UDAAN

2025

ELECTRICITY

PHYSICS | Lecture -06

By - ER. RAKSHAK SIR

Topics to be covered

1. SERIES CIRCUIT (Part - 02)
2. PARALLEL CIRCUIT (Part - 02)
3. COMBINATION OF RESISTORS (Practice)
4. RESISTANCE OF AMMETER AND VOLTMETER
5. WORKING OF RHEOSTAT

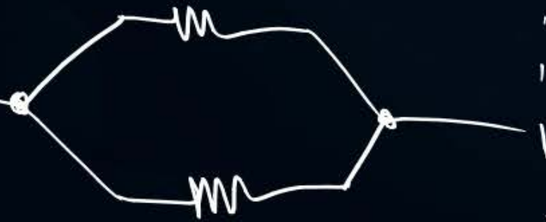
5-min Revision

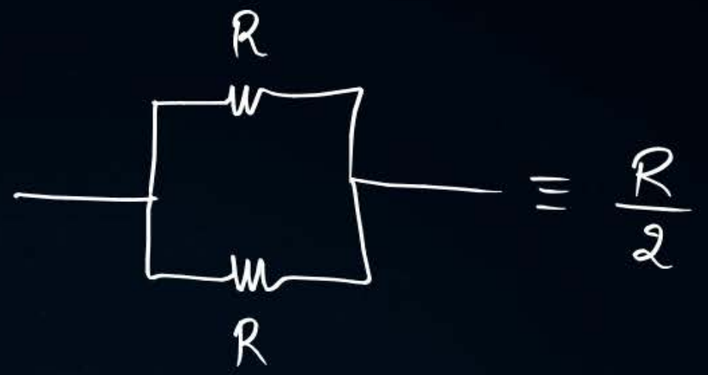
Series

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

Parallel

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

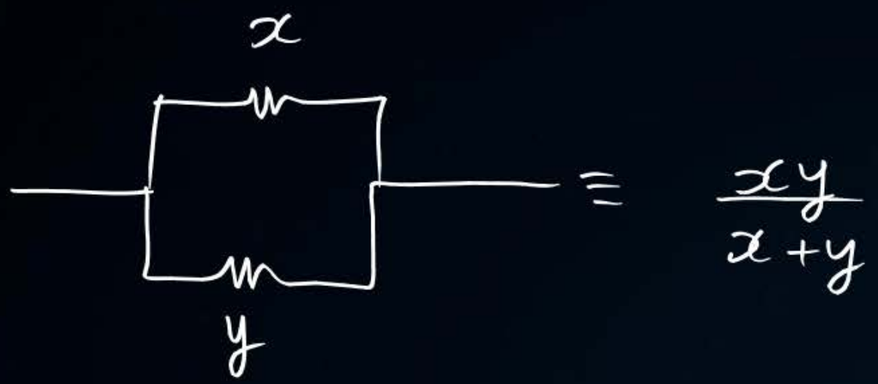




$$\equiv \frac{R}{2}$$

$$\equiv \frac{R}{3}$$

$$\equiv \frac{R}{n}$$



$$\equiv \quad \frac{xy}{x+y}$$

n-parts are joined in Parallel $\rightarrow R'$

$$\boxed{\frac{R}{R'} = \frac{n^2}{1}}$$

QUESTION

H.W.

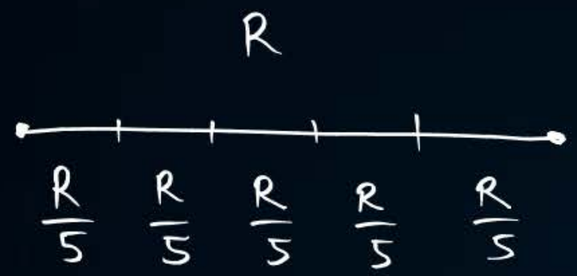
A piece of wire of resistance R is cut into five equal parts. These parts are then connected in parallel. If the equivalent resistance of this combination is R', then the ratio (R/R') is:

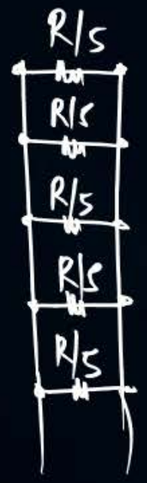
A 1/25

B 1/5

C 5

D 25





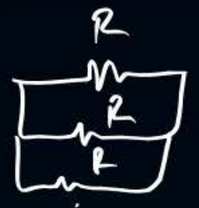
$$\frac{1}{R'} = \frac{1}{R/5} + \frac{1}{R/5} + \frac{1}{R/5} + \frac{1}{R/5} + \frac{1}{R/5}$$

$$\frac{1}{R'} = \frac{5}{R} + \frac{5}{R} + \frac{5}{R} + \frac{5}{R} + \frac{5}{R} = \frac{25}{R}$$

$$\frac{1}{R'} = \frac{25}{R}$$

$$\frac{R}{R'} = 25$$

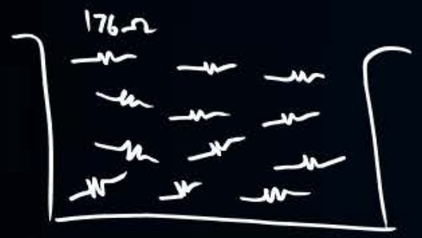
QUESTION (H.W.) Shortcut

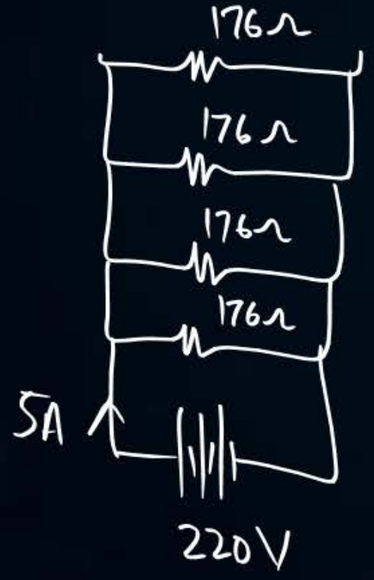


$\equiv \left(\frac{R}{n}\right) = 44 \Rightarrow \frac{176}{n} = 44 \Rightarrow n = 4$

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

number 'n' = ?





$V = 220V$

$I = 5A$

$R_t = \frac{V}{I} = \frac{220}{5} = 44\Omega$

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

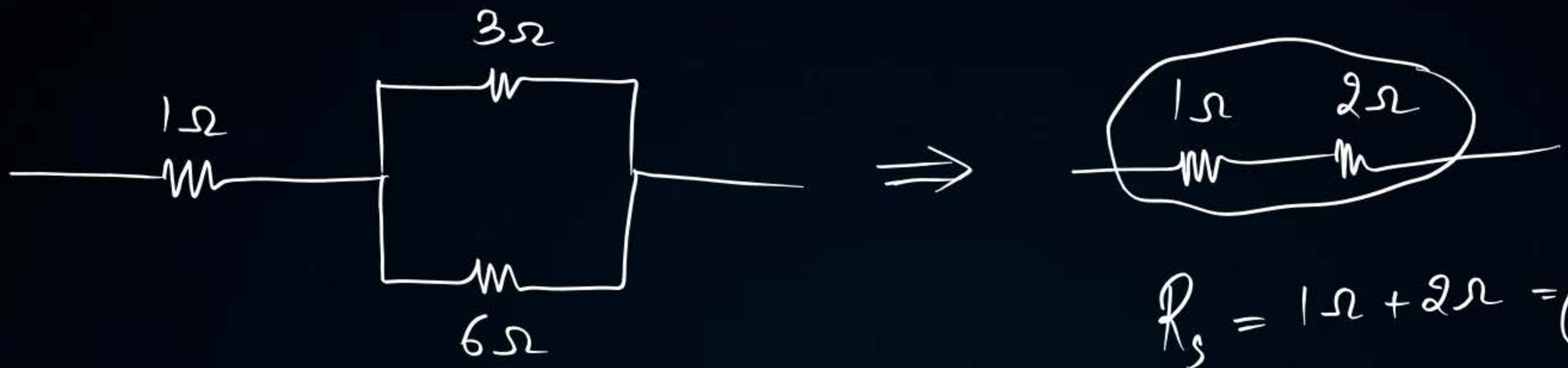
$$\frac{1}{44} = \frac{1}{176} + \frac{1}{176} + \frac{1}{176} \cdots\cdots \text{ n बार}$$

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

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

$n = 4$

PRACTICE PROBLEMS 1 :

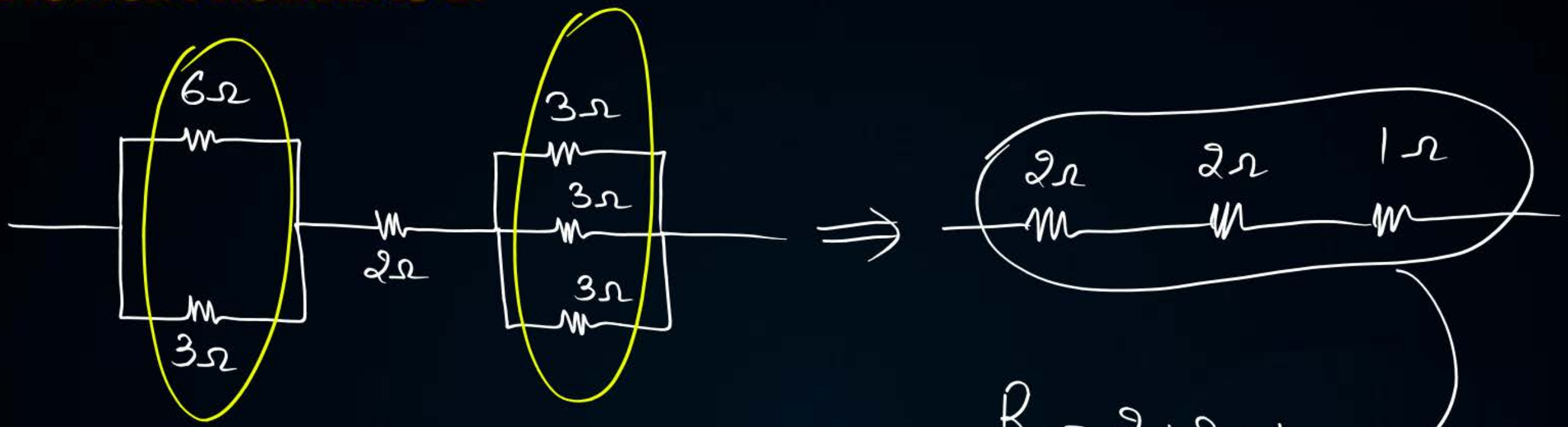


$R_s = 1\Omega + 2\Omega = 3\Omega$ Ans

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

$R_p = 2\Omega$

PRACTICE PROBLEMS 2:



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

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

$R_p = 2\Omega$

$\frac{1}{R_p} = \frac{1}{3} + \frac{1}{3} + \frac{1}{3}$

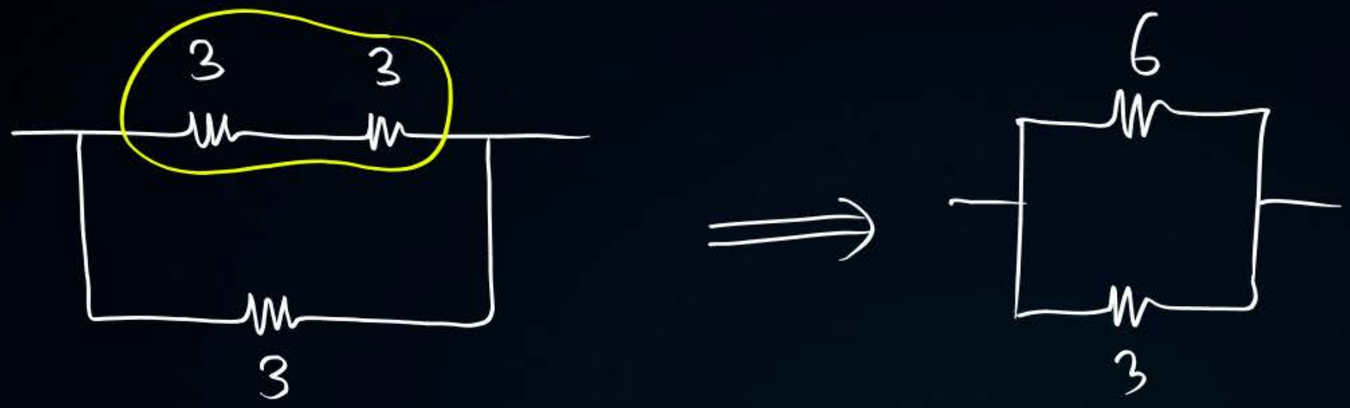
$\frac{1}{R_p} = \frac{3}{3}$

$R_p = 1\Omega$

$R_s = 2 + 2 + 1$

$= 5\Omega$

Ex-3



$$R_s = R_1 + R_2$$
$$= 3 + 3$$
$$= 6\Omega$$

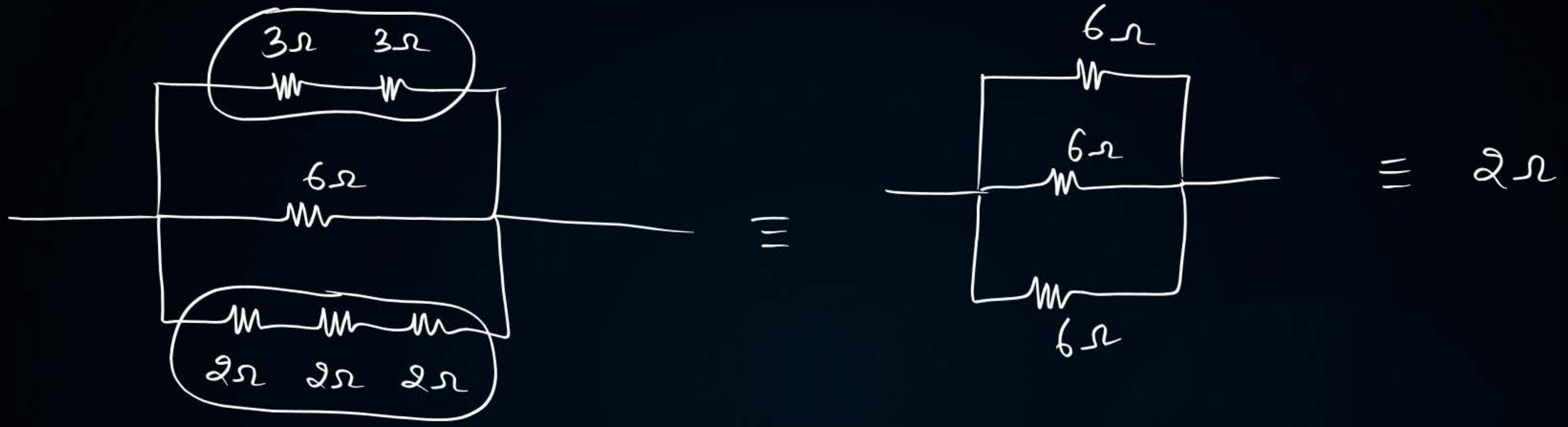
$$\frac{1}{R_p} = \frac{1}{6} + \frac{1}{3}$$

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

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

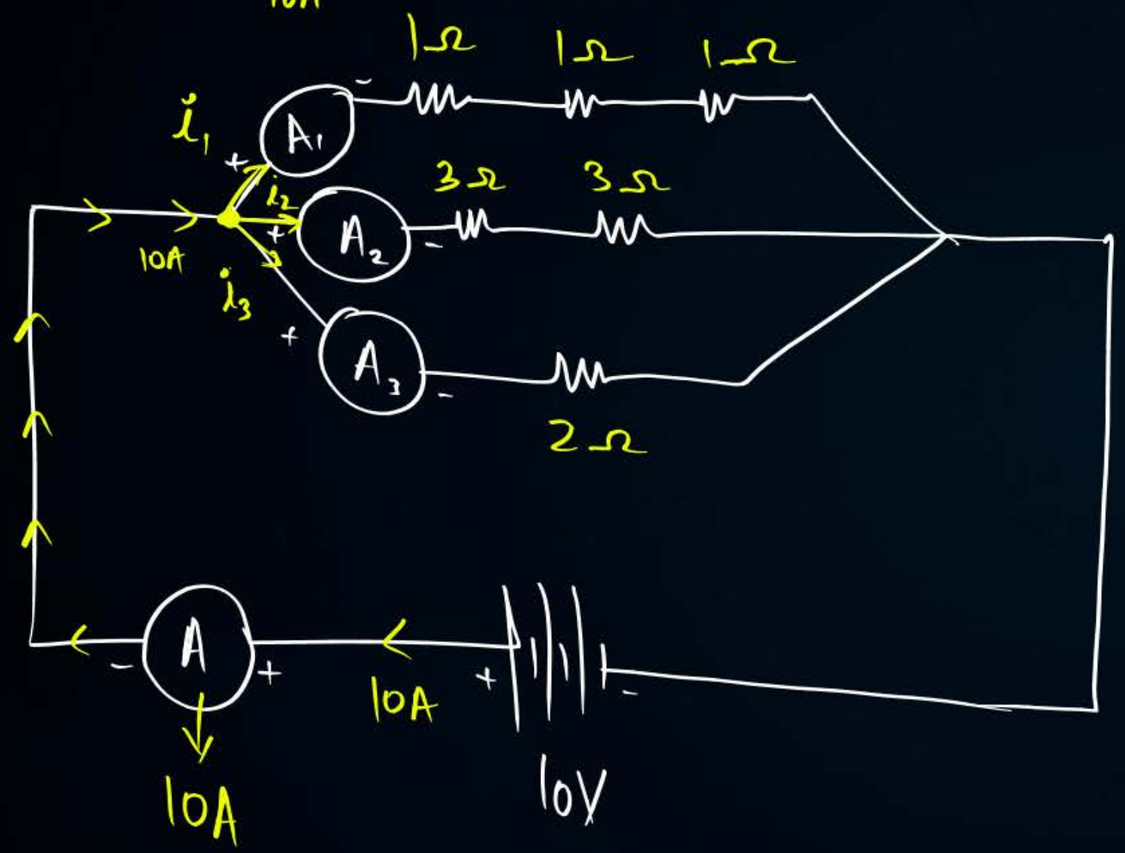
$$R_p = 2\Omega \quad \text{Ans}$$

Ex-4



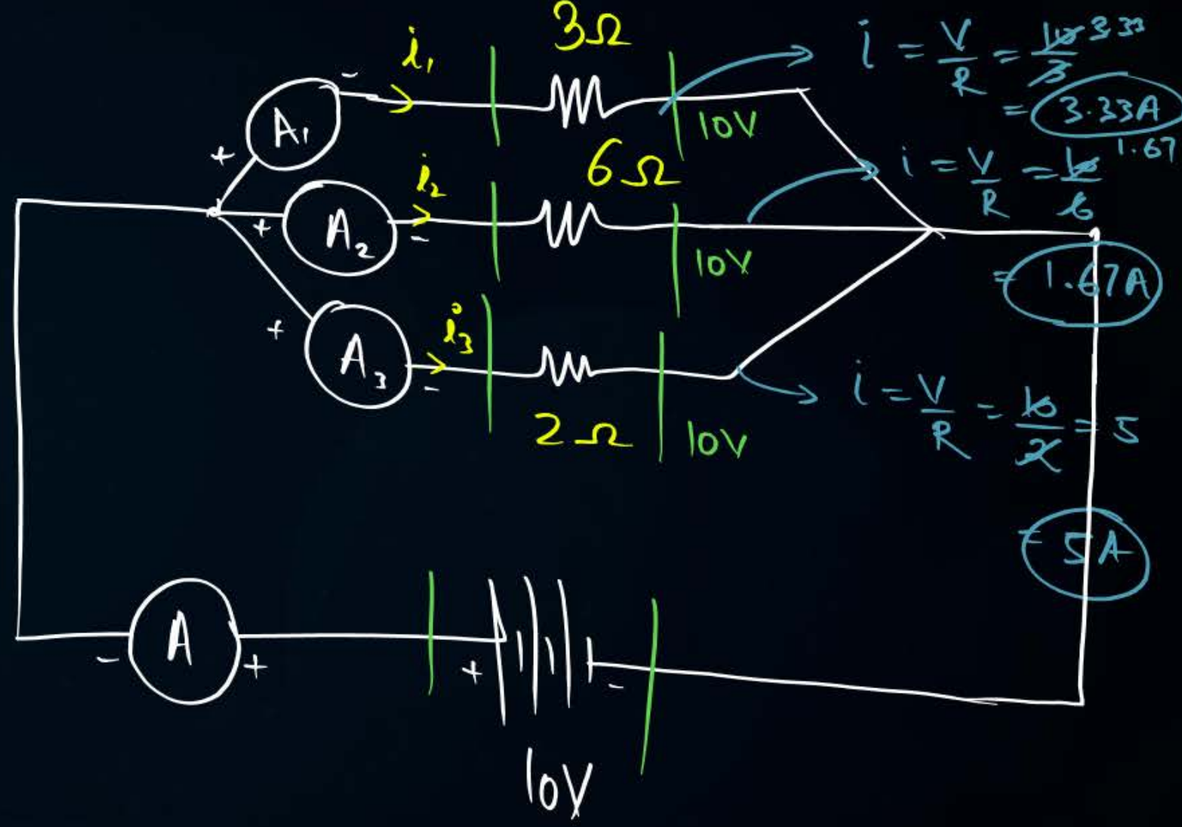
Ex-5 find the readings in A, A_1, A_2, A_3.

A: 10A, A_1: 3.33A, A_2: 1.67A, A_3: 5A

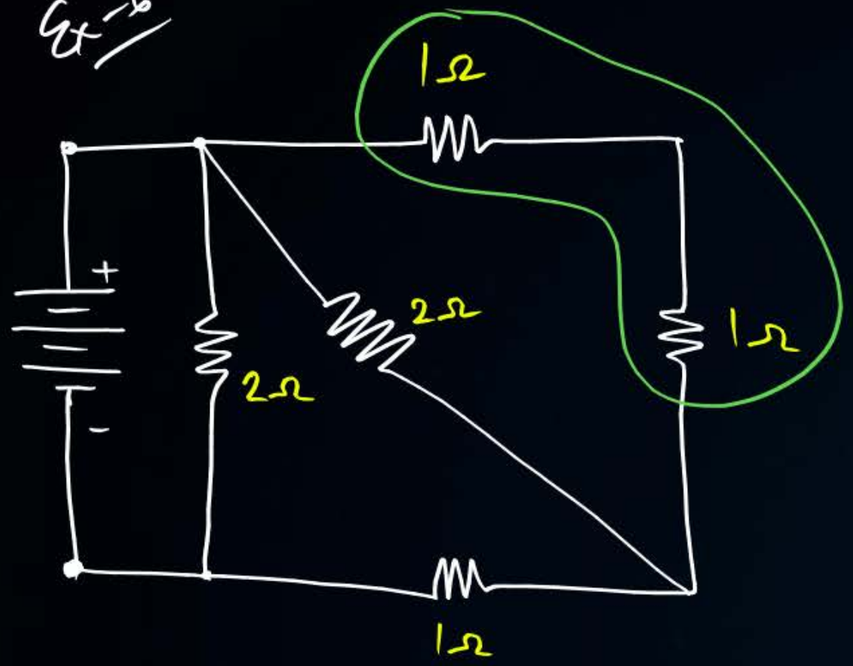


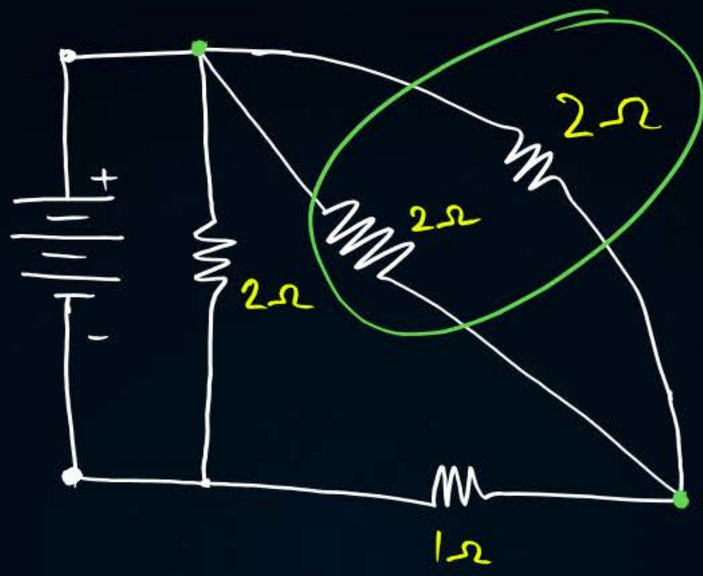
$\frac{1}{R_p} = \frac{1}{3} + \frac{1}{6} + \frac{1}{2} = \frac{2+1+3}{6} = \frac{6}{6} = 1$

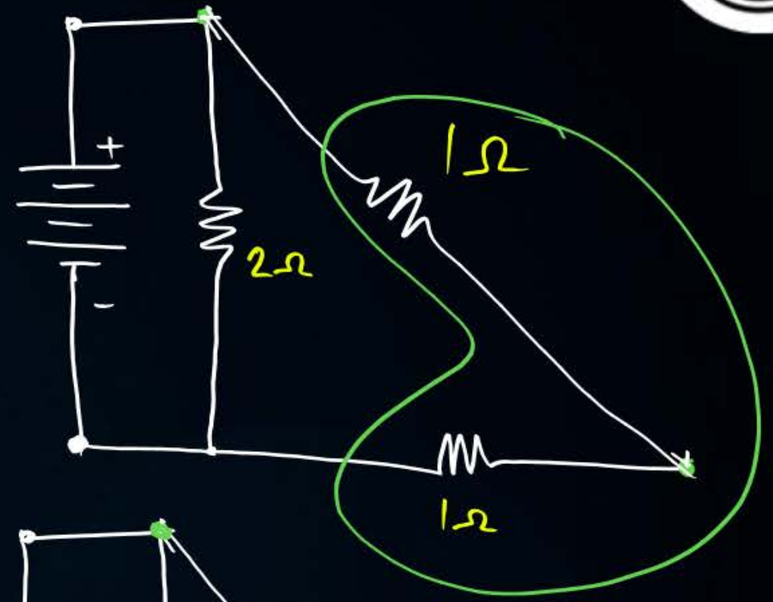
$R_t = 1\Omega$, $V = 10V$, $I = \frac{V}{R} = \frac{10}{1} = 10A$



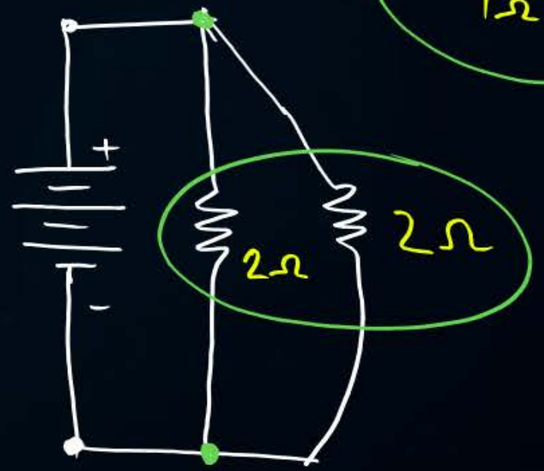
Ex-6



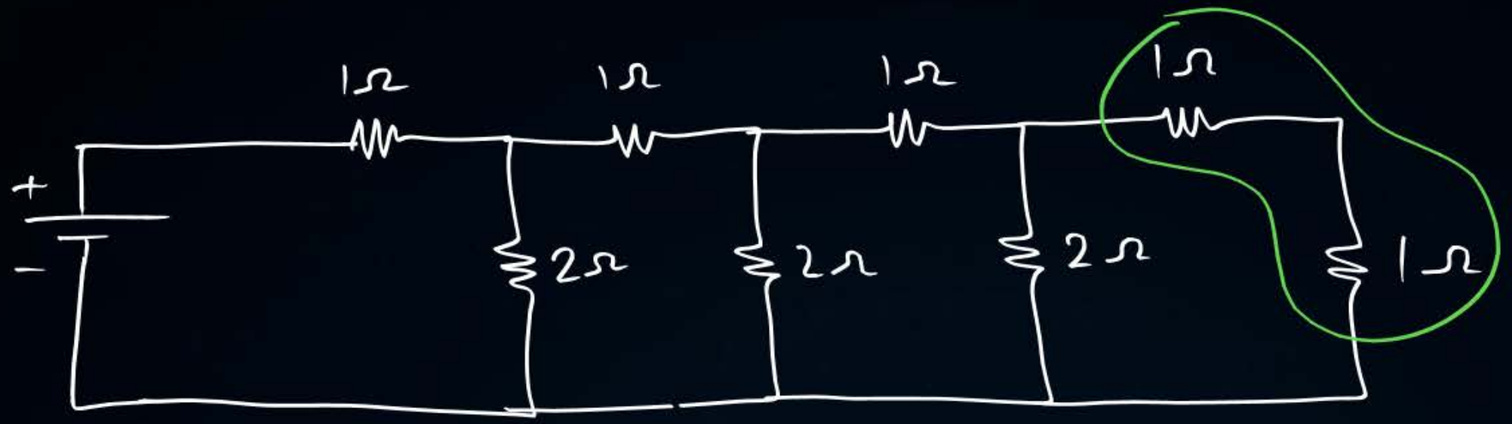




Ans



Ex-7



Ans

QUESTION

How can three resistors each of resistances 3 Ω be connected to give a total resistance of

(i) 4.5 Ω

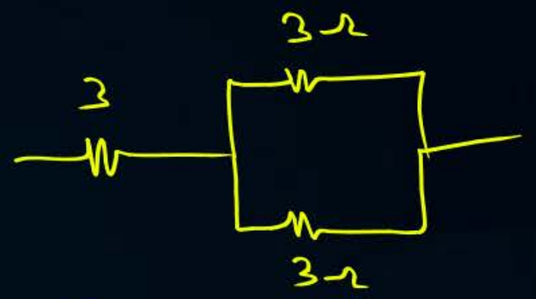
(ii) 2 Ω

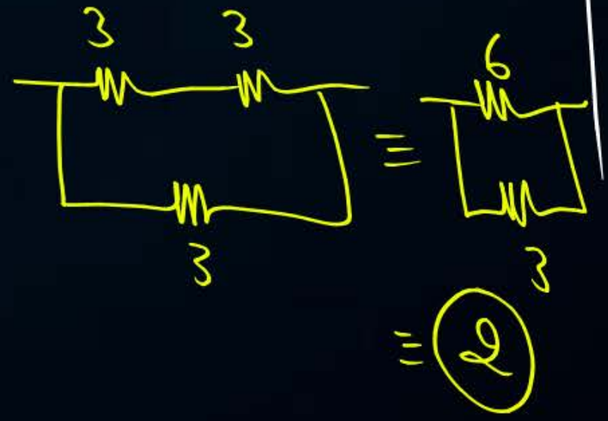
X Pure Series :- 3 3 3 ≡ 9Ω

X Pure Parallel :-

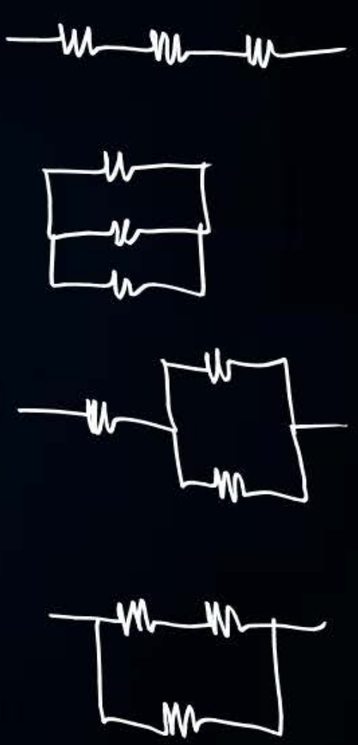
$$\frac{1}{R_p} = \frac{1}{3} + \frac{1}{3} + \frac{1}{3} = \frac{3}{3}$$

$$R_p = 1\Omega$$





NOTE



QUESTION

Show how you would connect three resistors, each of resistance 6 Ω, so that the combination has a resistance of

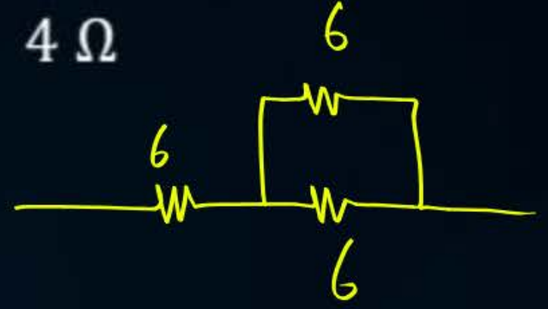
(i) 9 Ω

(ii) 4 Ω

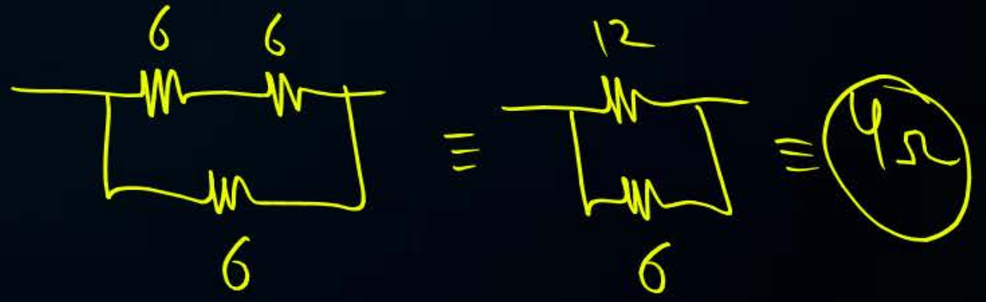
Pure Series – $6+6+6 \equiv 18\,\Omega$ ×

Pure Parallel – $\frac{1}{6}+\frac{1}{6}+\frac{1}{6} = \frac{3}{6} = 2\,\Omega$ ×

i)



ii)



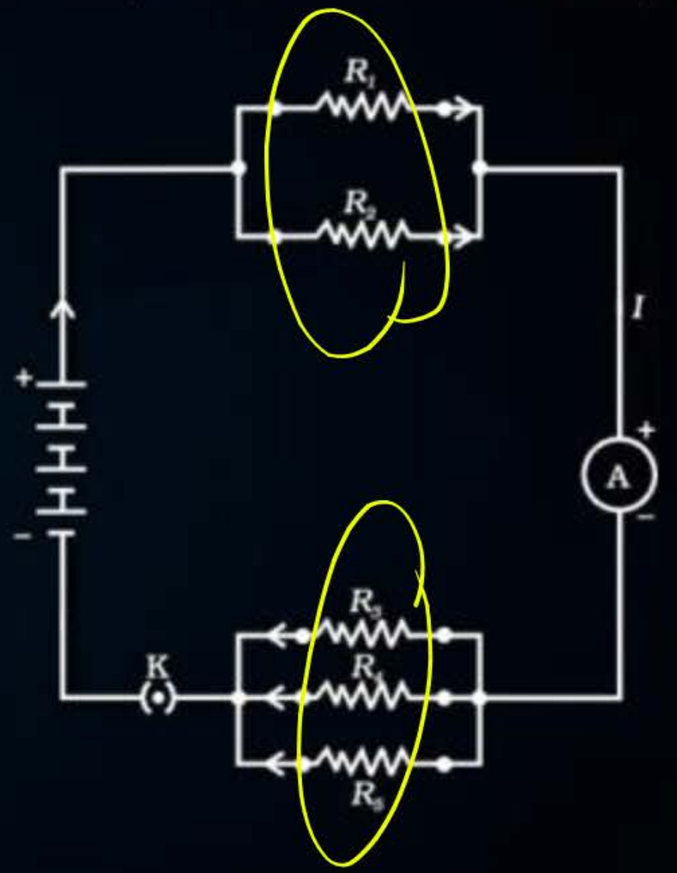
QUESTION H.W.

If in figure, $R_1 = 10\ \Omega$, $R_2 = 40\ \Omega$, $R_3 = 30\ \Omega$, $R_4 = 20\ \Omega$, $R_5 = 60\ \Omega$, and a $12\ V$ battery is connected to the arrangement. Calculate:

(a) The total resistance

(b) The total current flowing

$$i = \frac{V}{R} = \frac{12}{}$$



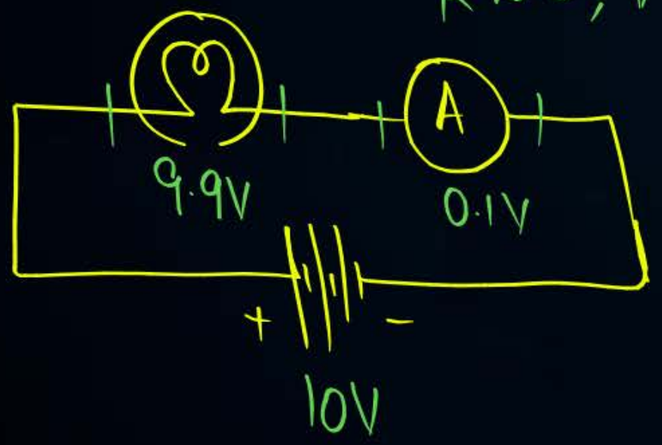
RESISTANCE OF AMMETER AND VOLTMETER

Ideal Ammeter

$R = 0\,\Omega$

'Series device'

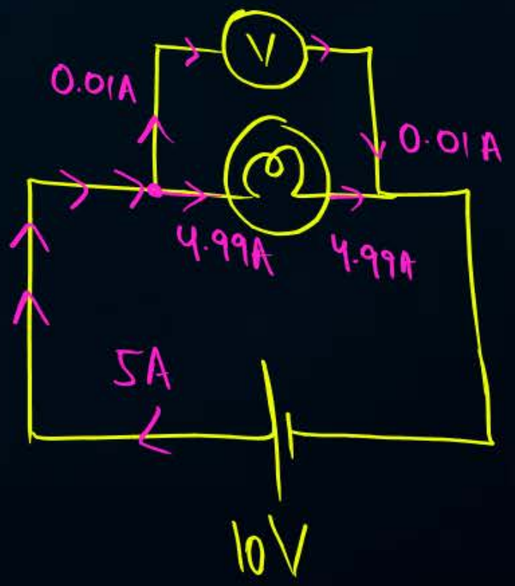
$R \approx 0, V = 0$



Ideal Voltmeter

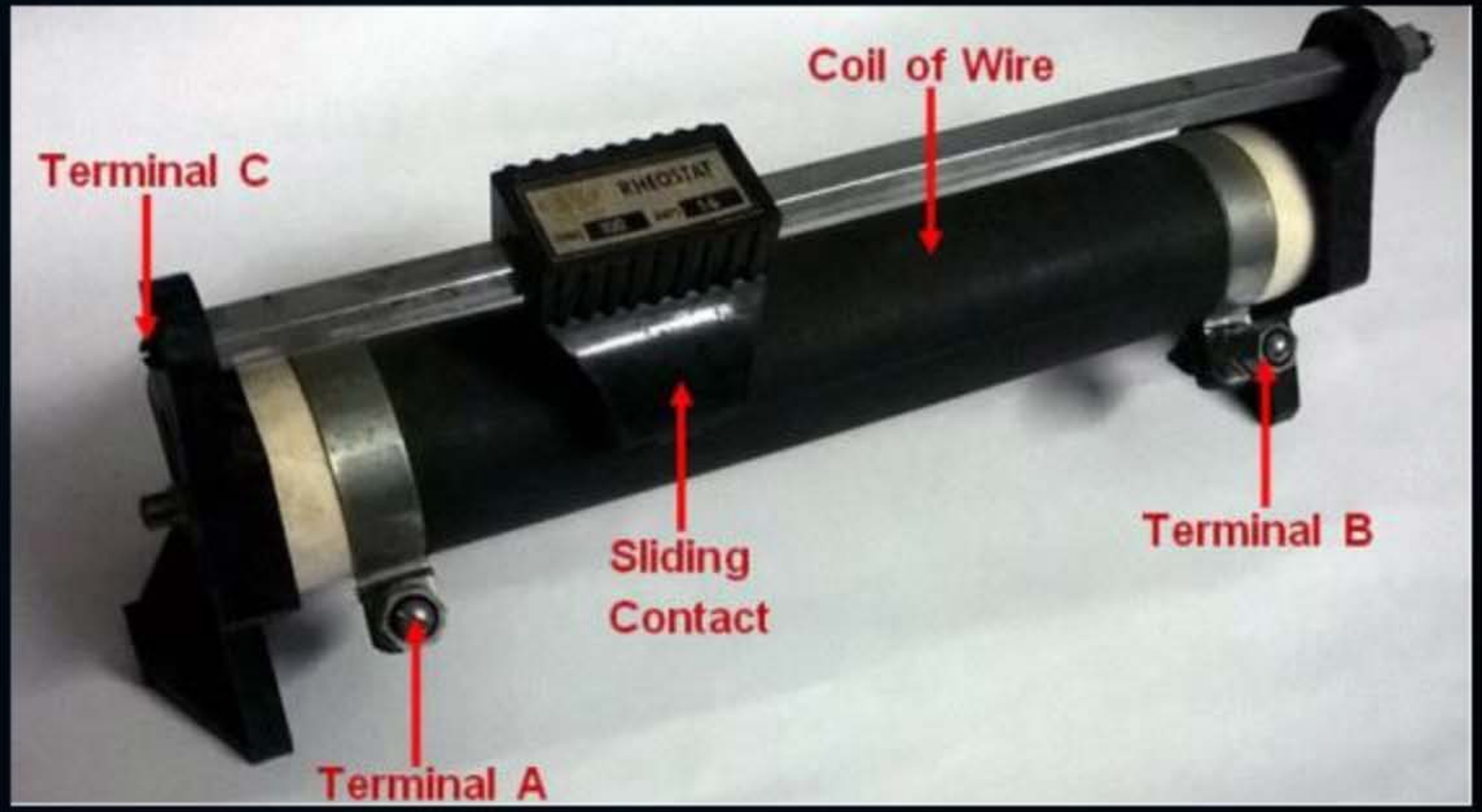
$R = \infty$

'Parallel Device'



$R \Rightarrow$ Very high

WORKING OF RHEOSTAT



THANK YOU