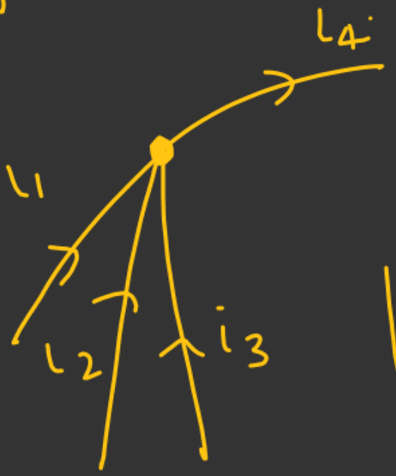
Nishant Jindal

Nodal Analysis

→ Assume any node as refrance potential.

→ Mark the potential of other node w.r.t assumed zero potential



$$i_1 + i_2 + i_3 = i_4$$

$$\boxed{i_1 + i_2 + i_3 - i_4 = 0}$$

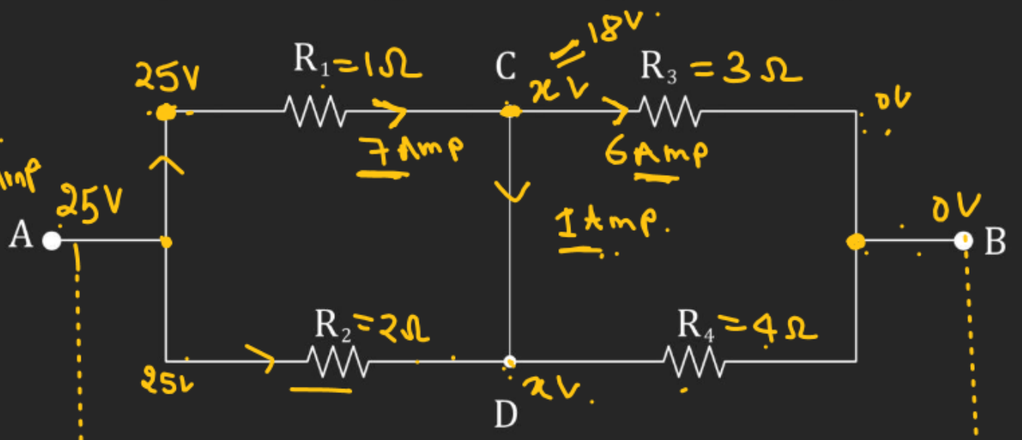
→ Apply K.C.L at node.

Nishant Jindal

CURRENT ELECTRICITY

Nodal Analysis

Q.1 A constant voltage $V = 25\ V$ is maintained between points A and B of the circuit as shown in figure. Find the magnitude and direction current flowing through the wire CD if the resistances are equal to $R_1 = 1\Omega, R_2 = 2\Omega, R_3 = 3\Omega$ and $R_4 = 4\Omega$.



M-1

Nodal analysis Method

$\frac{25-18}{1} = i_{AC}$

$i_{AC} = 7\ Amp.$

$i_{CB} = \frac{18-0}{3} = 6\ Amp$

$i_{CD} = 1\ Amp$

For Node D.

$$\left(\frac{x-0}{4}\right) + \left(\frac{x-25}{2}\right) + \left(\frac{x-0}{3}\right) + \left(\frac{x-25}{1}\right) = 0.$$

$$\left[\frac{x}{4} + \frac{x}{2} + \frac{x}{3} + x\right] - \frac{25}{2} - 25 = 0.$$

$$\frac{3x+6x+4x+12x}{12} = \left(\frac{75}{2}\right) \Rightarrow \frac{25x}{12} = \frac{75}{2} \Rightarrow x = \frac{75 \times 12}{25 \times 2}^{3} 6$$

$x = 18\ Volt$

Nishant Jindal

CURRENT ELECTRICITY

Nodal Analysis

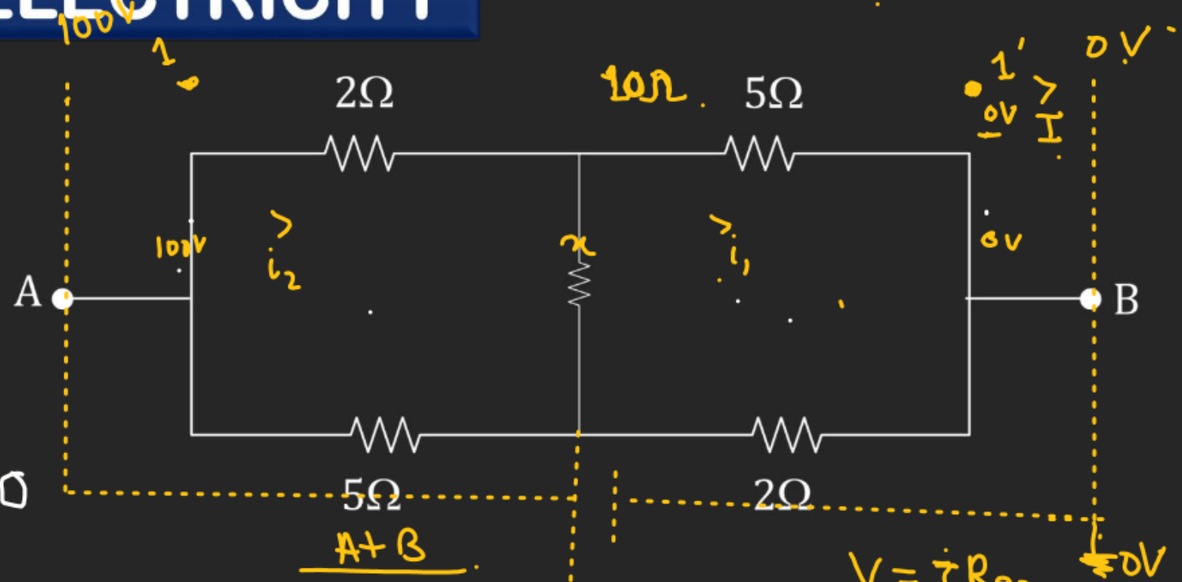
Find $(R_{eq})_{A-B}$.

R_{eq}

$V = IR_{eq}$

$V_{12} = V_{1'2'}$

$\frac{(100-x)}{2}$



i_2

i_1

$\frac{x-100}{5} + \frac{x-0}{2} +$

$\frac{x-100}{5} + \left(\frac{x-0}{2}\right) + \frac{x-(100-x)}{10} = 0$

$\left(\frac{x}{5} + \frac{x}{2} + \frac{x}{5}\right) - 20 - 10 = 0.$

$\frac{2x+2x+5x}{10} = 30.$

$9x = 300 \Rightarrow x = \frac{300}{9} = \frac{100}{3}$ Volt

A+B

$i_1 + i_2 = i$

$\frac{x-0}{2} + \frac{100-x}{5} = i$

$\frac{100}{3\times 2} + \frac{100}{5} - \frac{100}{5}\times\frac{1}{3} = i.$

100V.

$V = IR_{eq}$

$\frac{100}{I} = R_{eq}.$

Nishant Jindal

$R_{eq} = \left(\frac{100}{I}\right)$

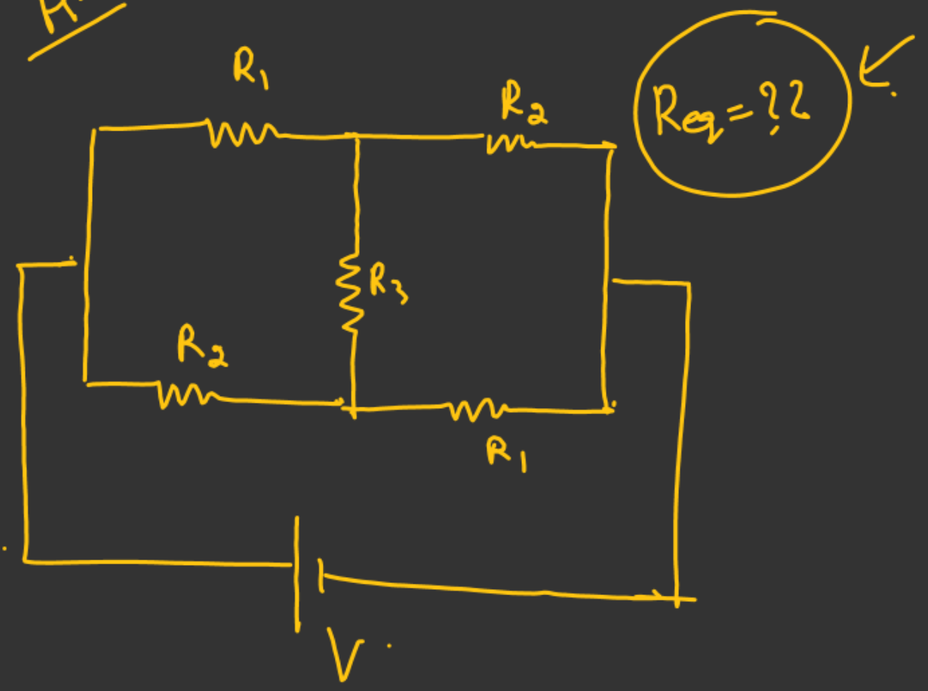
$\frac{100}{3\times 2} + \frac{100}{5} - \frac{100}{5}\times\frac{1}{3} = I.$

$100\left[\frac{1}{6} + \frac{1}{5} - \frac{1}{15}\right] = I.$

$\frac{100}{I} = \frac{1}{\left[\frac{1}{6}+\frac{1}{5}-\frac{1}{15}\right]}.$

$R_{eq} = \frac{1}{\frac{15+18-6}{90.}} = \left(\frac{90}{27}\right) = \left(\frac{10}{3}\right)\Omega.$

H.W.

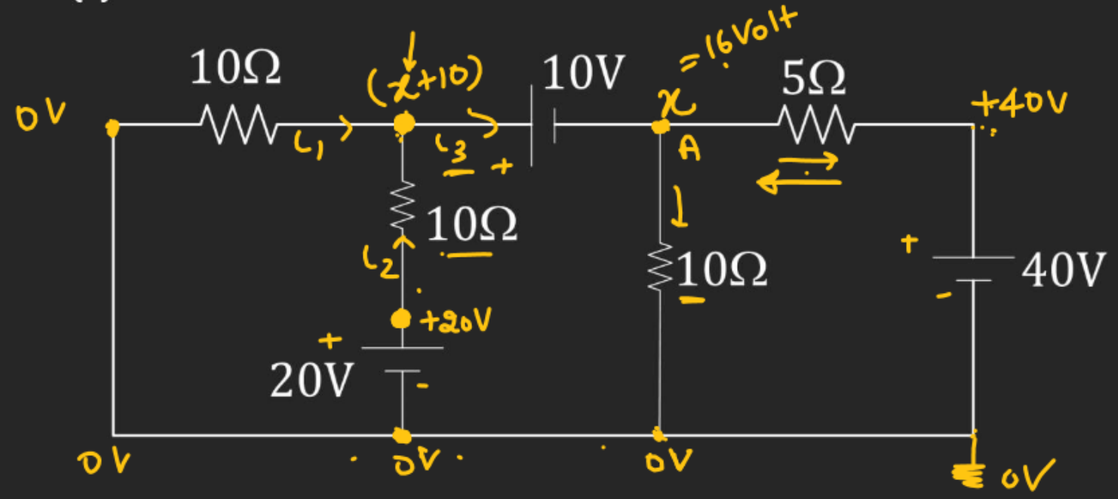


Nishant Jindal

Nodal Analysis

CURRENT ELECTRICITY

Q.2 (i) Find the current in 5Ω resistance in circuit shown in figure



$(I_3 = I_2 + I_1)$

$$i_3 = \left[\frac{x+10}{10} + \frac{(x+10)-20}{10}\right]$$

K.C.L at node A

$$\frac{x-40}{5} + \left(\frac{x-0}{10}\right) + \left(\frac{x+10}{10}\right) + \left(\frac{x-10}{10}\right) = 0$$

$$\left[\frac{x}{5} + \frac{x}{10} + \frac{x}{10} + \frac{x}{10}\right] - 8 + 1 - 1 = 0$$

$$\frac{2x+3x}{10} = 8$$

$$5x = 80$$

$$x = 16\text{ Volt}$$

Current in 5Ω

$$= \frac{40-16}{5}$$

$$= \frac{24}{5}\text{ Amp}$$

$$= 4.8\text{ Amp}$$

Nishant Jindal

Nodal Analysis

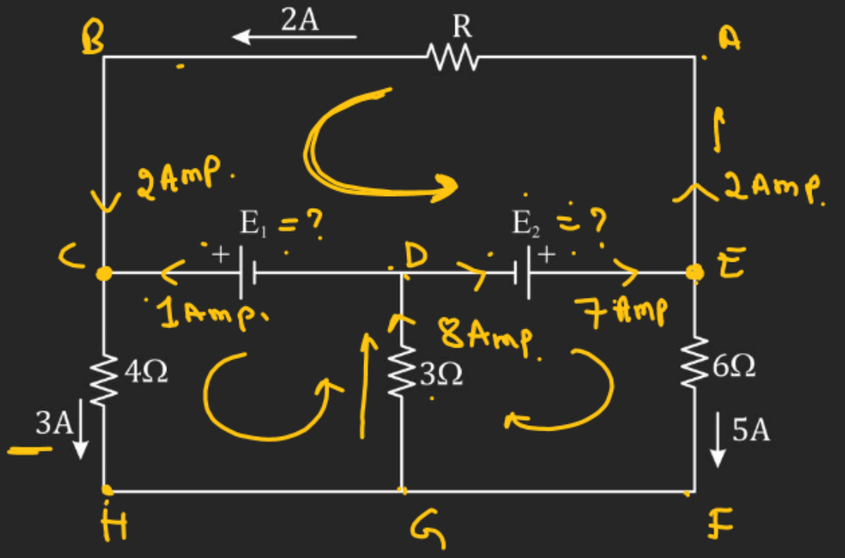
CURRENT ELECTRICITY

Q.3 In the circuit shown in figure, find:

(a) The current in the 3Ω resistor = (8Amp) ✓

(b) The unknown emfs E_1 and E_2

(c) The resistance R = ?



K-V-L in loop. ABCDEA :-

$-2R - E_1 + E_2 = 0$

$2R = (E_2 - E_1)$

$R = \frac{E_2 - E_1}{2} = \frac{54-36}{2} = \frac{18}{2} = 9\Omega$

K-V-L in loop DCHGD

$E_1 - (3\times4) - (3\times8) = 0$

$E_1 = (12 + 24)$

$E_1 = 36$ Volt ✓

K-V-L in loop DEFGD

$E_2 - (6\times5) - (8\times3) = 0$

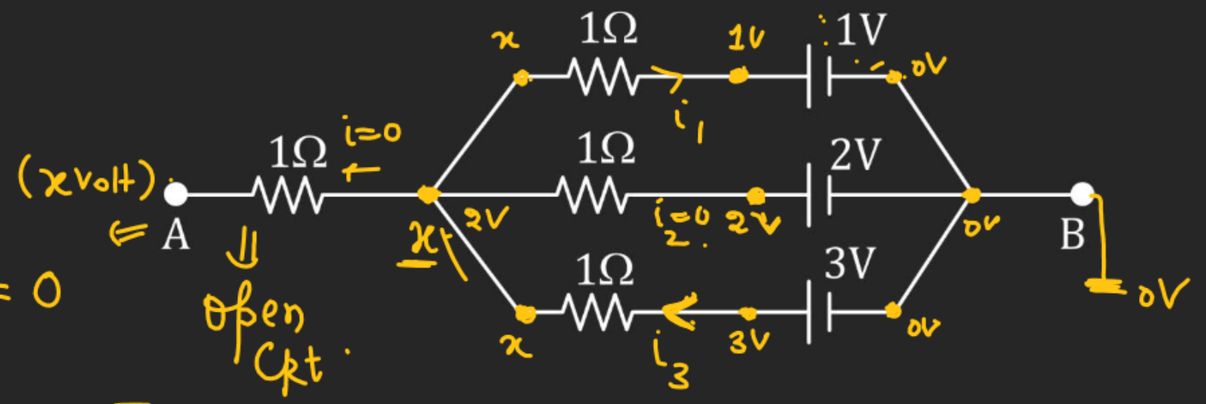
$E_2 = 30 + 24 = 54$ Volt

Nodal Analysis

CURRENT ELECTRICITY

Q.4 In the circuit shown in figure find potential difference between the point A and B and the currents through each branch.

$|V_A - V_B| = ??$



M-1 :-

Open Ckt.

$$\frac{x-1}{1} + \frac{x-2}{1} + \frac{x-3}{1} = 0$$

$$3x - 6 = 0$$

$$(x = 2 \text{ volt})$$

$i_2 = 0$

$i_1 = \frac{2-1}{1} = 1 \text{ Amp.}$

$i_3 = \frac{3-2}{1} = 1 \text{ Amp.}$

Nodal Analysis

H.W.

CURRENT ELECTRICITY

Q.5 Find out the value of current through 2Ω resistance for the given circuit.

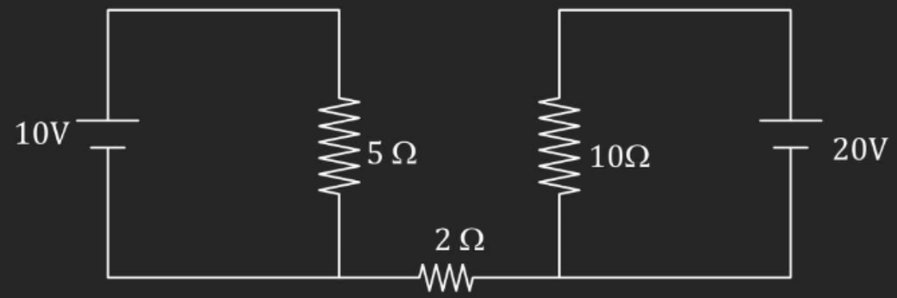
(2005)

(A) Zero

(B) 2 A

(C) 5 A

(D) 4 A.



Nodal Analysis H.W.

CURRENT ELECTRICITY

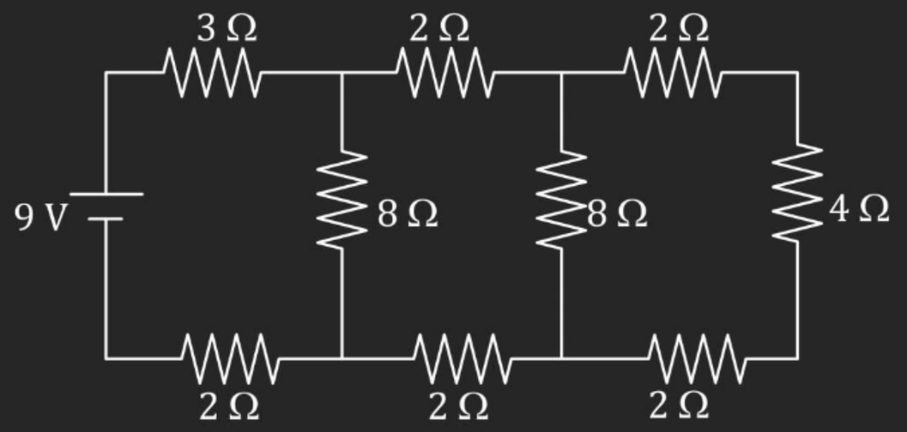
Q.6 In the circuit shown in figure the current through (1998)

(A) the 3Ω resistor is 0.50 A.

(B) the 3Ω resistor is 0.25 A.

(C) the 4Ω resistor is 0.50 A.

(D) the 4Ω resistor is 0.25 A.



Nodal Analysis H.W.

CURRENT ELECTRICITY

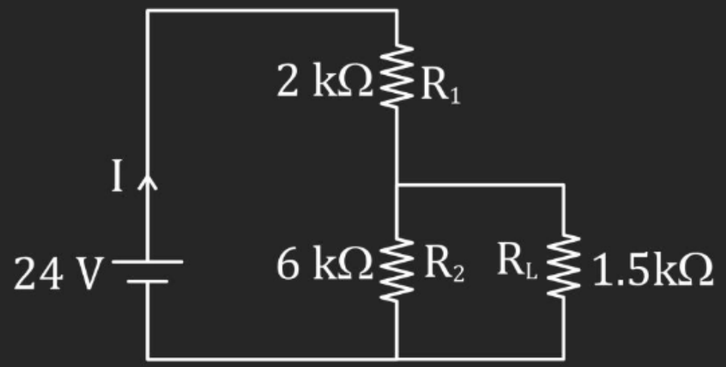
Q.7 For the circuit shown in the figure **(2009)**

(A) the current I through the battery is $7.5\ \text{mA}$

(B) the potential difference across R_L is $18\ \text{V}$

(C) ratio of powers dissipated in R_1 and R_2 is 3

(D) if R_1 and R_2 are interchanged, magnitude of the power dissipated in R_L will decrease by a factor of 9 .

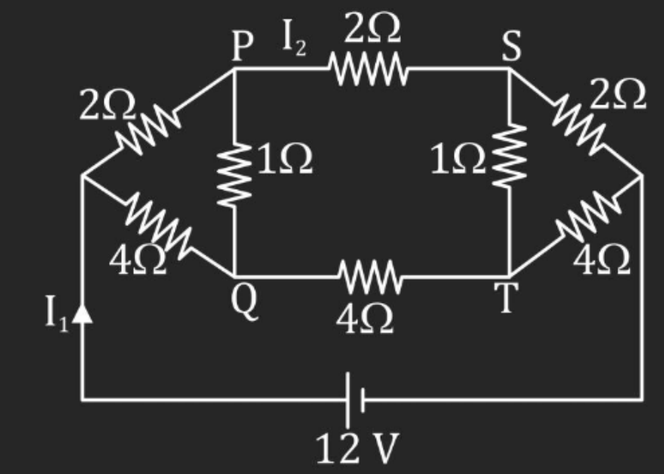


Nodal Analysis H.W.

CURRENT ELECTRICITY

Q.8 For the resistance network shown in the figure, choose the correct option(s).

(2012)



(A) The current through PQ is zero.

(B) $I_1 = 3$ A.

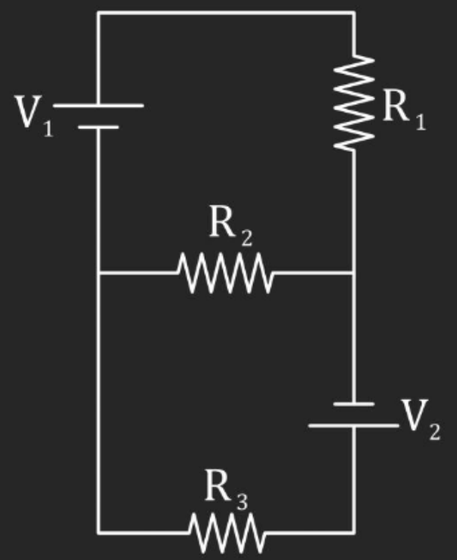
(C) The potential at S is less than that at Q.

(D) $I_2 = 2$ A

Nodal Analysis H.W.

CURRENT ELECTRICITY

Q.10 Two ideal batteries of emf V_1 and V_2 and three resistances R_1, R_2 and R_3 are connected as shown in the figure. The current in resistance R_2 would be zero if **(2014)**



(A) $V_1 = V_2$ and $R_1 = R_2 = R_3$

(B) $V_1 = V_2$ and $R_1 = 2R_2 = R_3$

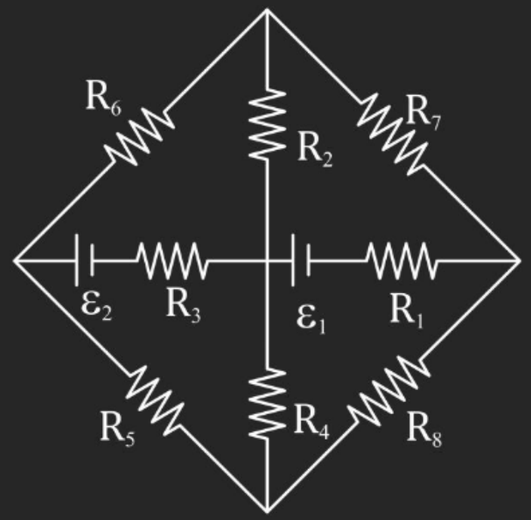
(C) $V_1 = 2V_2$ and $2R_1 = 2R_2 = R_3$

(D) $2V_1 = V_2$ and $2R_1 = R_2 = R_3$

Nodal Analysis H.W.

CURRENT ELECTRICITY

Q.11 The figure shows a circuit having eight resistances of 1Ω each, labelled R_1 to R_8, and two ideal batteries with voltages $\varepsilon_1 = 12\ V$ and $\varepsilon_2 = 6\ V$. Which of the following statement(s) is (are) correct? **(2022)**



(A) The magnitude of current flowing through R_1 is $7.2\ A$.

(B) The magnitude of current flowing through R_2 is $1.2\ A$.

(C) The magnitude of current flowing through R_3 is $4.8\ A$.

(D) The magnitude of current flowing through R_5 is $2.4\ A$.

Nodal Analysis H.W.

CURRENT ELECTRICITY

Q.12 An electrical circuit is shown in the figure. Calculate the potential difference across the resistor of 400ohm, as will be measured by the voltmeter V of resistance 400ohm, either by applying Kirchhoff's rules or otherwise. **(1996)**