Physicsaholics

DPP – 5 (Current Electricity)

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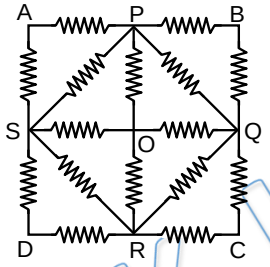
Written Solution on Website:- https://physicsaholics.com/note/notesDetalis/53

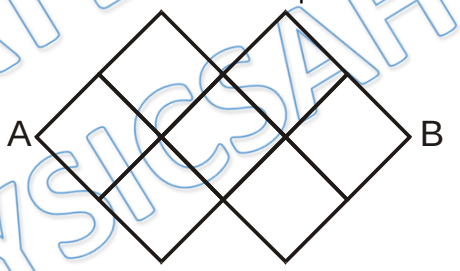
Q 1. In figure point O is maintained zero volt and A, B, C and D are maintained at V volt. If all resistors have same resistance R, then current through branch



(a) OP is $\frac{2V}{3R}$ (b) PQ is zero

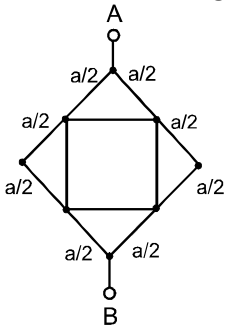
(c) QR is $\frac{V}{3R}$ (d) SD is $\frac{V}{3R}$

Q 2. In the shown wire frame, each side of a square (the smallest square) has a resistance R. The equivalent resistance of the circuit between the points A and B is :



(a) R (b) 2R (c) 4R (d) 8R

Q 3. Figure consists two squares made of uniform wire of resistance per unit length λ. Find out equivalent resistance between A and B. Side of large square is a.

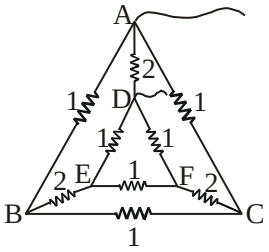


(a) $\frac{(\sqrt{2}+1)\lambda a}{2}$

(b) $\frac{\lambda a}{\sqrt{2}}$

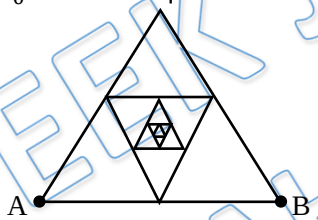
(c) $\frac{\sqrt{2}\lambda a}{3}$
(d) $\sqrt{2}\lambda a$

Q 4. A network of nine conductors connects six points A, B, C, D, E and F as shown. The figures denote resistances in ohms. The equivalent resistance between A and D is



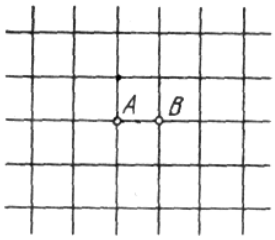
(a) 1Ω
(b) 2 Ω
(c) 3 Ω
(d) 4 Ω

Q 5. A frame made of thin homogeneous wire is shown in figure. Assume that the number of successively embedded equilateral triangle with sides decreasing by half tends to infinity. The side AB has a resistance R_0. Find the equivalent resistance between A and B.



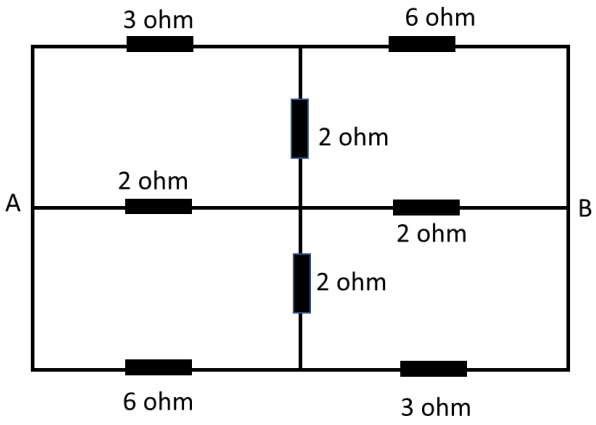
(a) $\left(\frac{\sqrt{5}-1}{3}\right)R_0$
(b) $\left(\frac{\sqrt{3}-1}{3}\right)R_0$
(c) $\left(\frac{\sqrt{7}-1}{2}\right)R_0$
(d) $\left(\frac{\sqrt{7}-1}{3}\right)R_0$

Q 6. There is an infinite wire grid with square cells. The resistance of each wire between neighbouring joint connections is equal to *R.* Find the resistance of the whole grid between points *A* and *B.*



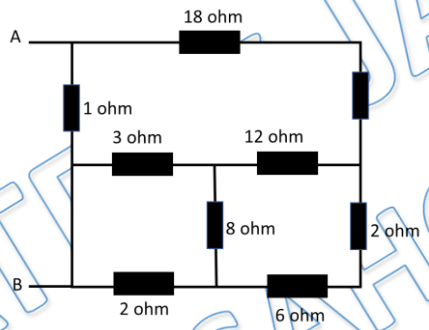
(a) R
(b) R/2
(c) R/3
(d) R/4

Q 7. Effective resistance between A and B is



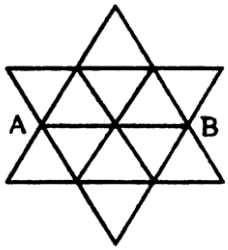
(a) 35/72 ohm
(b) 72/35 ohm
(c) 17/36 ohm
(d) 36/17 ohm

Q 8. Effective resistance between A and B is



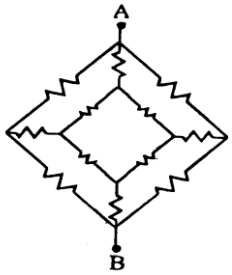
(a) 2 ohm
(b) 3 ohm
(c) 6 ohm
(d) 4 ohm

Q 9. Find the equivalent resistance of the circuit between points A and B shown in figure is: (each branch is of resistance = 1Ω)



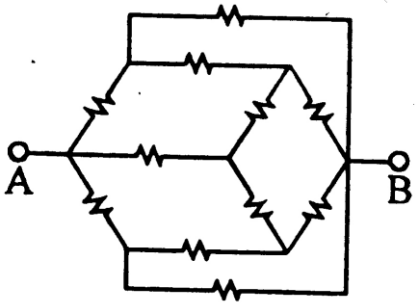
(a) 3 ohm
(b) 17/30 ohm
(c) 10/23 ohm
(d) 22/35 ohm

Q 10. The figure shown a network of resistor each having value 12Ω. Find the equivalent resistance between points A and B.



(a) 6 ohm
(b) 3 ohm
(c) 9 ohm
(d) 2 ohm

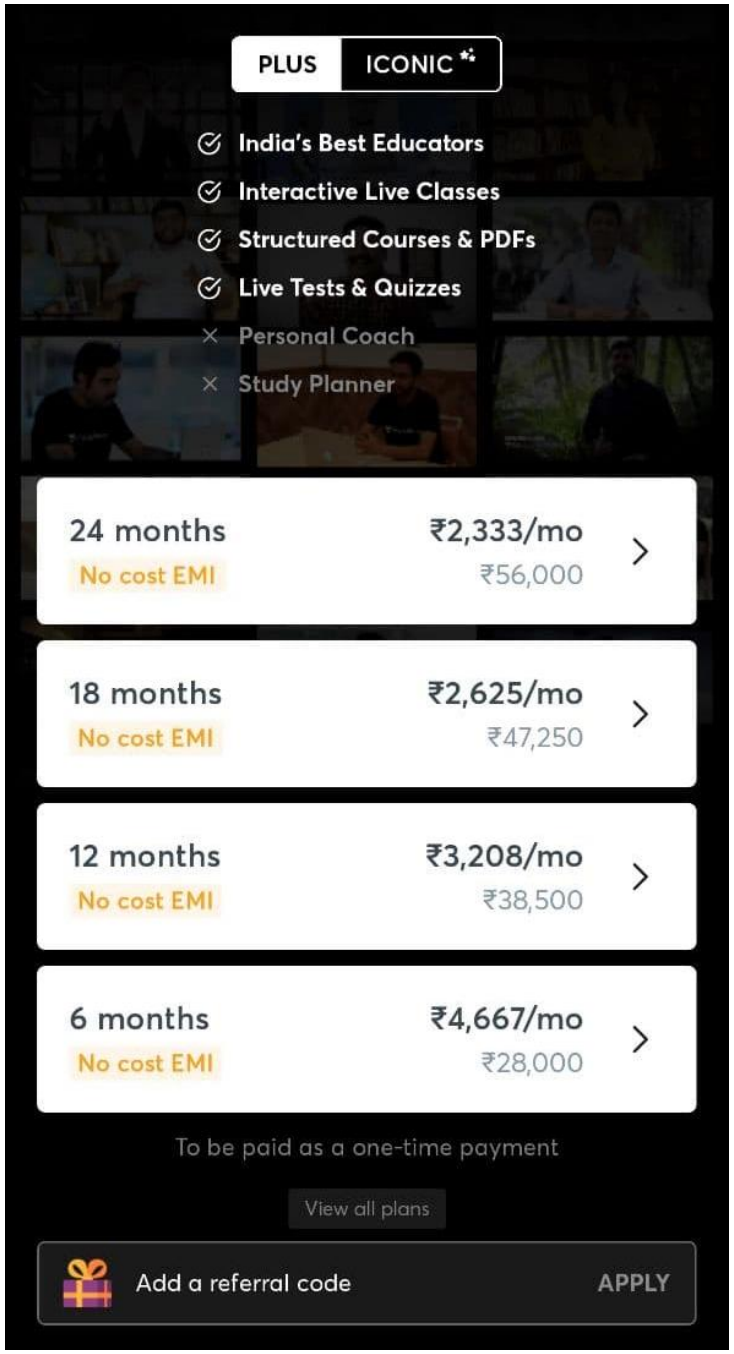
Q 11. Calculate equivalent resistance of the network between points A and D .



(a) 3R/5
(b) 5R/7
(c) R
(d) 2R

Answer Key

Q.1 a, b, d	**Q.2 b**	**Q.3 b**	**Q.4 a**	**Q.5 d**
Q.6 b	**Q.7 b**	**Q.8 c**	**Q.9 d**	**Q.10 c**
Q.11 c				



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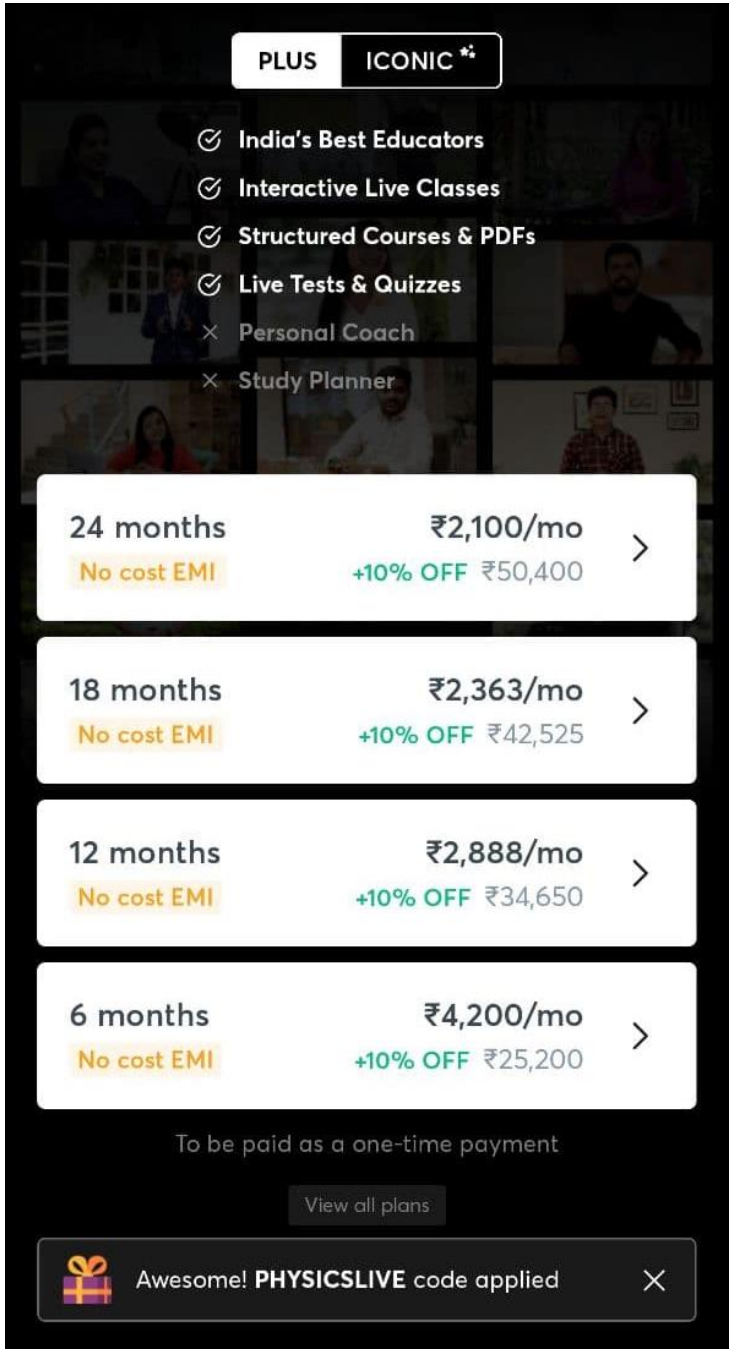


Written Solution

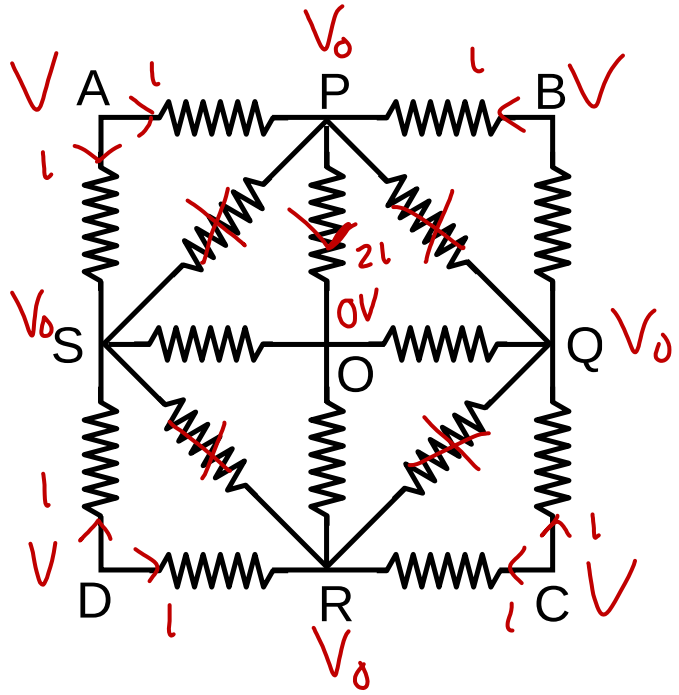
DPP- 5 Current :Wheat Stone Bridge,Symmetric Circuits

By Physicsaholics Team

Q.1) In figure point O is maintained zero volt and A, B, C and D are maintained at V volt. If all resistors have same resistance R, then current through branch

$V_P = V_Q = V_R = V_S$

by symmetry



(a) ~~OP~~ is $\frac{2V}{3R}$

(b) ~~PQ~~ is zero

(c) QR is $\frac{V}{3R}$

(d) ~~SD~~ is $\frac{V}{3R}$

Using junction law at P →

$\frac{V-V_0}{R} + \frac{V-V_0}{R} = \frac{V_0-0}{R}$

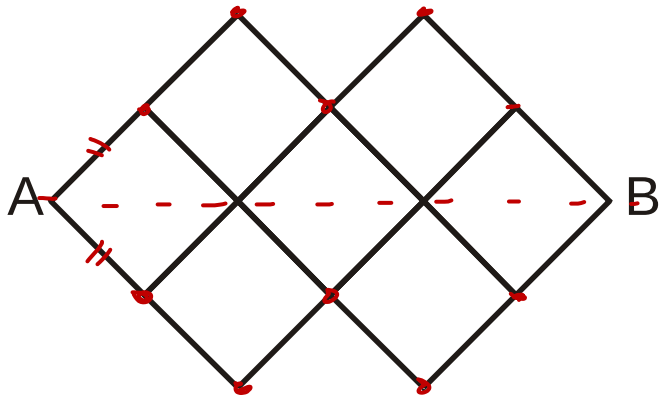
$2V - 2V_0 = V_0$

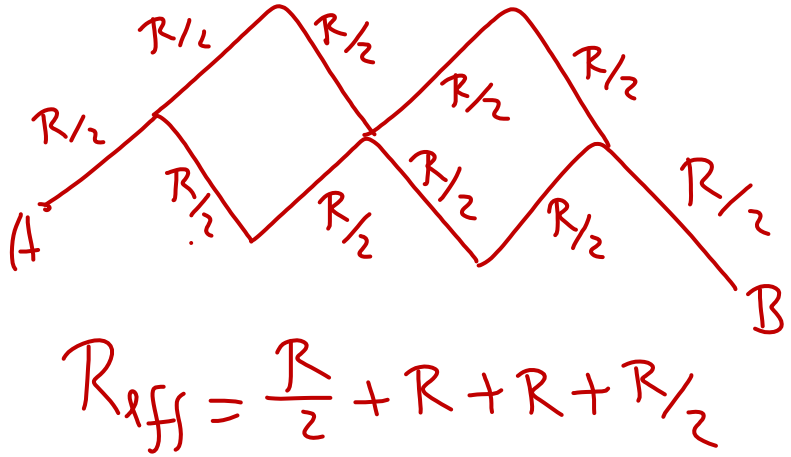
$3V_0 = 2V \Rightarrow V_0 = \frac{2V}{3}$

$I = \frac{V-2V/3}{R} = \frac{V}{3R}$

$2I = \frac{2V}{3R}$

Q.2) In the shown wire frame, each side of a square (the smallest square) has a resistance R. The equivalent resistance of the circuit between the points A and B is :





$$R_{eff} = \frac{R}{2} + R + R + \frac{R}{2}$$

(a) R (b) 2R (c) 4R (d) 8R

Q.3) Figure consists two squares made of uniform wire of resistance per unit length λ. Find out equivalent resistance between A and B. Side of large square is a.

P_1 & P_2 are at same potential

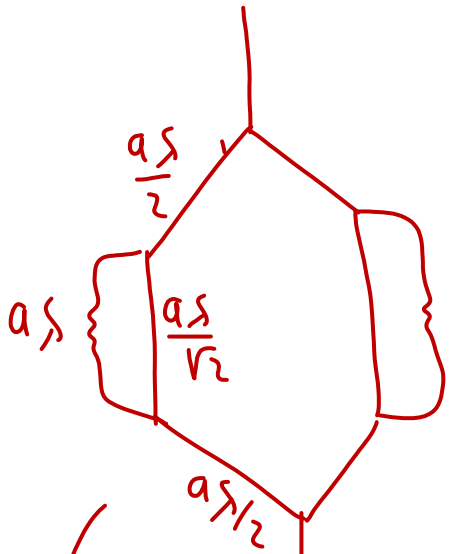
S_1 & S_2 , , ,

(a) $\frac{(\sqrt{2}+1)\lambda a}{2}$

(b) $\frac{\lambda a}{\sqrt{2}}$

(c) $\frac{\sqrt{2}\lambda a}{3}$

(d) $\sqrt{2}\lambda a$



$$R_{eff} = \left(a\lambda + \frac{a\lambda \cdot a\lambda/\sqrt{2}}{a\lambda + a\lambda/\sqrt{2}} \right)^{1/2}$$

$$R_{eff} = \frac{a\sqrt{3}}{2}\left[1 + \frac{1}{\sqrt{2}+1}\right]$$

$$= \frac{a\sqrt{3}}{2}\left[1 + \frac{1}{\sqrt{2}+1} \times \frac{\sqrt{2}-1}{\sqrt{2}-1}\right]$$

$$= \frac{a\sqrt{3}}{2}\left[1 + \sqrt{2} - 1\right]$$

$$= \frac{a\sqrt{3}}{\sqrt{2}}$$

Ans. b

Q.4) A network of nine conductors connects six points A, B, C, D, E and F as shown. The figures denote resistances in ohms. The equivalent resistance between A and D is

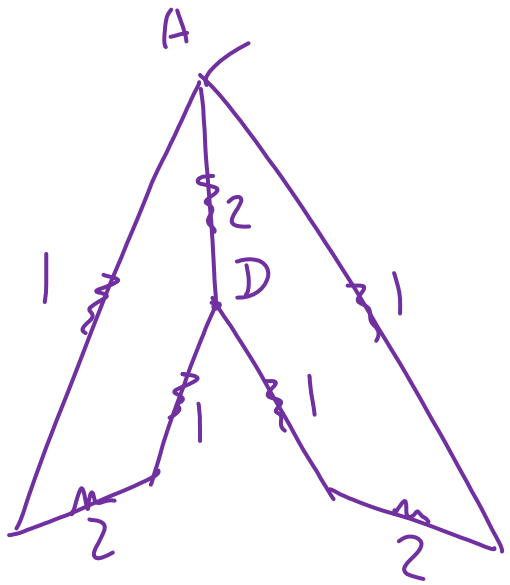
$V_B = V_C$, $V_E = V_F$

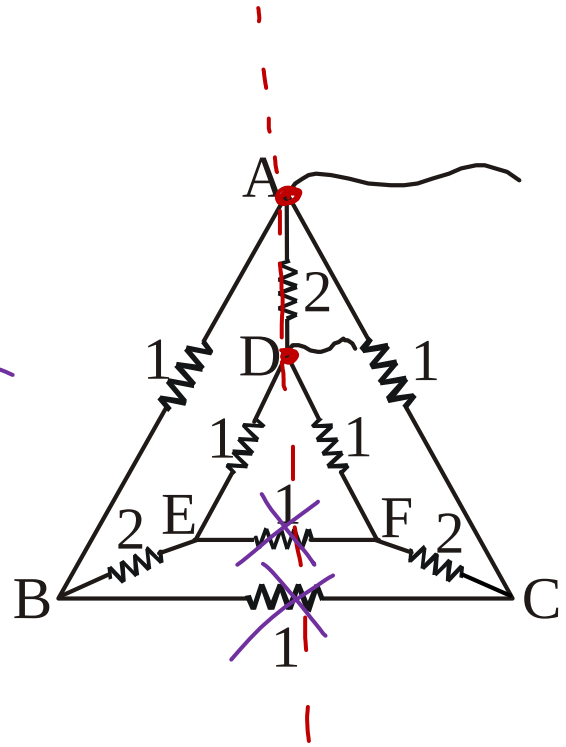
(a) 1Ω

(b) 2Ω

(c) 3Ω

(d) 4Ω





$\frac{1}{R_{eff}} = \frac{1}{4} + \frac{1}{4} + \frac{1}{2} = 1$

$R_{eff} = 1\Omega$

$$R_0 + \frac{RR_0}{2R_0+R} = \frac{2R_0^2+RR_0+RR_0}{2R_0+R} = \frac{2R_0(R_0+R)}{2R_0+R}$$

Q.5) A frame made of thin homogeneous wire is shown in figure. Assume that the number of successively embedded equilateral triangle with sides decreasing by half tends to infinity. The side AB has a resistance R_0. Find the equivalent resistance between A and B.

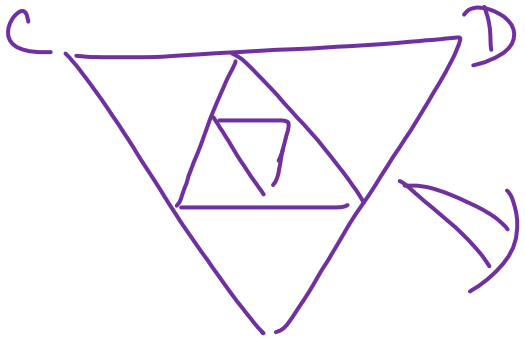
effective resistance b/w A & B $= R = ?$

(a) $\left(\frac{\sqrt{5}-1}{3}\right)R_0$

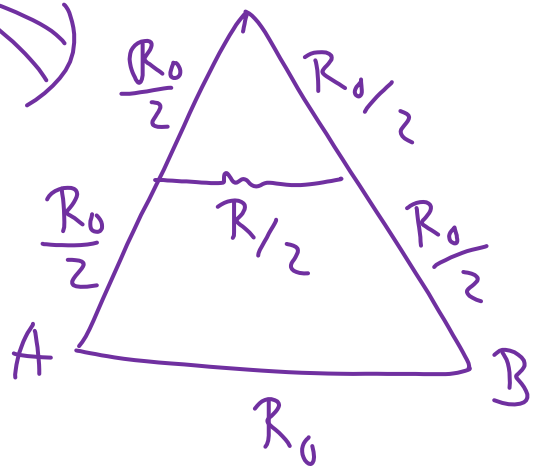
(b) $\left(\frac{\sqrt{3}-1}{3}\right)R_0$

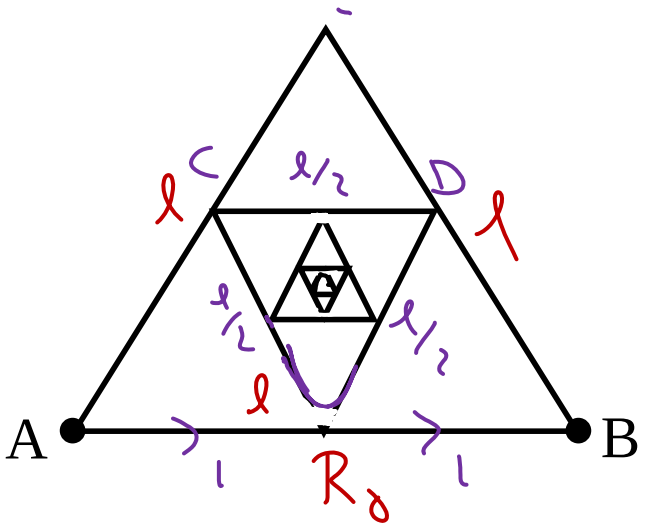
(c) $\left(\frac{\sqrt{7}-1}{2}\right)R_0$

(d) $\left(\frac{\sqrt{7}-1}{3}\right)R_0$

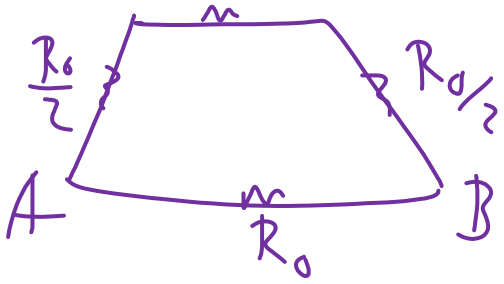


$R_{CD} = R/2$





$$\frac{R_0 R/2}{R_0 + R/2} = \frac{RR_0}{2R_0+R}$$



$$\frac{1}{R} = \frac{1}{R_0} + \frac{2R_0+R}{2R_0(R_0+R)}$$

$$\frac{1}{R} - \frac{1}{R_0} = \frac{2R_0 + R}{2R_0(R_0 + R)}$$

$$\Rightarrow \quad \frac{R_0 - R}{R R_0} = \frac{2R_0 + R}{2R_0(R_0 + R)}$$

$$\Rightarrow \quad 2\left(R_0^2 - R^2\right) = 2R_0 R + R^2$$

$$\Rightarrow \quad 0 = 3R^2 - 2R_0^2 + 2RR_0$$

$$R = \frac{-2R_0 + \sqrt{4R_0^2 + 24R_0^2}}{6} = \frac{-2R_0 + 2R_0\sqrt{7}}{6}$$

$$= \frac{R_0}{3}\left(\sqrt{7} - 1\right)$$

Ans. d

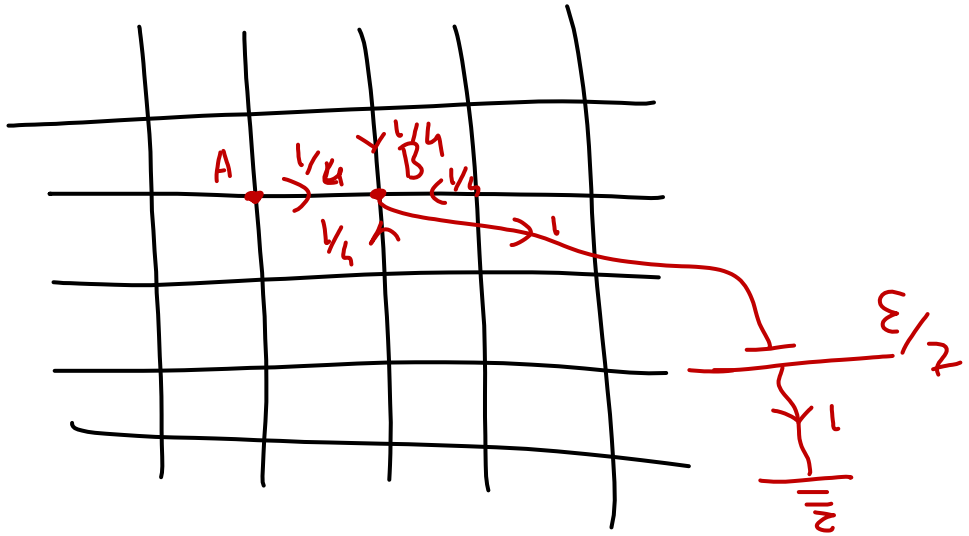
Q.6) There is an infinite wire grid with square cells. The resistance of each wire between neighbouring joint connections is equal to *R*. Find the resistance of the whole grid between points *A* and *B*.

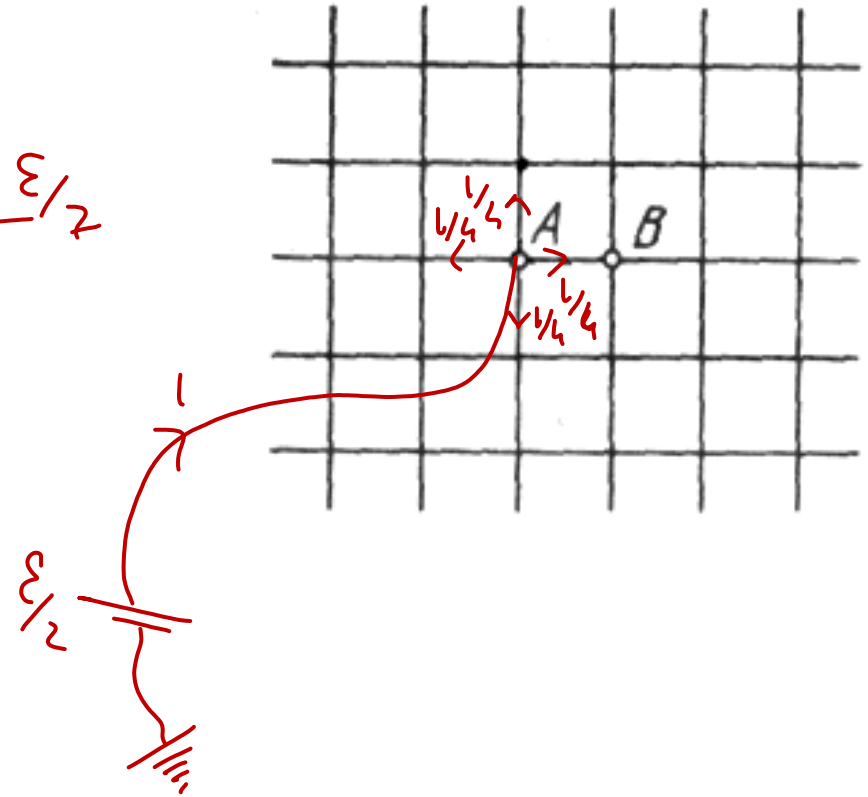
(a) R

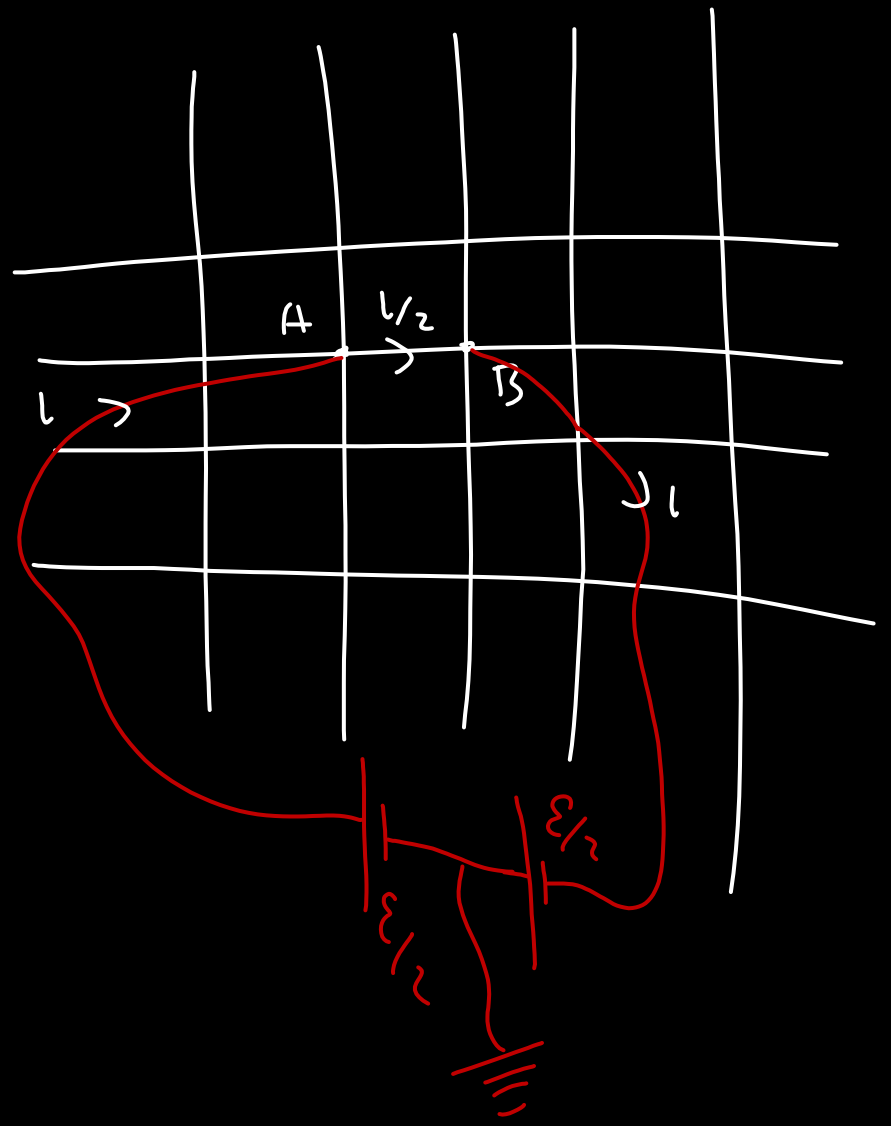
(b) R/2

(c) R/3

(d) R/4







for wire AB

$$\mathcal{E} = \frac{i}{2} R$$

$$\frac{\mathcal{E}}{i} = R/2$$

Total Emf applied $= \mathcal{E}$

$$R_{eff} = \frac{\mathcal{E}}{i} = \frac{R}{2}$$

Ans. b

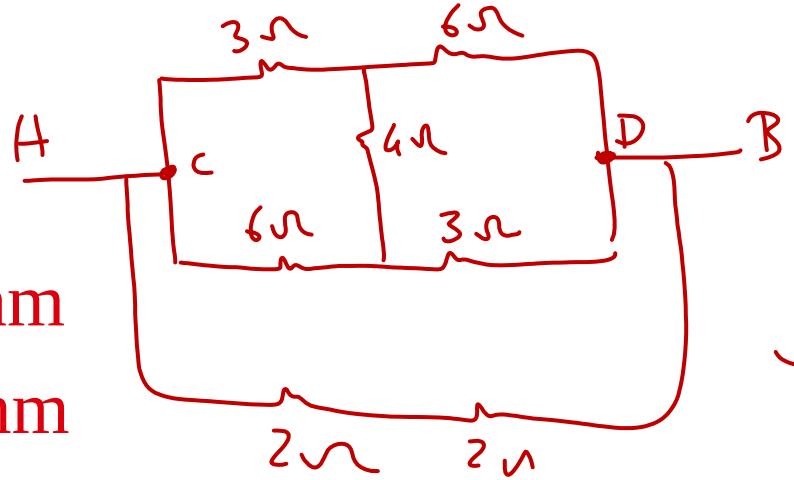
Q.7) Effective resistance between A and B is

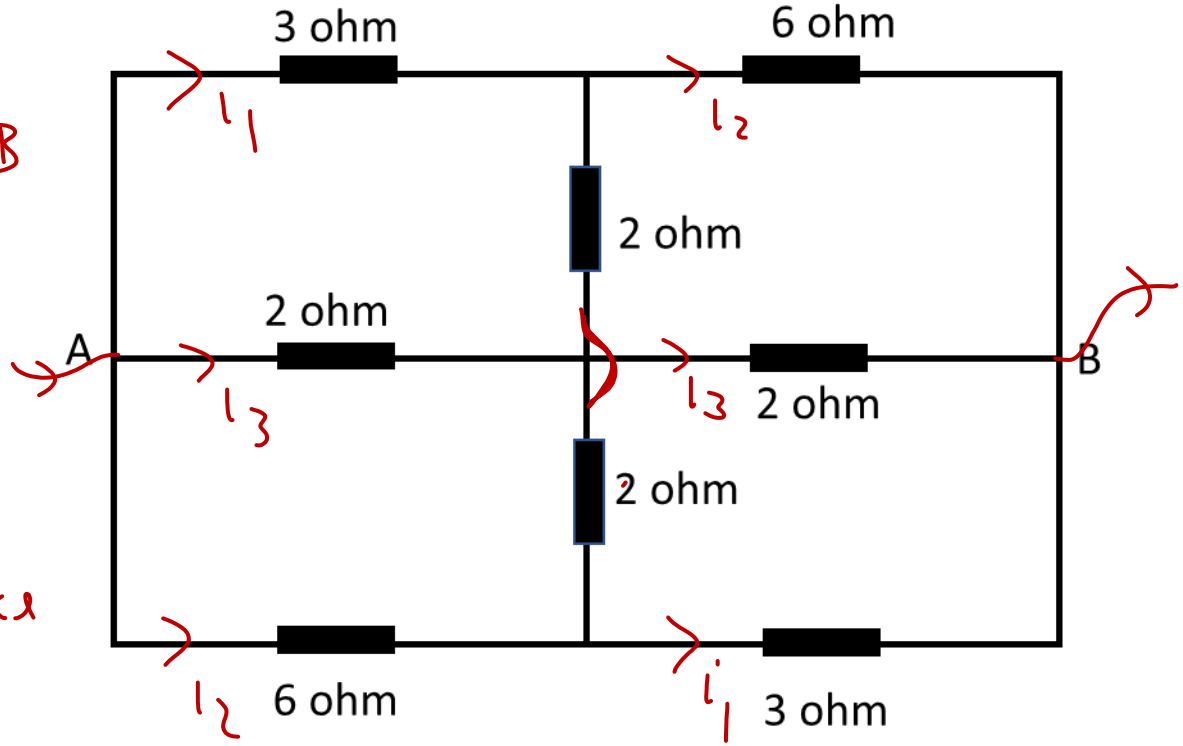
(a) 35/72 ohm

(b) 72/35 ohm

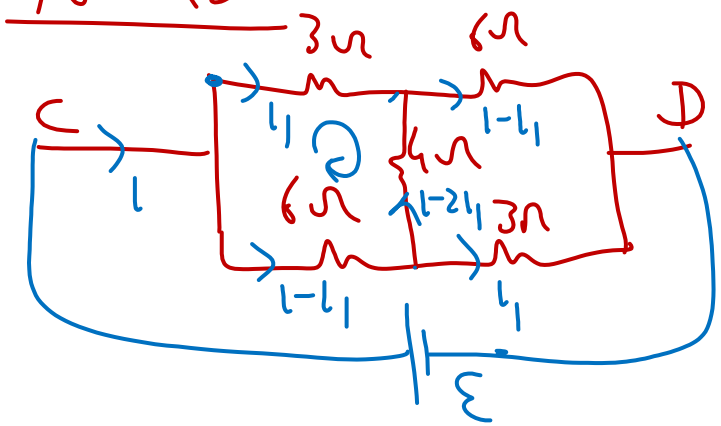
(c) 17/36 ohm

(d) 36/17 ohm





To find effective resistance b/w C & D



$-3i_1 + 4(1-2i_1) + 6(1-i_1) = 0$

$17i_1 = 10i$

$i_1 = \frac{10i}{17}$

$$I_1 = 10I/17$$

$$+\mathcal{E} - 6(I - I_1) - 3I_1 = 0$$

$$\Rightarrow \quad \mathcal{E} - 6 \times \frac{7}{17} I - \frac{30}{17} I = 0 \quad \Rightarrow \quad \mathcal{E} = \frac{72}{17} I$$

$$\Rightarrow \quad R_{CD} = \frac{\mathcal{E}}{I} = \frac{72}{17} \text{ ohm}$$

$$\frac{1}{R_{AB}} = \frac{1}{4} + \frac{17}{72} = \frac{18 + 17}{72} = \frac{35}{72}$$

$$R_{AB} = \frac{72}{35} \Omega$$

Ans. b

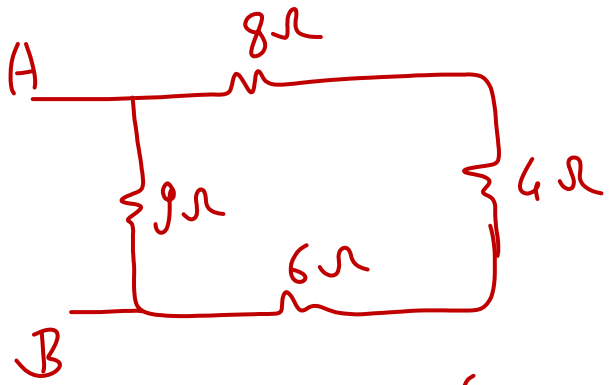
Q.8) Effective resistance between A and B is

(a) 2 ohm

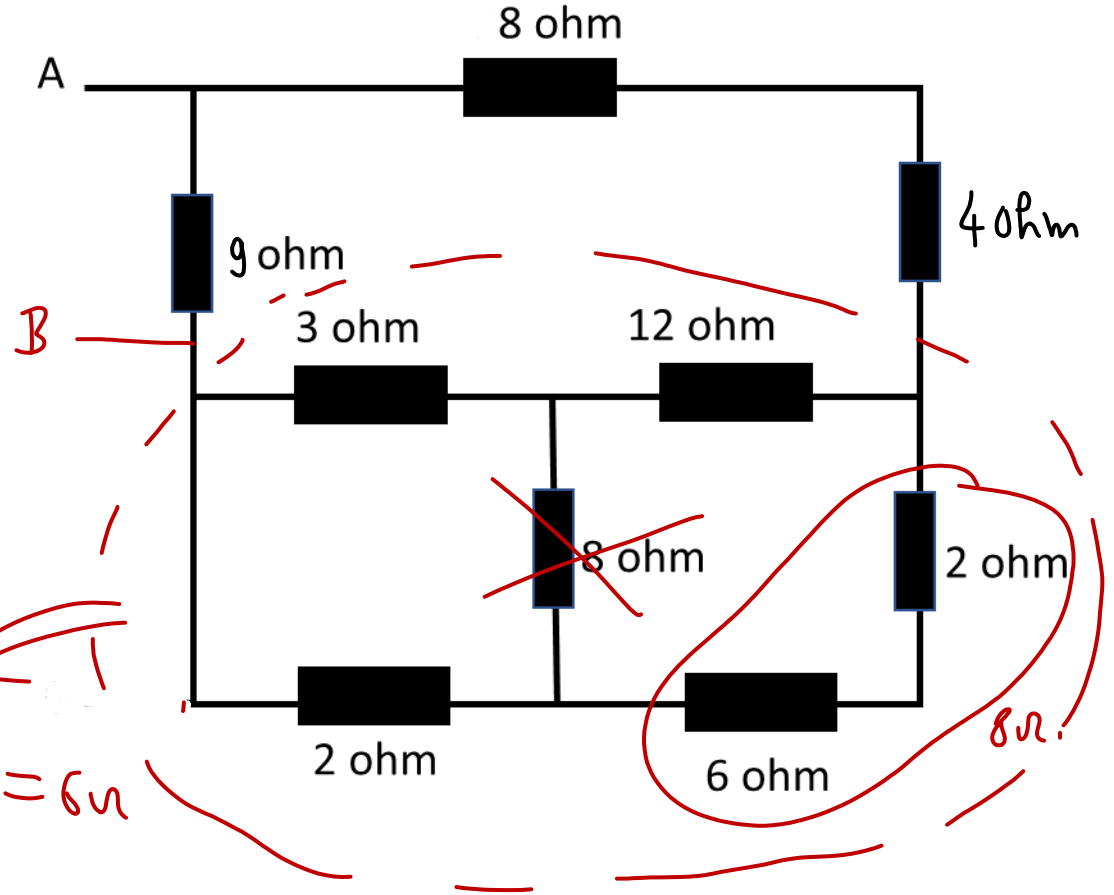
(b) 3 ohm

(c) 6 ohm

(d) 4 ohm



$R_{AB} = \frac{9 \times 18}{27} = 6\Omega$



$\frac{15 \times 10}{25} = 6\Omega$

$\frac{R \times R/2}{R + R/2} = \frac{R}{3}$ $\qquad$ $\frac{R \times R/3}{R + R/3} = \frac{R}{4}$

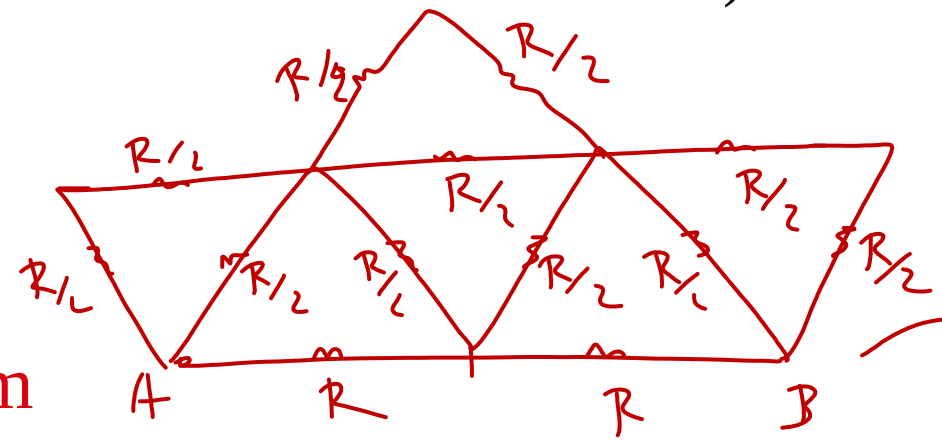
Q.9) Find the equivalent resistance of the circuit between points A and B shown in figure is: (each branch is of resistance = 1Ω)

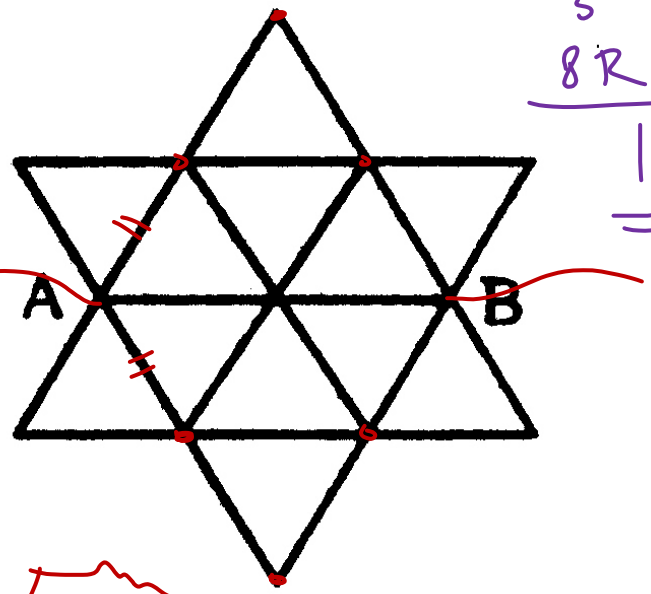
(a) 3 ohm

(b) 17/30 ohm

(c) 10/23 ohm

(d) 22/35 ohm

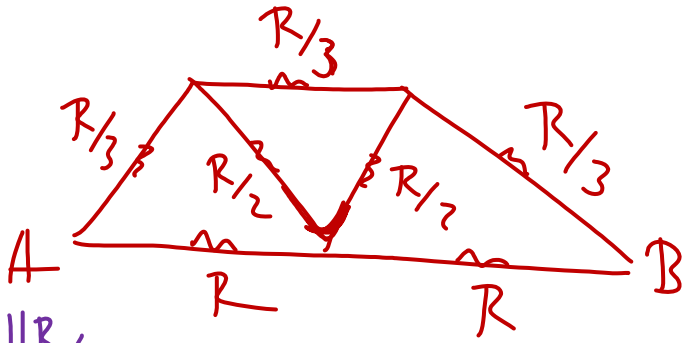


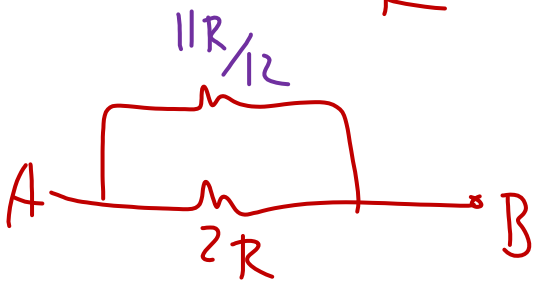


$\frac{2R}{3} + \frac{R}{4}$

$\frac{8R + 3R}{12}$

$= \frac{11R}{12}$





$\frac{1}{R_{eff}} = \frac{1}{2R} + \frac{12}{11R} = \frac{11 + 24}{22R} = \frac{35}{22R} \Rightarrow R_{AB} = \frac{22R}{35}$

Q.10) The figure shown a network of resistor each having value 12Ω. Find the equivalent resistance between points A and B.

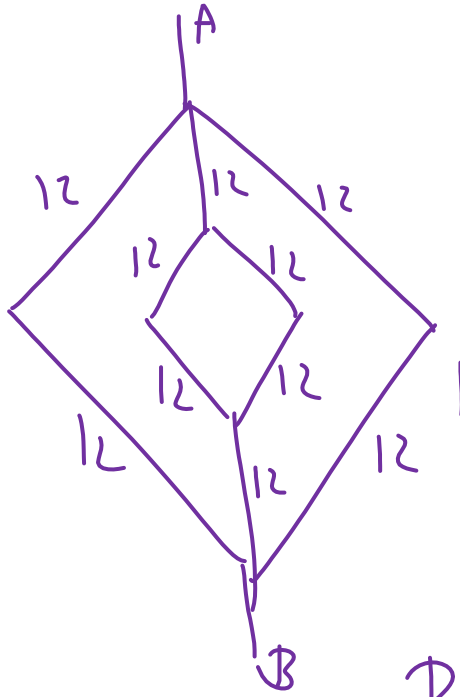
(a) 6 ohm

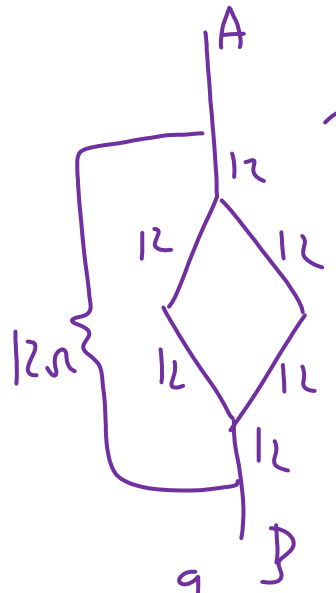
(b) 3 ohm

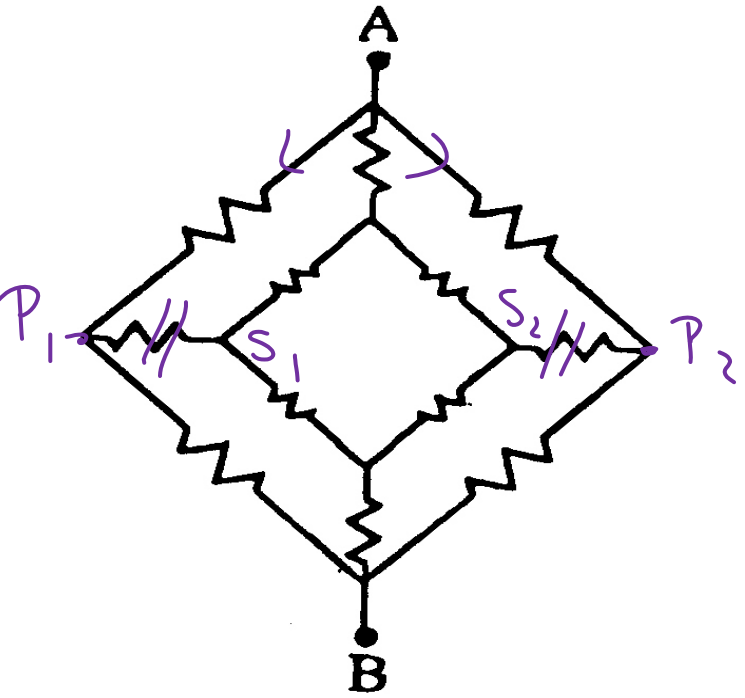
(c) 9 ohm

(d) 2 ohm

$V_{P_1} = V_{P_2}$ & $V_{S_1} = V_{S_2}$







$R_{AB} = \frac{3 \times 12}{4} = 9\ \Omega$

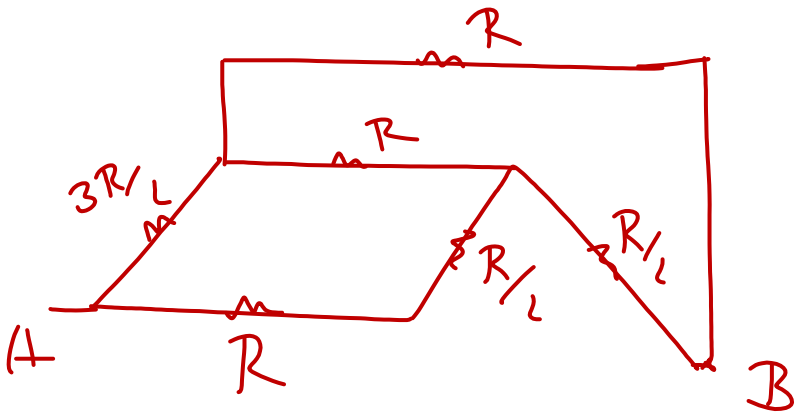
Q.11) Calculate equivalent resistance of the network between points A and D .

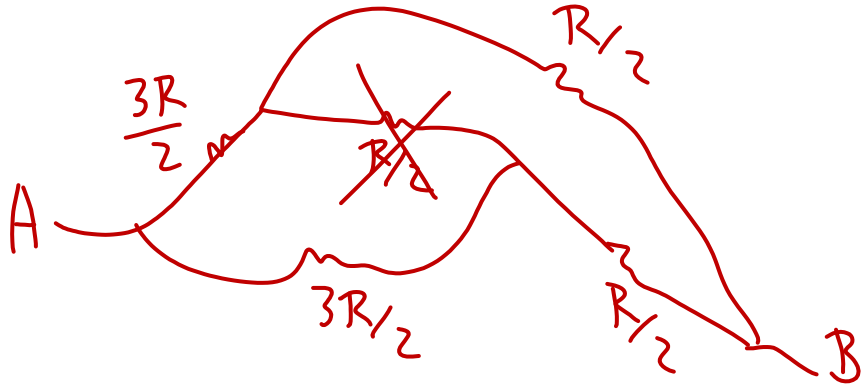
(a) 3R/5

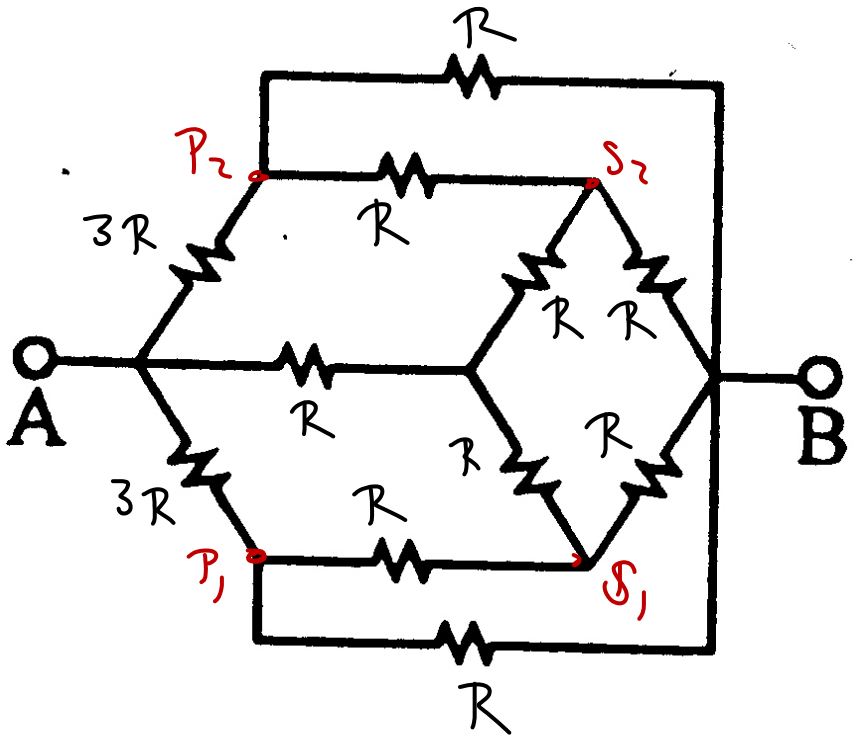
(b) 5R/7

(c) ~~R~~

(d) 2R







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