Nishant Jindal

CURRENT ELECTRICITY

Equivalent resistance by symmetry

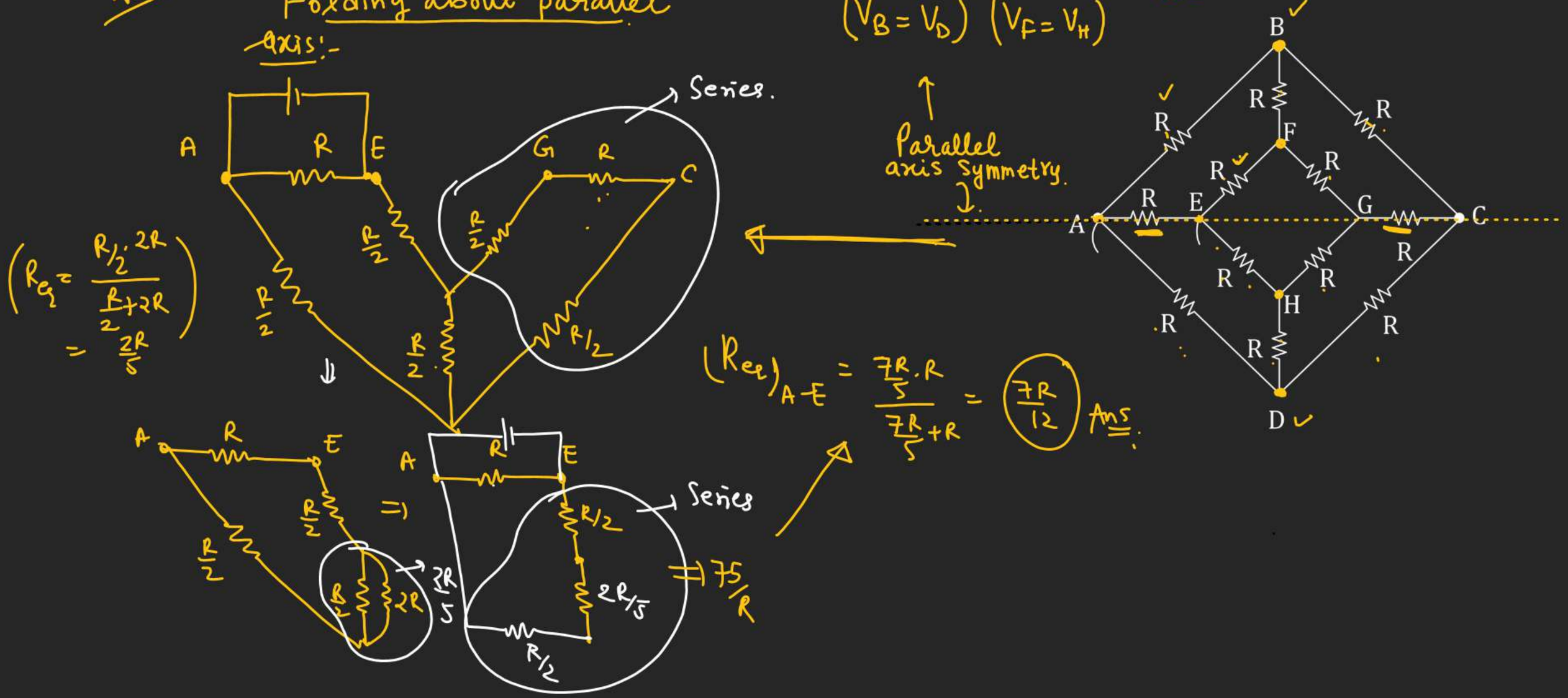
Last lecture ||[Correction]

AA.

Folding about parallel axis:-

$(V_B = V_D)$ $(V_F = V_H)$

Parallel axis symmetry.



$\left(R_{eq} = \frac{\frac{R}{2} \cdot 2R}{\frac{R}{2} + 2R}\right) = \frac{2R}{5}$

$(R_{eq})_{A-E} = \frac{\frac{7R}{5} \cdot R}{\frac{7R}{5} + R} = \frac{7R}{12}$ Ans.

$= 75/R$

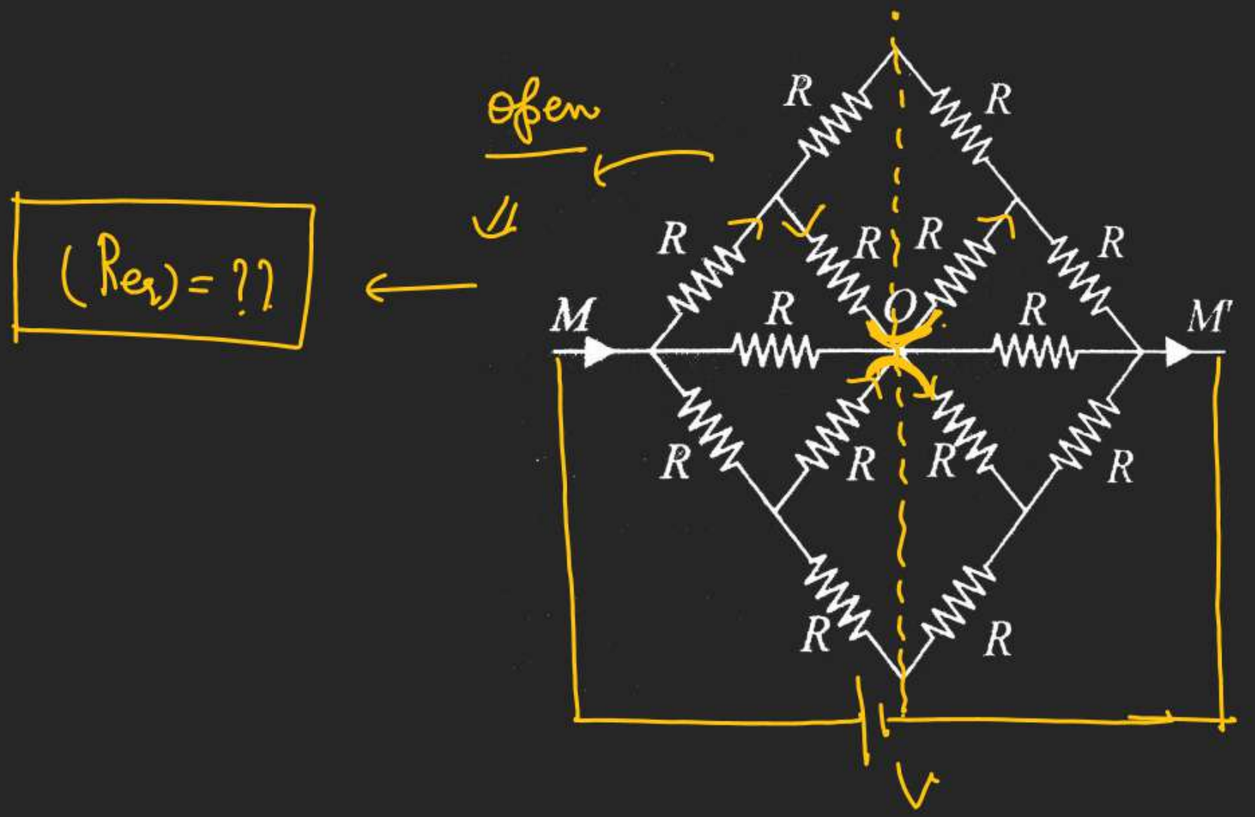
∴

Equivalent resistance by symmetry

CURRENT ELECTRICITY

Q.4 In the network shown in figure find the equivalent resistance across the points M and M′.

H.W.



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Equivalent resistance by symmetry

CURRENT ELECTRICITY

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

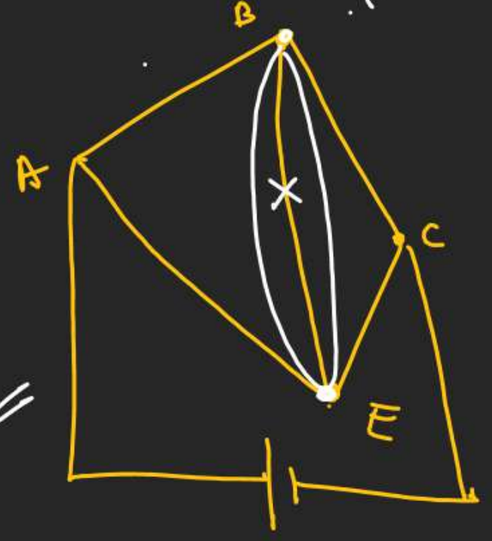
Q.6 ABCD is square see Fig where each side is a uniform wire of resistance 1Ω. A point E lies on CD such that if a uniform wire of resistance 1Ω is connected across AE and constant potential difference is applied across A and C then B and E are equipotential.

(A) $\frac{CE}{ED} = 1$

(B) $\frac{CE}{ED} = 2$

(C) $\frac{CE}{ED} = \frac{1}{\sqrt{2}}$

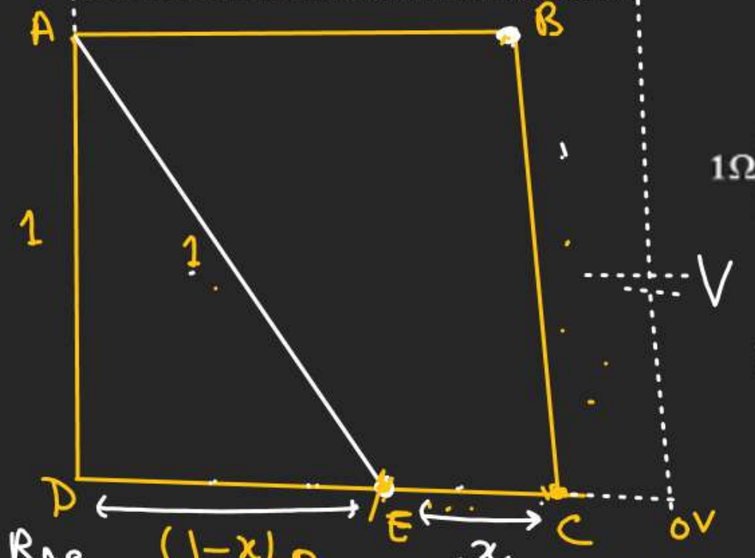
(D) $\frac{CE}{ED} = \sqrt{2}$ ✓



$V_B = V_E$ (giv...

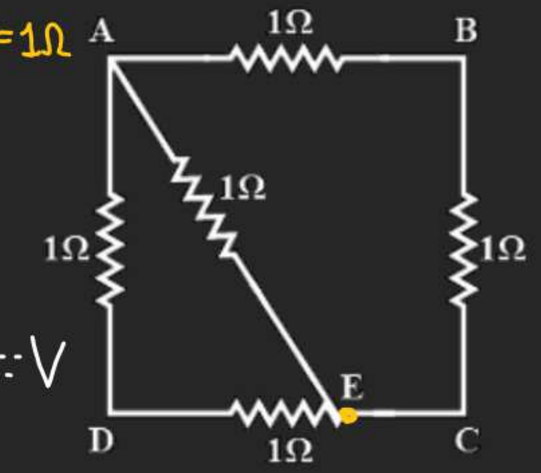
$R_{CD} = 1\Omega$

$(R_{AB}) = (R_{BC}) = (R_{CD}) = R_{DA} = 1\Omega$



$\frac{R_{AB}}{R_{AE}} = \frac{R_{BC}}{R_{CE}}$

$R_{AE} = \frac{(2-x)1}{(2-x)+1} = \left(\frac{2-x}{3-x}\right)$



CURRENT ELECTRICITY

Equivalent resistance by symmetry

$$\frac{1}{\left(\frac{2-x}{3-x}\right)} = \frac{1}{x}$$

$$x = \left(\frac{2-x}{3-x}\right)$$

$$3x - x^2 = 2 - x$$

$$x^2 - 4x + 2 = 0$$

$$x = \frac{4 \pm \sqrt{16-8}}{2}$$

$$x = \left(\frac{4 \pm 2\sqrt{2}}{2}\right) = (2 \pm \sqrt{2})$$

$x = (2+\sqrt{2})$ ✗ — $R > 1\Omega$ Not possible

$x = (2-\sqrt{2})$ ✓

$EC = x = (2-\sqrt{2})$

$DE = (1-x) = 1-(2-\sqrt{2})$

$= (\sqrt{2}-1)$

$$\frac{CE}{ED} = \left(\frac{2-\sqrt{2}}{\sqrt{2}-1}\right)$$

$$= \sqrt{2}\,\frac{(\sqrt{2}-1)}{(\sqrt{2}-1)}$$

$$= \sqrt{2}$$ ✓

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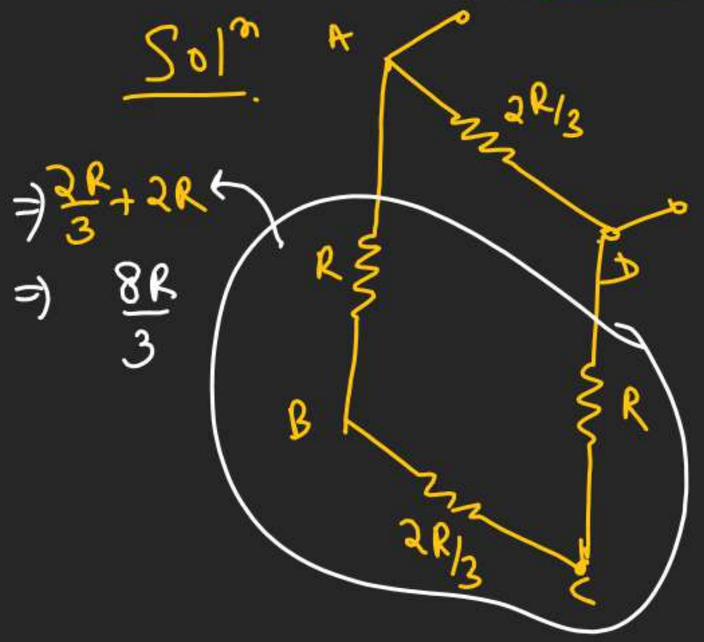
Equivalent resistance by symmetry

CURRENT ELECTRICITY

$\frac{2R \cdot R}{2R+R}$

Q.3 Nine wires each of resistance r are connected to make a prism as shown in figure. Find the equivalent resistance of the arrangement across terminals (a) A and D (b) A and B

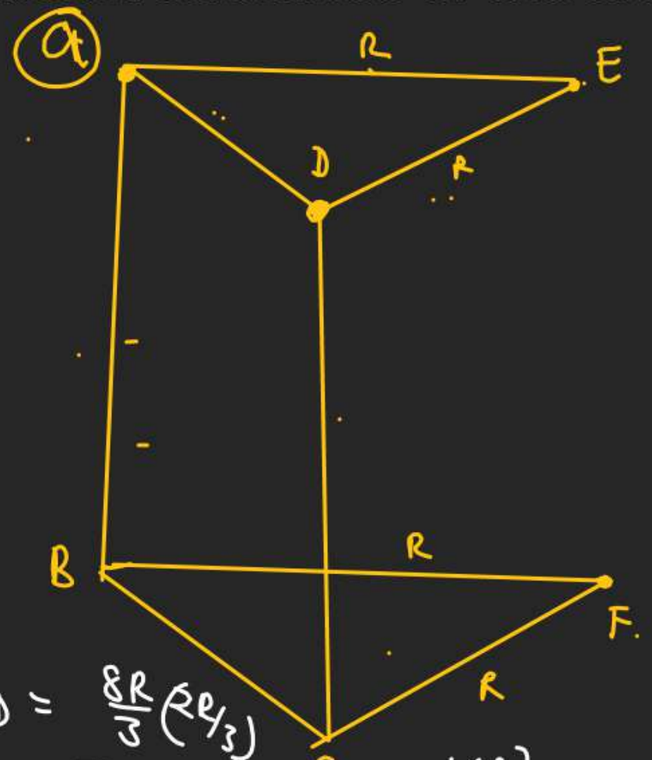
Sol^n



$\Rightarrow \frac{2R}{3} + 2R$

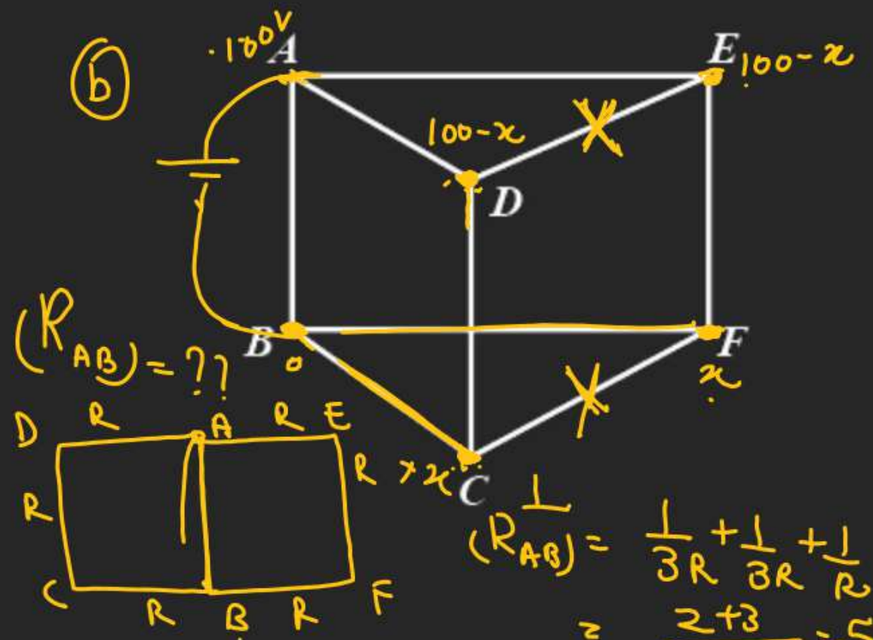
$\Rightarrow \frac{8R}{3}$

(a)



$R_{AD} = \frac{\frac{8R}{3}\left(\frac{2R}{3}\right)}{\frac{8R}{3}+\frac{2R}{3}} = \frac{\frac{16R^2}{9}}{\frac{10R}{3}} = \frac{16R^2}{9} \times \frac{3}{10R} = \frac{16R}{30} = \frac{8R}{15}\ \Omega$

(b)



$\frac{1}{(R_{AB})} = \frac{1}{3R} + \frac{1}{3R} + \frac{1}{R}$

$= \frac{2+3}{3R} = \frac{5}{3R}$

$R_{AB} = \frac{3R}{5}\ \Omega$

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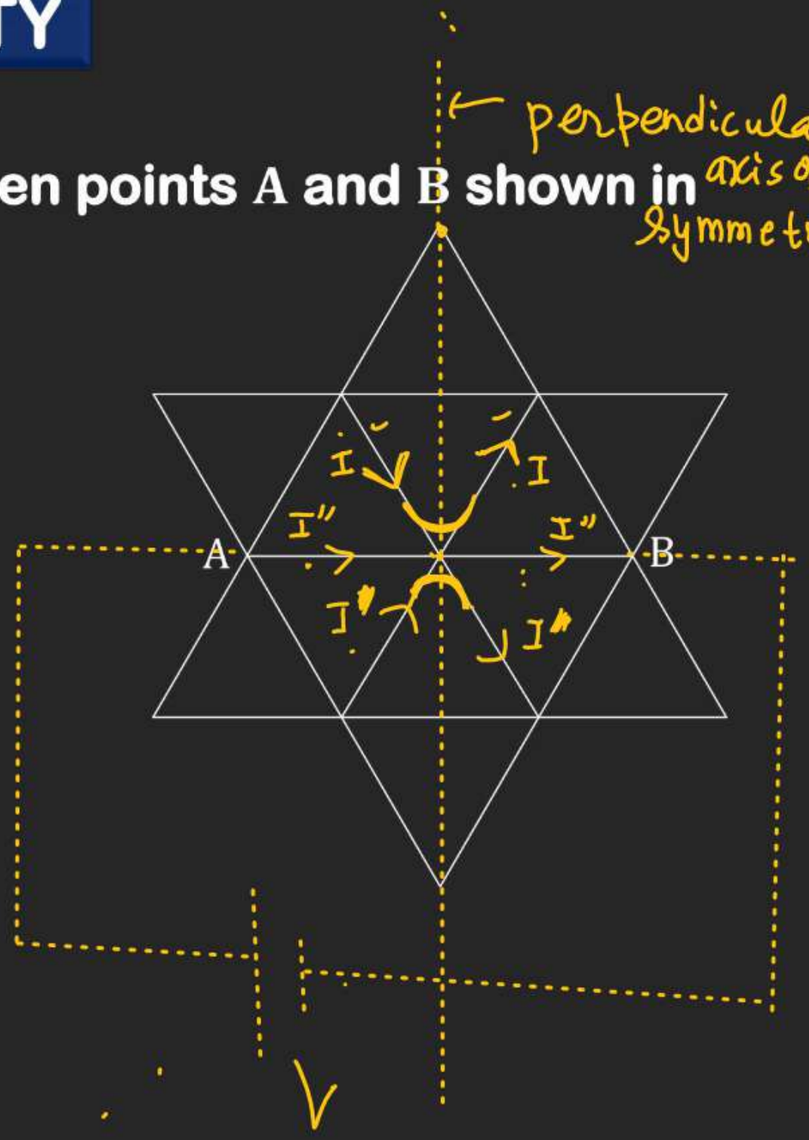
Equivalent resistance by symmetry

CURRENT ELECTRICITY

Q.4 Find the equivalent resistance of the circuit between points A and B shown in figure is: (each branch is of resistance $= 1\Omega$)

Hw.

$(R_{eq})_{AB} = ??$ ⇐



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Equivalent resistance by symmetry

CURRENT ELECTRICITY

Q.5 Figure shows five identical wires connected in symmetrical zig-zag fashion between points A and F. What will be the change in the resistance of the circuit between A and F if two similar identical wires are added as shown by the dashed line in figure.

H.W.

$R_i = 5R$.

$R_f = ??\ 3R$.

$\Delta R = 2R$

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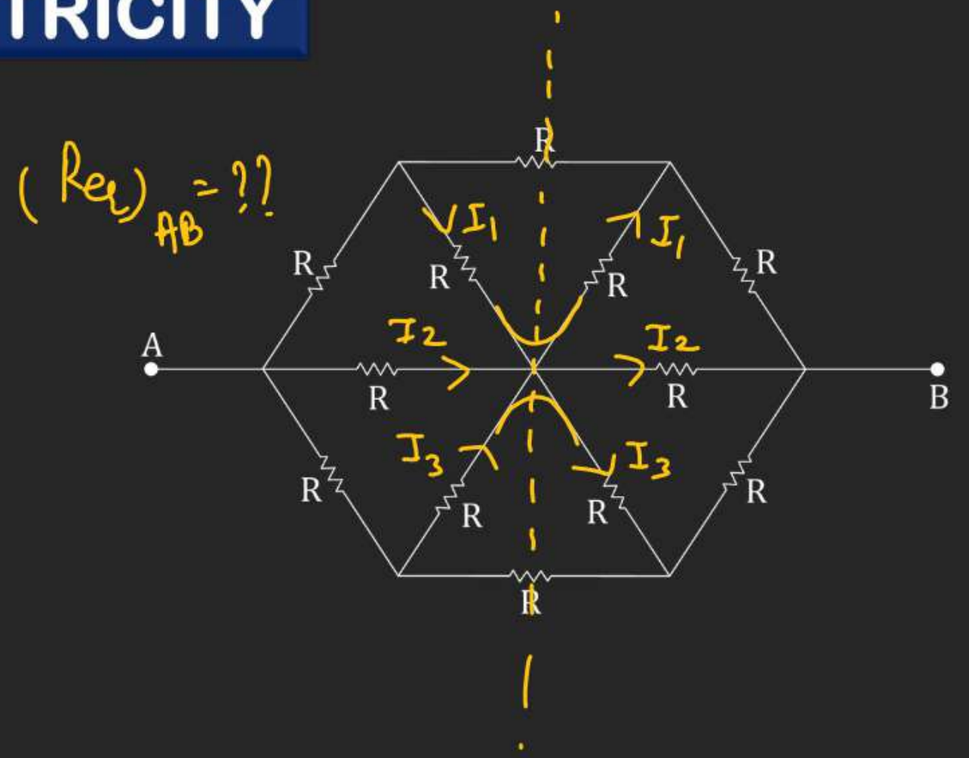
Equivalent resistance by symmetry

CURRENT ELECTRICITY



Equivalent resistance by symmetry

CURRENT ELECTRICITY

Q.7 Find the equivalent resistance across the terminals A and G in the circuit shown in figure. Each resistance in circuit is R.

Body diagonal.

K.C.L at x.

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

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

$$5x - 200 = 0.$$

$$x = 40V$$

$$V = I R_{eq}.$$

$$R_{eq} = \left[\frac{100}{I}\right]$$

$$\frac{3x}{R} = I.$$

$$\frac{3\times 40}{R} = I.$$

$$R_{eq} = \frac{100}{120} \times R$$

$$= (5R/6)\ \text{Ans}$$