Physicsaholics

DPP – 5 (Current Electricity)

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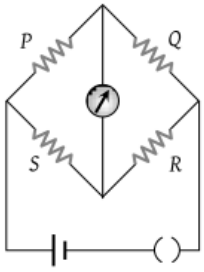
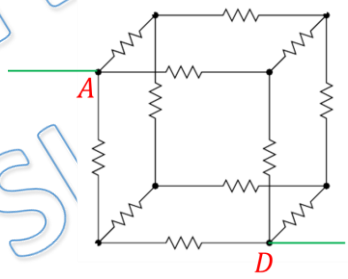
Q 1. In a Wheatstone bridge circuit $P = 2\,\Omega$, $Q = 3\,\Omega$, $R = 6\,\Omega$ and $S = 8\,\Omega$. In order to obtain balance, shunt resistance across S must be:



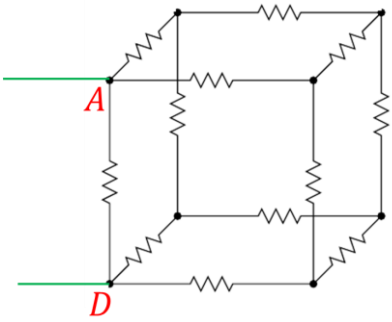
(a) $2\,\Omega$ (b) 3Ω
(c) $6\,\Omega$ (d) $8\,\Omega$

Q 2. If all the resistors are identical having resistance $\boldsymbol{R\Omega}$. Find equivalent resistance between A and D?



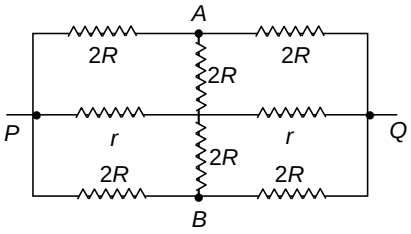
(a) $\frac{7R}{12}$ (b) $\frac{4R}{3}$
(c) $\frac{3R}{4}$ (d) $\frac{12R}{7}$

Q 3. If all the resistors are identical having resistance $\boldsymbol{R\Omega}$. Find equivalent resistance between A and D?



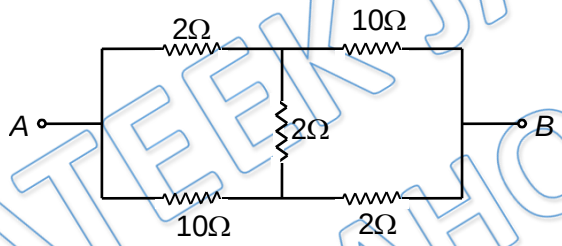
(a) $\frac{7R}{12}$ (b) $\frac{4R}{3}$
(c) $\frac{3R}{4}$ (d) $\frac{12R}{7}$

Q 4. The effective resistance between point P and Q of the electrical circuit shown in the figure is



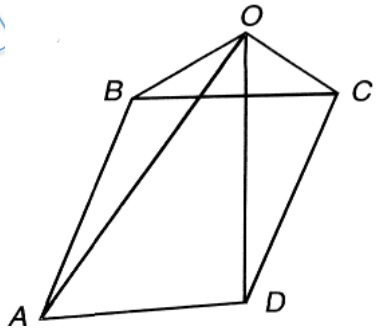
(a) $2Rr/(R+\mathrm{r})$
(b) $8\,R(R+r)/(3R+r)$
(c) $2r+4R$
(d) $5\,R/2\,R+2r$

Q 5. Find the effective resistance (in ohm) between the points A and B of the following network.



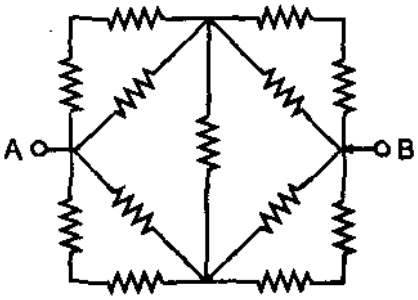
(a) 4 (b) 8
(c) 13 (d) 10

Q 6. Eight identical resistance r each are connected as shown. If equivalent resistance between AD is R_1 and that between AC is R_2 then $\frac{R_1}{R_2}$



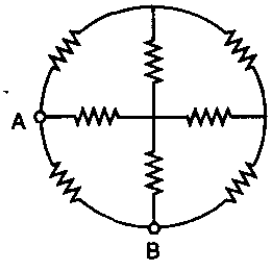
(a) 4 : 5
(b) 2 : 3
(c) 3 : 5
(d) 1 : 3

Q 7. Thirteen resistors each of resistance H are connected in the circuit as shown in figure. Net resistance between A and B is:



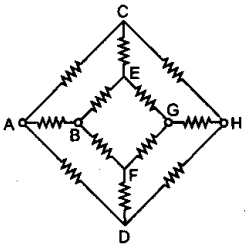
(a) 2R (b) 4R/3
(c) 2R/3 (d) R

Q 8. Eight resistances each of resistance 50Ω are connected in the circuit as shown in figure. The equivalent resistance between A and B is:



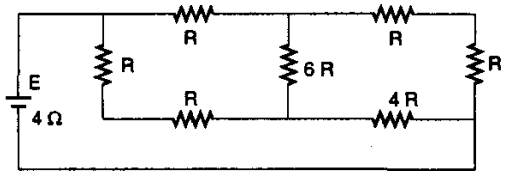
(a) $\frac{80}{3}\ \Omega$ (b) $\frac{16}{3}\ \Omega$
(c) $\frac{150}{7}\ \Omega$ (d) $\frac{19}{2}\ \Omega$

Q 9. Twelve resistors each of resistance 1 Ω are connected in the circuit shown in figure. Net resistance between points A and H would be



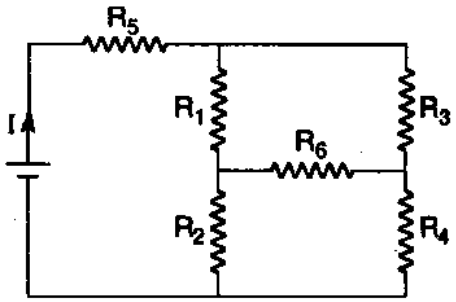
(a) $\frac{5}{3}\Omega$
(b) 1 Ω
(c) $\frac{3}{4}\Omega$
(d) $\frac{7}{6}\Omega$

Q 10. A battery of internal resistance 4Ω is connected to the network of resistances as shown. In order that the maximum power can be delivered to the network the value of R in Ω should be



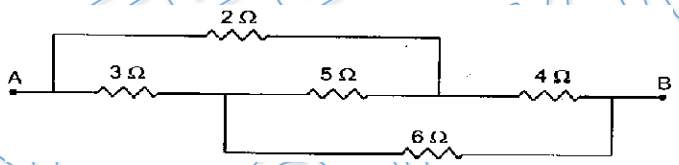
(a) $\frac{4}{9}$
(b) 2
(c) $\frac{8}{3}$
(d) 18

Q 11. In the given circuit, it is observed that the current I is independent of the value of the resistance R_6. Then, the resistance values must satisfy



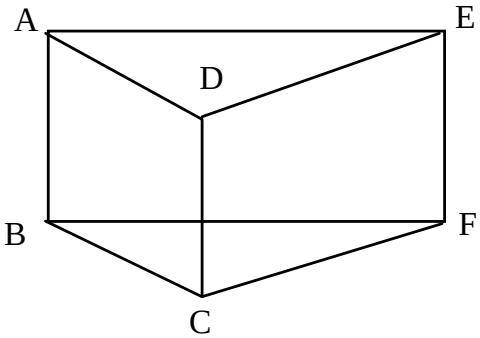
(a) $R_1R_2R_5 = R_3R_4R_6$
(b) $\frac{1}{R_5} = \frac{1}{R_G} = \frac{1}{R_1+R_2} + \frac{1}{R_3+R_4}$
(c) $R_1 R_4 = R_2 R_3$
(d) $R_1 R_3 = R_2 R_4$

Q 12. In the circuit shown, some potential difference is applied between A and B. The equivalent resistance between A and B is R.



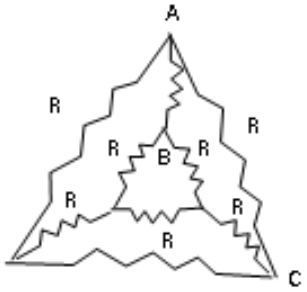
(a) No current flows through the 5-Ω resistor.
(b) R = 15Ω
(c) R = 12.5 Ω
(d) R = $\frac{18}{5}\Omega$

Q 13. Find effective resistance between A and B, if all sides of prism have equal resistance R.



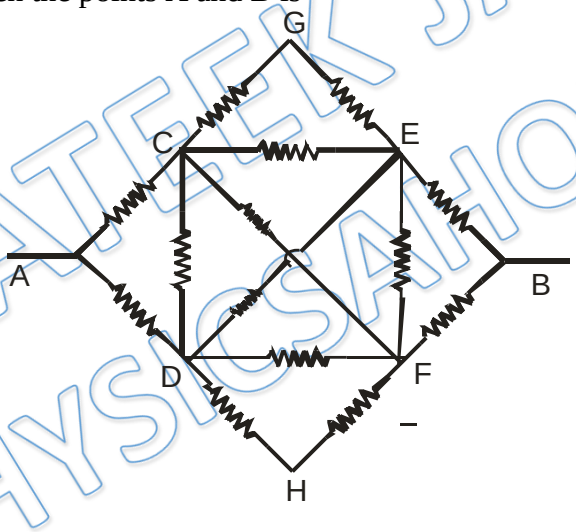
(a) 3R/5 (b) 2R/5
(c) R/5 (d) 2R

Q 14. Find effective resistance between A and B, if all sides of prism have equal resistance R.



(a) 3R/5 (b) 2R/5
(c) R/8 (d) 2R

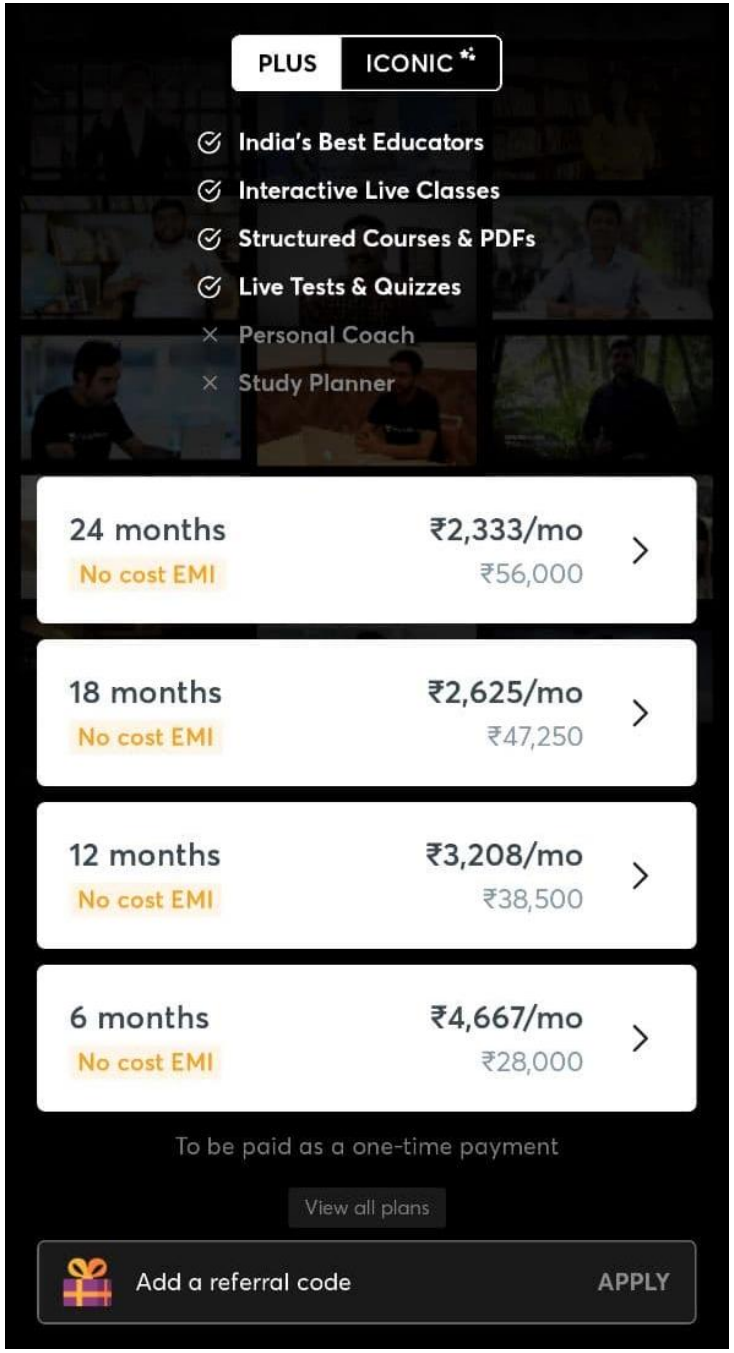
Q 15. Fourteen identical resistors each of resistance r are connected as shown. The equivalent resistance between the points A and B is



(a) r
(b) 14 r
(c) r/14
(d) 1.2 r

Answer Key

Q.1 d	**Q.2 c**	**Q.3 a**	**Q.4 a**	**Q.5 a**
Q.6 a	**Q.7 c**	**Q.8 a**	**Q.9 c**	**Q.10 b**
Q.11 c	**Q.12 a, d**	**Q.13 a**	**Q.14 a**	**Q.15 d**



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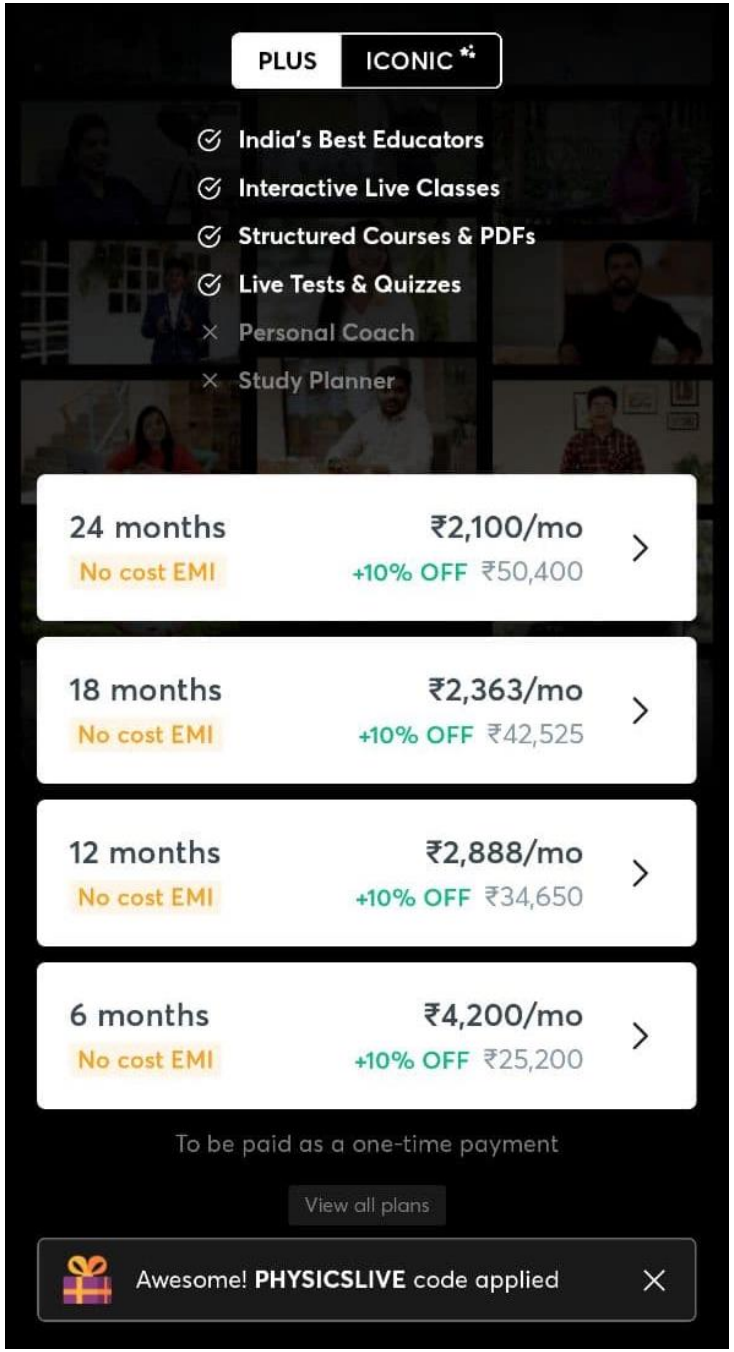


Written Solution

DPP-5 Current Electricity: Wheat Stone bridge, Symmetric circuit, Cube problems

By Physicsaholics Team

Solution: 1

To ballance what-stone bridge —

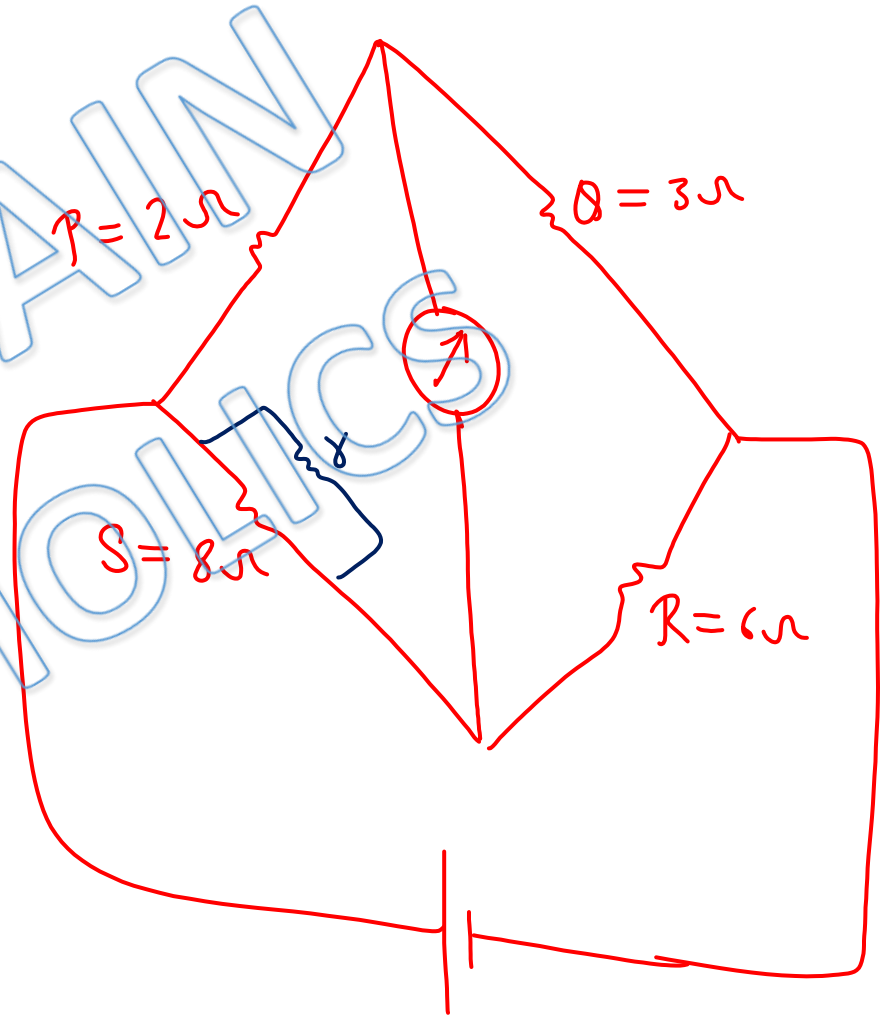
$$\frac{P}{\theta} = \frac{S'}{R}$$ where S' is effective of S & γ

$$\Rightarrow S' = \frac{PR}{\theta} = \frac{2 \times 6}{3} = 4\,\Omega$$

$$\Rightarrow \frac{8\gamma}{\gamma + 8} = 4$$

$$\Rightarrow \gamma + 8 = 2\gamma$$

$$\Rightarrow \gamma = 8\,\Omega$$



Ans. d

Solution: 2

AB & BD are reverse symmetric wires

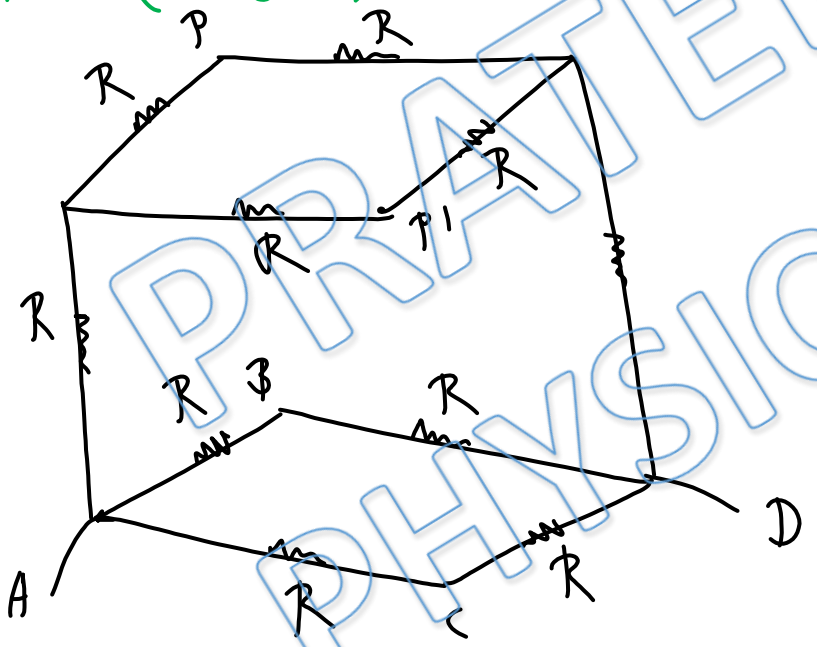
$\Rightarrow$ They have equal Current i_1.

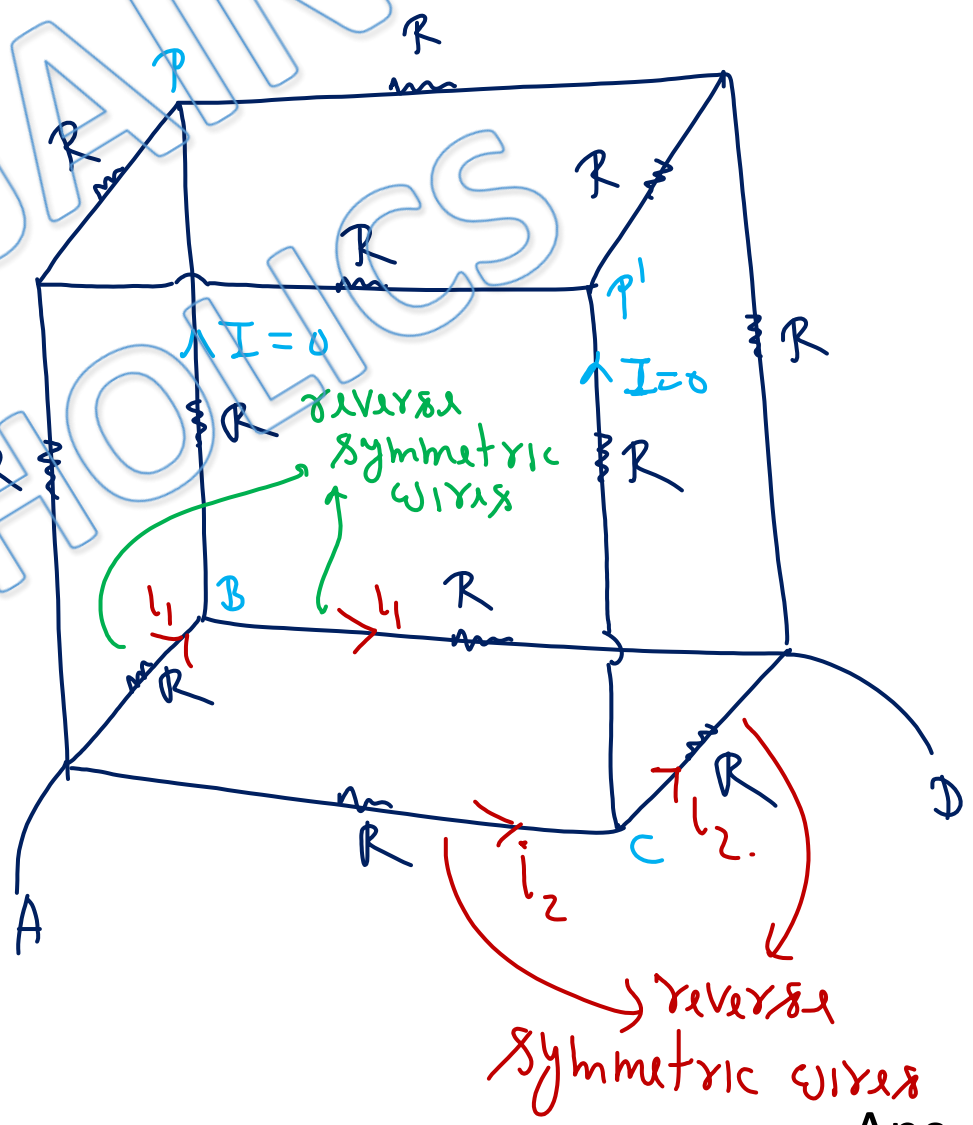
$\Rightarrow$ Current in wire BP $= 0$

Similarly AC & CD are reverse symmetric $\Rightarrow$ equal Current i_2

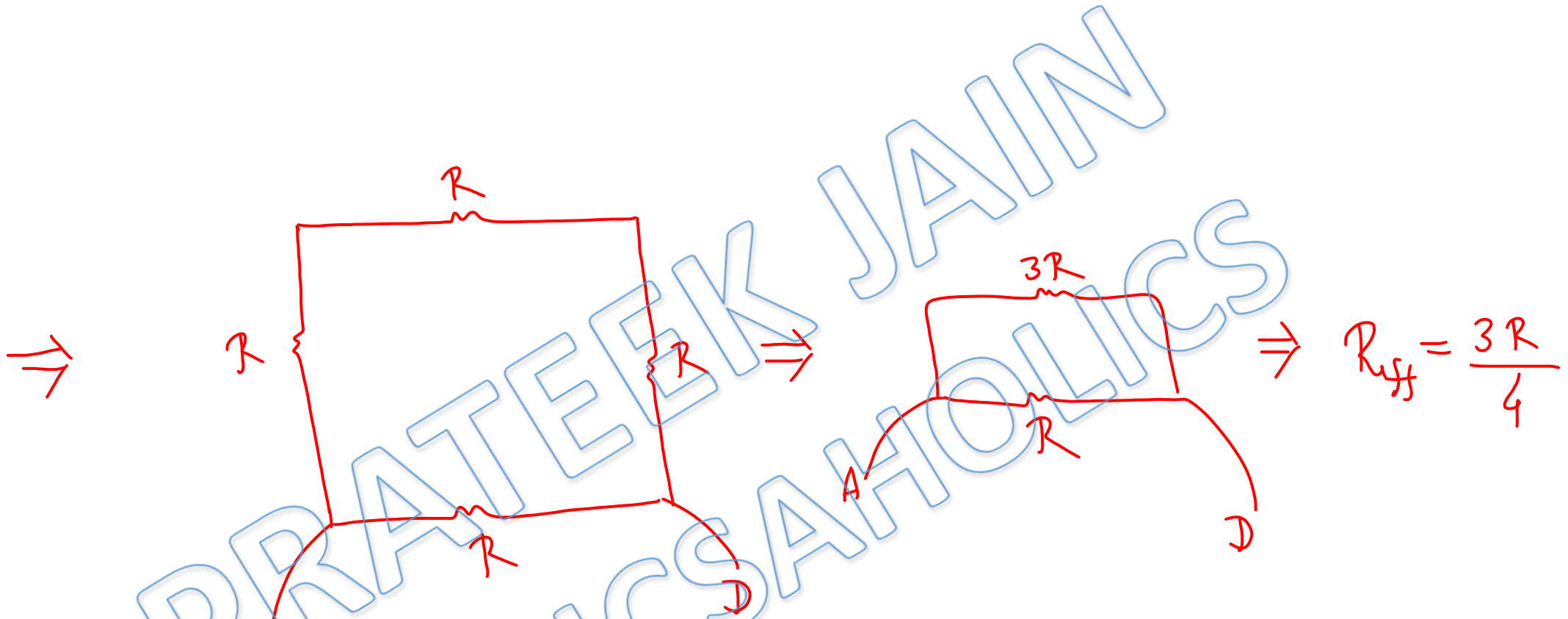
AC & CD $\Rightarrow$ Current in CP' $= 0$

$\Rightarrow$





Ans. c



Ans. c

Solution: 3

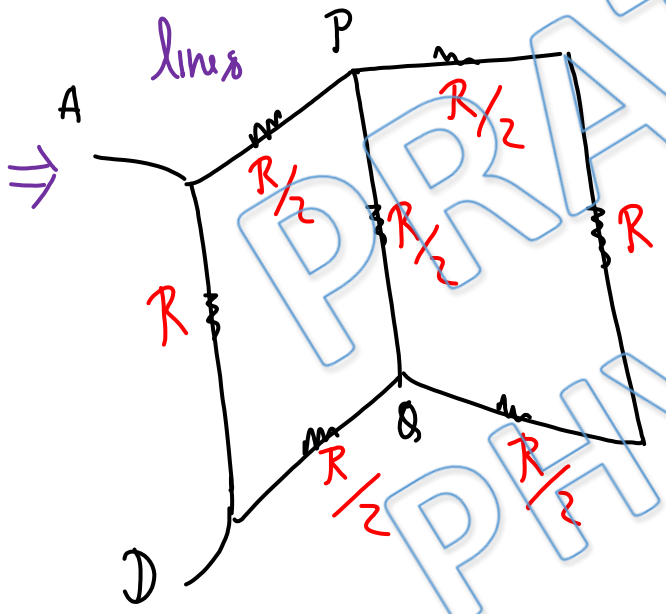
In circuit P & P' are symmetric points

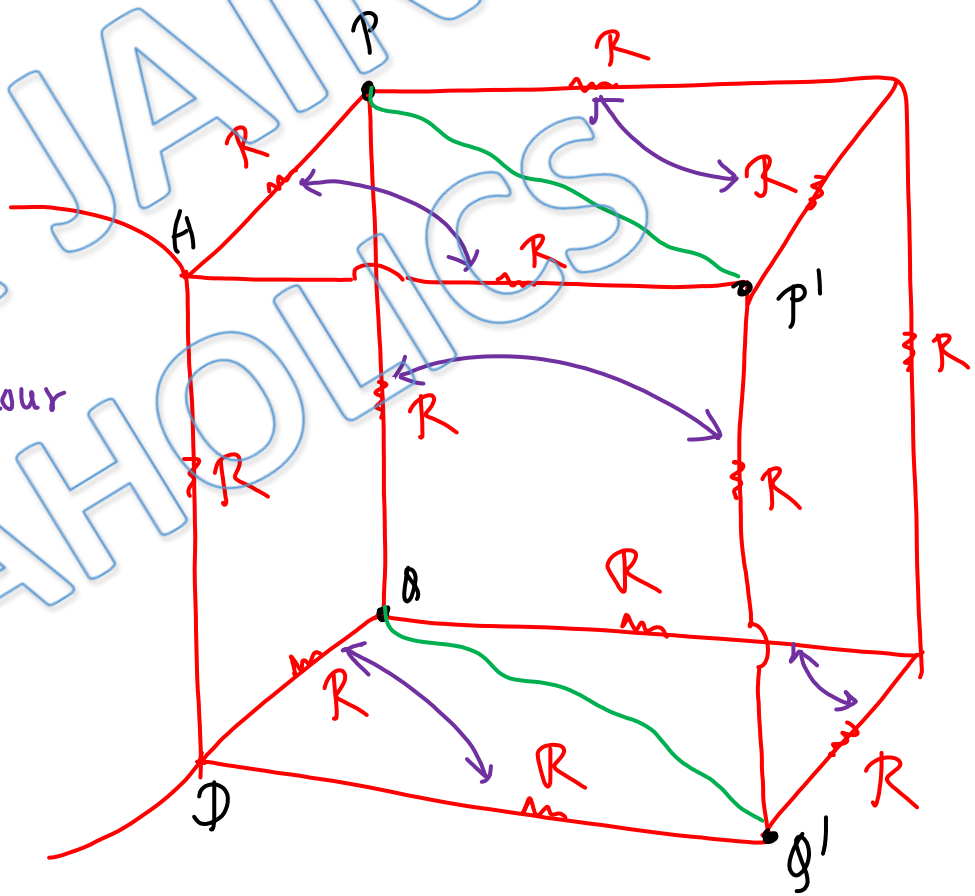
" " Q & Q' " " " .

symmetric points have same potential

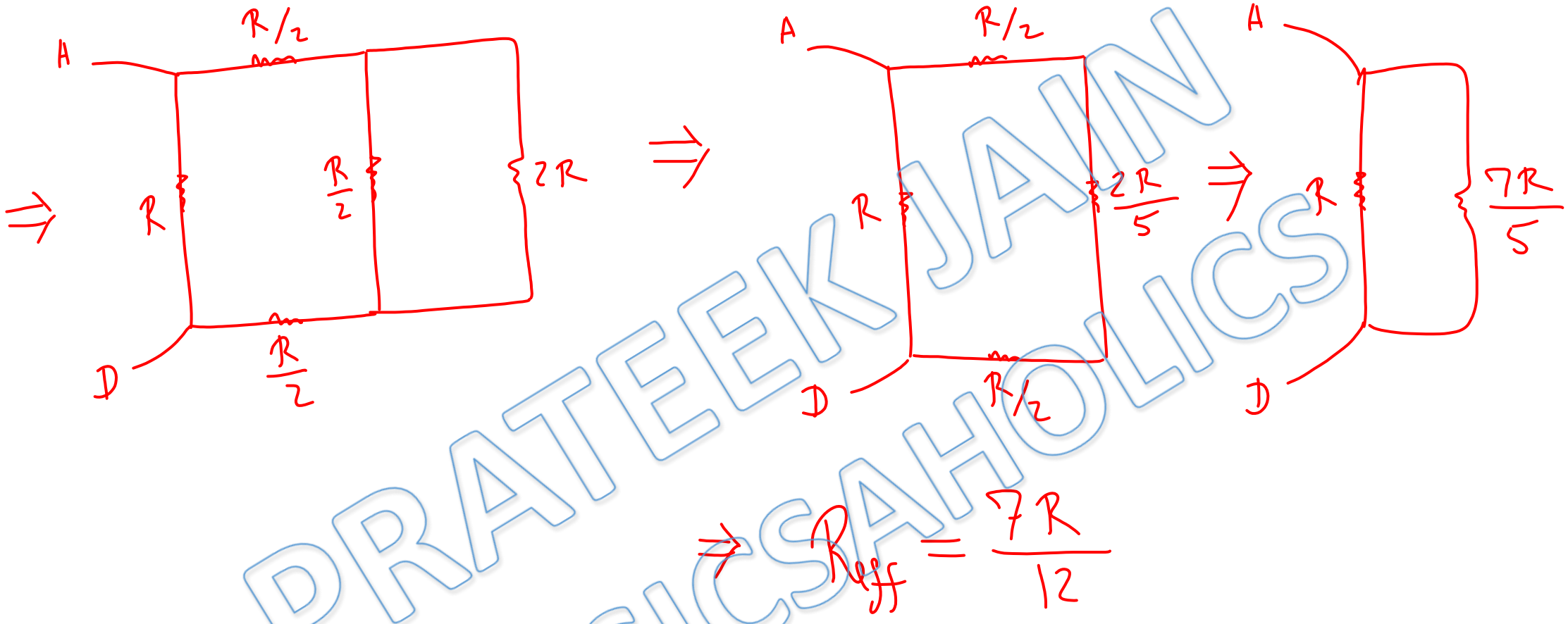
⇒ Connect P to P', Q to Q' as shown by green wires

⇒ Parallel wires are shown by violet Colour lines





Ans. a

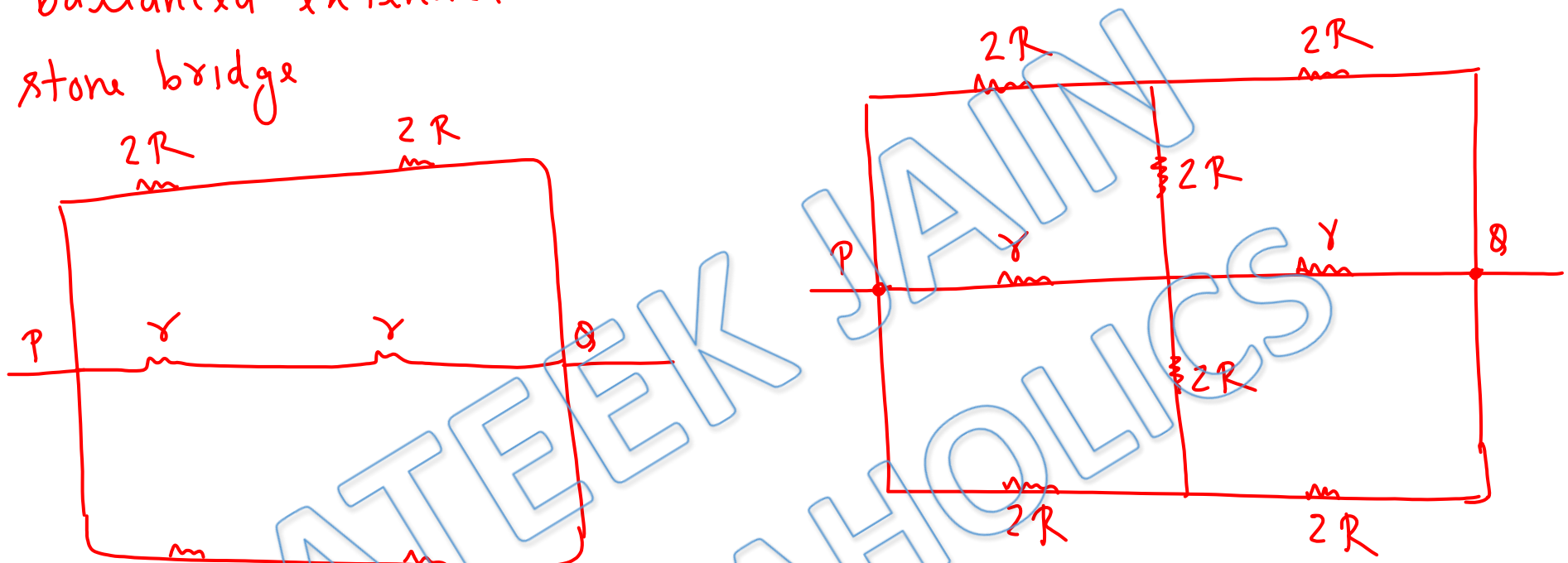


$$\Rightarrow R_{eff} = \frac{7R}{12}$$

Ans. a

Solution: 4

This is ballanced extended wheat stone bridge



$$\Rightarrow \frac{1}{R_{eff}} = \frac{1}{4R} + \frac{1}{4R} + \frac{1}{2r} = \frac{1}{2R} + \frac{1}{2r} = \frac{r+R}{2Rr}$$

$$\Rightarrow R_{eff} = \frac{2Rr}{R+r}$$

Ans. a

Solution: 5

Using symmetry we can say that

Current in P = Current in P'

" " Q = " " Q'

Using KVL in loop abcd →

$-2i_1 + 2(i-2i_1) + 10(i-i_1) = 0$

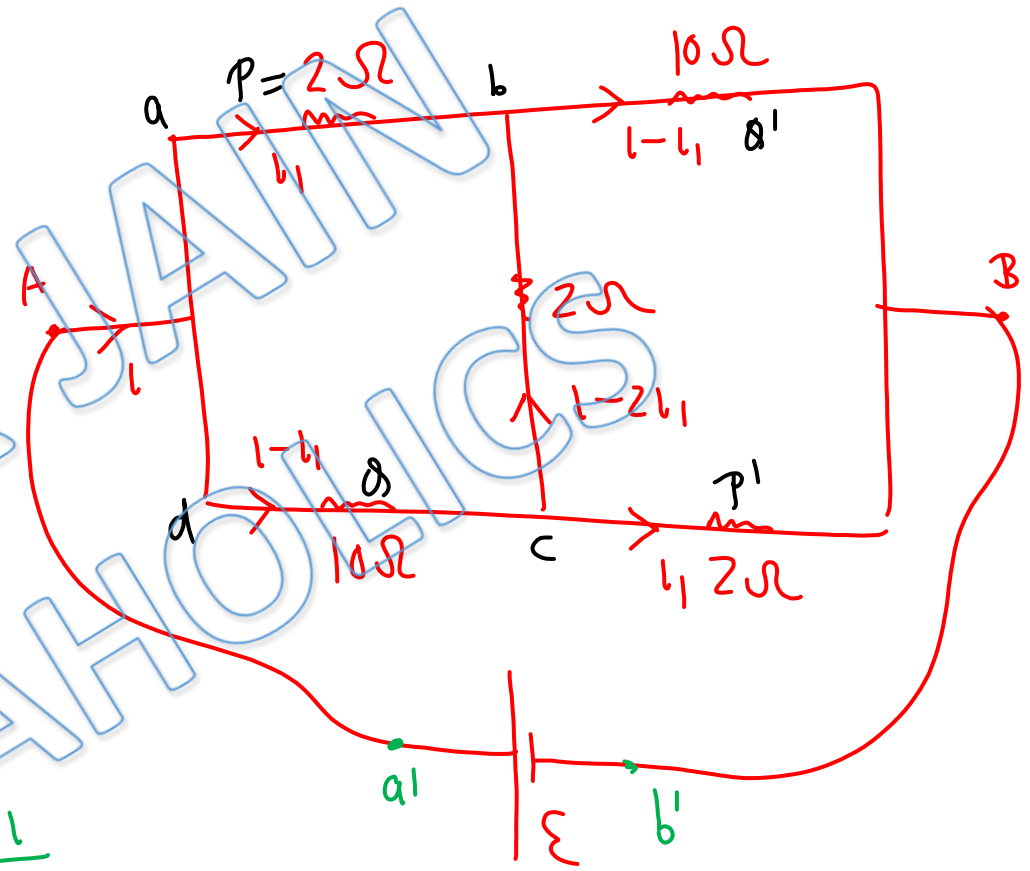
$\Rightarrow \quad 12i - 16i_1 = 0 \Rightarrow i_1 = \frac{3i}{4}$

Using KVL in loop a'AdCBb' →

$-10(i-i_1) - 2i_1 + \varepsilon = 0$

$\Rightarrow -10 \times i/4 - 2 \times 3i/4 + \varepsilon = 0 \Rightarrow \varepsilon = \frac{10i}{4}$

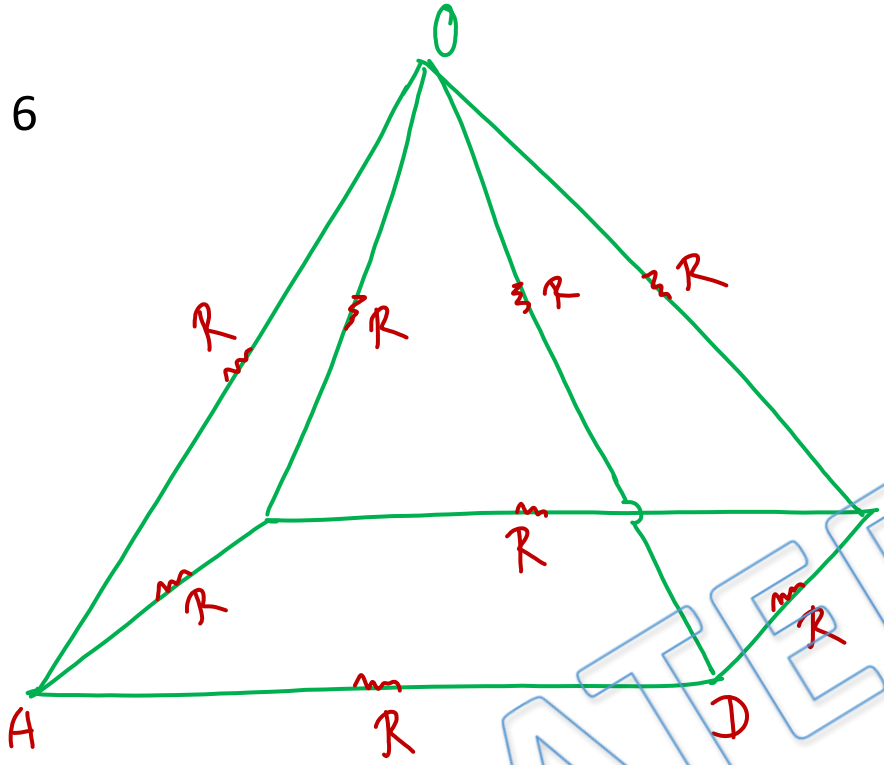
$\Rightarrow R_{eff} = \varepsilon/i = 4\Omega$



$R_{eff} = \varepsilon/i$

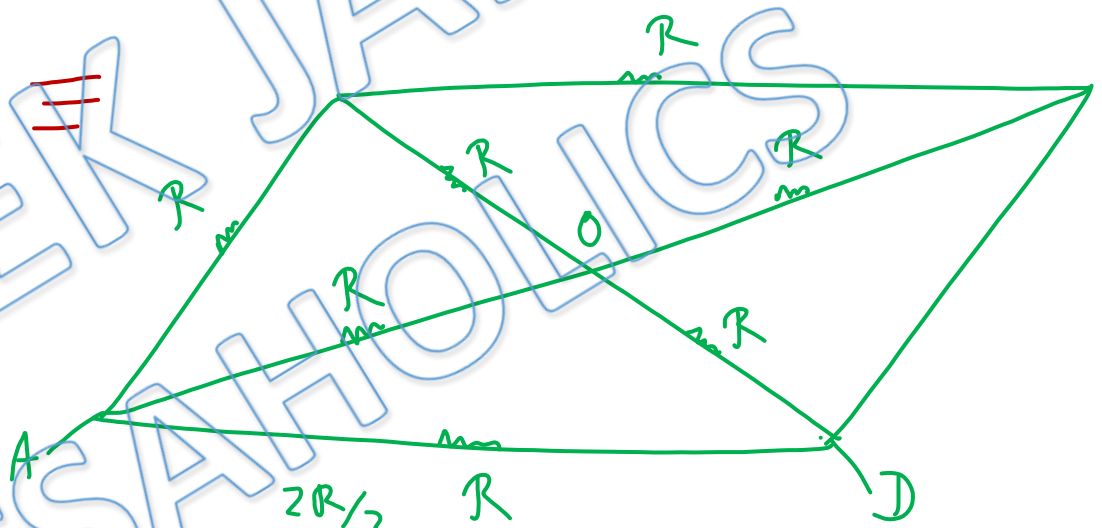
Ans. a

Solution: 6

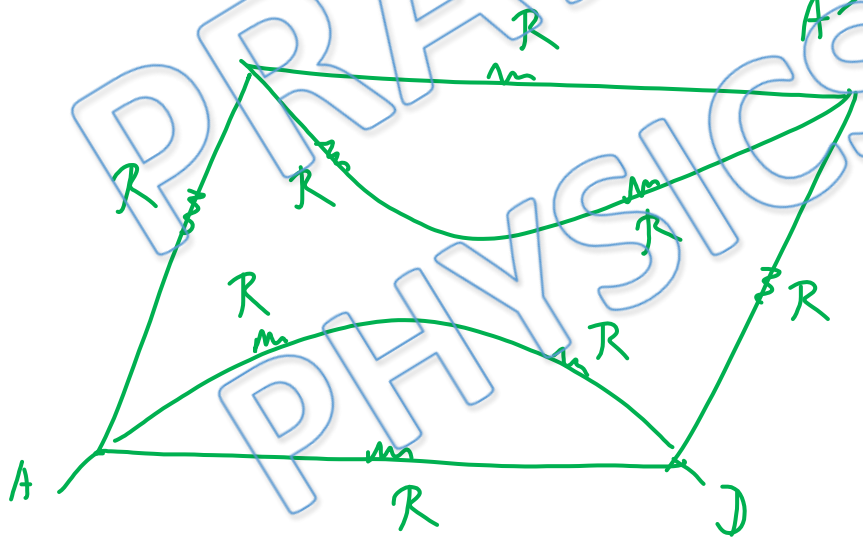


$$R_1 = \frac{8R/3 \times 2R/3}{8R/3 + 2R/3} = \frac{16R/9\ 3}{10R/3}$$

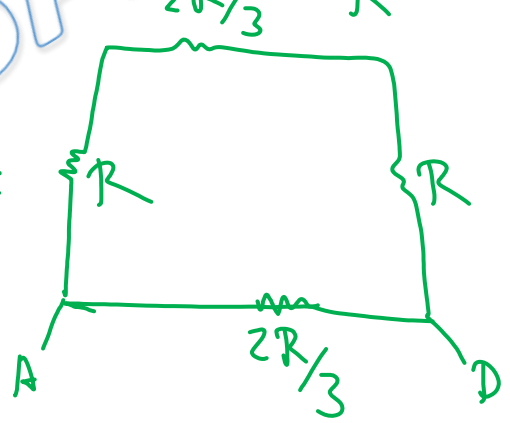
$$= \frac{16R}{30} = \frac{8R}{15}$$



$\Rightarrow$

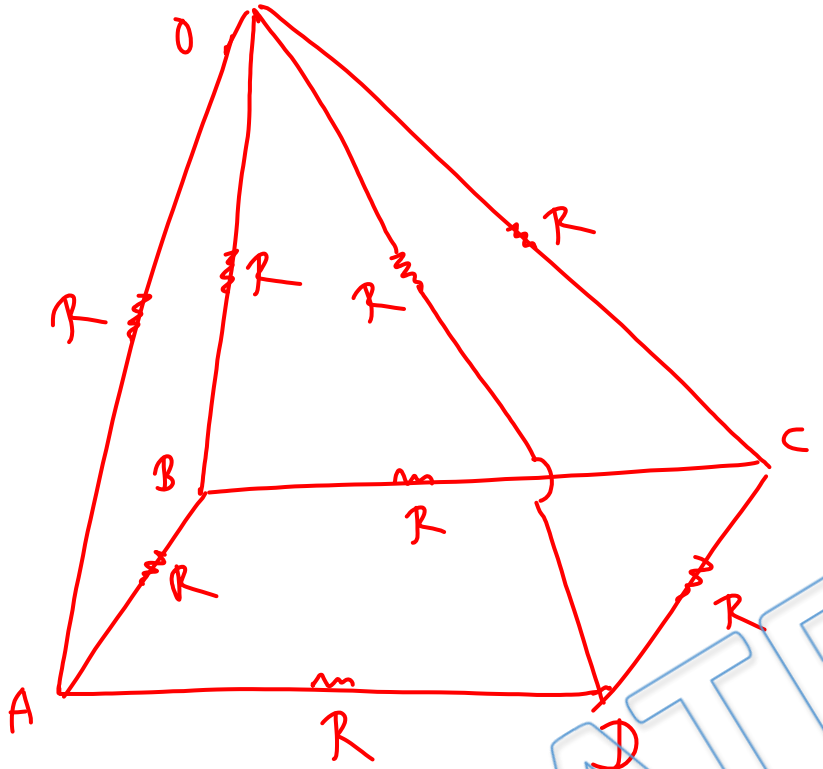


$\equiv$



$$\Rightarrow R_1 = \frac{8R}{15}$$

Ans. a



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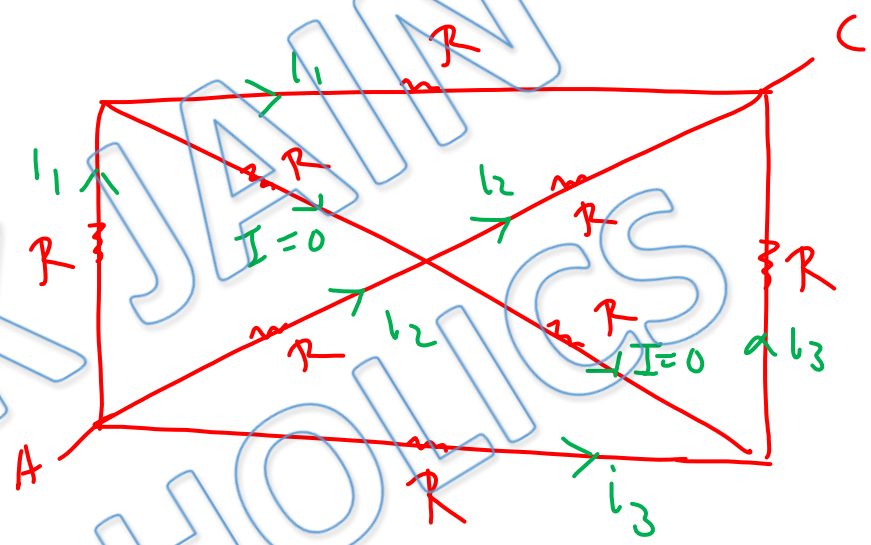
Using Concept of Symmetry, $I = 0$



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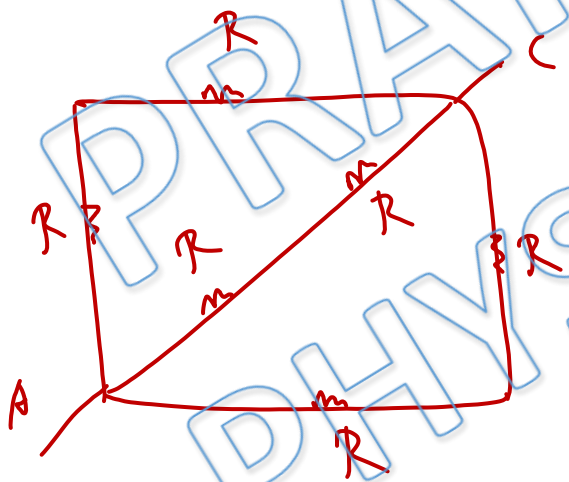
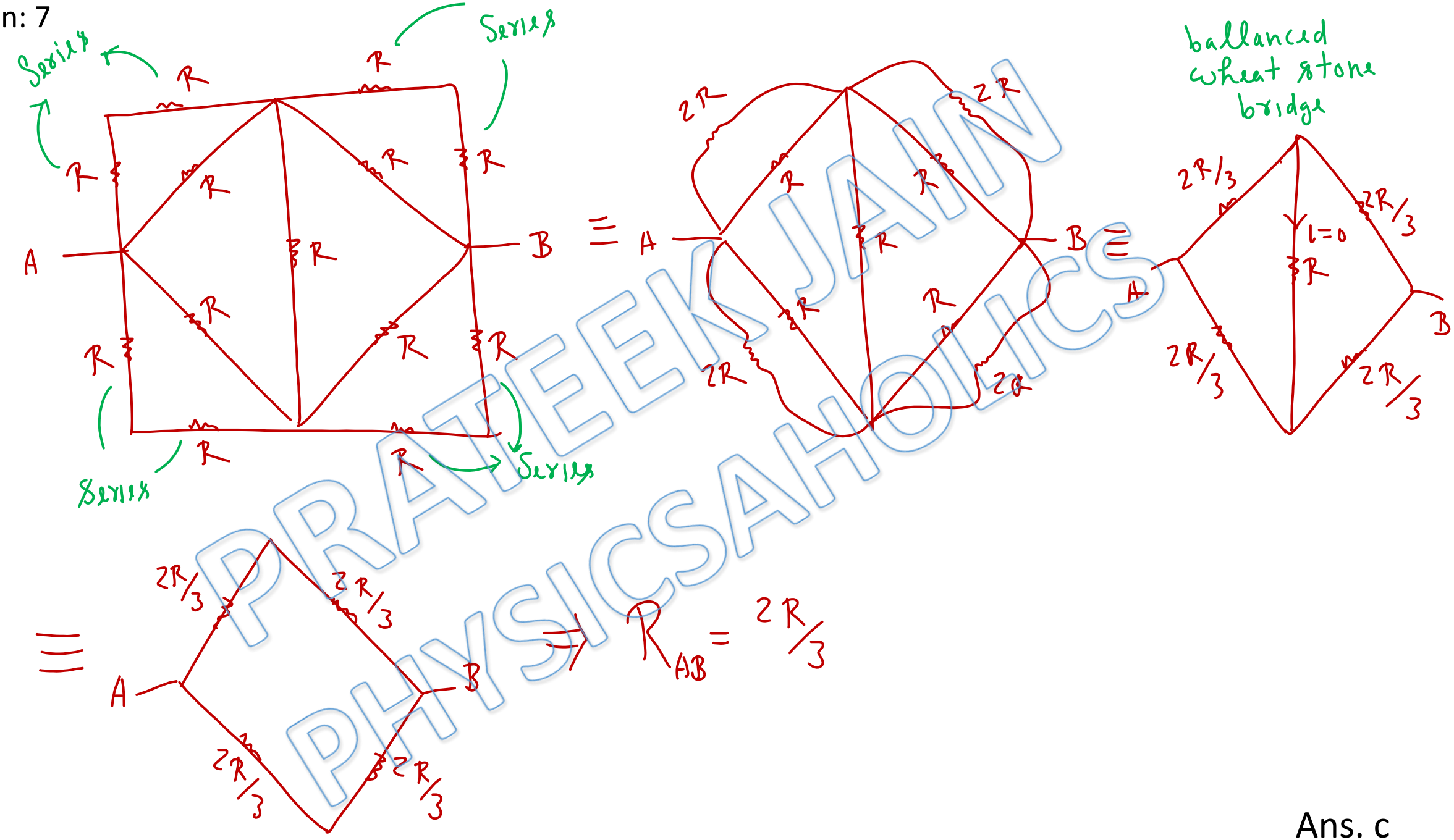


$\equiv R_2 = \frac{2R}{3} \Rightarrow \frac{R_1}{R_2} = \frac{8R}{15} \times \frac{3}{2R} = \frac{4}{5}$

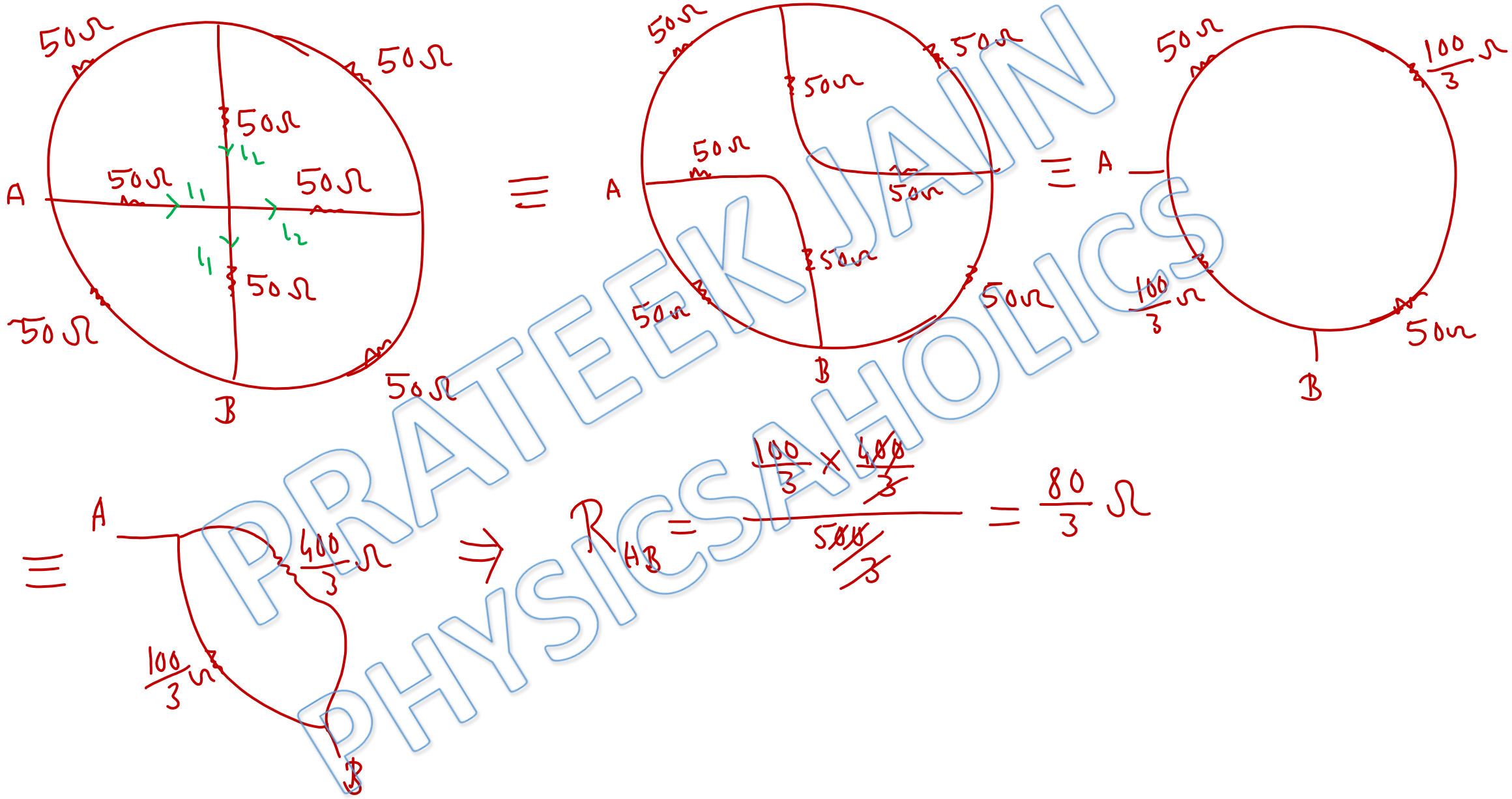
Ans. a

Solution: 7



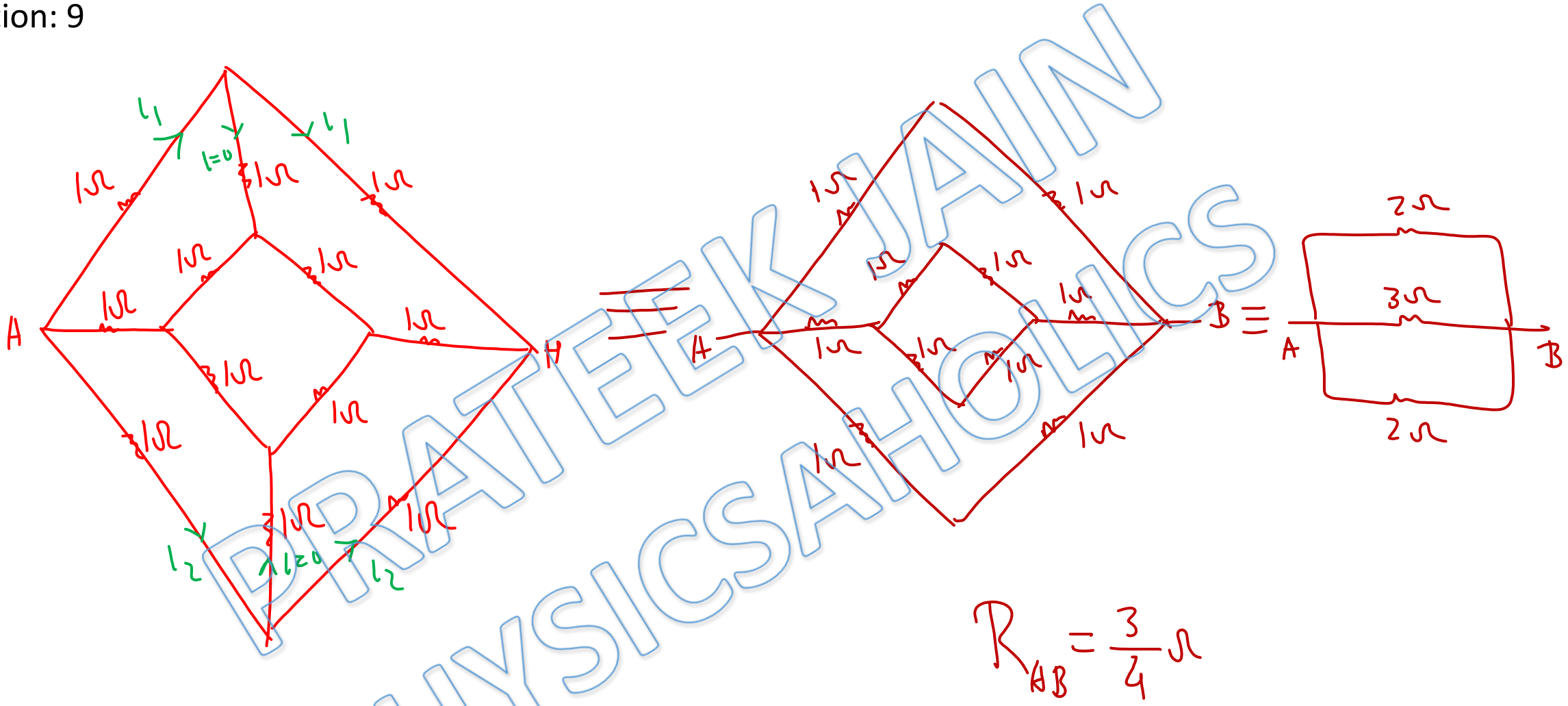
Ans. c

Solution: 8



Ans. a

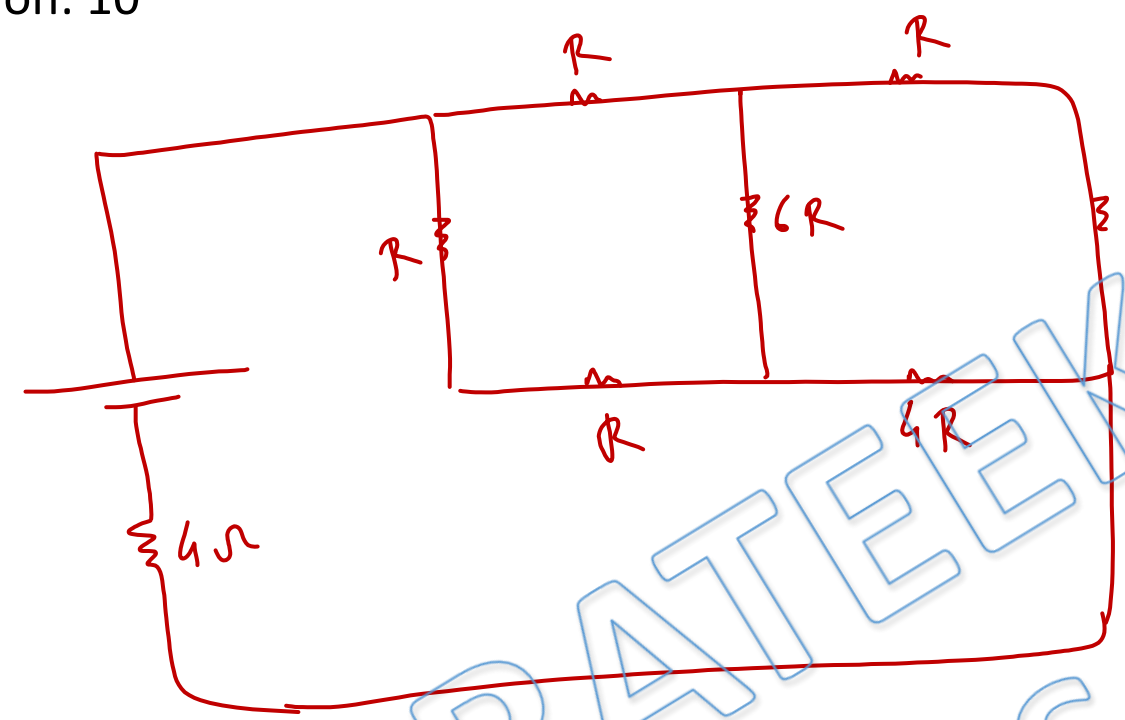
Solution: 9



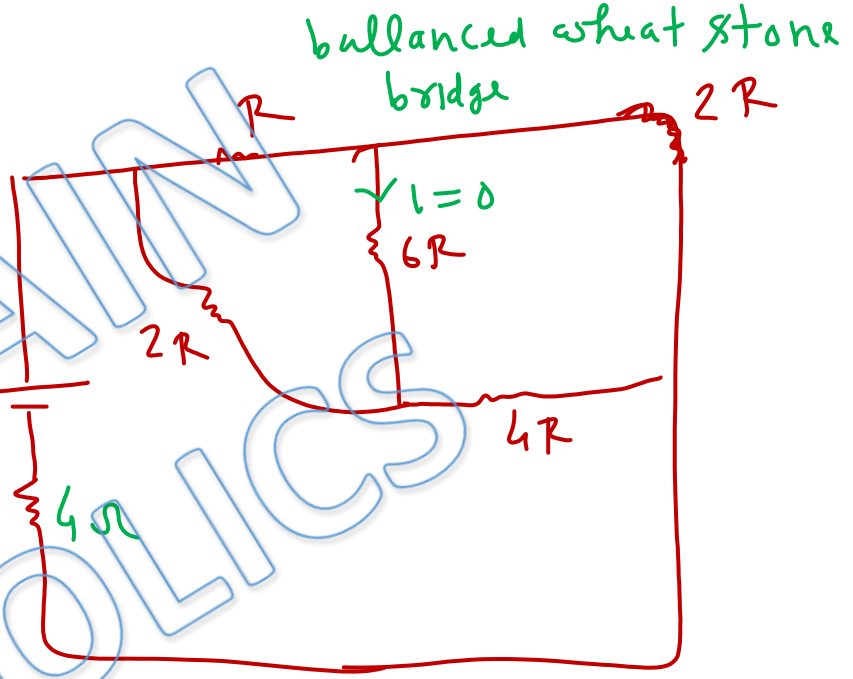
$$R_{AB} = \frac{3}{4}\Omega$$

Ans. c

Solution: 10



balanced wheat stone bridge



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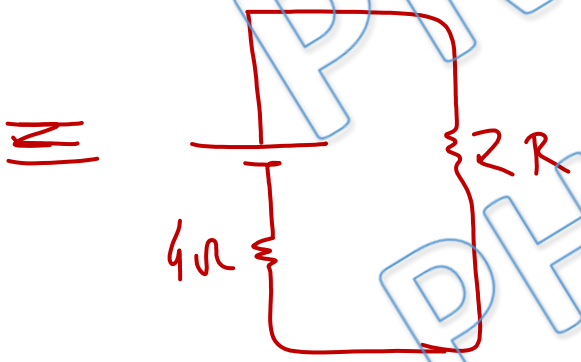


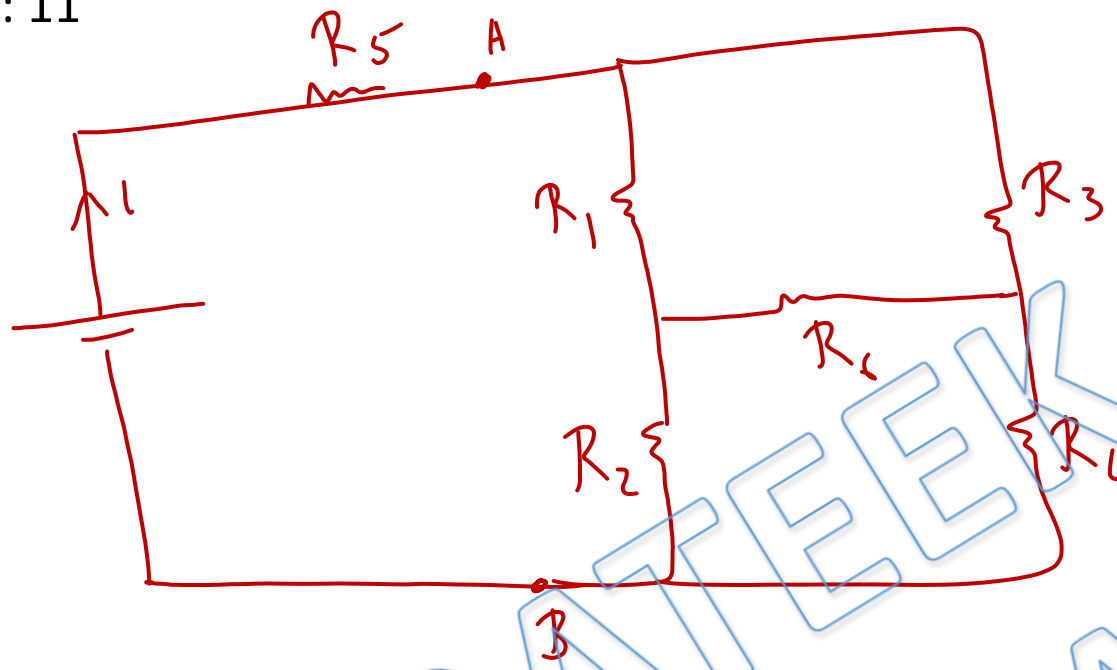
To produce maximum power in 2R

$2R = 4\Omega$

$R = 2\Omega$

Ans. b

Solution: 11



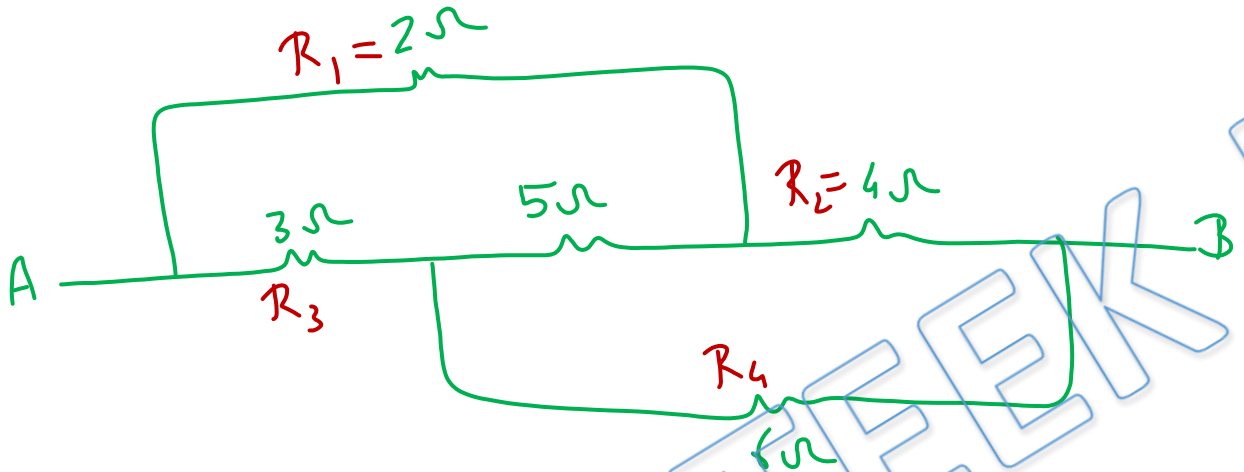
Circuit right to AB is wheat stone bridge. R_{eff} of Circuit will be independent of R_6 if bridge is ballanced

$$\Rightarrow \frac{R_1}{R_2} = \frac{R_3}{R_4}$$

$$\Rightarrow R_1 R_4 = R_2 R_3$$

Ans. c

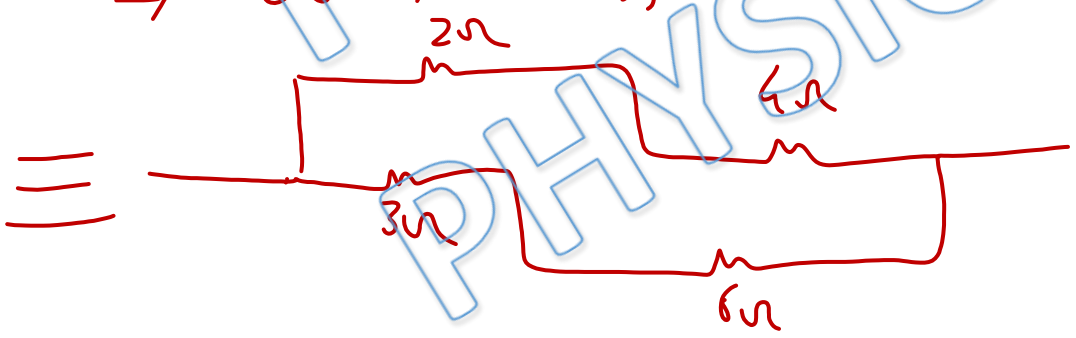
Solution: 12



Since $\frac{R_1}{R_2} = \frac{R_3}{R_4} = \frac{1}{2} \Rightarrow$ bridge is ballanced

$\Rightarrow$ 5Ω is useless

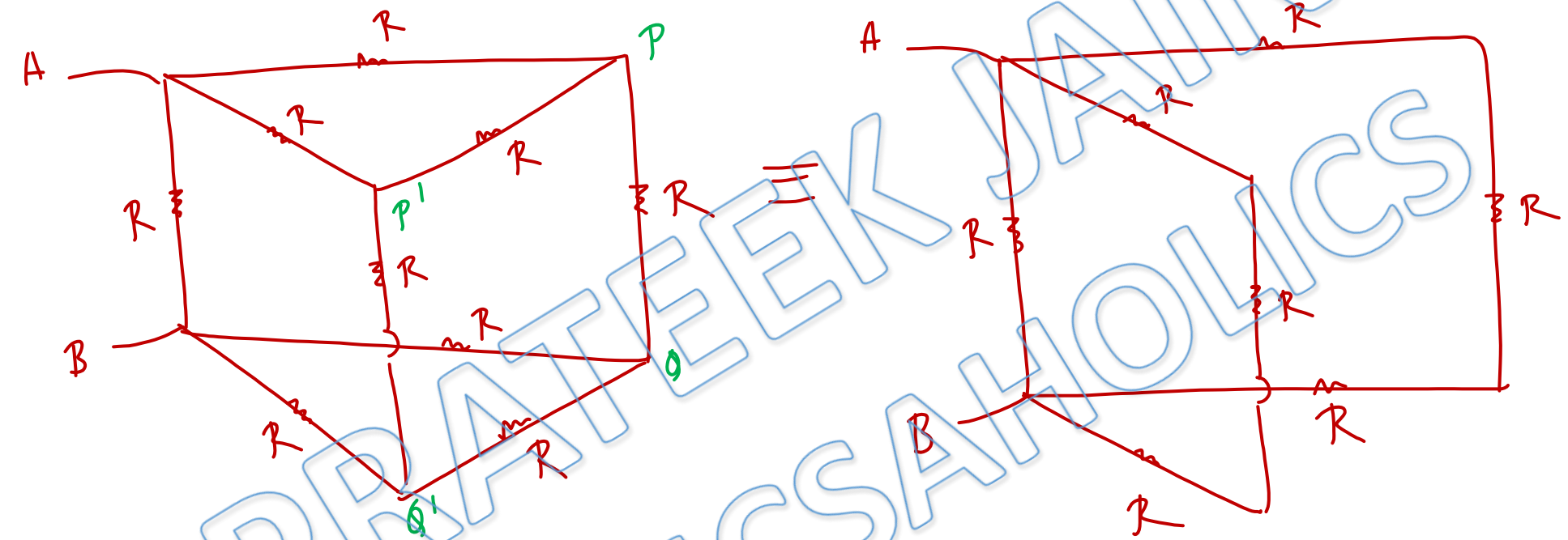
$$R_{AB} = \frac{6 \times 9}{15} = \frac{18}{5}\Omega$$



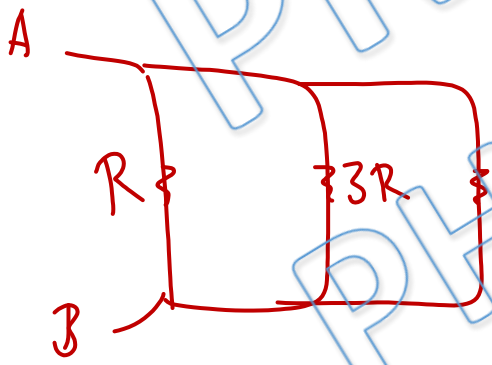
Ans. a, d

Solution: 13

P & P' are symmetric points.
Q & Q' " " " .



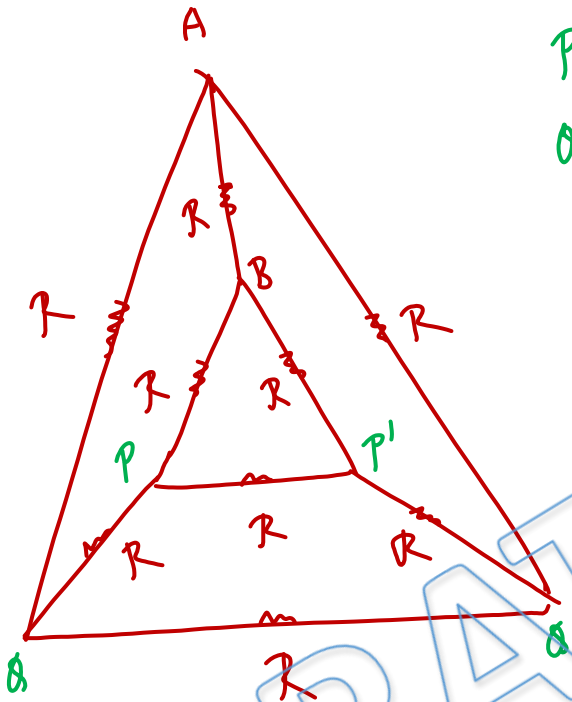
$\equiv$



$$\Rightarrow R_{AB} = \frac{R \times 3R/2}{R + 3R/2} = \frac{3R}{5}$$

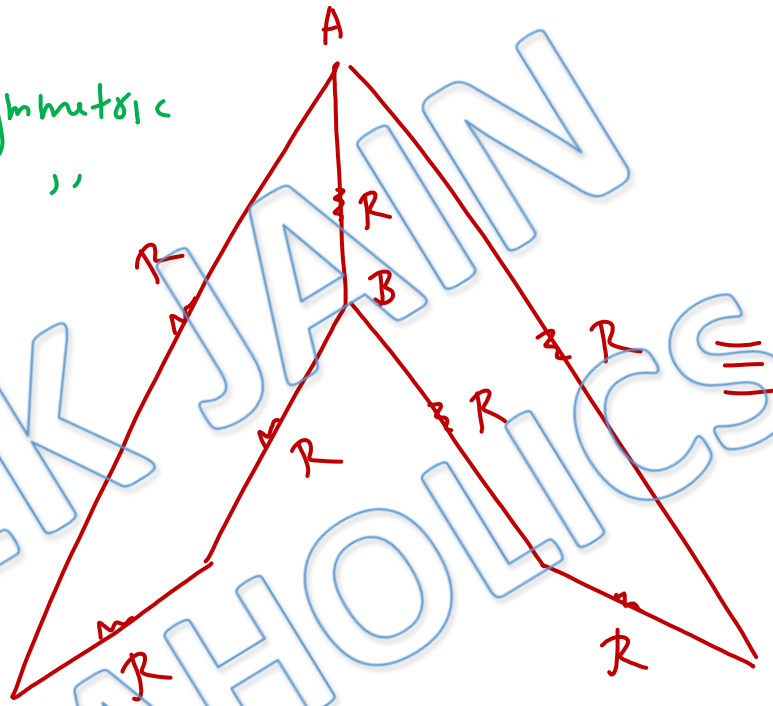
Ans. a

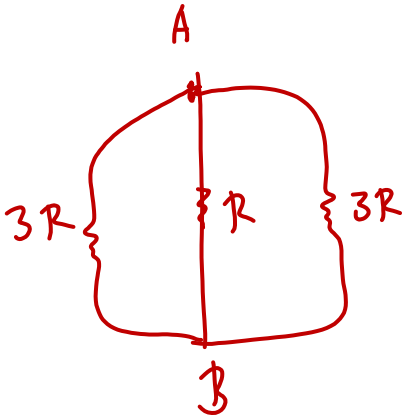
Solution: 14



P & P' are symmetric

B & B' " "



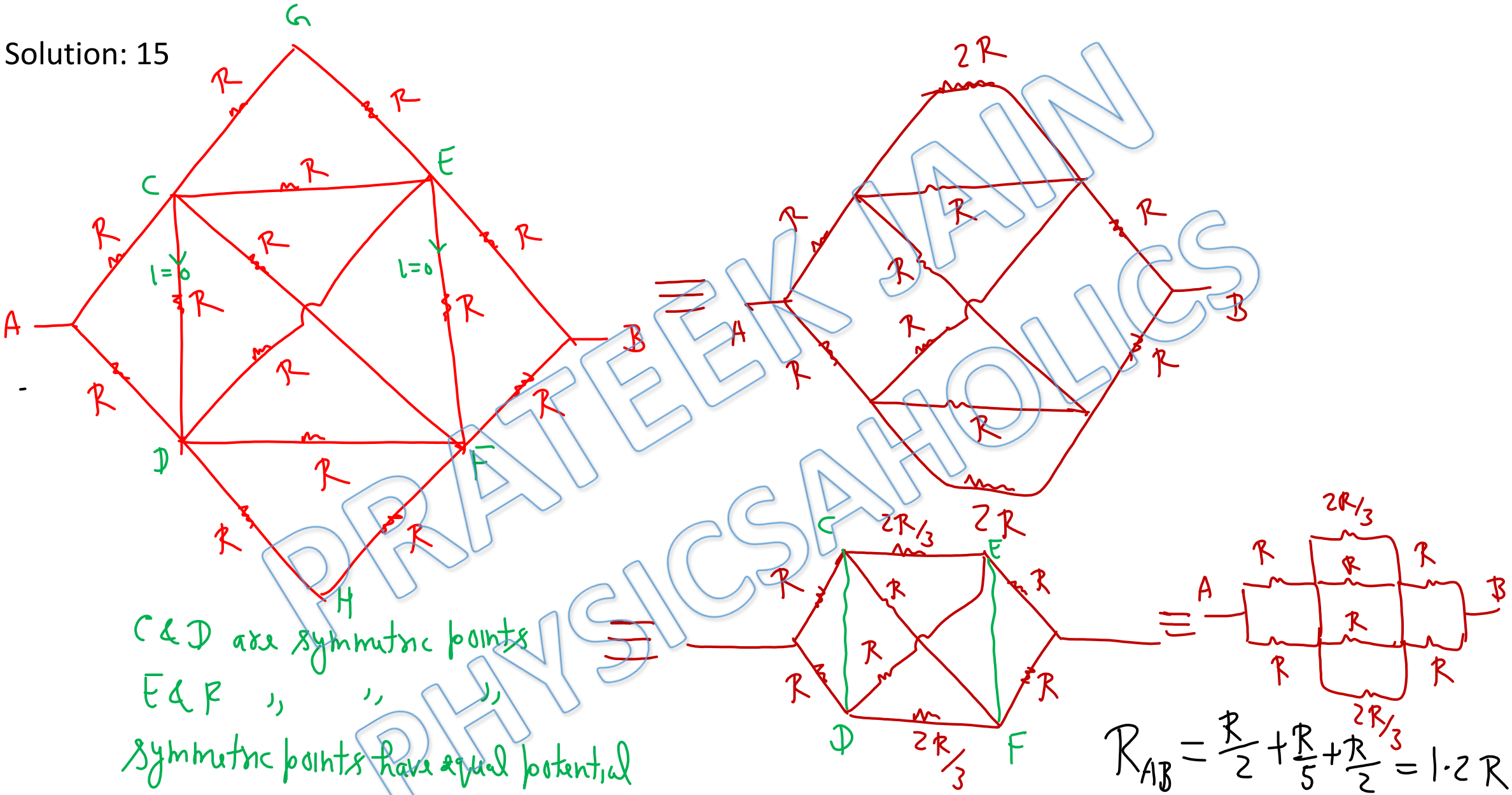


$$\frac{1}{R_{eff}} = \frac{1}{R} + \frac{1}{3R} + \frac{1}{3R} = \frac{3+1+1}{3R} = \frac{5}{3R}$$

$$R_{eff} = \frac{3R}{5}$$

Ans. a

Solution: 15



C & D are symmetric points

E & F " " "

Symmetric points have equal potential

$$R_{AB} = \frac{R}{2} + \frac{R}{5} + \frac{R}{2} = 1.2R$$

Ans. d

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