Kirchoff's law:-

1. Junction rule:- (current law)

$$\boxed{\sum I_i = 0}$$ (Algebraic sum of current at a junction)

2. Valtage Rule:-

$$\boxed{\sum V_i = 0}$$ (Around any closed loop)

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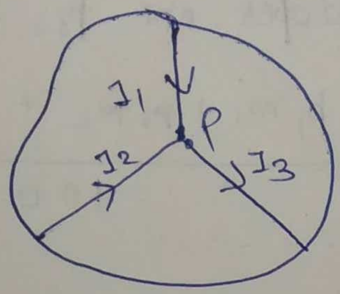


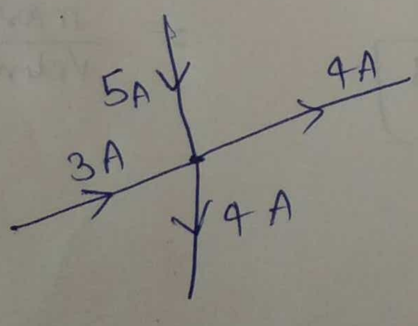
$\sum I_i = 0$

At junction point, P

$$\boxed{I_1 + I_2 - I_3 = 0}$$

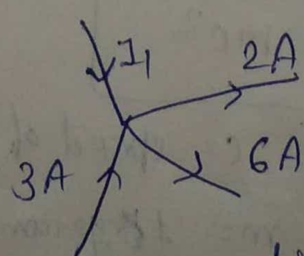
Current coming at the junction = +ve

current going from the junction = -ve



$$\Rightarrow \boxed{5A + 3A - 4A + 4A = 0}$$

Q. $I = ?$



from current law:- At junction

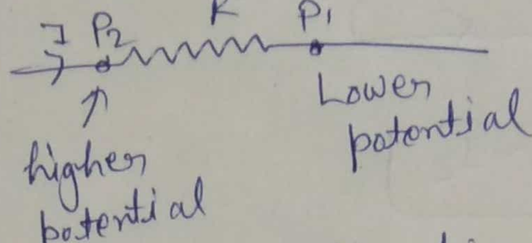
$I_1 + 3 - 2 - 6 = 0$

$$\boxed{I_1 = \frac{8}{3} \text{ Amp}}$$

→ Voltage Rule :-

for a static field

$$\oint \vec{E} \cdot d\vec{l} = 0$$

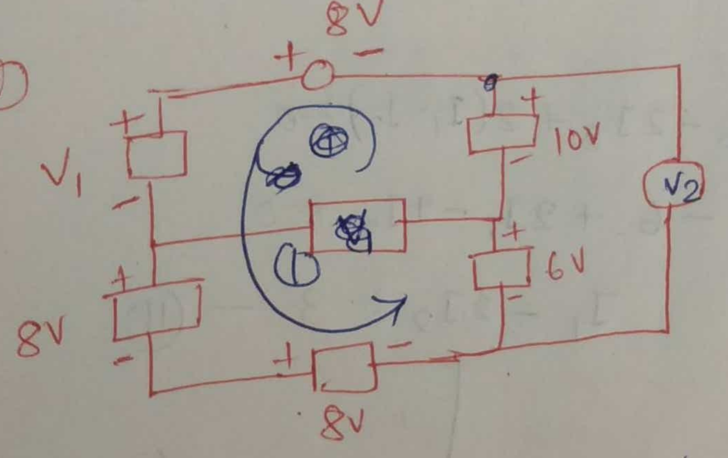


$V_{P_2} > V_{P_1}$

→ Moving in the direction of current $\Delta V =$ negative $= IR$ (drop)

Across a battery ΔV is +ve in going from negative to positive terminals.

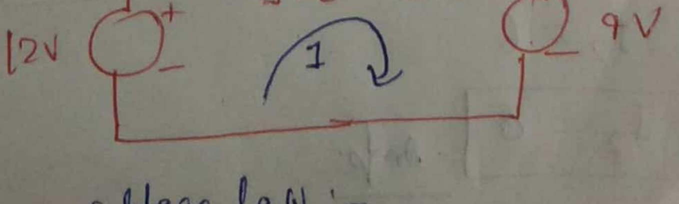
Q. 1



for loop ①:- $\cancel{8} - V_1 - \cancel{8} - 8 + 6 + 10 = 0$

$$\boxed{V_1 = 8V}$$

Q. 2

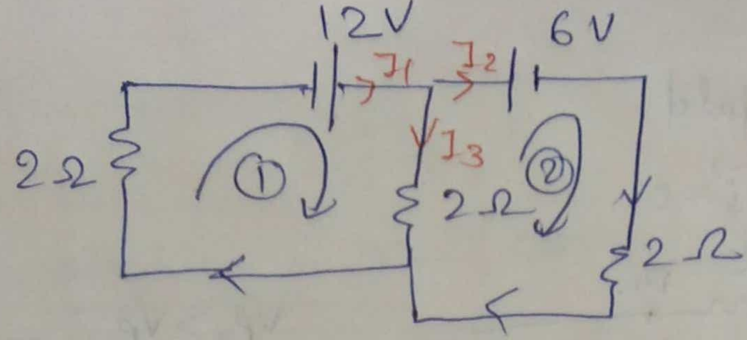


from voltage law :-

$$-I \cdot 1 - I \cdot 3 - 4 + 12$$

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

Q.3



here $\boxed{I_3 = I_1 - I_2}$

I_1 + I_2 are two unknowns.

for loop 1:-

$$-2(I_1 - I_2) - 2I_1 + 12 = 0$$

$$-4I_1 + 2I_2 = -12$$

$$2I_1 - I_2 = 6 \quad \text{— (I)}$$

for loop 2:-

$$-6 - 2I_2 + 2(I_1 - I_2) = 0$$

$$-6 + 2I_1 - 4I_2 = 0$$

$$I_1 - 2I_2 = 3 \quad \text{— (II)}$$

$$(2I_1 - I_2 = 6) \times 2 \Rightarrow 4I_1 - \cancel{2I_2} = 12$$

$$I_1 - \cancel{2I_2} = 3$$

$$- \quad + \quad -$$

$$3I_1 = 9$$

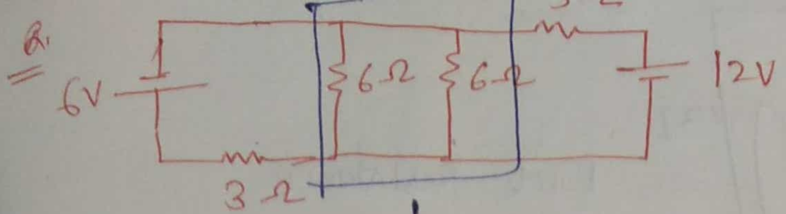
$$\boxed{I_1 = 3 \text{ Amp}}$$

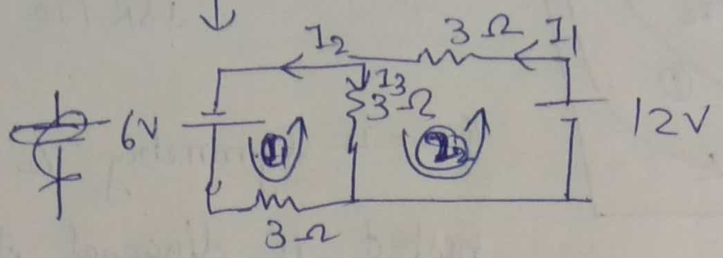
from (I)

$$2 \times 3 - I_2 = 6$$

$$\boxed{I_2 = 0} \text{ Amp.}$$

Q.





Also $I_3 = I_1 - I_2$

From loop ②:– $-3I_1 - 3I_3 + 12 = 0$

$I_1 + I_3 = 4$ —(I)

From loop ①:–

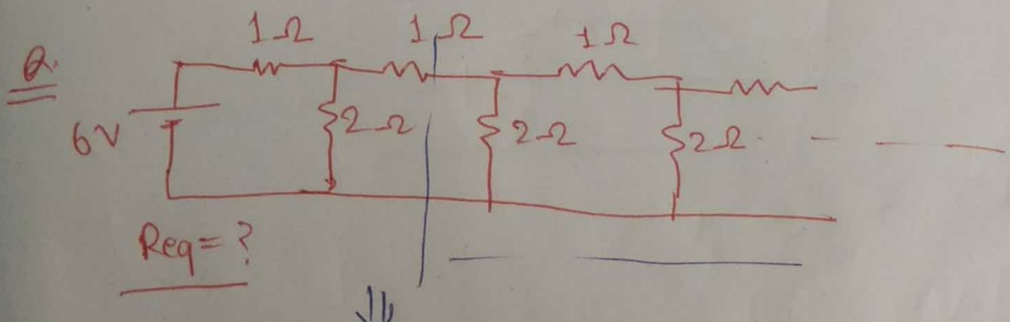
$3I_2 - 3I_3 = 6$

$I_2 - I_3 = 2$ —(II)

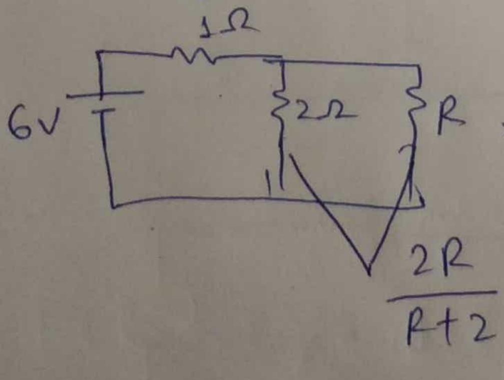
Solving we get:– $I_1 = \frac{10}{3}$ A, $I_2 = \frac{8}{3}$ A

$I_3 = \frac{2}{3}$ A

Q.



Req = ?



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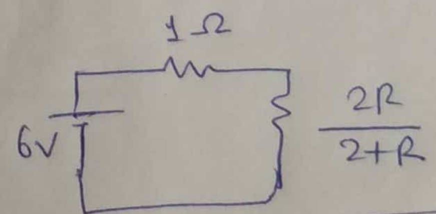


$$\boxed{Req = 1 + \frac{2R}{2+R}}$$

Req = R

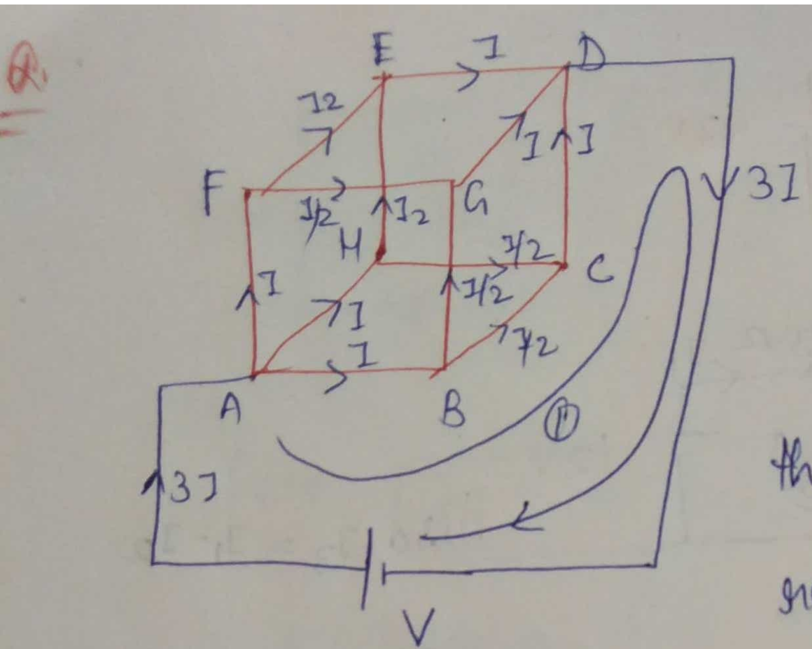
$$R = 1 + \frac{2R}{2+R}$$

$$\Rightarrow \boxed{R = 2\Omega}$$

$$\therefore \text{current} = \frac{6}{1 + \frac{2R}{2+R}}$$

$$= 3A \text{ Ans}$$

Q.



Each Resistance is R (i.e. each case)

there is symmetry with respect to diagonal AD.

then current in FE, FG, BG, HC, BC, FH $= \frac{I}{2}$

Now loop ①:- $IR + IR + \frac{I}{2}R = V$

$$\boxed{I = \frac{2}{5} \cdot \frac{V}{R}}$$

If $R = 1\,\Omega$, $V = 10\,V$

then $\boxed{I = 4\,A}$