Physicsaholics

DPP – 4 (Current Electricity)

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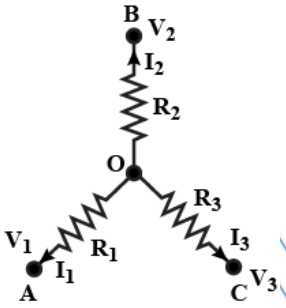
Written Solution on Website:- https://physicsaholics.com/note/notesDetalis/52

Q 1. A circuit has a section ABC as shown in figure. If the potentials at points A, B and C are V_1, V_2 and V_3 respectively. The potential at point O is?



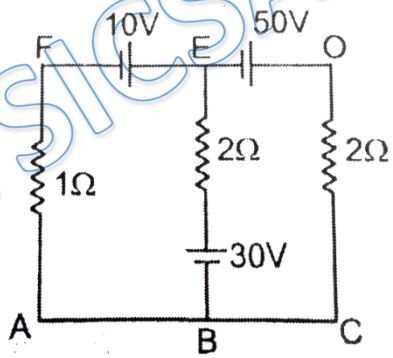
(a) $V_1 + V_2 + V_3$

(b) $\left[\frac{V_1}{R_1} + \frac{V_2}{R_2} + \frac{V_3}{R_3}\right]\left[\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right]^{-1}$

(c) $\left[\frac{V_1}{R_1} + \frac{V_2}{R_2} + \frac{V_3}{R_3}\right]$

(d) zero

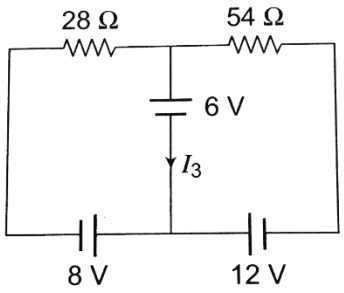
Q 2. Find the current in wire AB:



(a) 10 *amp* (b) 12 *amp*

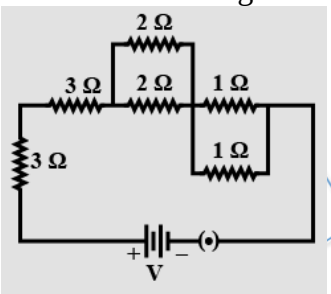
(c) 7 *amp* (d) 4 *amp*

Q 3. Consider the circuit shown in the figure. The magnitude of current I_3 is equal to:



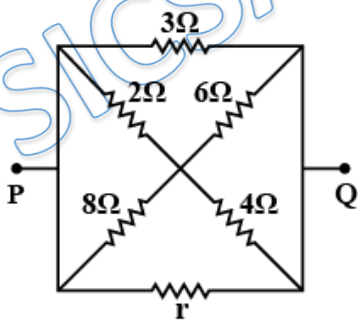
(a) 5 *amp* (b) 3 *amp*
(c) 2 *amp* (d) $\frac{5}{6}$ *amp*

Q 4. Find the equivalent resistance of the following circuit.



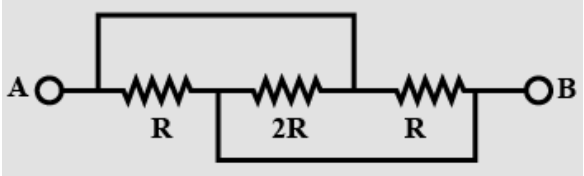
(a) $\frac{15}{2}\ \Omega$ (b) $\frac{13}{2}\ \Omega$
(c) $7\ \Omega$ (d) $12\ \Omega$

Q 5. In the network shown, the equivalent resistance between P and Q is $\frac{4}{3}\ \Omega$. Hence the value of r is:



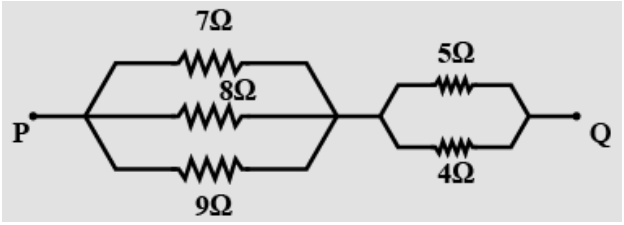
(a) $3\ \Omega$ (b) $4\ \Omega$
(c) $5\ \Omega$ (d) $6\ \Omega$

Q 6. The effective equivalent resistance between A and B in the figure, is?



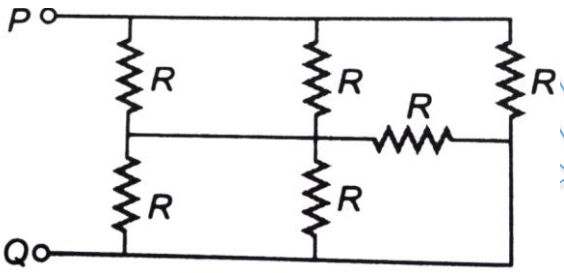
(a) $\frac{3}{2}R$ (b) $\frac{2}{3}R$
(c) $\frac{2}{5}R$ (d) $2R$

Q 7. For the circuit given below, calculate the equivalent resistance between the points P and Q:



(a) 3.56 Ω (b) 2.56 Ω
(c) 4.86 Ω (d) 7.26 Ω

Q 8. In the circuit shown in figure $R = 55\Omega$ the equivalent resistance between the point P and Q is:

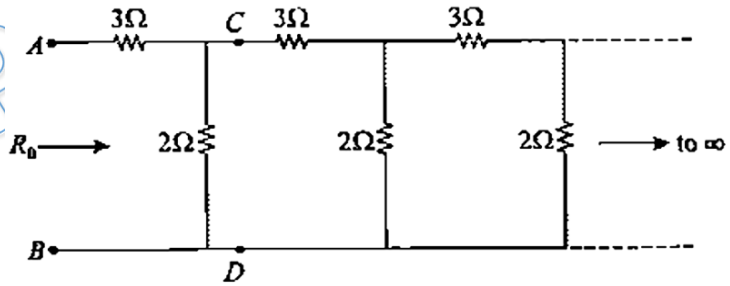


(a) 30 Ω (b) 35 Ω
(c) 55 Ω (d) 25 Ω

Q 9. A wire of resistance R is cut into n equal parts. These parts are then connected in parallel. The equivalent resistance of combination will be:

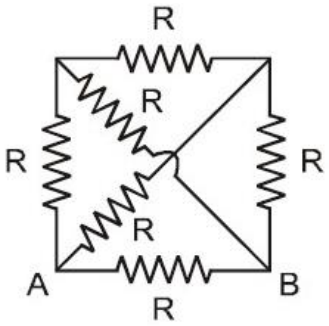
(a) nR (b) $\frac{R}{n}$
(c) $\frac{n}{R}$ (d) $\frac{R}{n^2}$

Q 10. Find the equivalent resistance of the infinite ladder circuit shown in figure across terminals A and B :



(a) $\frac{3+\sqrt{33}}{2}$ (b) $\frac{3+\sqrt{35}}{2}$
(c) $\frac{2+\sqrt{35}}{3}$ (d) $\frac{2+\sqrt{33}}{3}$

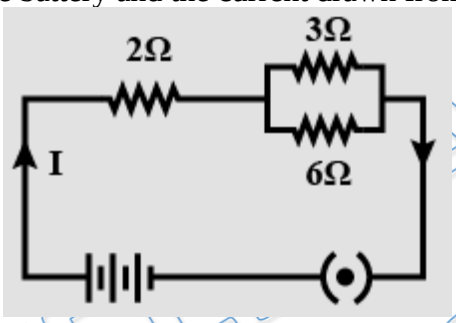
Q 11. The equivalent resistance between A and B is:



(a) R (b) $\frac{R}{2}$

(c) $2R$ (d) none of these

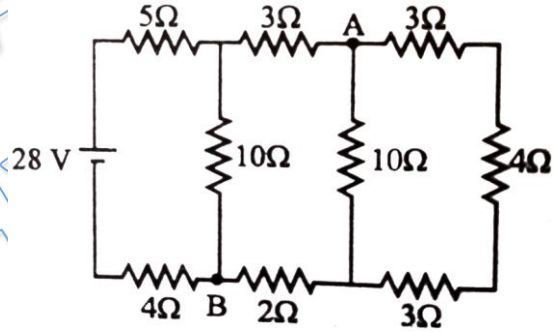
Q 12. In the given electric circuit, the current flowing through 3 ohm resistor is 1 ampere. Find the voltage of the battery and the current drawn from it:



(a) 6 V, 1 amp (b) 4 V, 1.5 amp

(c) 6 V, 1.5 amp (d) 4 V, 1 amp

Q 13. Consider the circuit shown in the figure:



(a) the current in the 5Ω resistor is 2A

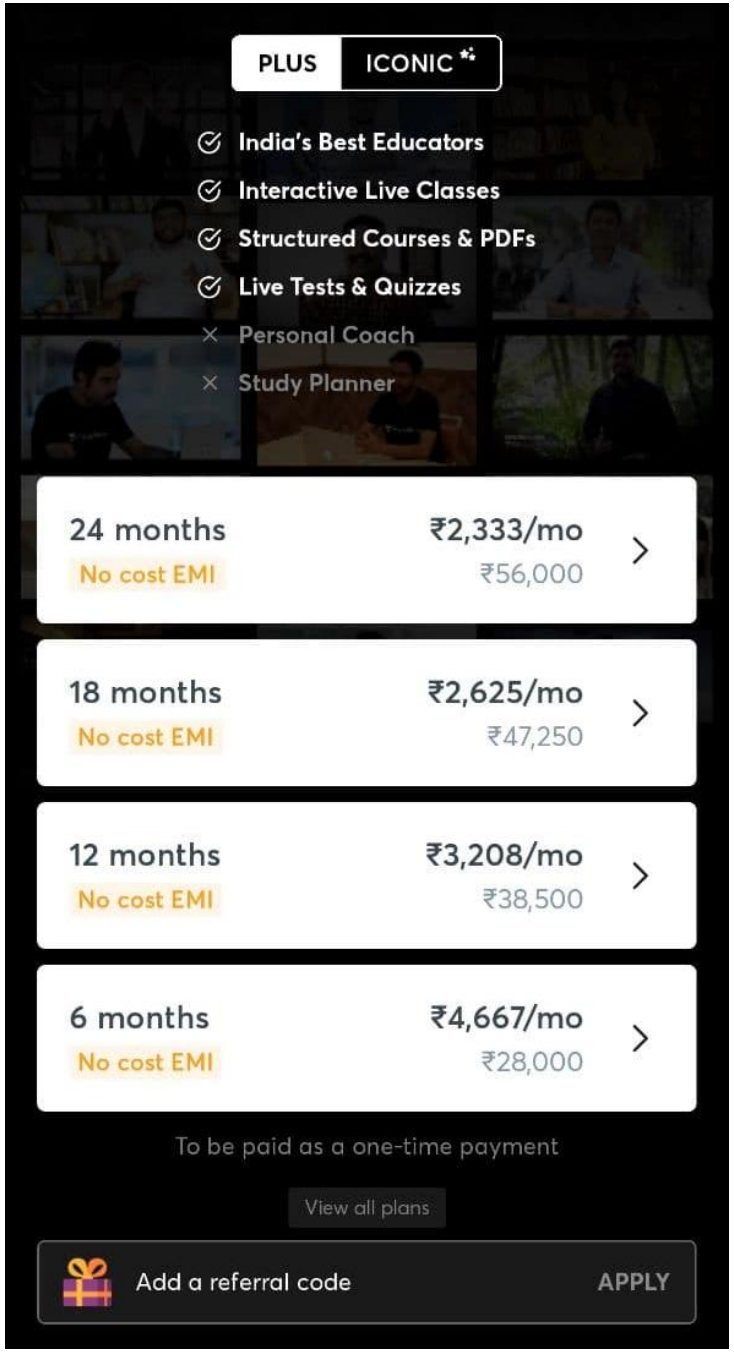
(b) the current in the 5Ω resistor is 1A

(c) the potential difference $V_A - V_B$ is 10V

(d) the potential difference $V_A - V_B$ is 5V

Answer Key

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



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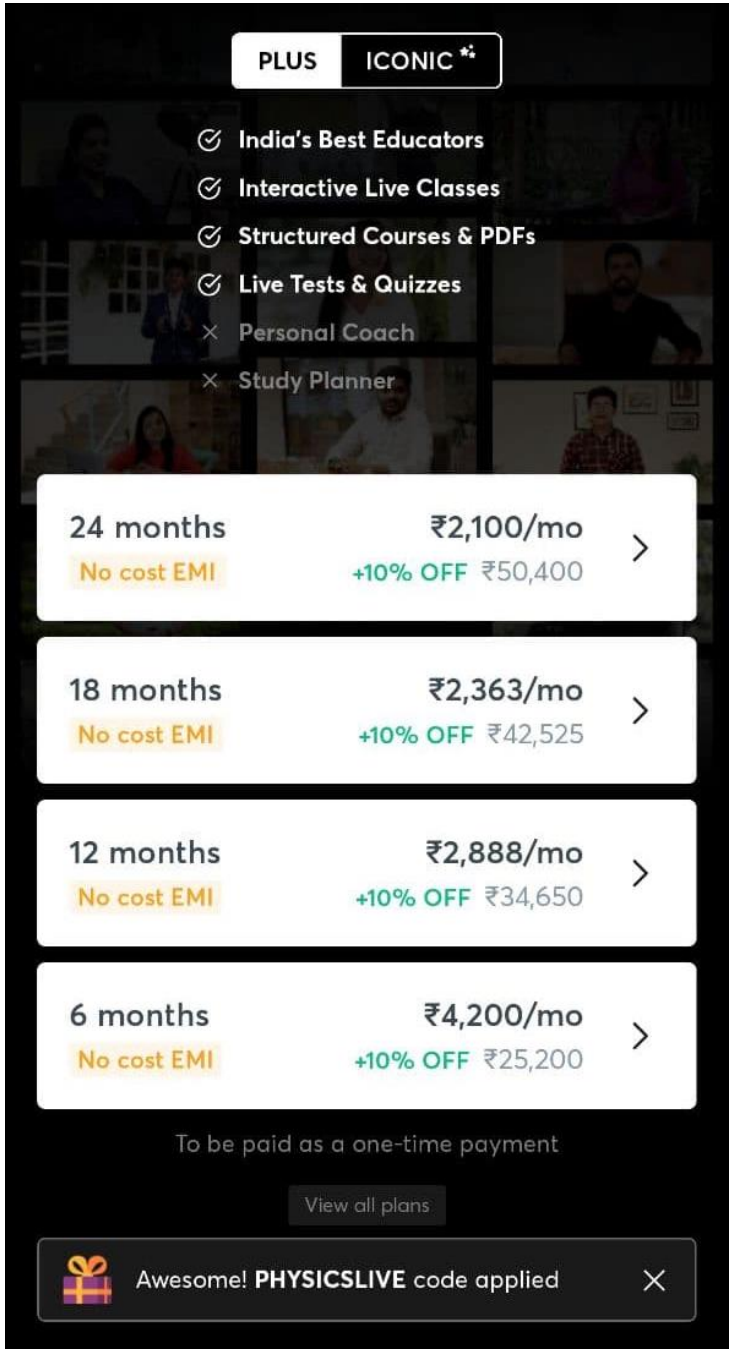
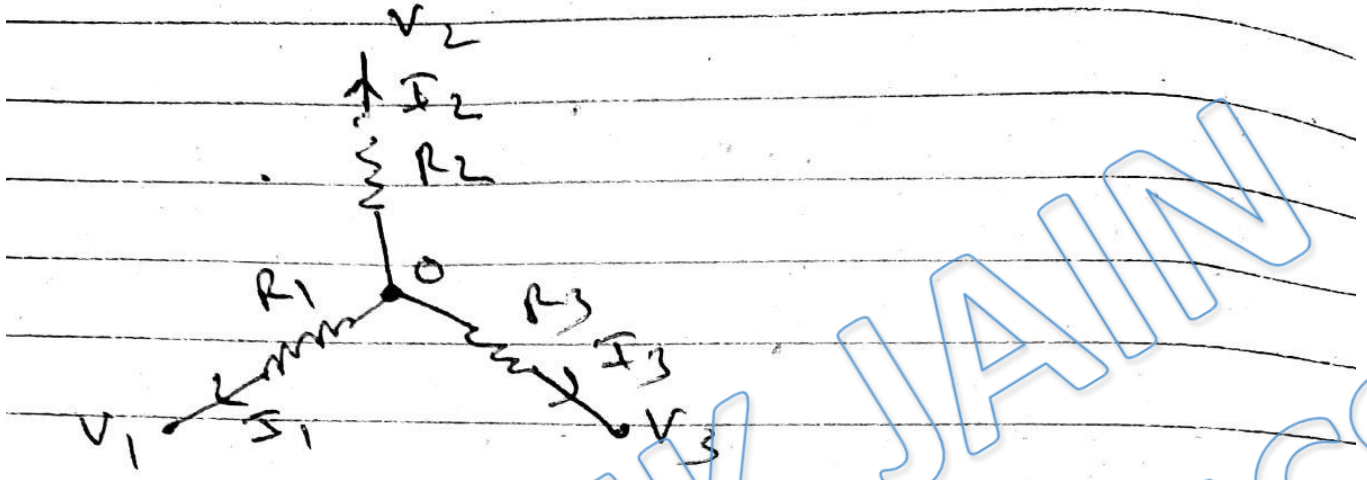


Written Solution

DPP-4 Current Electricity: Kirchhoff's Voltage Law, Series & Parallel combination of resistance and Wheatstone bridge

By Physicsaholics Team

Solution: 1



at node 'O'

$$I_1 + I_2 + I_3 = 0$$

$$\frac{V_0 - V_1}{R_1} + \frac{V_0 - V_2}{R_2} + \frac{V_0 - V_3}{R_3} = 0$$

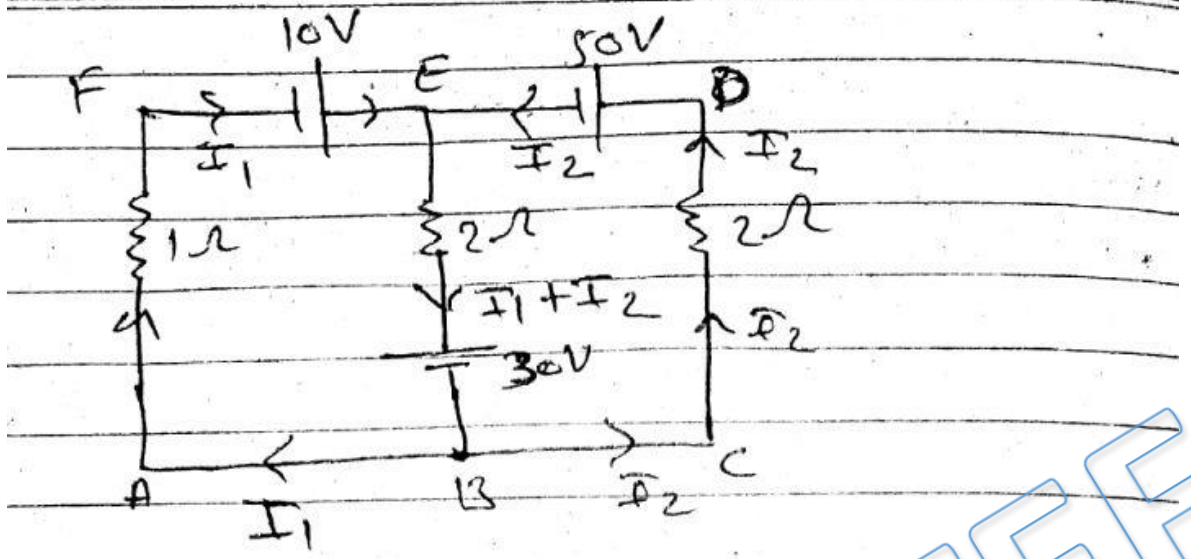
$$\frac{V_0}{R_1} + \frac{V_0}{R_2} + \frac{V_0}{R_3} - \frac{V_1}{R_1} - \frac{V_2}{R_2} - \frac{V_3}{R_3} = 0$$

$$V_0\left[\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right] = \frac{V_1}{R_1} + \frac{V_2}{R_2} + \frac{V_3}{R_3}$$

$$\boxed{V_0 = \left[\frac{V_1}{R_1} + \frac{V_2}{R_2} + \frac{V_3}{R_3}\right]\left[\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right]}$$

Ans. b

Solution: 2



in loop AFEBA

$$-I_1 \times 1 + 10 - (I_1+I_2)\times 2 - 30 = 0$$

$$-I_1 - 2I_1 - 2I_2 = 20$$

$$\boxed{-2I_2 - 3I_1 = 20} \quad -①$$

in loop BCDEB

$$-I_2 \times 2 - 50 - (I_1+I_2)\times 2 - 30 = 0$$

$$-2I_2 - 50 - 2I_1 - 2I_1 - 30 = 0$$

$$\boxed{-4I_2 - 2I_1 = 80} \quad -②$$

from eq^n ① & ②

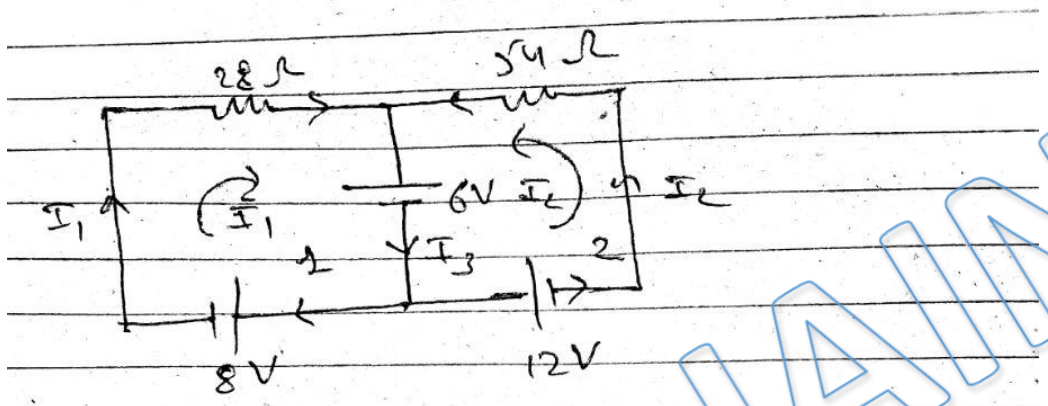
$I_1 = 10$ Amp;

∴ current in wire AB = I_1

$$\boxed{I_1 = 10 \text{ amp}}$$

Ans. a

Solution: 3



$I_3 = I_1 + I_2$

in loop - 1

$-8 - 28I_1 - 6 = 0$

$I_1 = -\frac{14}{28} = -1/2$ Amp. — (1)

in loop - 2

$-12 - 54I_2 - 6 = 0$

$I_2 = \frac{-18}{54} = -1/3$ Amp — (2)

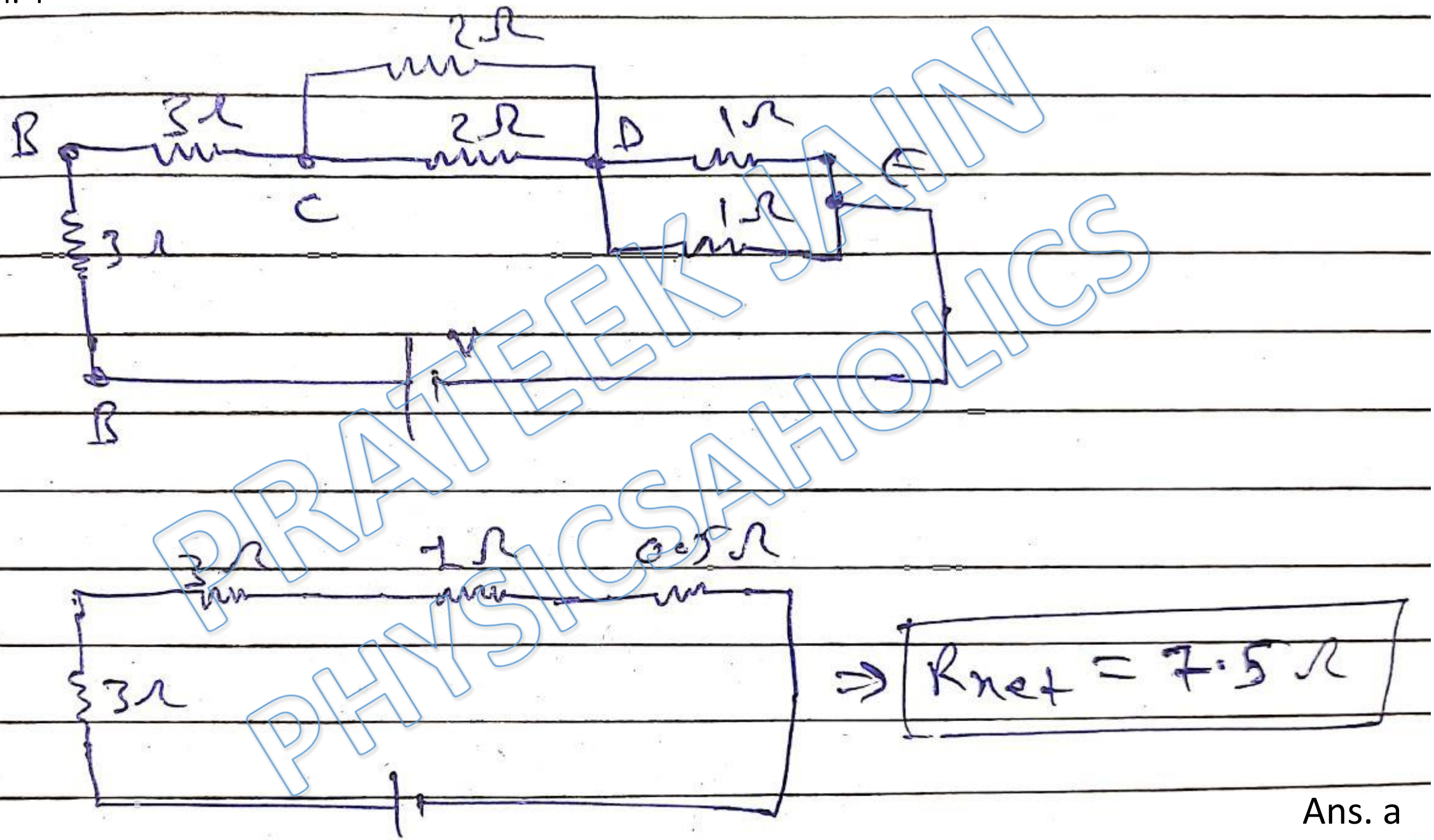
$I_3 = I_1 + I_2 = -\frac{1}{2} - \frac{1}{3} = -5/6$ amp.

$\boxed{|I_3| = 5/6 \text{ Amp}}$

-ve sign shows that the direction of current will be opposite to that is assumed.

Ans. d

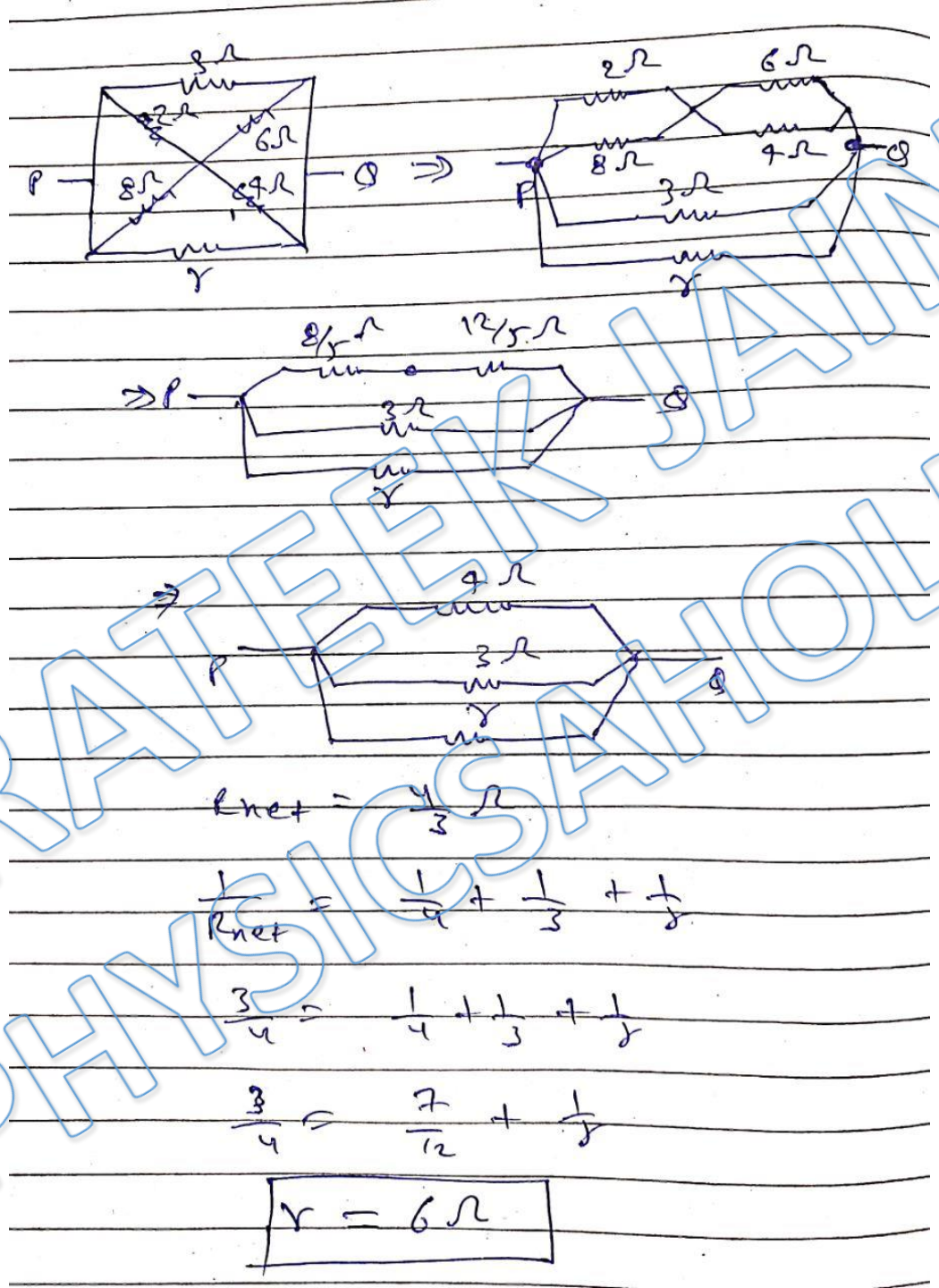
Solution: 4



$$\Rightarrow R_{net} = 7.5\ \Omega$$

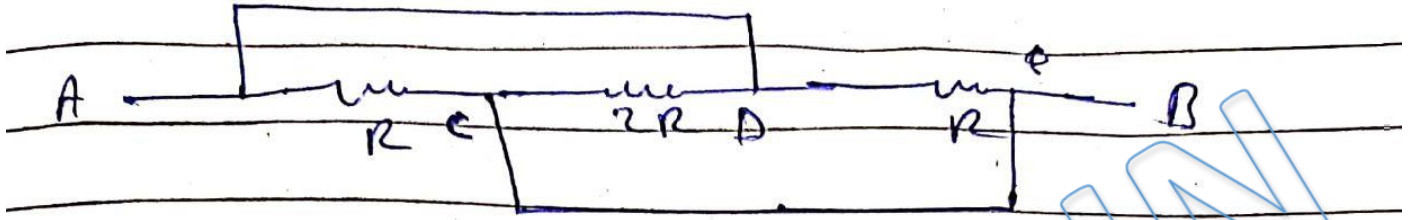
Ans. a

Solution: 5



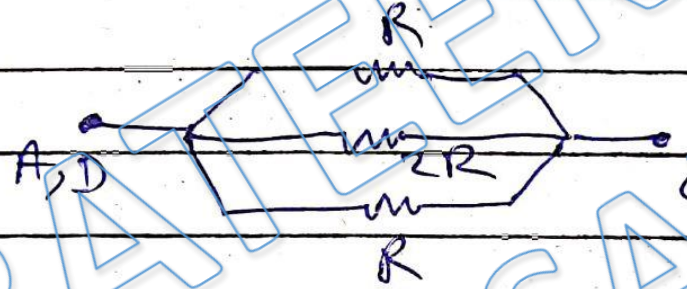
Ans. d

Solution: 6



$V_A = V_D$

$V_C = V_B$



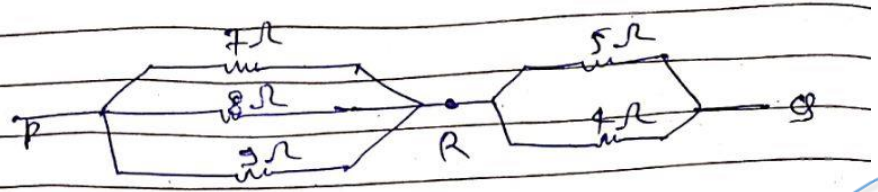
$$\frac{1}{R_{net}} = \frac{1}{R} + \frac{1}{2R} + \frac{1}{R}$$

$$= \frac{2}{2R} + \frac{1}{2R} + \frac{2}{2R}$$

$$\boxed{R_{net} = \frac{2R}{5}}$$

Ans. c

Solution: 7



$R_{PR} = ?$

$$\frac{1}{R_{PR}} = \frac{1}{7} + \frac{1}{8} + \frac{1}{9}$$

$$R_{PR} = \frac{7 \times 8 \times 9}{8\times9 + 7\times9 + 7\times8}$$

$$R_{PR} = \frac{504}{191}\ \Omega$$

$$R_{RQ} = \frac{4\times5}{4+5} = \frac{20}{9}\ \Omega$$

$$R = R_{PR} + R_{RQ}$$

$$= \frac{504}{191} + \frac{20}{9}$$

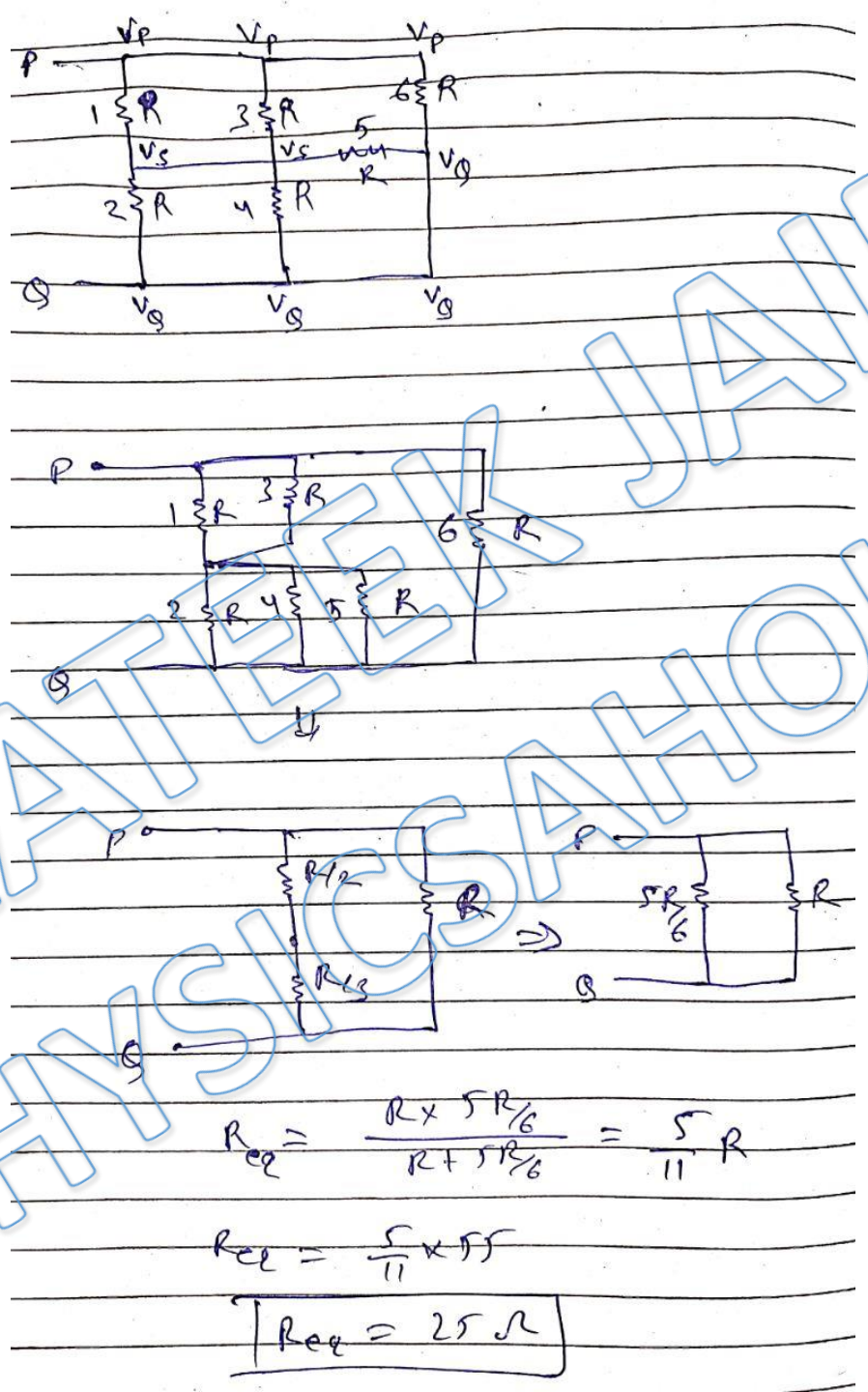
$$R = \frac{3820 + 4536}{1719}\ \Omega$$

$$R = \frac{8356}{1719}\ \Omega$$

$$\boxed{R = 4.86\ \Omega}$$

Ans. c

Solution: 8



Ans. d

Solution: 9

$$R = \frac{\rho l}{A}$$

$R \propto l$

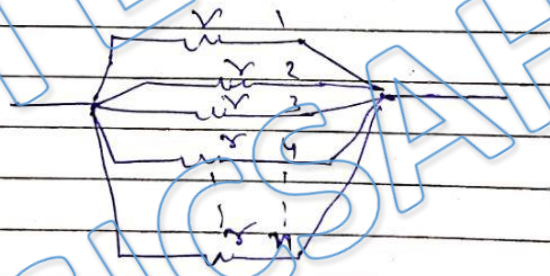
∴ when wire is cutted in n parts then length of one part $= \frac{l}{n}$

∴ Resistance (r) of one part $r = ?$

$$\frac{R}{r} = \frac{l}{l/n} = n$$

$$\boxed{r = R/n}$$

r's connected in parallel



$$\frac{1}{R_{eq}} = \frac{1}{r} + \frac{1}{r} + \frac{1}{r} + \text{- n times}$$

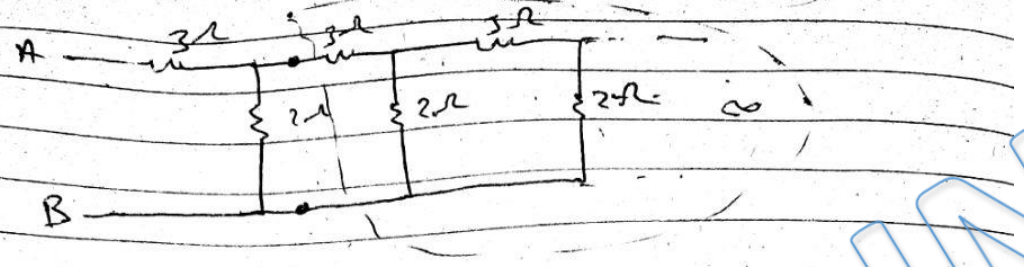
$$= \frac{n}{r}$$

$$R_{eq} = \frac{r}{n} = \frac{R/n}{n}$$

$$\boxed{R_{eq} = \frac{R}{n^2}}$$

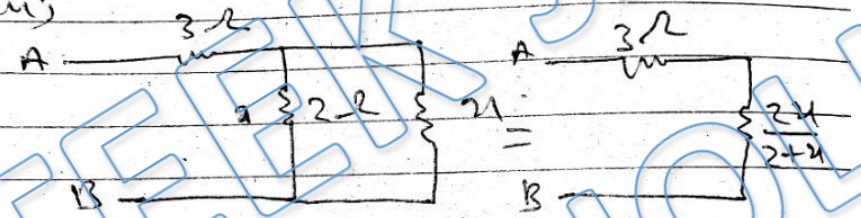
Ans. d

Solution: 10



Let net Resistance across AB is ; = x

then;



$$R_{AB} = x = 3 + \frac{2x}{2+x}$$

$$x = \frac{6+5x}{2+x}$$

$$2x + x^2 = 6 + 5x$$

$$x^2 - 3x - 6 = 0$$

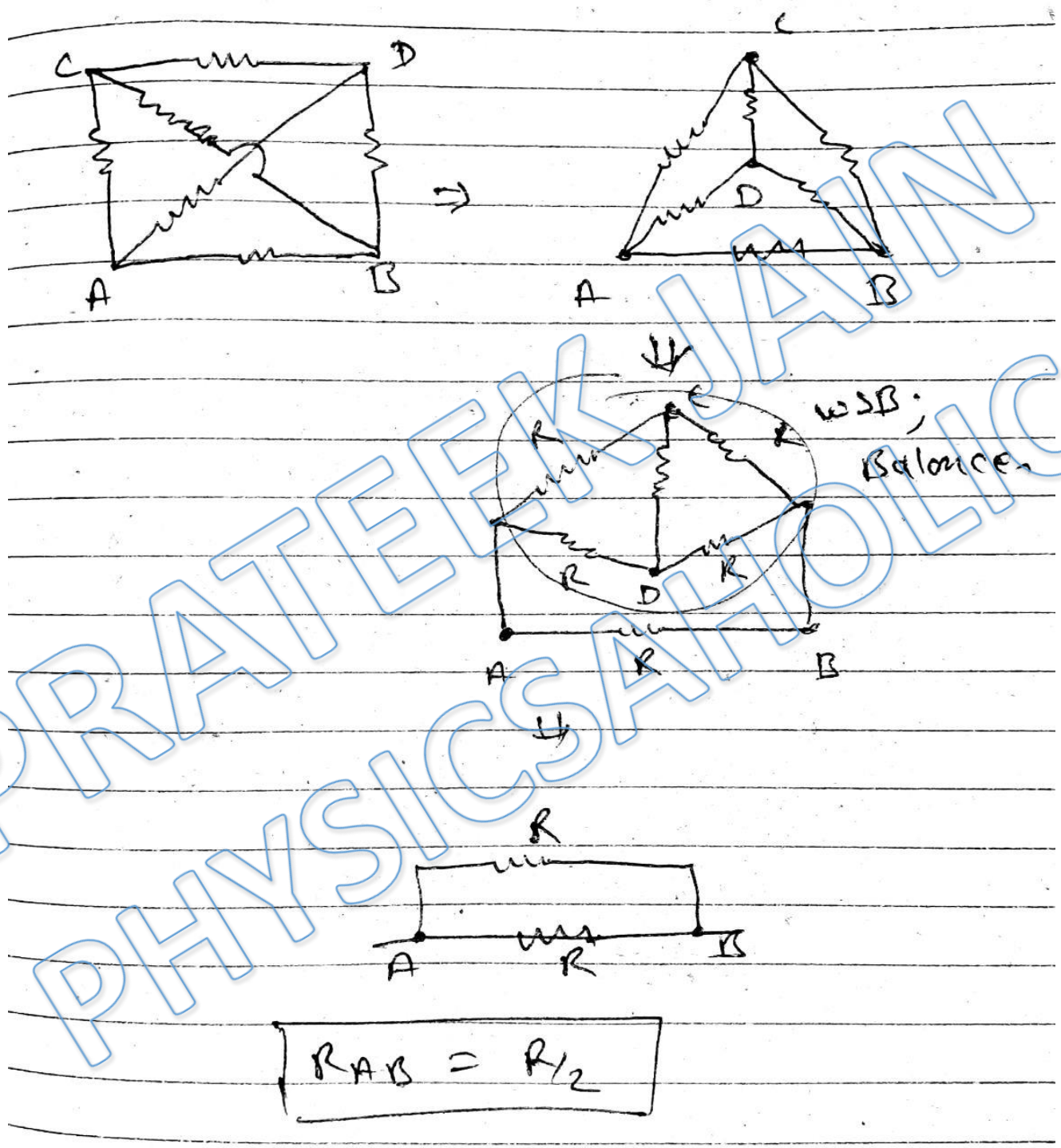
$$x = \frac{-(-3) \pm \sqrt{(-3)^2 - 4 \times 1 \times (-6)}}{2 \times 1}$$

$$= \frac{3 \pm \sqrt{9+24}}{2}$$

$$\boxed{x = \frac{3+\sqrt{33}}{2}\ \Omega.}$$

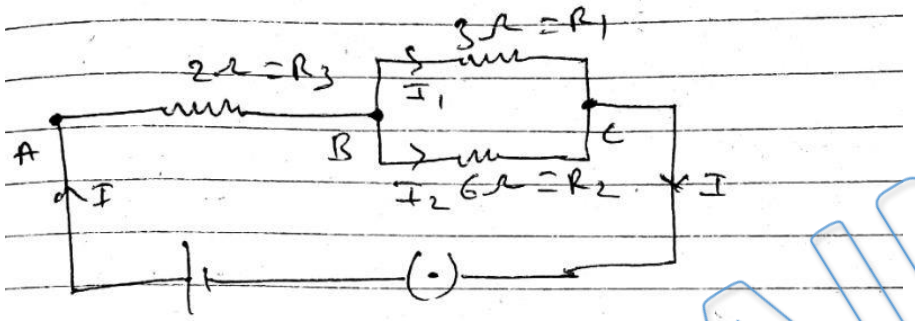
Ans. a

Solution: 11



Ans. b

Solution: 12



~~Voltag~~

Potential difference across 3Ω & 6Ω are same.

$I_1 = 1$ Amp.

$V = I_1 R_1 = I_2 R_2$

$1 \times 3 = I_2 \times 6$

$I_2 = 1/2$ Amp.

$I = I_1 + I_2$

$I = 1 + 1/2 \Rightarrow \boxed{I = 3/2 \text{ Amp}}$

$$R_{eq} = 2 + \frac{1}{\frac{1}{3} + \frac{1}{6}}$$

$R_{eq} = 2 + 2 = 4\Omega$

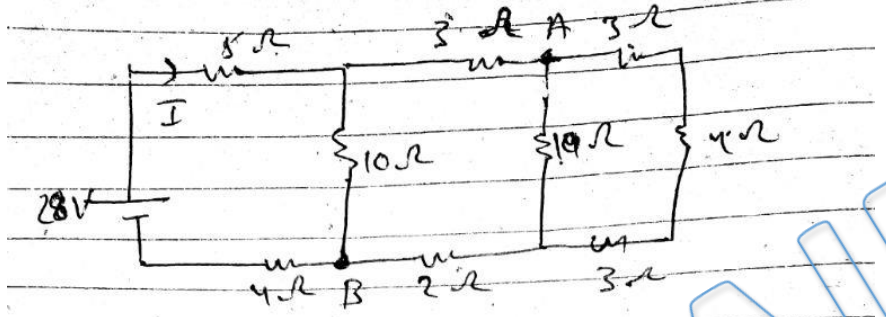
$V = IR$

$V = \frac{3}{2} \times (4)$

$\boxed{V = 6 \text{ Volt}}$

Ans. c

Solution: 13



Current in 5Ω resistor is = I

$$I = \frac{28}{R_{eq}}$$

$R_{eq} = 14\Omega$

$$I = \frac{28}{14}$$

$$\boxed{I = 2 \text{ Amp}}$$

~~top~~

$A \to C \to B$

$$V_A + 1 \times 3 - 1 \times 10 = V_B$$

$$V_A - V_B = 10 - 3$$

$$\boxed{V_A - V_B = 7 \text{ Volt}}$$

Ans. a

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