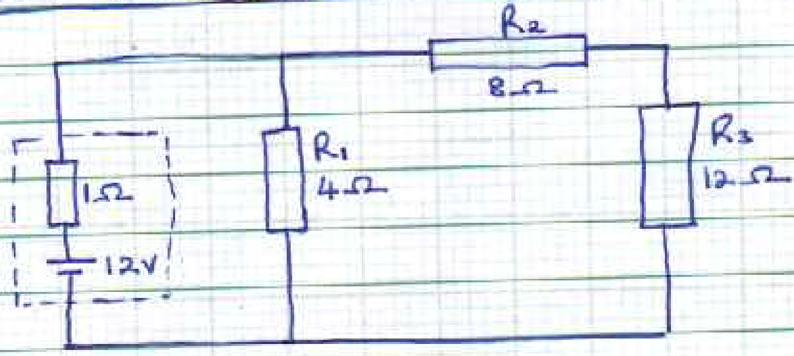
DC Electric Current

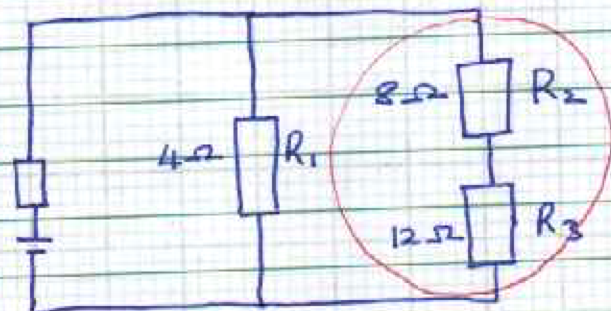
1.



(i) Battery current, I

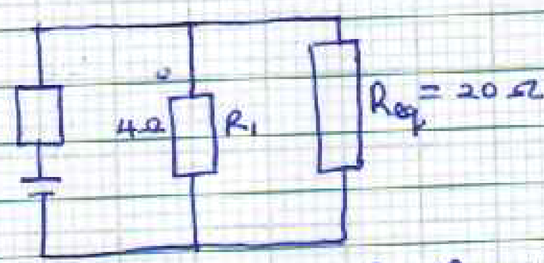
$$I = \frac{\text{Terminal Voltage}, V}{\text{Total Resistance}\,(R+r)}$$ 1

Resistor R_2 and R_3 are in series.
Reason; They are in the same loop and connected in series.



$$R_{equivalent} = R_2 + R_3 = 8\,\Omega + 12\,\Omega$$
$$= 20\,\Omega$$ 1

∴

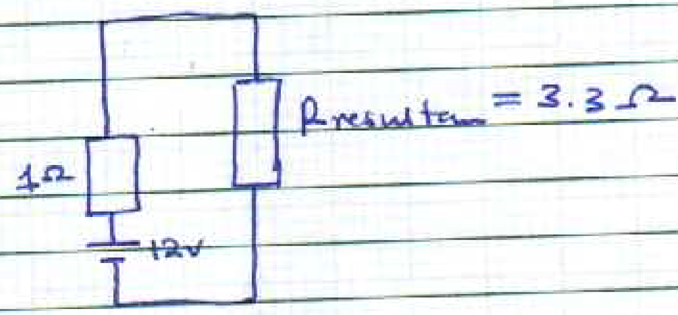


Combining R_1 and R_{eq}; They are parallel

$$\therefore \frac{1}{R_{resultant}} = \frac{1}{R_1} + \frac{1}{R_{eq}} = \frac{1}{4\,\Omega} + \frac{1}{20\,\Omega}$$

$$\Rightarrow \frac{1}{R_R} = \frac{24}{80} \Longrightarrow R_r = \frac{80}{24} = 3.3\,\Omega$$ 1

Then we have:



$$\therefore \text{ Current, } I = \frac{\mathcal{E} = 12V}{R + r} = \frac{12\,V}{3.3 + 1}$$

$$I = \frac{12}{4.3} = 2.79\,A$$

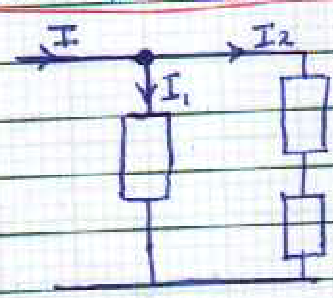
✓ ①

(ii) Terminal voltage $= I \times R$ ✓ ①
$= 2.79 \times 3.3$
$= 9.23\,V$ ✓ ①

R — external resistance
r — internal resistance.

and $\mathcal{E} = I(R + r)$
or $\mathcal{E} = V + Ir$
wher $V = IR$

(iii)



At the junction, the current, I is split into I_1 and I_2 depending on the ratio of resistors.

✓ ① ✓ ①

$$\therefore I_1 = \frac{20}{24} \times 2.79 = 2.325\,A$$

$\therefore$ Voltage across 4Ω resistor $= I_1 \times 4\,\Omega$

$\therefore V = 2.325 \times 4\,\Omega$
$= 9.3\,V$

I_2 is the current through both $8\,\Omega$ and $12\,\Omega$ resistor.

$$I_2 = \frac{4}{24} \times 2.79 = 0.465\,A$$

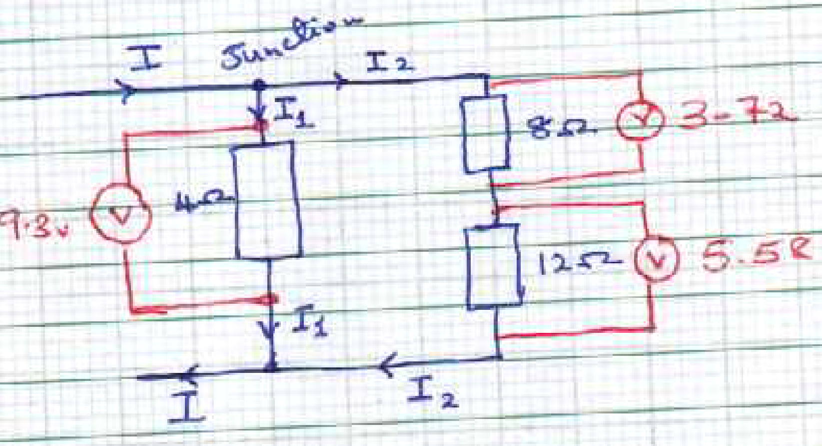
① ①

Voltage across the $8\,\Omega$ resistor

$V = I_2 \times 8\,\Omega$
$= 0.465 \times 8\,\Omega$
$= 3.72$

Voltage across the $12\,\Omega$ resistor

$V = I_2 \times 12\,\Omega$
$= 0.465 \times 12$
$= 5.58$



NB/ The question in testing the Kirchoff's Law of current at the junction.