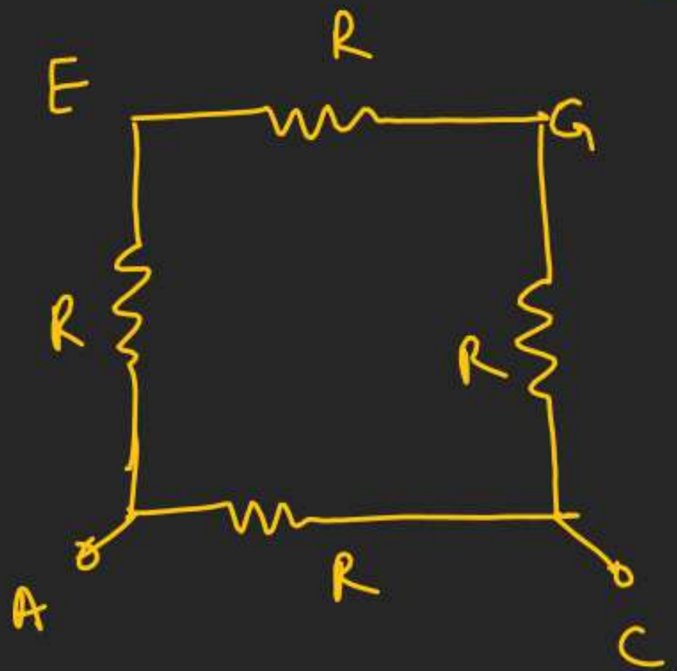
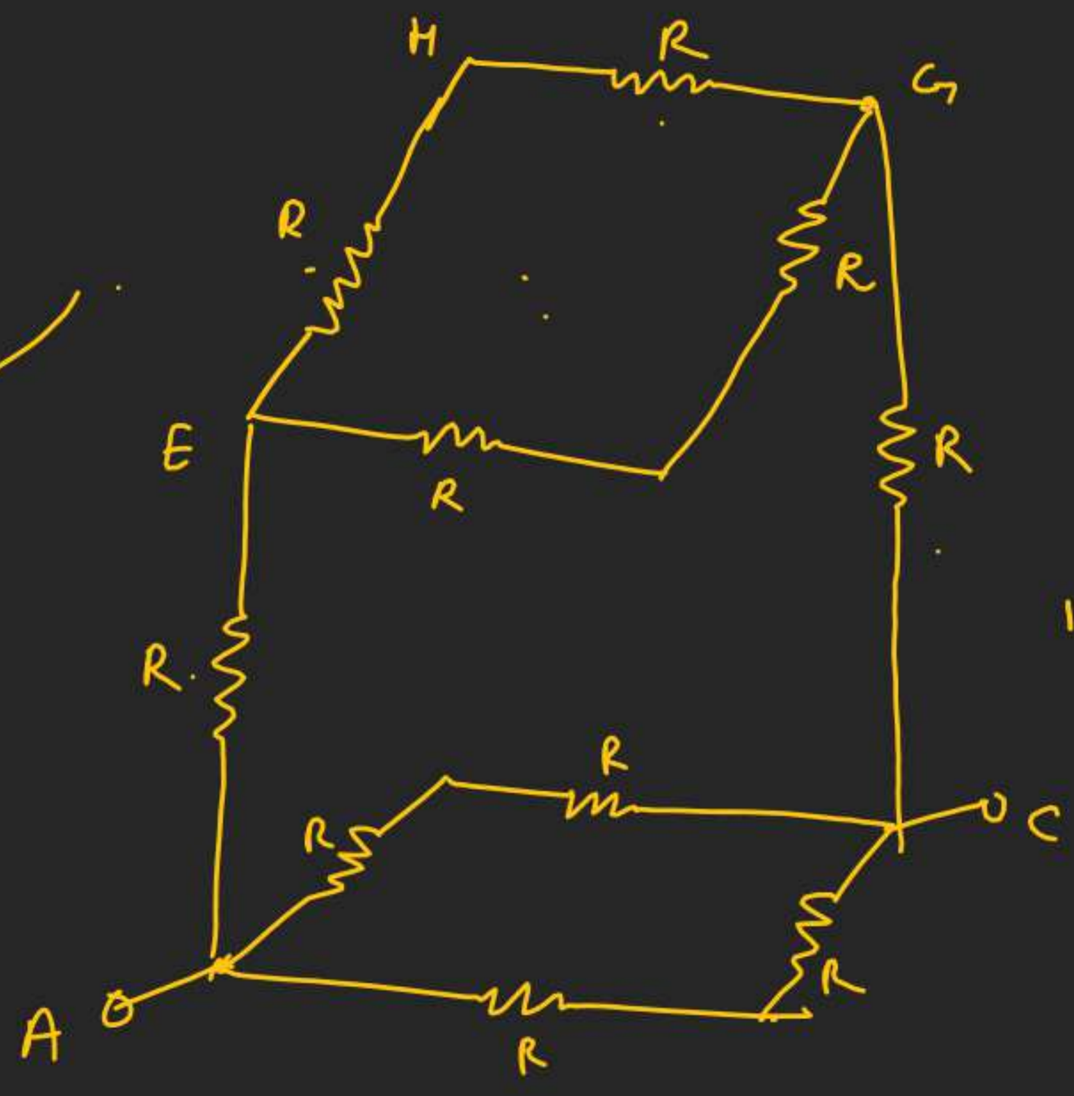
Nishant Jindal

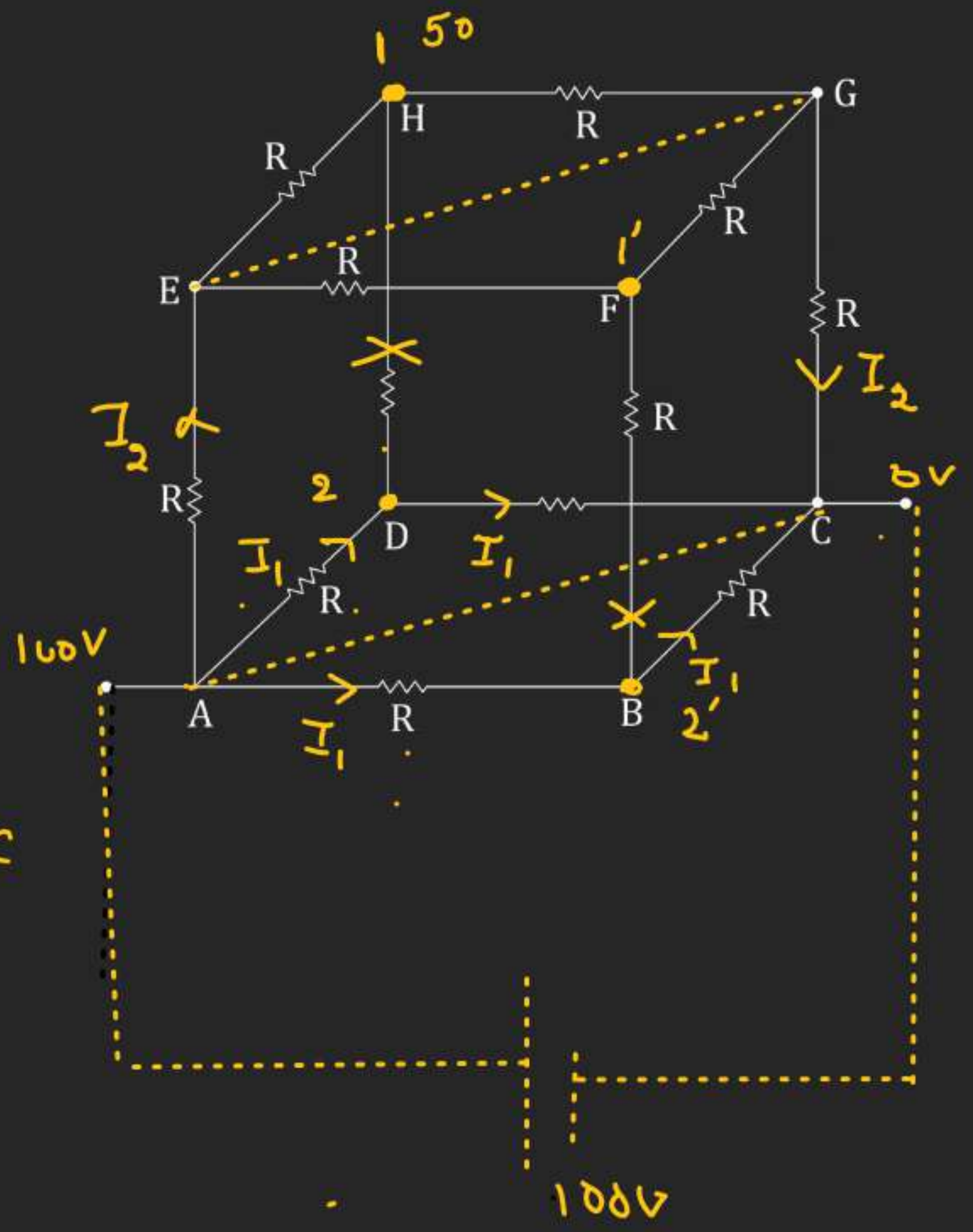
Equivalent resistance by symmetry

CURRENT ELECTRICITY

$$(R_{eq})_{AB} = \frac{3R \cdot R}{3R+R} = \left(\frac{3R}{4}\right)$$



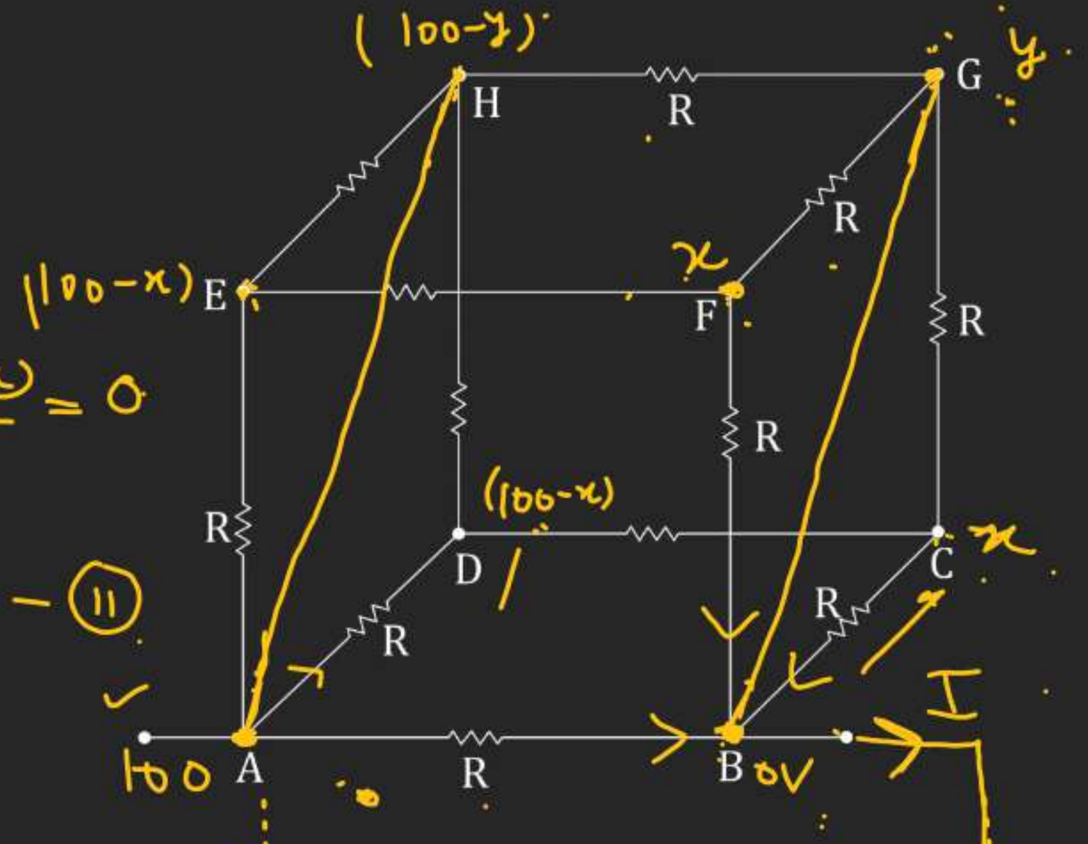




CURRENT ELECTRICITY

$$V = I R_{eq} \Rightarrow R_{eq} = \frac{V}{I} = \frac{100}{I}$$

Q.8 Find the equivalent resistance across the terminals A and B in the circuit shown in figure. Each resistance in circuit is R.



(R_{eq}) about edge ??

For Node F

$$\frac{x-y}{R} + \frac{x-0}{R} + \frac{x-(100-x)}{R} = 0$$

$$4x - y = 100 \quad \text{— (1)}$$

$$4x - \frac{6x}{5} = 100$$

$$14x = 500$$

$$x = \frac{500}{14} = \left(\frac{250}{7}\right) \text{Volt}$$

For Node G

$$\frac{y-(100-y)}{R} + \frac{2(y-x)}{R} = 0$$

$$4y - 2x = 100 \quad \text{— (11)}$$

$$4y - 2x = 4x - y$$

$$5y = 6x$$

$$y = \left(\frac{6x}{5}\right)$$

A+B

$$\frac{100-0}{R} + \left(\frac{x-0}{R}\right) \times 2 = I$$

$$\frac{100}{R} + \frac{2}{R} \times \frac{250}{7} = I$$

$$\frac{100}{R} + \frac{500}{7R} = I \Rightarrow \frac{100}{R}\left(1 + \frac{5}{7}\right) = I$$

$$R_{eq} \leftarrow \frac{100}{I} = \frac{7R}{12}$$

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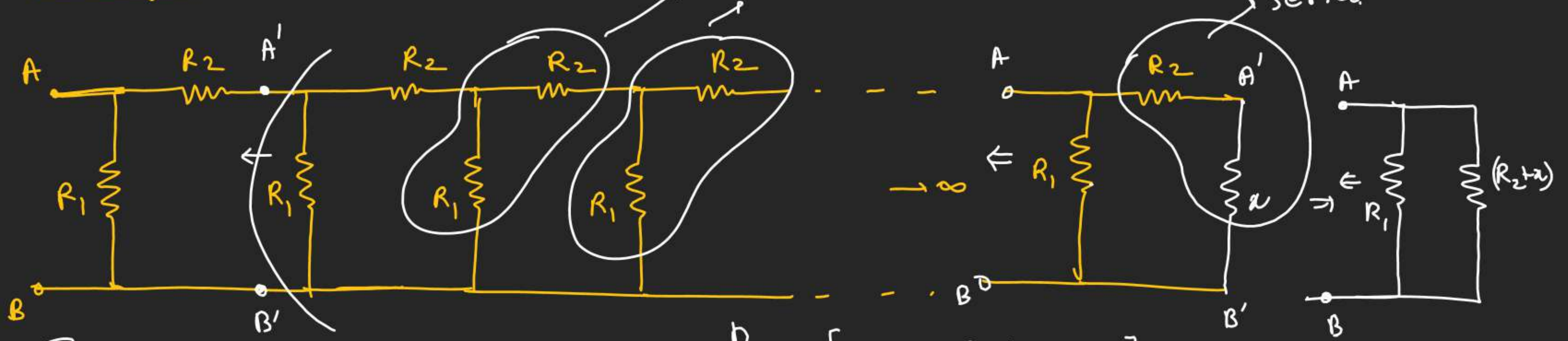
Case of infinite ladder

#



Since ladder is infinite

So, $(R_{eq})_{A-B} = (R_{eq})_{A'B'} = x$

$$R_{AB} \Rightarrow \left[x = \frac{R_1(R_2+x)}{R_1+R_2+x}\right]$$

$$x(R_1+R_2)+x^2 = R_1R_2+R_1x$$

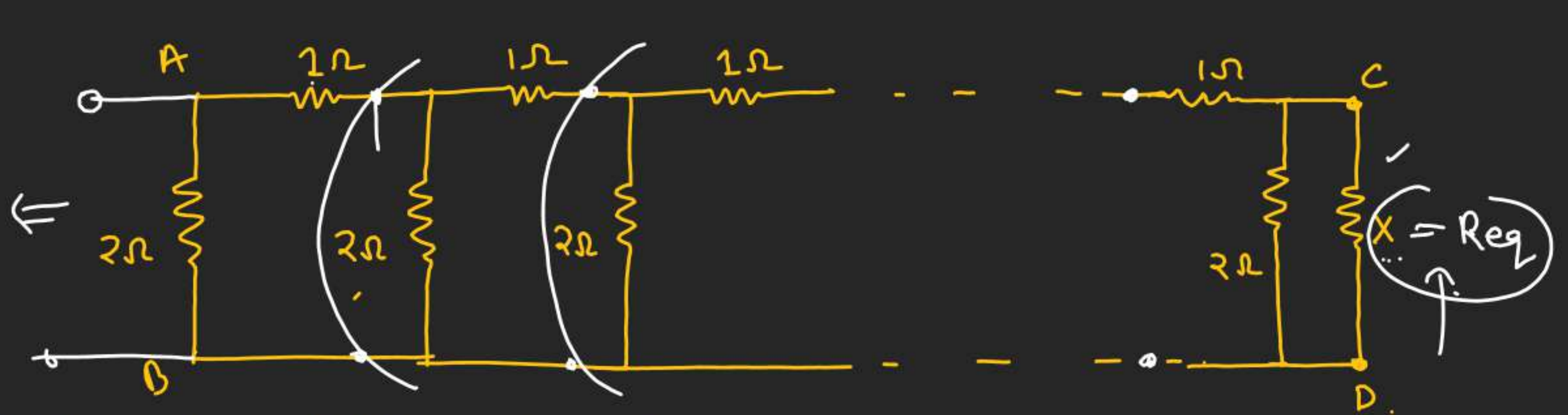
$$x^2 + R_2x - R_1R_2 = 0$$

$$x = \frac{-R_2 \pm \sqrt{R_2^2+4R_1R_2}}{2}$$

$$x = \frac{-R_2+\sqrt{R_2^2+4R_1R_2}}{2}$$

$$x = \frac{R_2}{2}\left[-1+\sqrt{1+\frac{4R_1}{R_2}}\right]$$

#



Find the value of 'x' so that Equivalent resistance of the Ckt is independent of the no of repeating sequence of the Ckt.

$\hookrightarrow$ $x = (R_{eq}) = 1\Omega$ ✓

$$\frac{(1+x)2}{1+x+2} = x$$

$$2+2x = x(3+x)$$

$$2+2x = 3x+x^2$$

$$x^2+x-2=0$$

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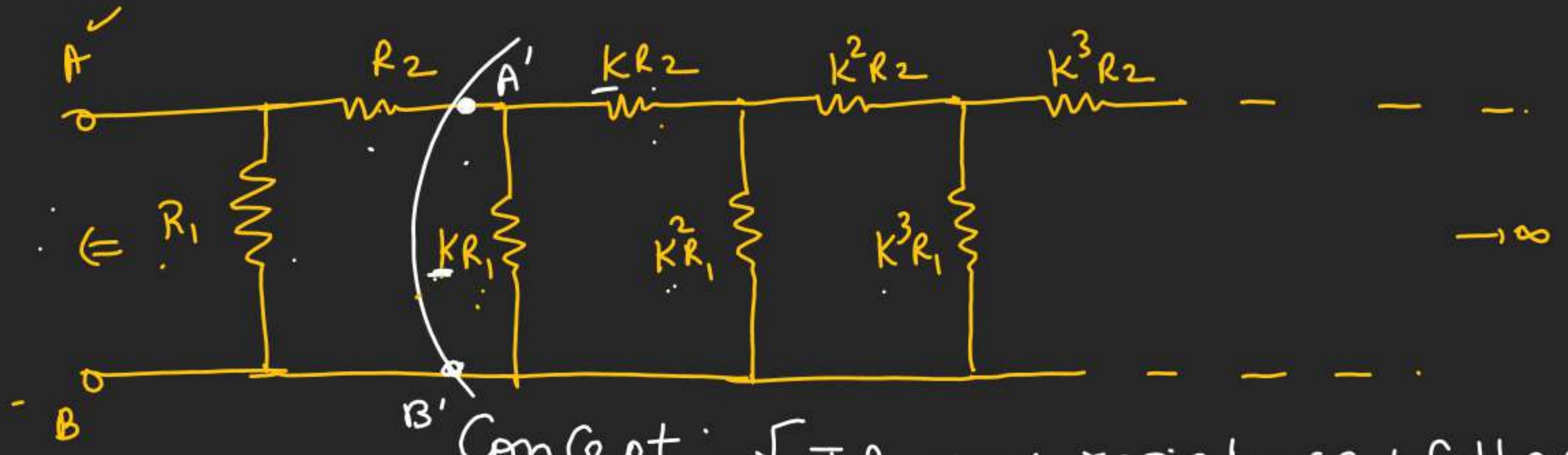
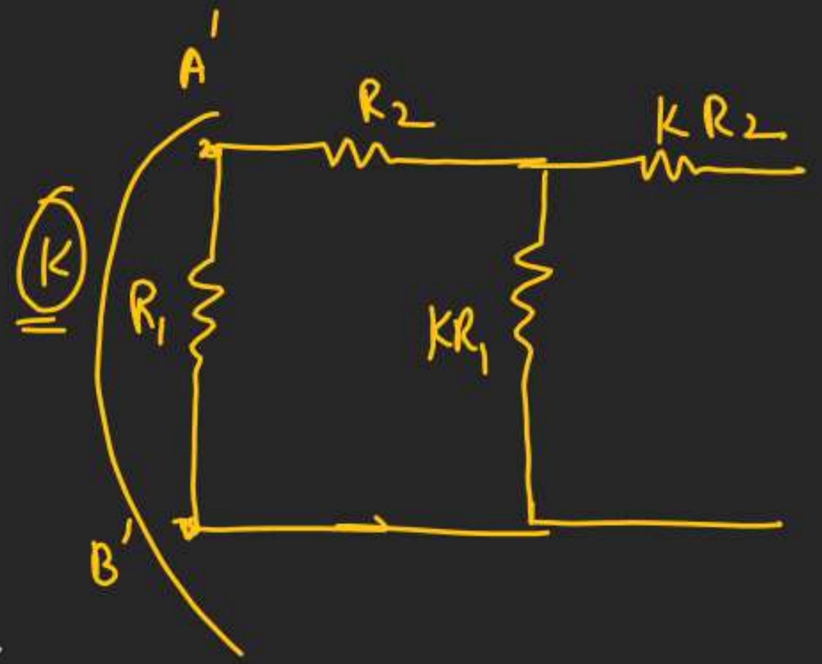
CURRENT ELECTRICITY



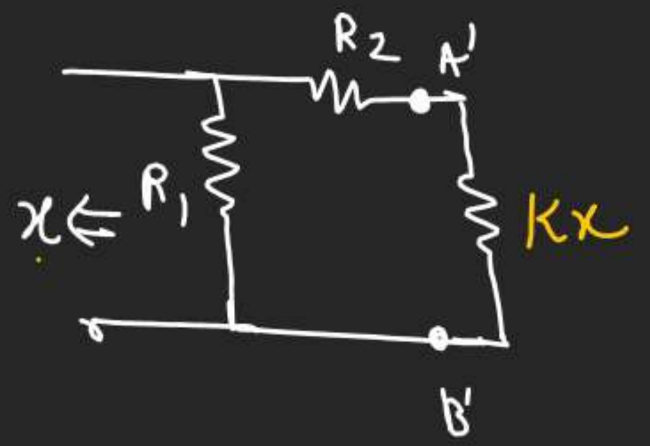


$(R_{eq})_{AB} = ??$

Concept → If each resistance of the Ckt is multiply by a constant 'K' then Equivalent resistance of the Ckt is also become 'K' times.

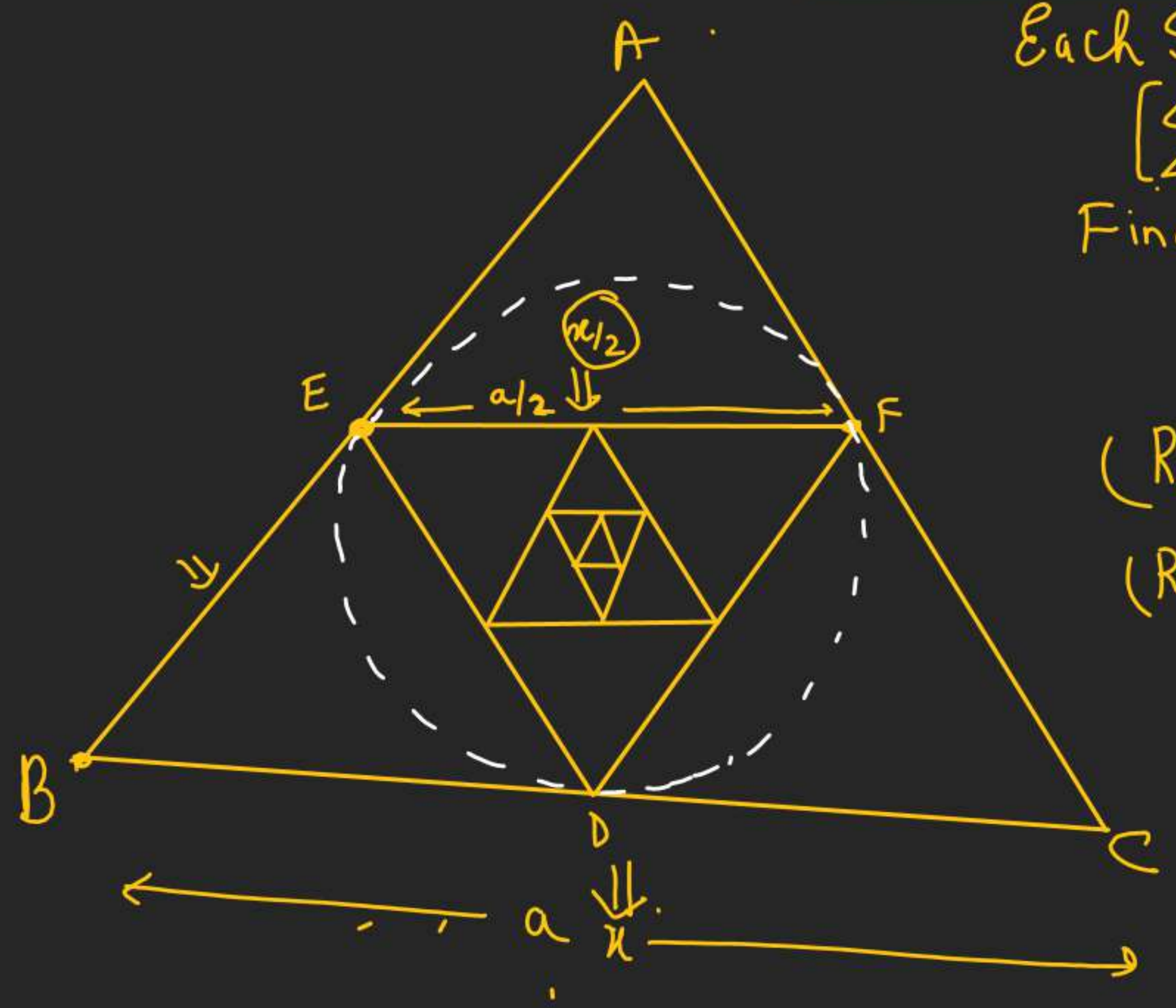
$(R_{eq})_{AB} = x$

$(R_{eq})_{A'B'} = Kx$



$$\boxed{x = \frac{(R_2 + Kx)R_1}{R_1 + R_2 + Kx}}$$

→ Solve for $K = \frac{1}{2}$ (given)



Each Side of the Successive triangle decreases by $\frac{1}{2}$.

$\Delta ABC \rightarrow$ Side length $\rightarrow a$
$\Delta DEF \rightarrow$ Side length $\rightarrow \frac{a}{2}$

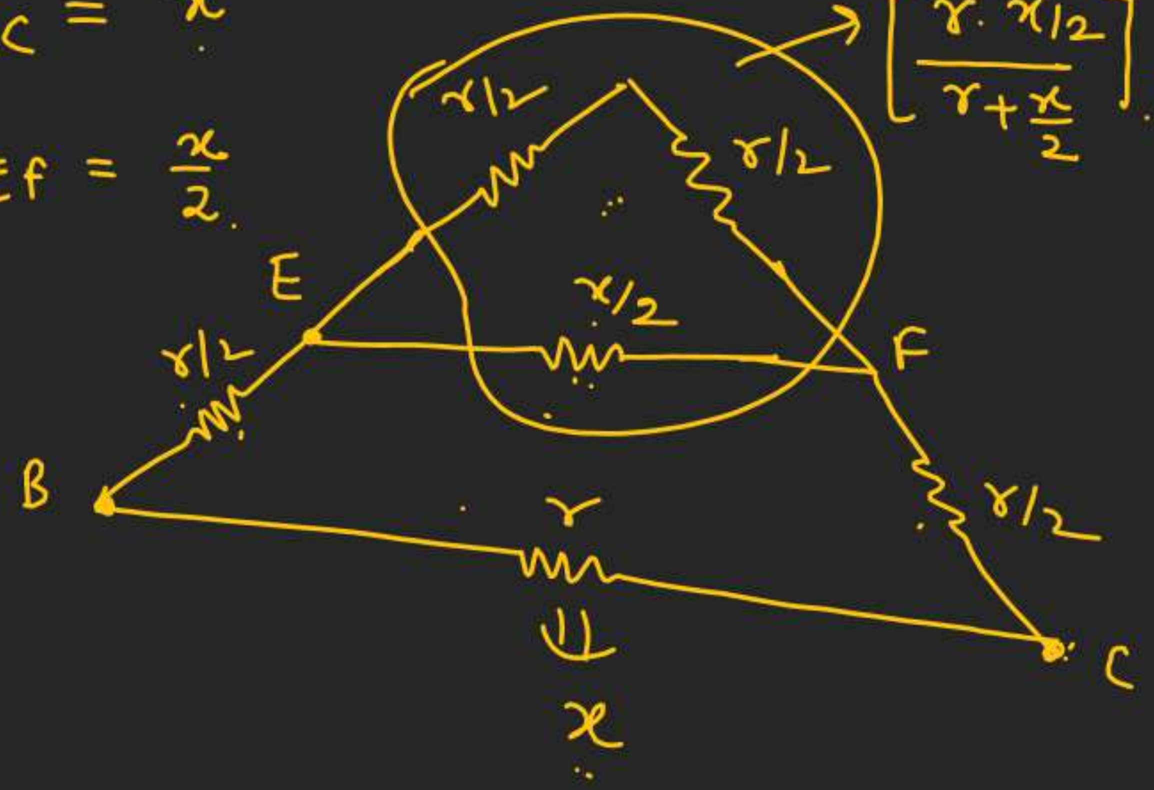
Find Equivalent resistance about BC of the network.

$BC \rightarrow r$

$BD = DC = BE = CF = EA = AF = \frac{r}{2}$

$(R_{eq})_{BC} = x$

$(R_{eq})_{EF} = \frac{x}{2}$



$\left[\frac{r \cdot x/2}{r + \frac{x}{2}}\right] = r_{EF}$

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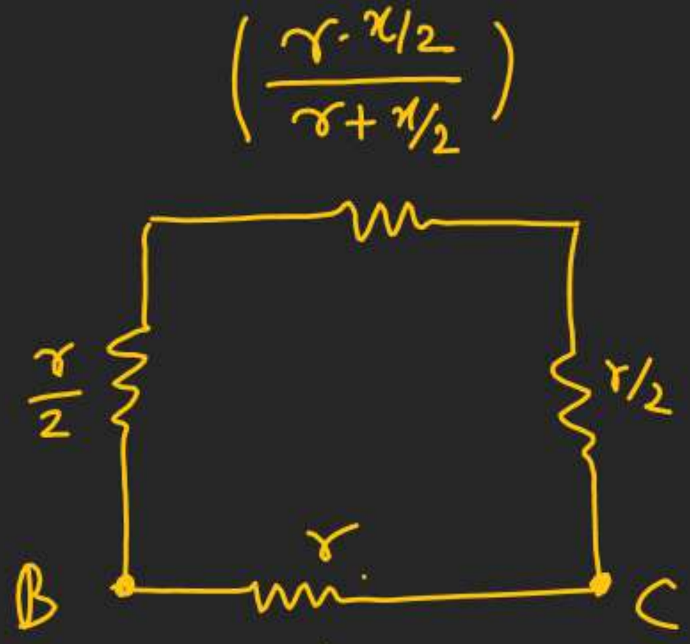

$\Downarrow$

x

$$\Rightarrow \frac{\left[\left[\frac{r \cdot (x/2)}{r + \frac{x}{2}}\right] + r\right] r}{\left[\frac{(r \cdot x/2)}{(r + x/2)} + r + r\right]} = x$$

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Each wire has resitance 'r'.

Find $(r_{eq})_{AB} = ??$