# Physicsaholics

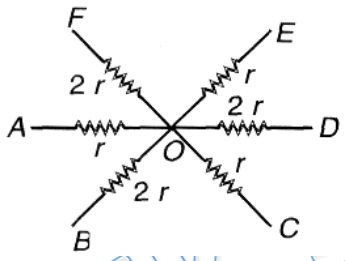
## DPP – 4 (Current Electricity)

Video Solution on Website :- https://physicsaholics.com/home/courseDetails/98

Video Solution on YouTube:- https://youtu.be/VQ1Y7ZGz3W4

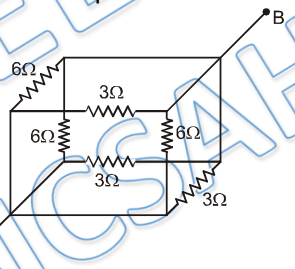
Written Solution on Website:- https://physicsaholics.com/note/notesDetalis/53

Q 1. The terminal network shown in the figure consists of 6 resistors. The points A, C and E all are at potential 20 V while points B, D and F are at potential -10 volt then potential of junction O will be



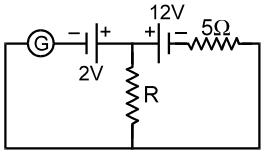

(a) Zero (b) 10 V (c)15 V (d) -5V

Q 2. Find the equivalent resistance between points A and B :



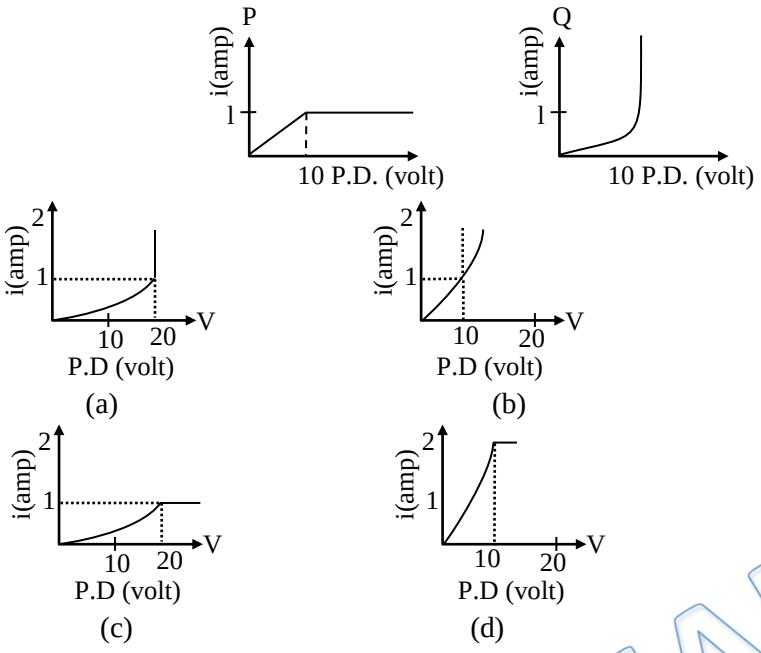

(a) 2Ω (b) $\frac{2}{3}\Omega$ (c) $\frac{3}{2}\Omega$ (d) $\frac{1}{2}\Omega$

Q 3. In the circuit shown, the galvanometer shows zero current. The value of resistance R is :

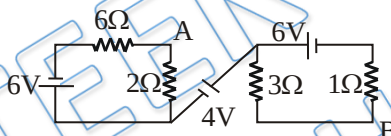



(a) 1 Ω (b) 2 Ω (c) 4 Ω (d) 9 Ω

Q 4. Two current elements P and Q have current voltage characteristics as shown below; Which of the graphs given below represents current voltage characteristics when P and Q are in series

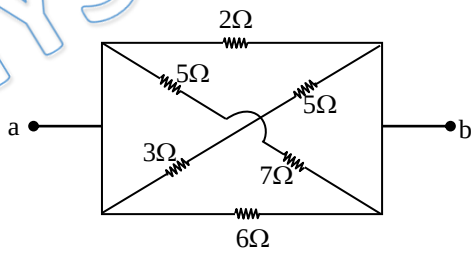



Q 5. In the network shown in the figure below, calculate the potential difference between A and B ? ( $V_B$- $V_A$) =



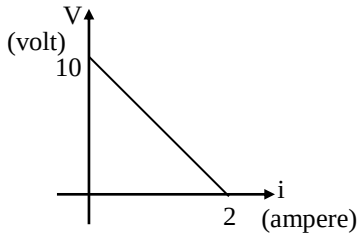

(a) 1V
(b) -1 V
(c) 2V
(d) -2V

Q 6. Find the equivalent resistance between a & b



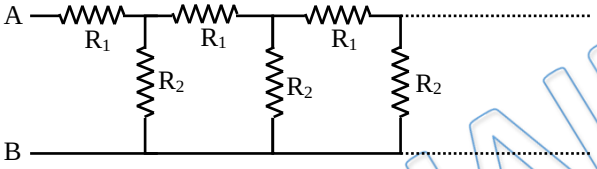

(a) $\frac{7}{8}\Omega$
(b) $\frac{8}{7}\Omega$
(c) $\frac{6}{7}\Omega$
(d) $\frac{7}{6}\Omega$

Q 7. A battery of emf E and internal resistance r is connected across a resistance R. Resistance R can be adjusted to any value greater than or equal to zero. A graph is plotted between the current (i) passing through the resistance and potential difference (V) across it. Select the correct alternative(s) –



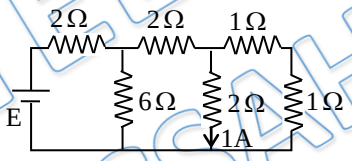

(a) internal resistance of battery is 5ohm
(b) emf of the battery is 20V
(c) maximum current which can be taken from the battery is 4A
(d) V-i graph can never be a straight line as shown in figure

Q 8. Consider an infinite ladder network. A voltage is applied between points A & B. If the voltage is halved after each section. Find the ratio $R_1/R_2$.



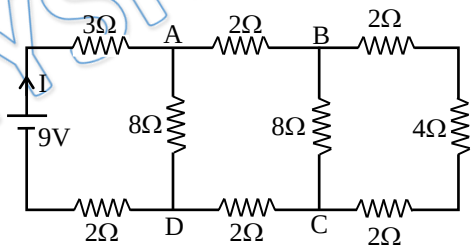

(a) 1/2
(b) 1/3
(c) 2
(d) None of these

Q 9. The emf of the battery shown in the figure is given by –




(a) 6 V (b) 12 V (c) 18 V (d) 8 V

Q 10. In the circuit shown in figure , the current through –

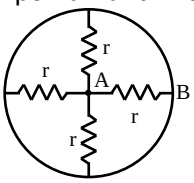



(a) the 3ohm resistor is 0.50 A
(b) the 3ohm resistor is 0.25 A
(c) the 4ohm resistor is 0.50 A
(d) the 4ohm resistor is 0.25 A

Q 11. There are two concentric spheres of radius *a* and *b* respectively. If the space between them is filled with medium of resistivity ρ, then the resistance of the inter gap between the two spheres will be

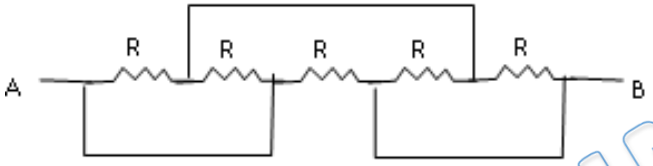
(a) $\frac{\rho}{4\pi(b+a)}$ (b) $\frac{\rho}{4\pi}\left(\frac{1}{b}+\frac{1}{a}\right)$
(c) $\frac{\rho}{4\pi}\left(\frac{1}{a^2}-\frac{1}{b^2}\right)$ (d) $\frac{\rho}{4\pi}\left(\frac{1}{a}-\frac{1}{b}\right)$

Q 12. The equivalent resistance between point A and B is -




(a) 4 r
(b) 2r
(c) r
(d) r/4

Q 13. The equivalent resistance between A and B in the given circuit

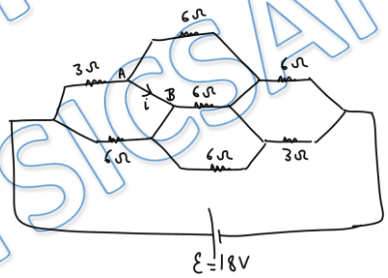



(a) R (b) R/2
(c) R/3 (d) 2R/3

Q 14. A 10 V car battery with negligible internal resistance is connected to a series combination of a $4\Omega$resistor that obey's Ohm's law and a thermistor that does not obey Ohm's law, but instead has a current –voltage relation $V = \alpha I + \beta I^2$ with $\alpha = 2\Omega$ and $\beta = 4\Omega/A$. The current through the $4\Omega$ resistor is

(a) 1 A (b) 2 A (c) 2/5 A (d) 5 A

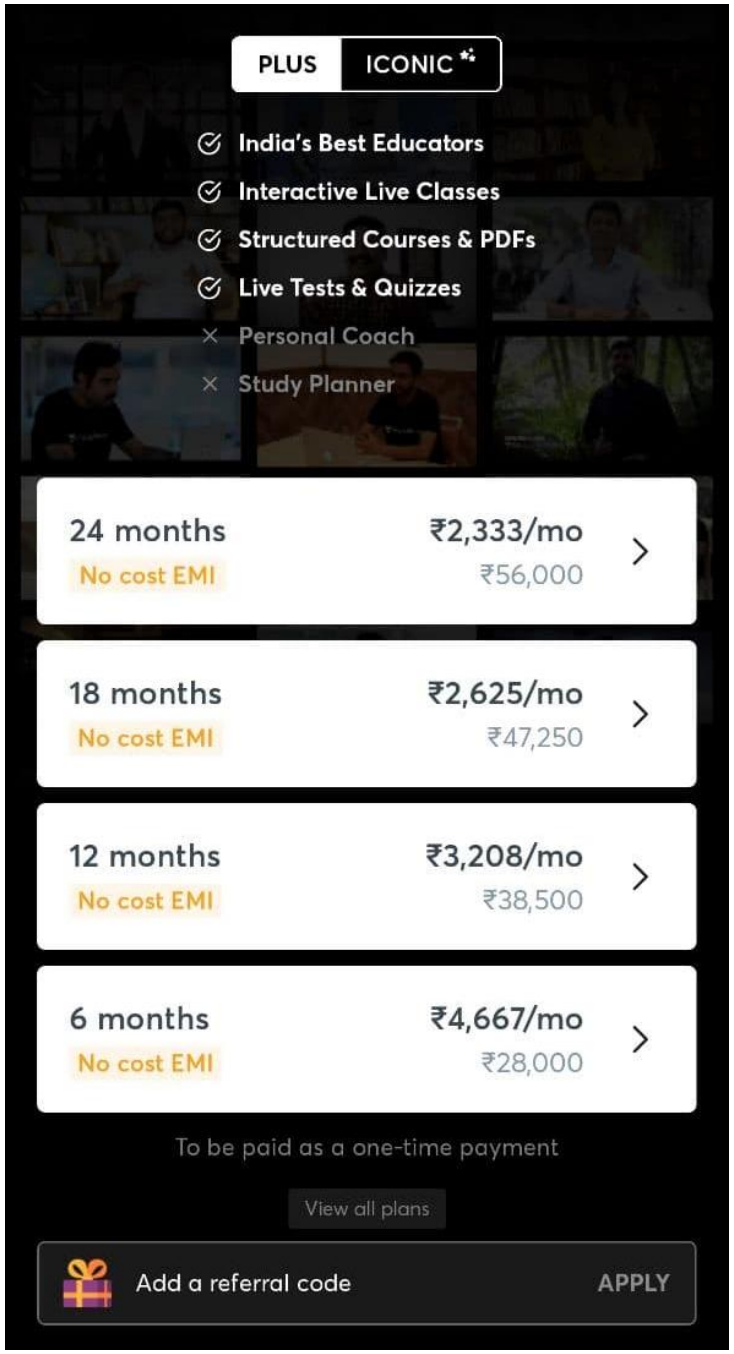
Q 15 Find current in wire AB ?




(a) 1A
(b) 2A
(c) 3A
(d) 4A

# Answer Key

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

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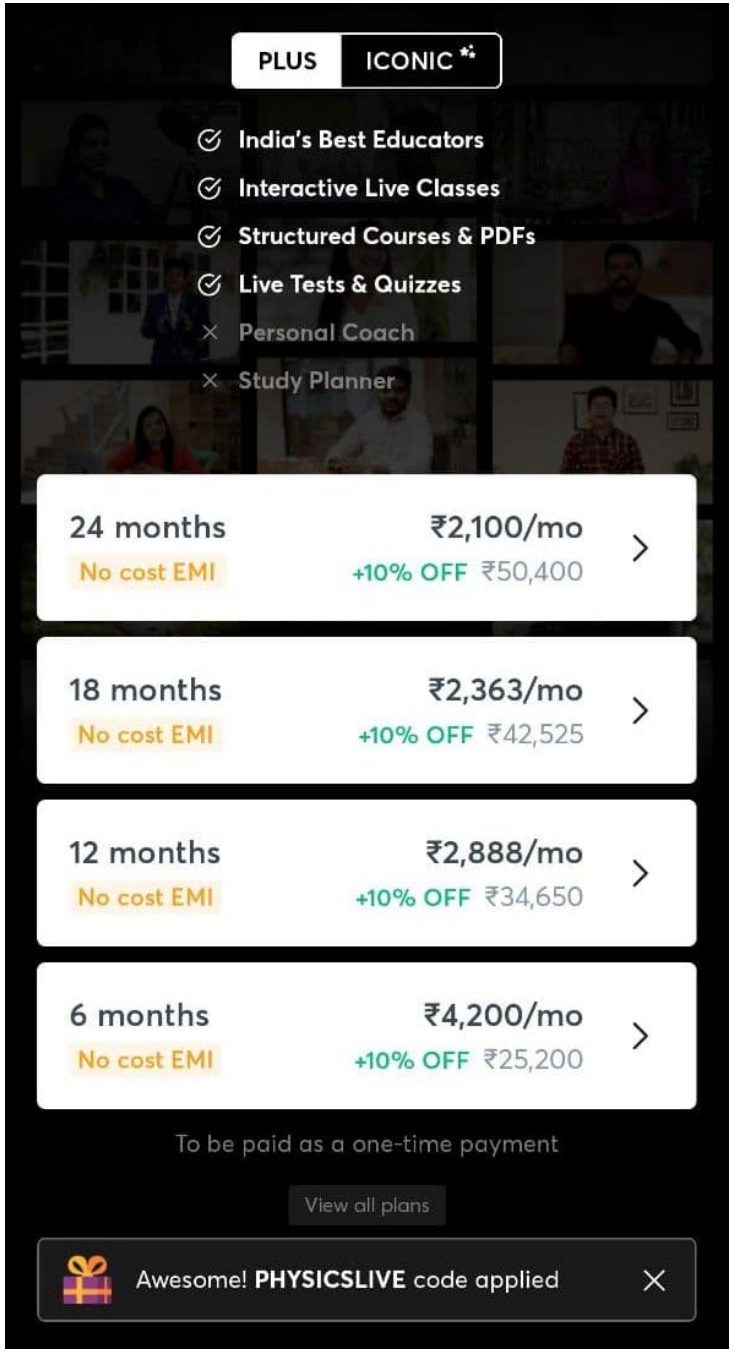
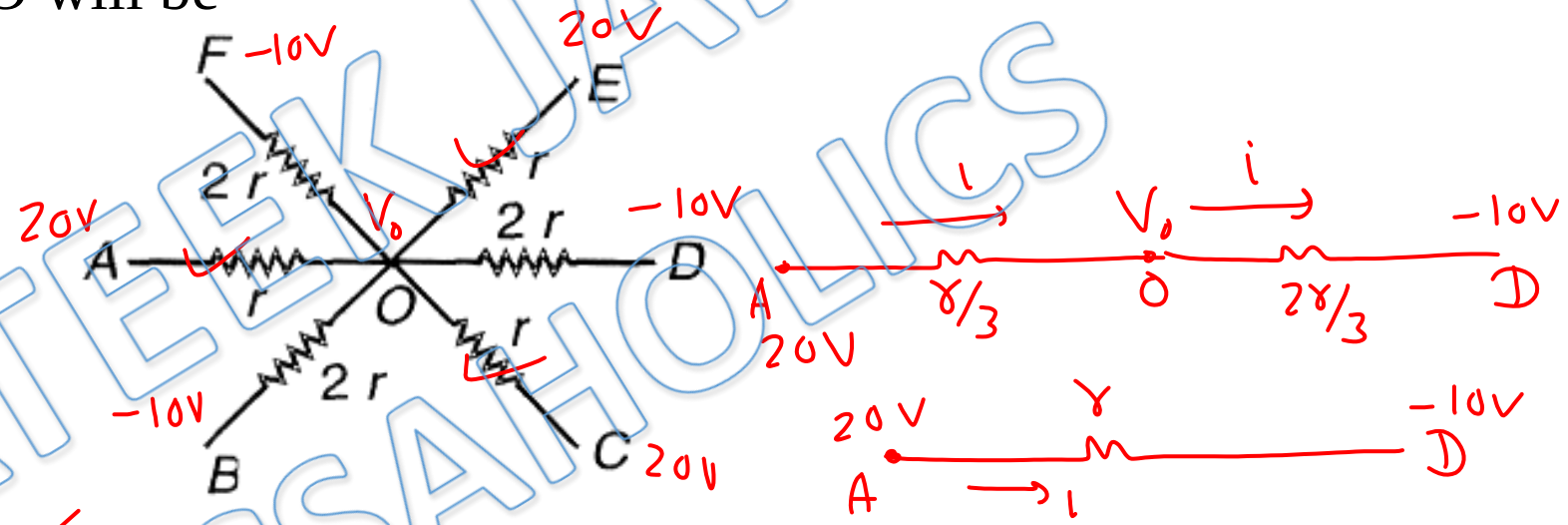


# Written Solution

## DPP- 4 Current : K.V.L.,Series and Parallel Combination

## By Physicsaholics Team

Q.1) The terminal network shown in the figure consists of 6 resistors. The points A, C and E all are at potential 20 V while points B, D and F are at potential -10 volt then potential of junction O will be







(a) Zero (b) 10 V (c)15 V (d) -5V

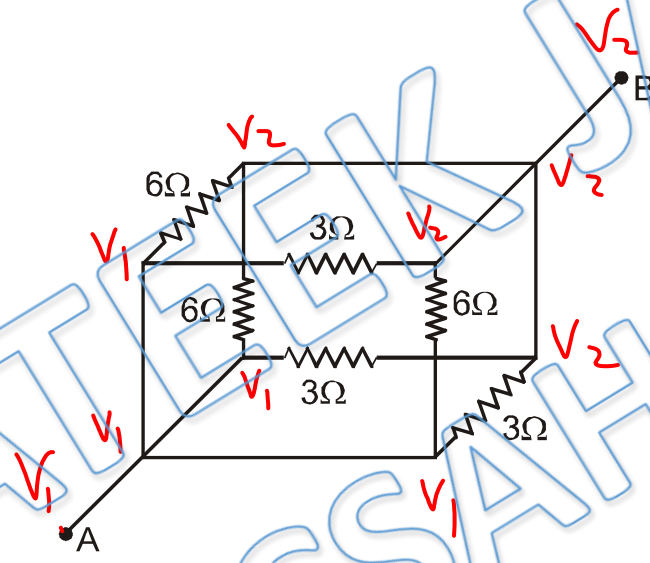
$$i = \frac{30}{r}$$

for AO

$$i = \frac{20 - V_0}{r/3} = \frac{30}{r} \Rightarrow 20 - V_0 = 10$$

$$V_0 = 10V$$

Q.2) Find the equivalent resistance between points A and B :



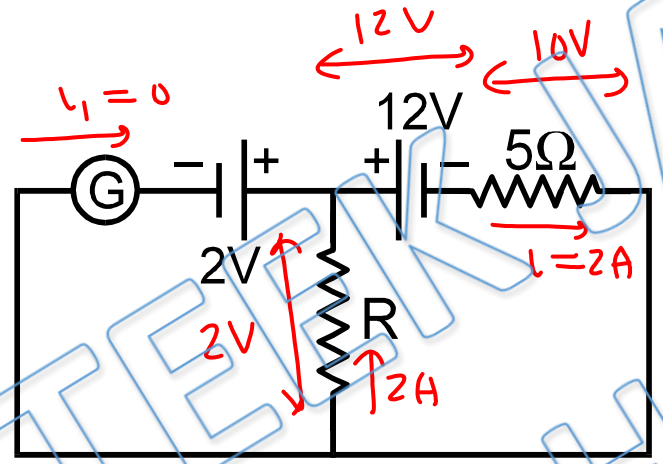

$$\frac{1}{R} = \frac{1}{3} + \frac{1}{3} + \frac{1}{3} + \frac{1}{6} + \frac{1}{6} + \frac{1}{6}$$

$$= \frac{1}{1} + \frac{1}{2} = \frac{3}{2}$$

$$R = \frac{2}{3}\,\Omega$$

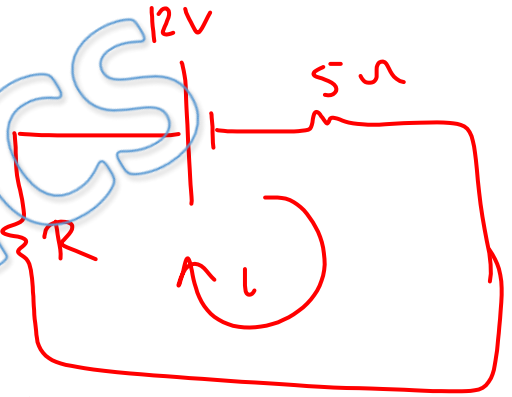
(a) $2\Omega$ (b) $\frac{2}{3}\Omega$ (c) $\frac{3}{2}\Omega$ (d) $\frac{1}{2}\Omega$

Q.3) In the circuit shown, the galvanometer shows zero current. The value of resistance R is :




$i_1 = 0$, 12V, 10V, $i = 2A$, 2V, 2A

$R = \frac{2V}{2A} = 1\Omega$




$i = \frac{12}{R+5}$

(a) 1 Ω (b) 2 Ω (c) 4 Ω (d) 9 Ω

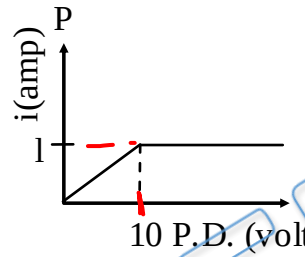
Voltage across R

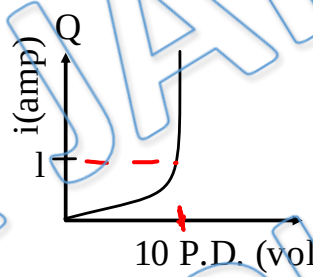
$2V = iR = \frac{12R}{R+5}$

$2R + 10 = 12R$

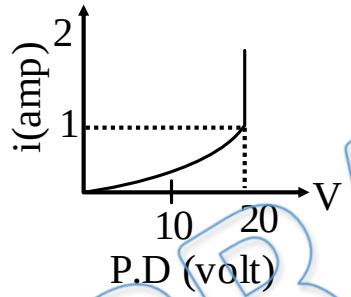
$16R = 10$, $R = 1\Omega$

Q.4) Two current elements P and Q have current voltage characteristics as shown below; Which of the graphs given below represents current voltage characteristics when P and Q are in series

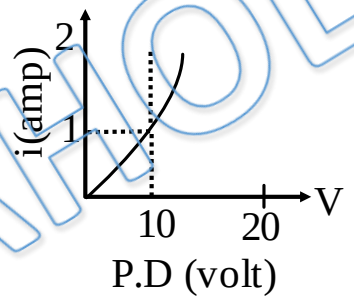


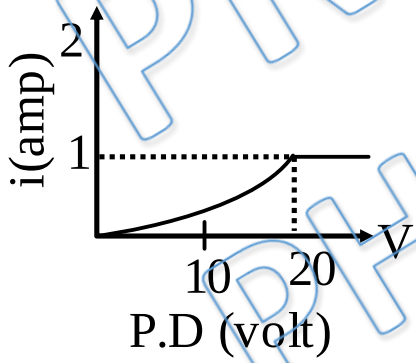

(a)



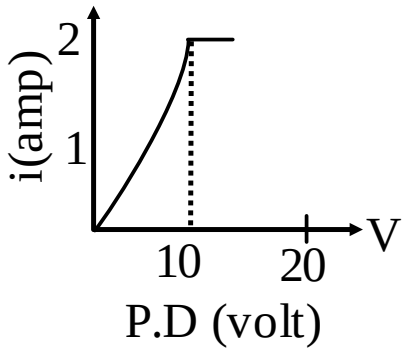

(b)

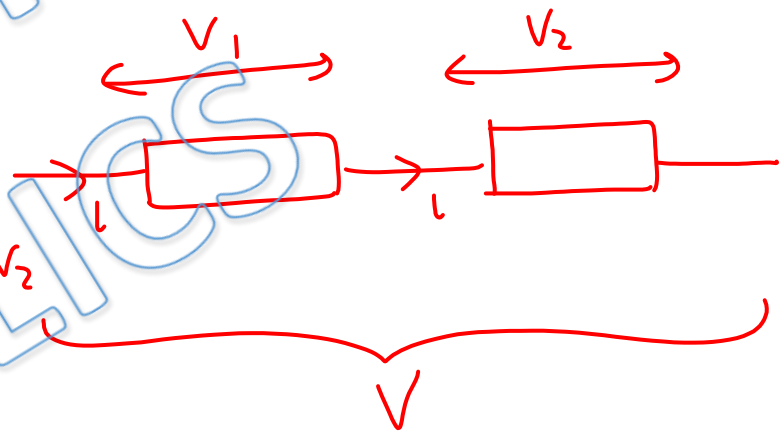



(c)




(d)




$V = 30$

$\Rightarrow V_2 = 10\,V$

$\Rightarrow V_1 = 20\,V$

$\Rightarrow I = 1\,A$

Q.5) In the network shown in the figure below, calculate the potential difference between A and B ? ( $V_B$ - $V_A$) =

(a) 1V

(b) -1 V

(c) 2V

(d) -2V

$I_1 = \frac{6}{8} = \frac{3}{4}$ A.

$I_2 = \frac{6}{3+1} = 1.5$ A

$\Delta V = V_B - V_A$

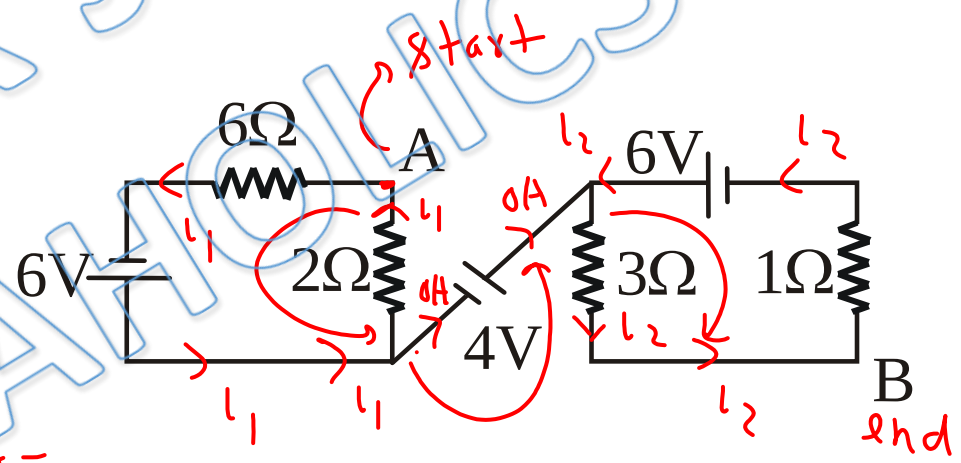
(final) (initial)

$= +\left(\frac{3}{4} \times 2\right) + 4 - 3 \times 1.5$

$= 1.5 + 4 - 4.5$

$= 5.5 - 4.5$

$= 1V$



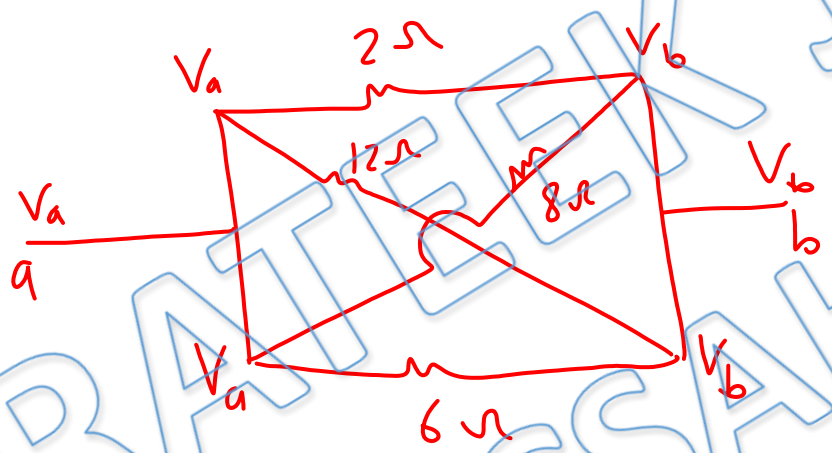
Q.6) Find the equivalent resistance between a & b

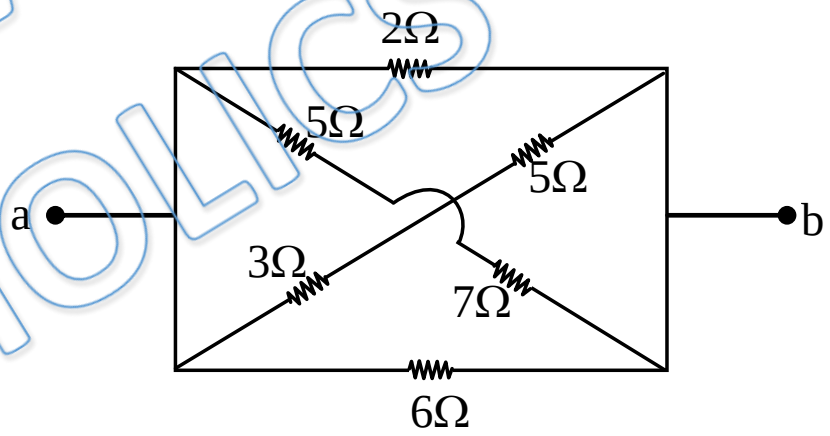
(a) $\frac{7}{8}\Omega$

(b) ~~$\frac{8}{7}\Omega$~~

(c) $\frac{6}{7}\Omega$

(d) $\frac{7}{6}\Omega$



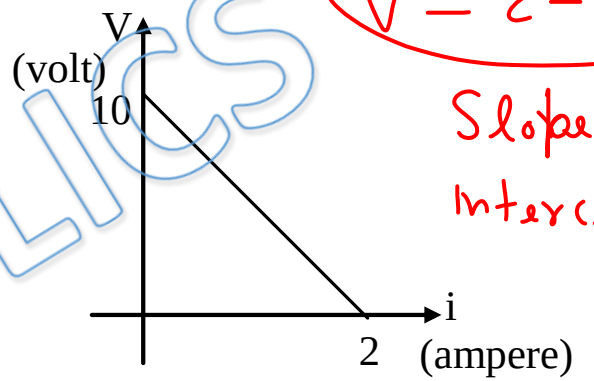

$$\frac{1}{R} = \frac{1}{2} + \frac{1}{12} + \frac{1}{8} + \frac{1}{6}$$

$$= \frac{12 + 2 + 3 + 4}{24}$$

$$= \frac{21}{24} = \frac{7}{8}$$

$$R = \frac{8}{7}\ \Omega$$

Q.7) A battery of emf E and internal resistance r is connected across a resistance R. Resistance R can be adjusted to any value greater than or equal to zero. A graph is plotted between the current (i) passing through the resistance and potential difference (V) across it. Select the correct alternative(s) -




$V = \varepsilon - ir$

Slope $= -r$

Intercept $= \varepsilon$

(a) internal resistance of battery is 5ohm

(b) emf of the battery is 20V

(c) maximum current which can be taken from the battery is 4A

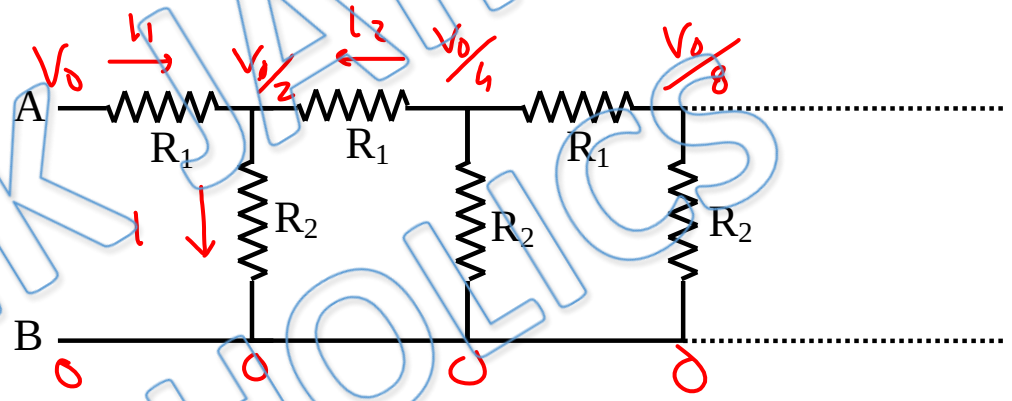
(d) V-i graph can never be a straight line as shown in figure

$\varepsilon = 10V$

$-r = -10/2$

$r = 5\Omega$

Q.8) Consider an infinite ladder network. A voltage is applied between points A & B. If the voltage is halved after each section. Find the ratio $R_1/R_2$.




(a) 1/2

(b) 1/3

(c) 2

(d) None of these

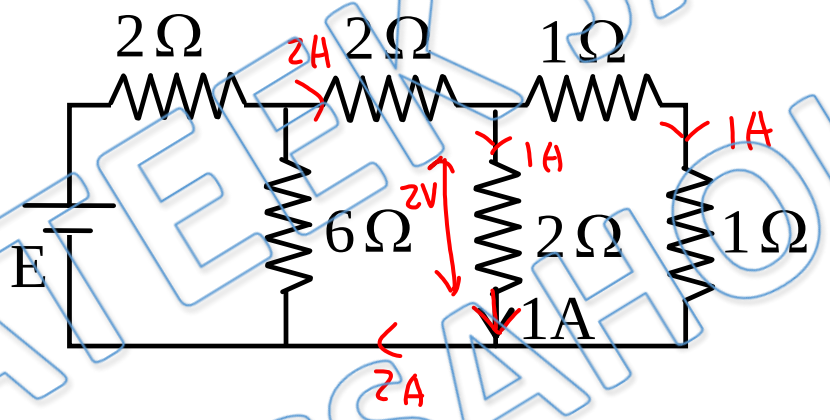
$I = I_1 + I_2$

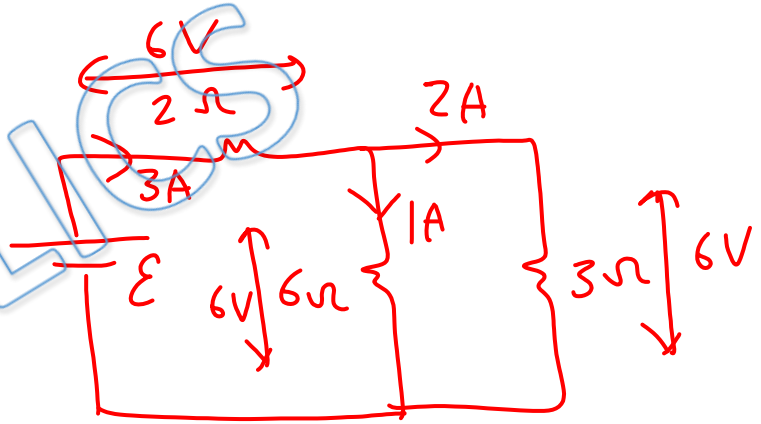
$$\frac{V_0/2 - 0}{R_2} = \frac{V_0 - V_0/2}{R_1} + \frac{\frac{V_0}{4} - V_0/2}{R_1}$$

$$\frac{V_0}{2R_2} = \frac{V_0/4}{R_1}$$

$$2R_2 = 4R_1 \Rightarrow \frac{R_1}{R_2} = 1/2$$

Q.9) The emf of the battery shown in the figure is given by -



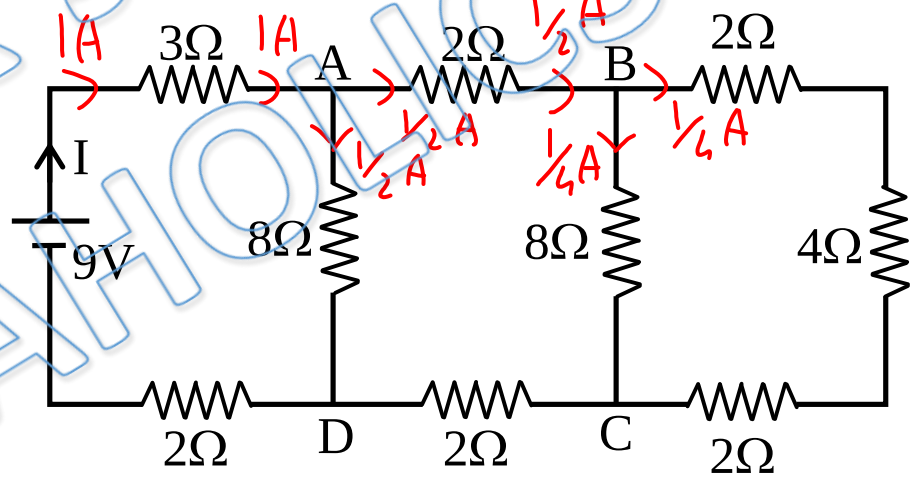




$\varepsilon = 12\,V$

(a) 6 V (b) 12 V (c) 18 V (d) 8 V

Q.10) In the circuit shown in figure , the current through –

$R_{eff} = 9\Omega \Rightarrow I = \frac{9}{9} = 1A$



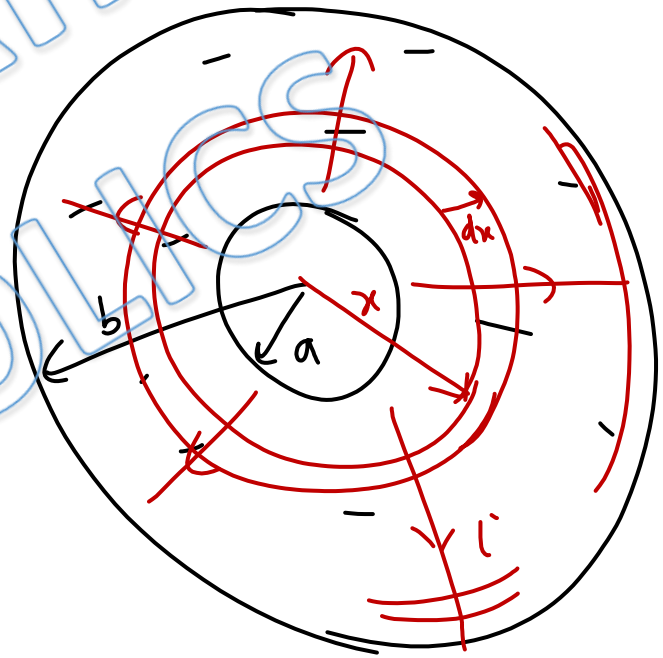

(a) the 3ohm resistor is 0.50 A

(b) the 3ohm resistor is 0.25 A

(c) the 4ohm resistor is 0.50 A

(d) the 4ohm resistor is 0.25 A

Q.11) There are two concentric spheres of radius $a$ and $b$ respectively. If the space between them is filled with medium of resistivity $\rho$, then the resistance of the inter gap between the two spheres will be




Resistance of differential shell

$$dR = \rho \frac{dx}{4\pi x^2}$$

all such shells are in series

$$R = \int dR = \frac{\rho}{4\pi}\int_a^b \frac{dx}{x^2} = \frac{\rho}{4\pi}\left(\frac{1}{a} - \frac{1}{b}\right)$$

(a) $\frac{\rho}{4\pi(b+a)}$

(b) $\frac{\rho}{4\pi}\left(\frac{1}{b} + \frac{1}{a}\right)$

(c) $\frac{\rho}{4\pi}\left(\frac{1}{a^2} - \frac{1}{b^2}\right)$

(d) $\frac{\rho}{4\pi}\left(\frac{1}{a} - \frac{1}{b}\right)$

Q.12) The equivalent resistance between point A and B is -

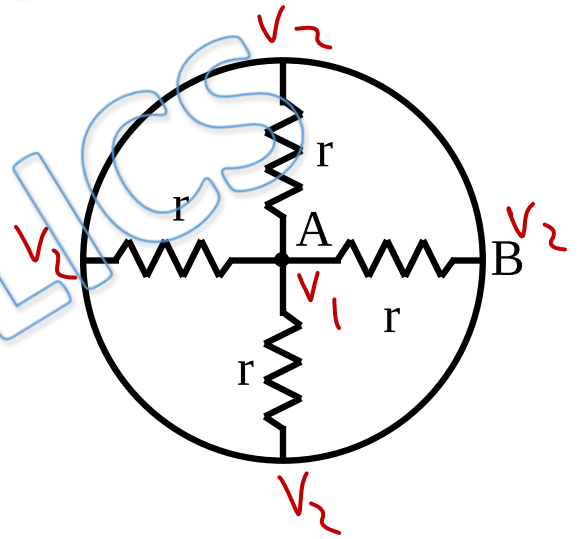
(a) 4 r

(b) 2r

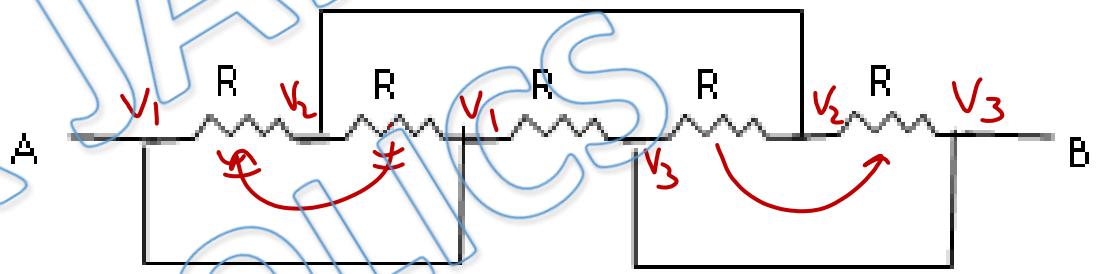
(c) r

(d) r/4

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



Q.13) The equivalent resistance between A and B in the given circuit

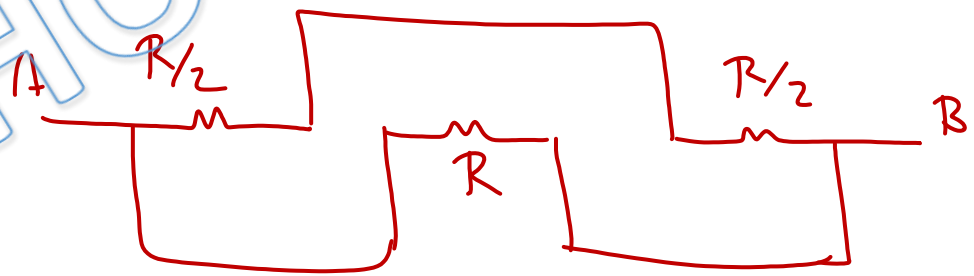



(a) R

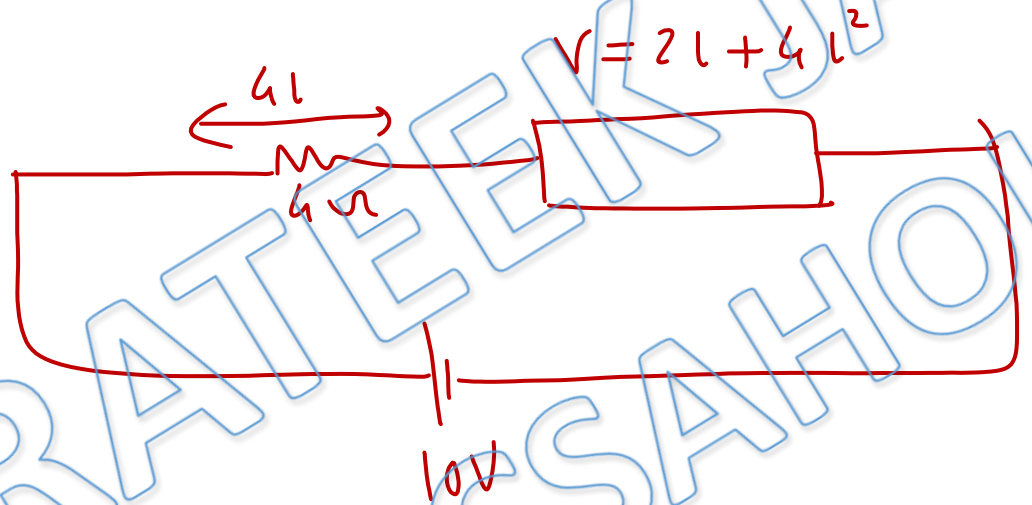
(b) R/2

(c) R/3

(d) 2R/3



Q.14) A 10 V car battery with negligible internal resistance is connected to a series combination of a $4\Omega$resistor that obey's Ohm's law and a thermistor that does not obey Ohm's law, but instead has a current –voltage relation $V = \alpha I + \beta I^2$ with $\alpha = 2\Omega$ and $\beta = 4\Omega/A$. The current through the $4\Omega$ resistor is




$V = 2I + 4I^2$

$4I^2 + 2I + 4I = 10$

$2I^2 + 3I = 5$

$I = 1A$

(a) 1 A (b) 2 A (c) 2/5 A (d) 5 A

Q.15) Find current in wire AB ?

$R_{eff} = 2+2+2$

$= 6\Omega$

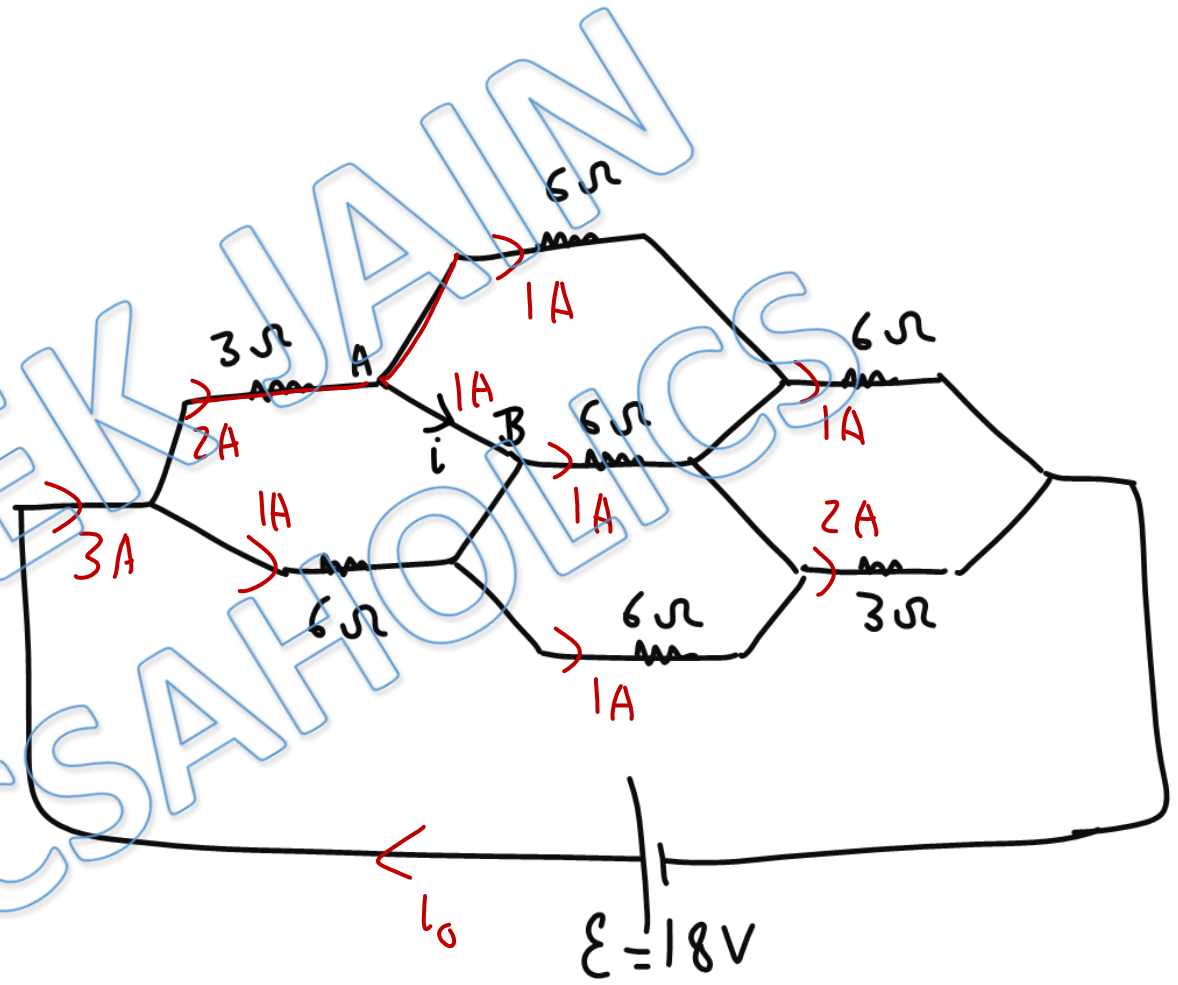
$I_0 = \frac{18}{6} = 3A$

(a) ~~1A~~

(b) 2A

(c) 3A

(d) 4A



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