Q.5 Find out the value of current through 2Ω resistance for the given circuit.

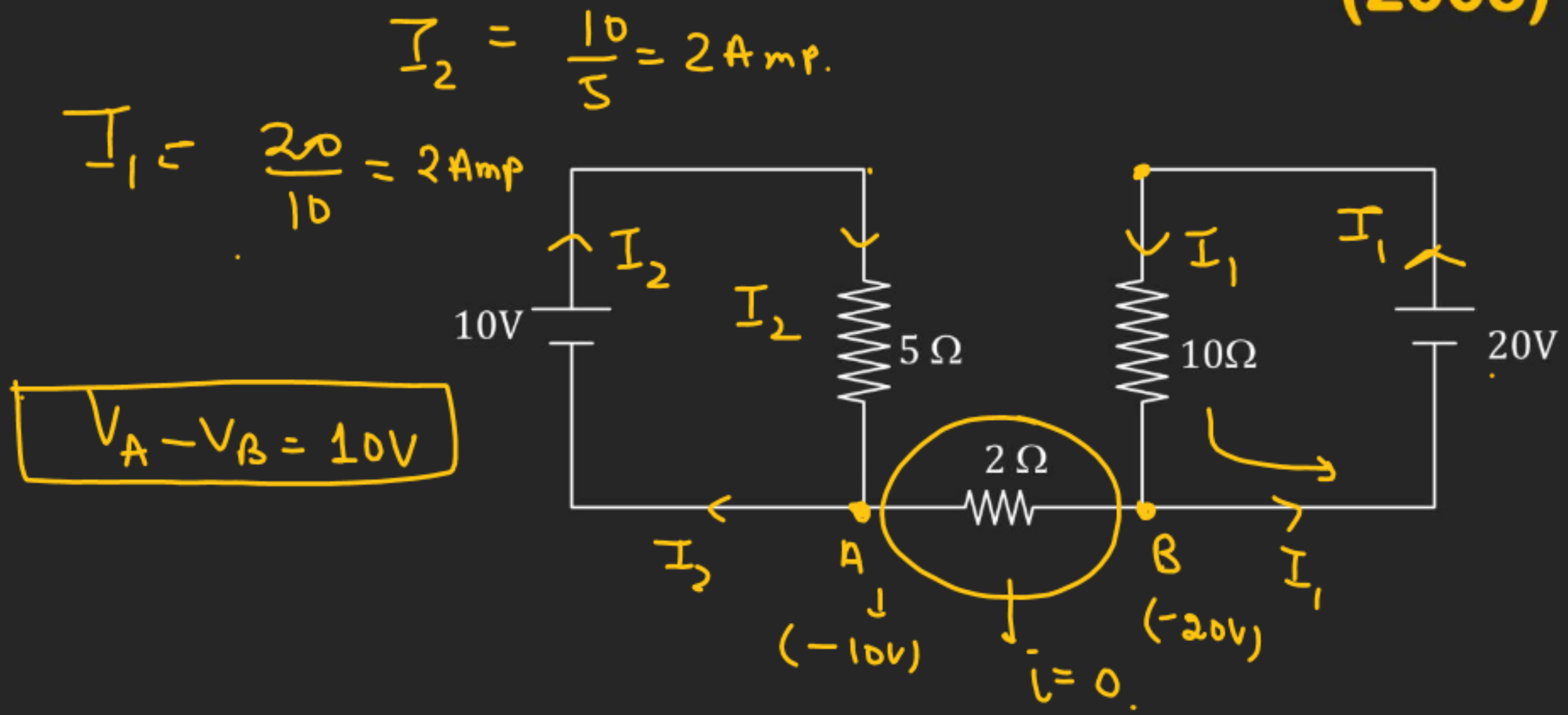
(2005)

(A) Zero ✓

(B) 2 A

(C) 5 A

(D) 4 A.



Nodal Analysis

CURRENT ELECTRICITY

Q.6 In the circuit shown in figure the current through **(1998)**

(A) the 3Ω resistor is 0.50 A.

(B) the 3Ω resistor is 0.25 A.

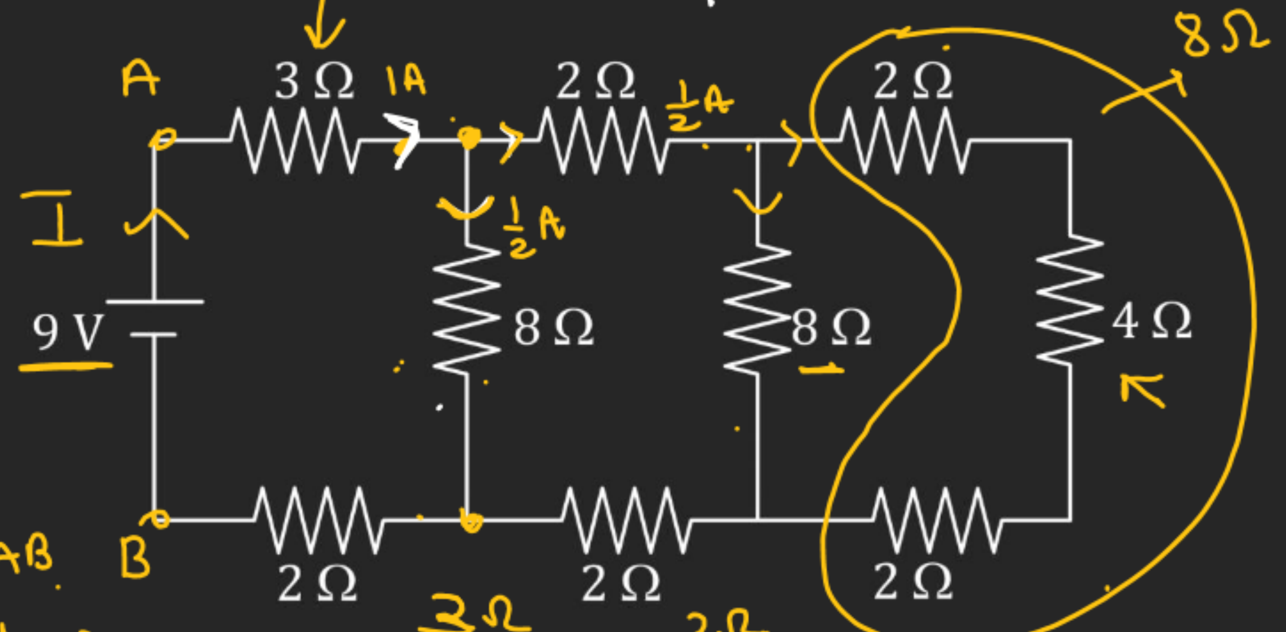
(C) the 4Ω resistor is 0.50 A.

(D) the 4Ω resistor is 0.25 A. ✓

$\frac{1}{R_{eq}} = \frac{1}{8} + \frac{1}{8}$

$\frac{1}{R_{eq}} = \frac{2}{8} = \frac{1}{4}$

$R_{eq} = 4$



$V = I_1R_1 = I_2R_2$

if $R_1 = R_2$

$\underline{I_1 = I_2}$

$I = \frac{9}{(R_{eq})_{AB}}$

$I = \frac{9}{9} = 1\ \text{Amp}.$

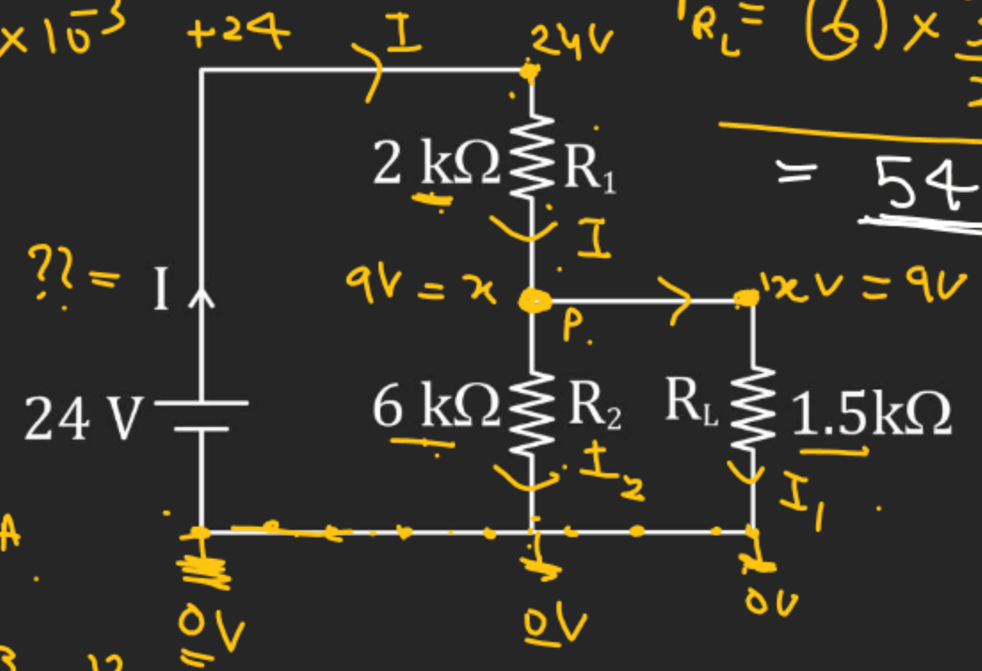
Q.7 For the circuit shown in the figure **(2009)**

(A) the current I through the battery is $7.5\ \mathrm{mA}$

(B) the potential difference across R_L is $18\ \mathrm{V}$

(C) ratio of powers dissipated in R_1 and R_2 is 3

(D) if R_1 and R_2 are interchanged, magnitude of the power dissipated in R_L will decrease by a factor of 9



$P_{2k\Omega} = \left(\frac{15}{2}\right)^2 \times 2$

$P_{6k\Omega} = \left(\frac{3}{2}\right)^2 \times 6$

$\frac{P_{2k\Omega}}{P_{6k\Omega}} = \left[\frac{15}{\cancel{2}} \times \frac{\cancel{2}}{3}\right]^2 \times \frac{2}{6} = 25 \times \frac{1}{3}$

⇒ K.C.L at P

$\frac{x-24}{2} + \frac{x}{6} + \frac{2x}{3} = 0$

$\left(\frac{x}{2} + \frac{x}{6} + \frac{2x}{3}\right) = 12$

$\frac{3x + x + 4x}{6} = 12$

$8x = 72$

$\Rightarrow x = 9\ \text{Volt}$

$I = \left(\frac{24-9}{2}\right) \times 10^{-3}$

$I = \frac{15}{2} \times 10^{-3}$

$= 7.5\ \mathrm{mA}$

$I_2 = \frac{9}{6}\ \mathrm{mA}$

$= \frac{3}{2}\ \mathrm{mA}$

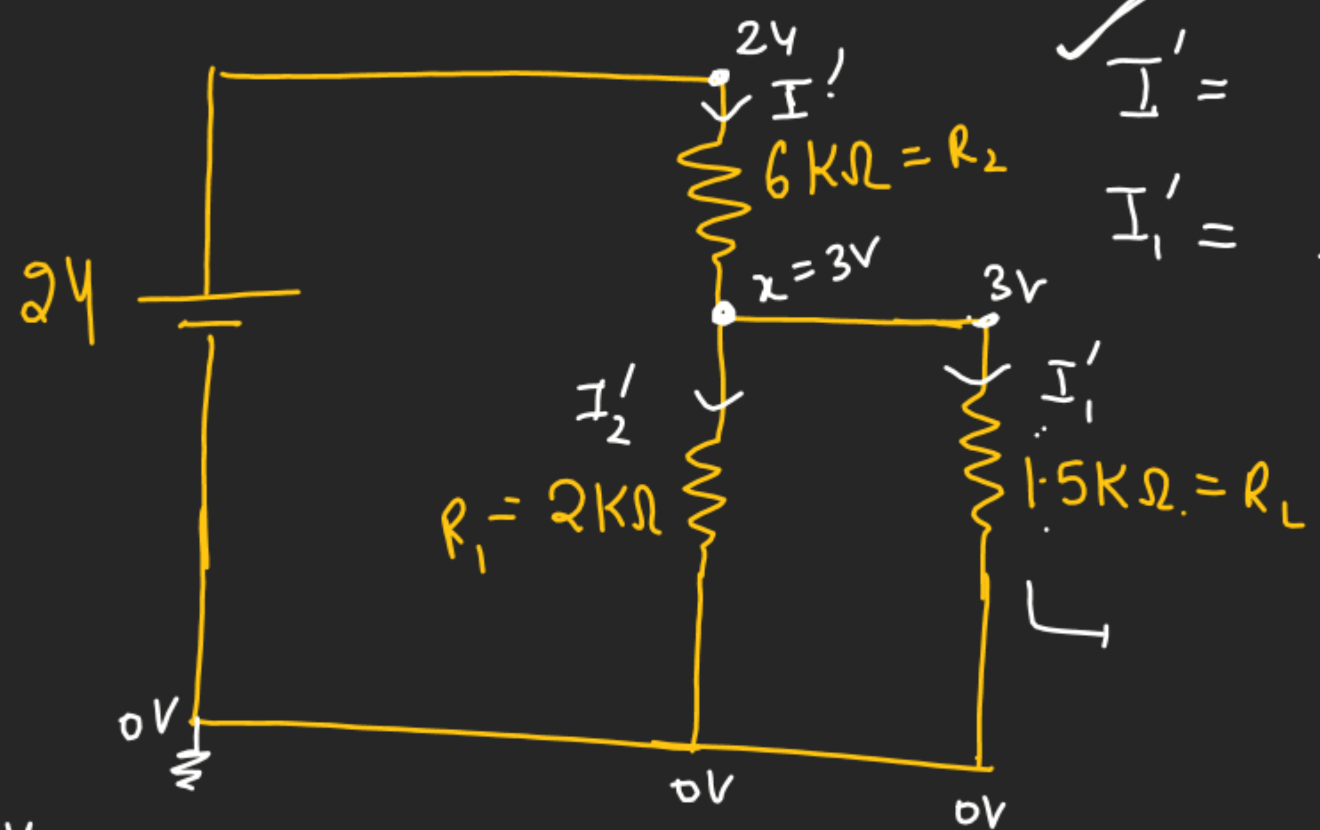
$I_1 = \frac{15}{2} - \frac{3}{2} = \frac{12}{2} = 6\ \text{Amp}$

$P_{R_L} = (6)^2 \times \frac{3}{2}$

$= 54\ \text{watt}$

Nodal Analysis

CURRENT ELECTRICITY



$$I' = \frac{24-3}{6} = \frac{21}{6} = 7/2 \text{ Amp.}$$

$$I_1' = \frac{3}{3/2} = 2 \text{ Amp.}$$

$$P'_{R_L} = (I_1'^2) \times R_L$$

$$= 4 \times \frac{3}{2}$$

$$= 6 \text{ watt}$$

$$\frac{x-24}{6} + \frac{x}{2} + \frac{2x}{3} = 0$$

$$\left(\frac{x}{6} + \frac{x}{2} + \frac{2x}{3}\right) = 4 \Rightarrow 8x = 24$$

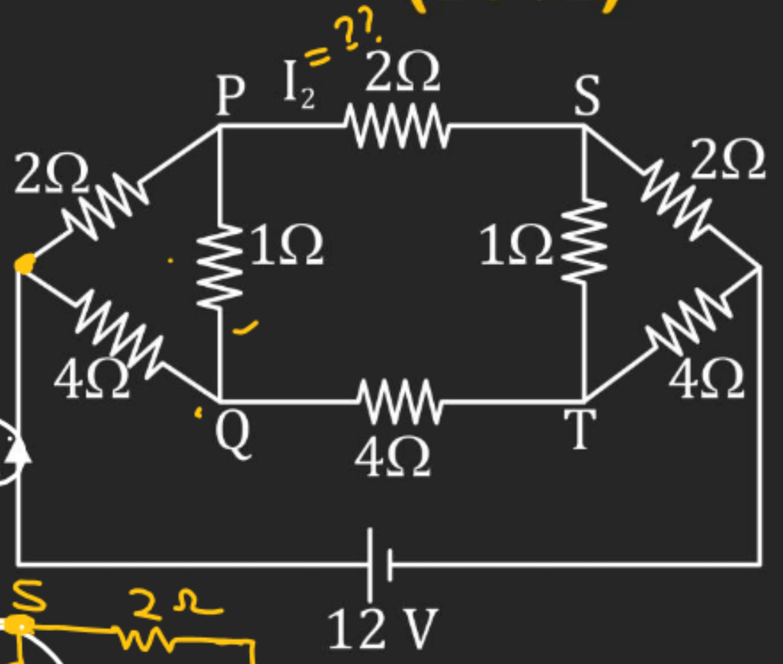
$$\frac{x+3x+4x}{6} = 4 \qquad x = 3\text{Volt}$$

Nodal Analysis

CURRENT ELECTRICITY

Q.8 For the resistance network shown in the figure, choose the correct option(s).

(2012)



(A) The current through PQ is zero.

(B) $I_1 = 3$ A.

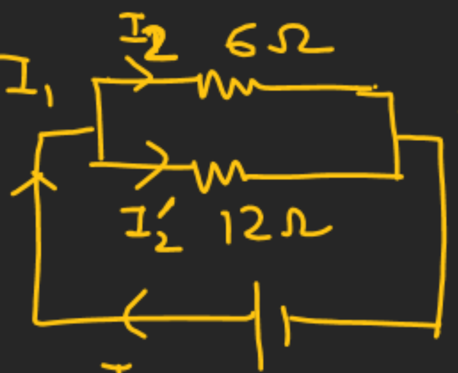
(C) The potential at S is less than that at Q.

(D) $I_2 = 2$ A

$R_{eq} = \frac{6 \times 12}{6+12}$

$= \frac{72}{18} = 4\Omega$

$I_1 = \frac{12}{4} = 3$ Amp.

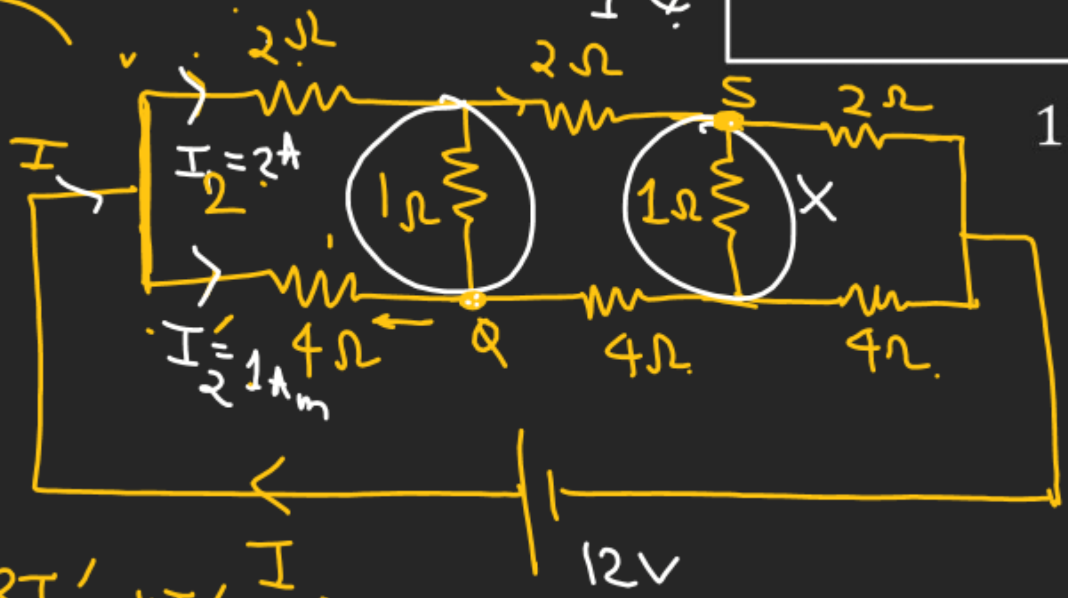


I_1

$I_2 6 = I_2' 12$

$\boxed{I_2 = 2I_2'}$

$I_2 + I_2' = 3$



$2I_2' + I_2' = 3$

$I_2' = 1$ Amp. $I_2 = 2$ Amp.

$V_Q + 4 - 4 - 4 = V_S$

$V_Q - V_S = 4$

$V_Q = 4 + V_S$

$V_Q > V_S$

Q.10 Two ideal batteries of emf V_1 and V_2 and three resistances R_1, R_2 and R_3 are connected as shown in the figure. The current in resistance R_2 would be zero if **(2014)**

(A) $V_1 = V_2$ and $R_1 = R_2 = R_3$

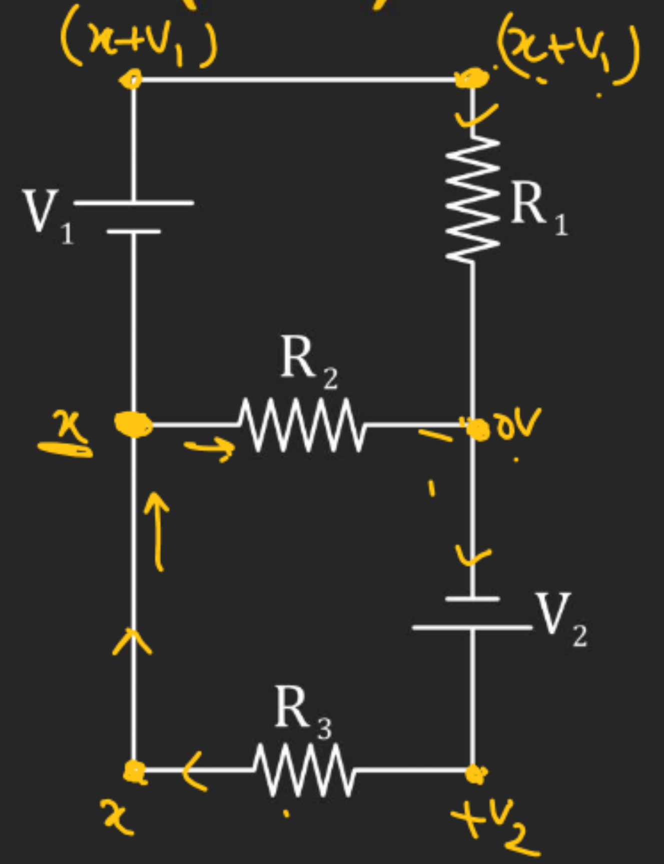
(B) $V_1 = V_2$ and $R_1 = 2R_2 = R_3$

(C) $V_1 = 2V_2$ and $2R_1 = 2R_2 = R_3$

(D) $2V_1 = V_2$ and $2R_1 = R_2 = R_3$

Node dependency ?

A B D



$$\frac{x+V_1}{R_1} + \frac{(x-0)}{R_2} + \frac{x-V_2}{R_3} = 0$$

$$\left(\frac{x}{R_1}+\frac{x}{R_2}+\frac{x}{R_3}\right) + \frac{V_1}{R_1} - \frac{V_2}{R_3} = 0$$

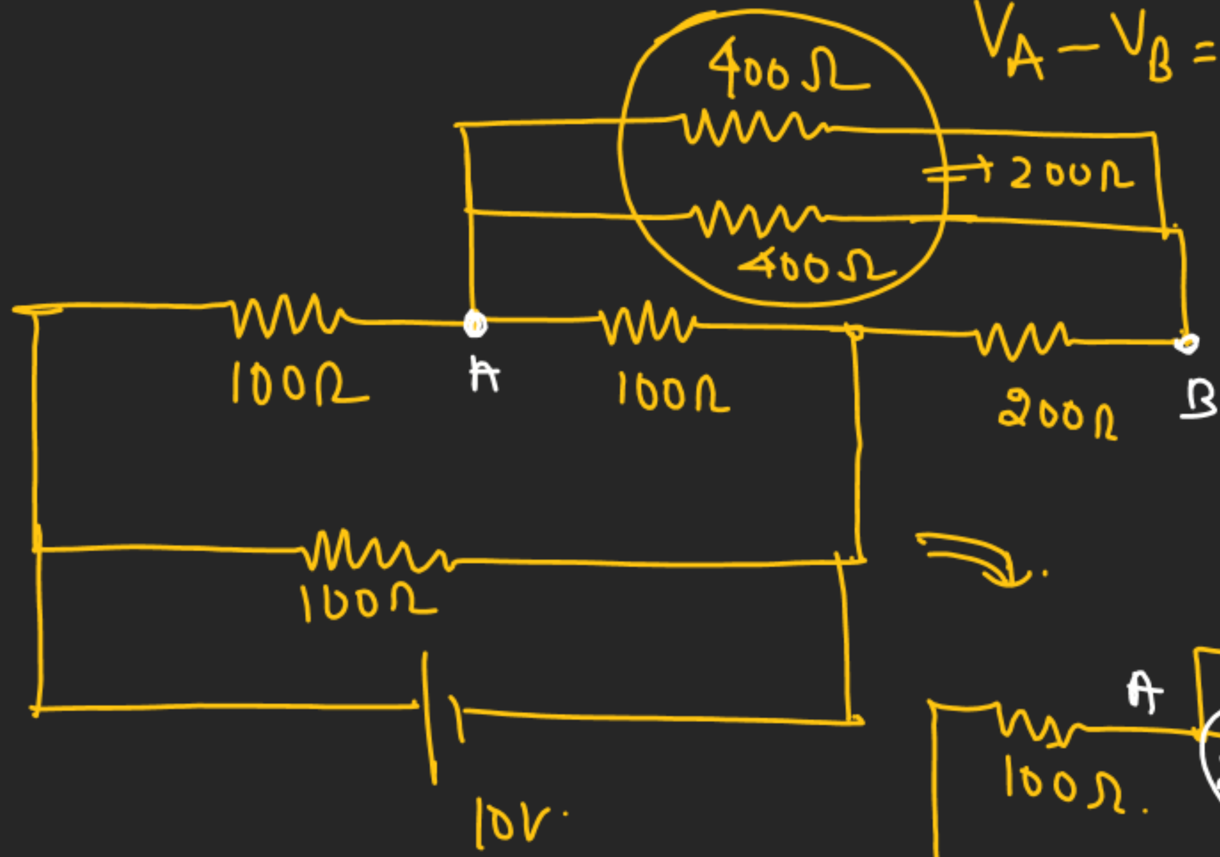
$$x\left(\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}\right) = \frac{V_2}{R_3} - \frac{V_1}{R_1}$$

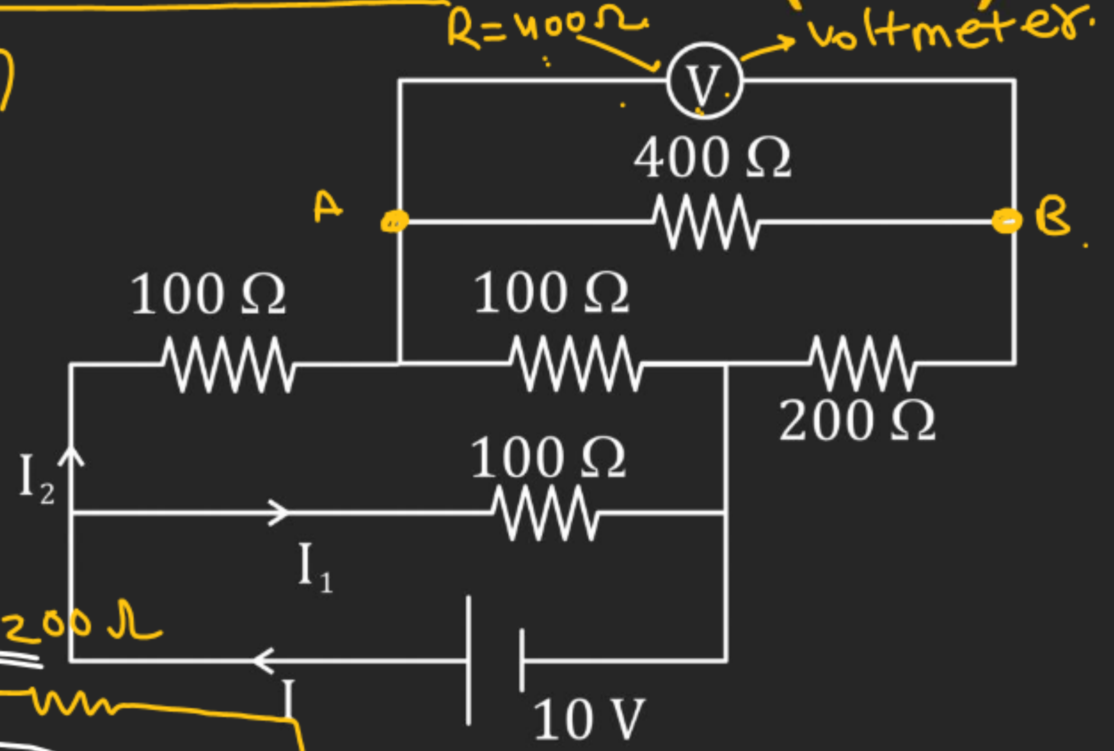
$$x = \left[\frac{V_2R_1 - V_1R_3}{\left(\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}\right)}\right]$$

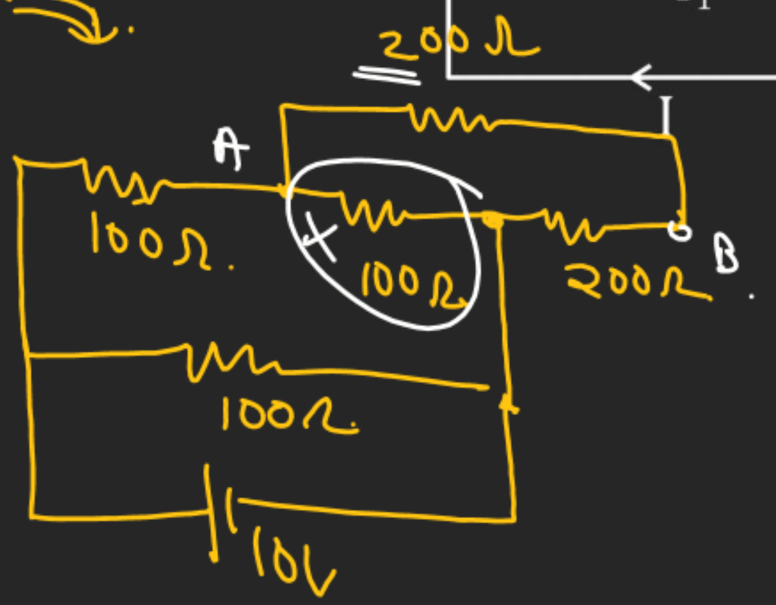
$V_2R_1 = V_1R_3$ $\quad x = 0$ for current in R_2 to be zero

Q.12 An electrical circuit is shown in the figure. Calculate the potential difference across the resistor of 400ohm, as will be measured by the voltmeter V of resistance 400ohm, either by applying Kirchhoff's rules or otherwise. **(1996)**

$V_A - V_B = ??$







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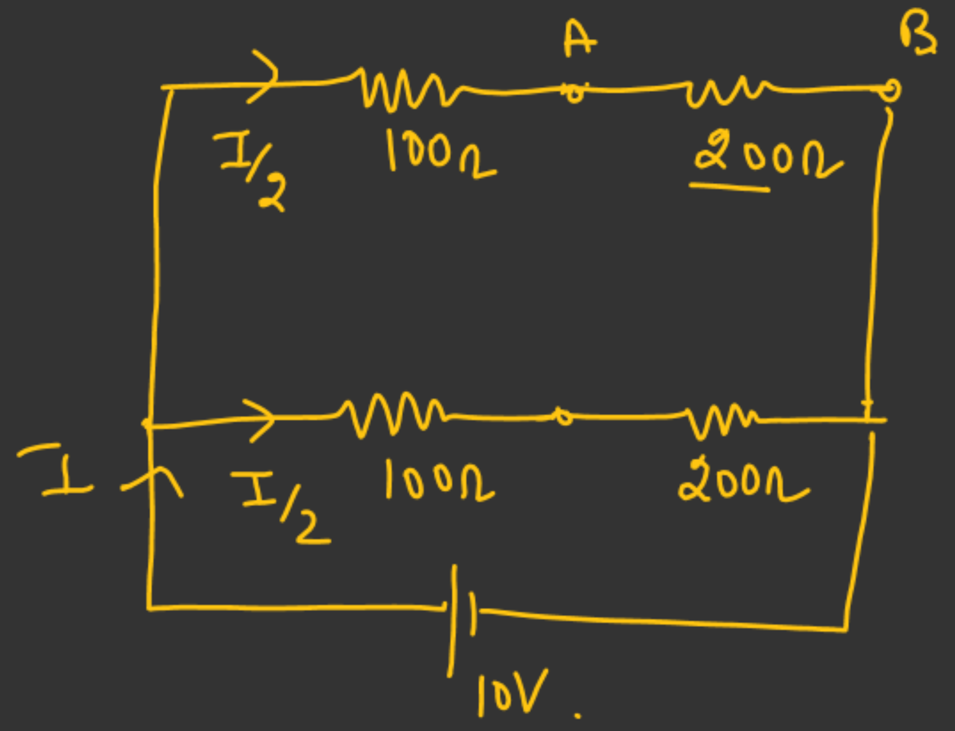
$R_{eq} = 150\Omega$.



$$V_{AB} = \frac{1}{30} \times 200$$

$$= \frac{20}{3} \text{ volt}$$

$$I = \frac{10}{150} = \left(\frac{1}{15}\right) \text{Amp.}$$