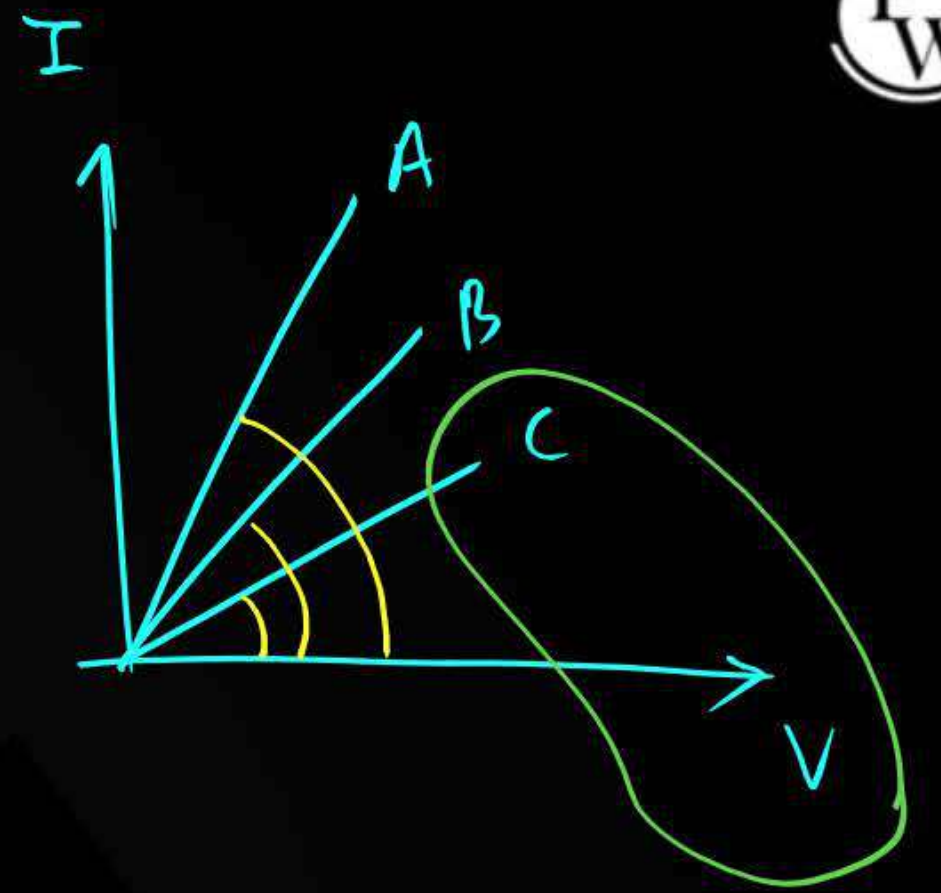
$$\begin{aligned} \text{Slope} &= \frac{\Delta y}{\Delta x} \\ &= \frac{\Delta I}{\Delta V} = \frac{1}{R} \end{aligned}$$

Ques



$$R_x > R_y$$

Ques



$$R_A < R_B < R_C$$

Question



How much current will an electric bulb draw from a 220 V source, if the resistance of the bulb filament is 1200 Ω ?

$$I = ?$$

$$V = 220\text{V}$$

$$R = 1200\Omega$$

$$I = \frac{V}{R} = \frac{220}{1200} = \frac{11}{60} \text{ A}$$

Question



H.W.

The values of current I flowing in a given resistor for the corresponding values of potential difference V across the resistor are given below. Plot a graph between V and I and calculate the resistance of that resistor.

I (amperes)	0.5	1.0	1.5	2.0	2.5
V (volts)	1.6	3.2	4.8	6.4	8.0

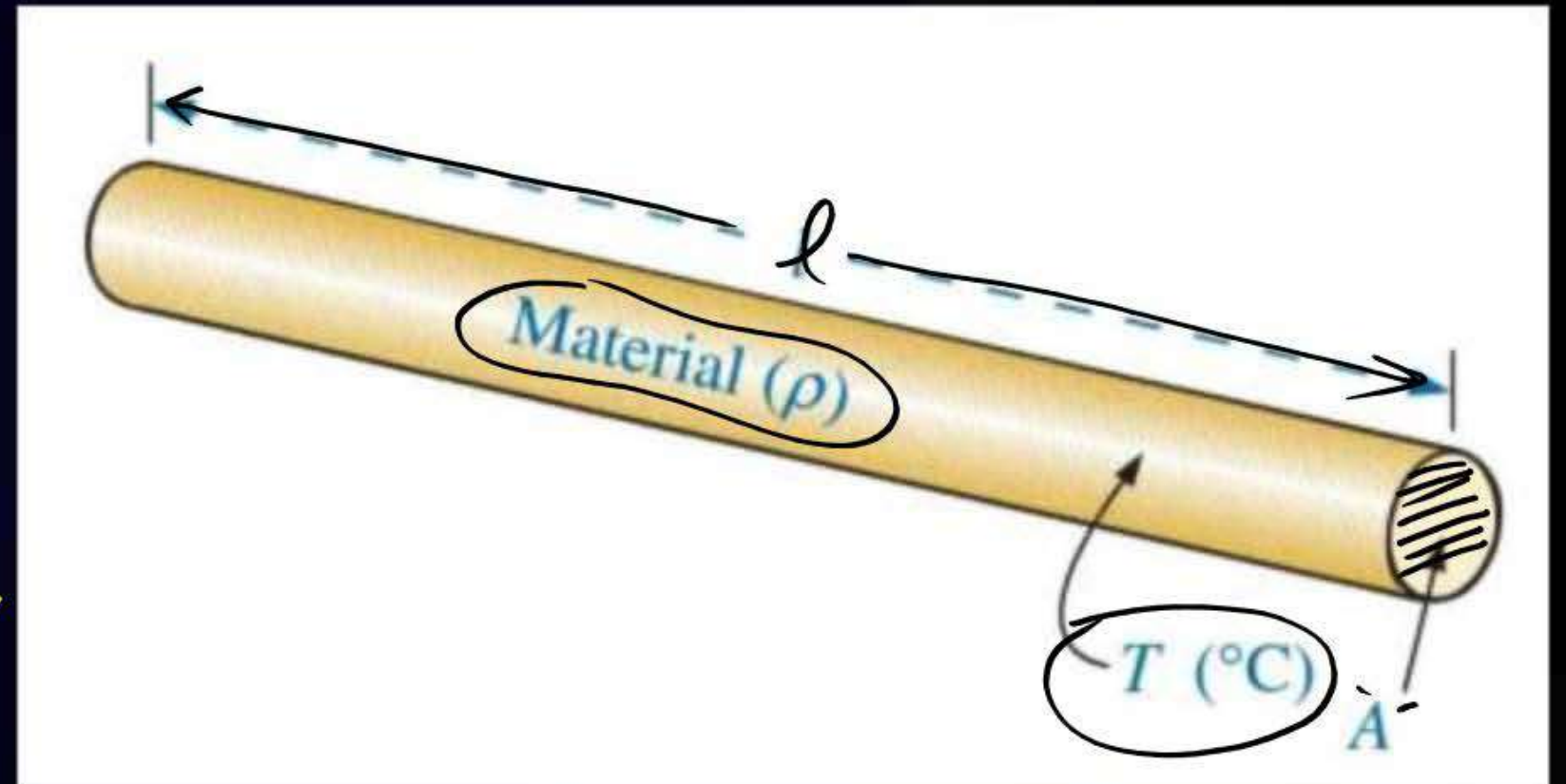
FACTORS AFFECTING RESISTANCE



$$V = IR$$

\rightarrow Constant

1. length of the conductor (l) \rightarrow 'm'
 $\uparrow R \propto l \uparrow$
2. Cross-sectional Area (A) \rightarrow 'm²'
 $\downarrow R \propto \frac{1}{A} \uparrow$
 $\rightarrow \pi r^2$
3. Material of the conductor
 \rightarrow Resistivity (ρ) \rightarrow 'ohm-m'
4. Temperature of the conductor $\uparrow R \uparrow$



$$\left. \begin{array}{l} R \propto l \\ R \propto \frac{1}{A} \end{array} \right\} R \propto \frac{l}{A}$$

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

↓
'constant'

* finding SI unit of ' ρ '

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

$$\Omega \leftarrow \rho \frac{\text{m}}{\text{m}^2}$$

$$\Omega \text{m} = \rho$$

(ohm-metre or Ωm)



DIFFERENCE BETWEEN



RESISTANCE

- opposition of offered by the conductor in the path of Current.
- It depends on length, Area of ^{Cross} Section, Resistivity and Temperature
- R
- ohm

RESISTIVITY

- property of a material to oppose the flow of Current
- it depends on Temperature $T \uparrow \rho \uparrow$
- ρ (Rho)
- ohm-metre (Ωm)



RESISTIVITY OF ELECTRICAL SUBSTANCES

Material \rightarrow Same
 $\rho \rightarrow$ Same

$\rho \rightarrow$ Very less \Rightarrow Conductor
 $\rho \rightarrow$ Thik-Thak \Rightarrow Alloy
 $\rho \rightarrow$ Very high \Rightarrow Insulator

	Material	Resistivity (Ω m)
<u>Conductors</u>	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}
<u>Alloys</u>	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}
	Glass ✓	$10^{10} - 10^{14}$
	Hard rubber ✓	$10^{13} - 10^{16}$
<u>Insulators</u>	Ebonite ✓	$10^{15} - 10^{17}$
	Diamond ✓	$10^{12} - 10^{13}$
	Paper (dry) ✓	10^{12}

Question



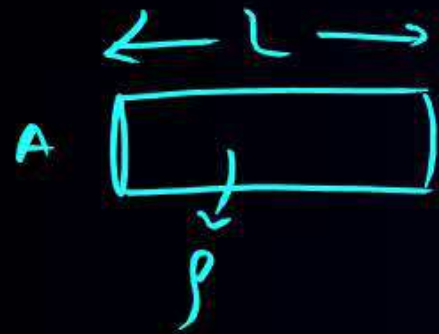
Imp.

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.

Gen Case :-



$$R = \frac{\rho L}{A} \dots \textcircled{1}$$



$$R' = \frac{\rho 2L}{\frac{A}{2}} \quad \text{i)}$$

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

$$R' = 4 \left(\frac{\rho L}{A} \right) = 4R \quad \text{ii)}$$

ρ does not change with the change of dimensions.

Question



H.W.

The resistance of a wire of 0.01 cm radius is 10 Ω If the resistivity of the material of the wire is $50 \times 10^{-8} \Omega\text{m}$. find the length of the wire.

$$r = 0.01 \text{ cm} \rightarrow A = \pi r^2$$

$$R = 10 \Omega$$

$$\rho = 50 \times 10^{-8} \Omega\text{m}$$

$$l = ?$$

Question



The resistance of a metallic wire becomes 8 times when:

☒ A length is doubled $2R$ $l \uparrow R \uparrow$

☒ B length is tripled $3R$

☒ C length is doubled and radius is halved
 $2l$ $r \rightarrow \frac{r}{2}, A \rightarrow \frac{A}{4}$

☒ D length is halved and radius is doubled

$$r \rightarrow \frac{r}{2}$$

$$A = \pi r^2$$

$$A' = \pi \left(\frac{r}{2}\right)^2 = \frac{\pi r^2}{4} = \frac{A}{4}$$

$$R = \rho \frac{l}{A}, \quad R' = \rho \frac{2l}{\frac{A}{4}} = 8 \left(\rho \frac{l}{A} \right)$$

$R' = 8R$

$$A' = \frac{A}{4} \checkmark$$

Question



A resistance with a resistance R is connected to a battery with a voltage V to produce a current I . What would be the new current (in terms of I) if the voltage is doubled and resistance is halved?

- A** $4 I$
- B** $I/4$
- C** $2 I$
- D** $I/2$

एक उत्कृष्ट बात जो शेर से सीखी जा सकती है वह यह है कि मनुष्य जो कुछ भी करने का इरादा रखता है उसे पूरे दिल से और ज़ोरदार प्रयास के साथ करना चाहिए।

The graphic features a dark blue background with three yellow stars in the top left. A dashed white line forms a semi-circle around the text. At the bottom, there are white, puffy cloud-like shapes. A yellow pencil with a grey eraser and a red band is positioned vertically on the right, appearing to rise from the clouds. The text 'Thank You' is centered, with 'Thank' in a bold yellow sans-serif font and 'You' in a white cursive script.

Thank
You