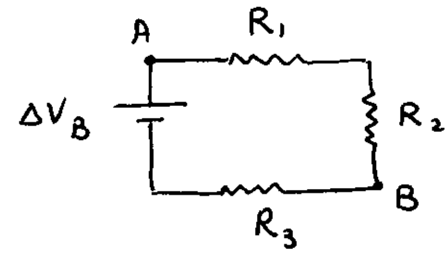
Unit 23 – Homework Solution

27 – 5

$R_1 = 12\,\Omega$ $\quad \Delta V_B = 15\,V$

$R_2 = 15\,\Omega$

$R_3 = 25\,\Omega$



$$R_{tot} = R_1 + R_2 + R_3 = 52\,\Omega$$

$$I_{tot} = \frac{\Delta V_B}{R_{tot}} = \frac{15\,V}{52\,\Omega} = 0.29\,A \qquad I_{tot} = I_1 = I_2 = I_3$$

$$\Rightarrow \Delta V_1 = R_1 I_1 = (12\,\Omega)(0.29A) = 3.48\,V$$

$$\Delta V_2 = R_2 I_2 = (15\,\Omega)(0.29\,A) = 4.35\,V$$

$$\Delta V_3 = R_3 I_3 = (25\,\Omega)(0.29\,A) = 7.25\,V$$

$$\Delta V_1 + \Delta V_2 + \Delta V_3 = 15\,V \checkmark$$
$$= \Delta V_B$$

---

27 – 11 $\quad R_2, R_3, R_4$ are parallel.

R_1 is in series with R_{234}.

a) $$\frac{1}{R_{234}} = \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4} = \frac{1}{50} + \frac{1}{50} + \frac{1}{75} \Rightarrow R_{234} = 18.75\,\Omega$$

$$R_{tot} = R_1 + R_{234} = 100 + 18.75 = 118.75\,\Omega = 119\,\Omega$$

b) $$I_{tot} = \frac{\Delta V_B}{R_{tot}} = \frac{6}{119} = 0.05\,A$$

$$I_{tot} = I_1 = I_{234} \Rightarrow \boxed{I_1 = 0.05\,A}$$

$$\Delta V_1 = R_1 I_1 = (100)(0.05) = 5\,V \Rightarrow \Delta V_2 = \Delta V_3 = \Delta V_4 = \Delta V_B - \Delta V_1$$
$$= 1.0\,V$$

$$I_2 = \frac{\Delta V_2}{R_2} = \frac{1}{50} = 0.02 \ A$$

$$I_3 = \frac{\Delta V_3}{R_3} = \frac{1}{50} = 0.02 \ A$$

$$I_4 = \frac{\Delta V_4}{R_4} = \frac{1}{75} = 0.01 \ A$$

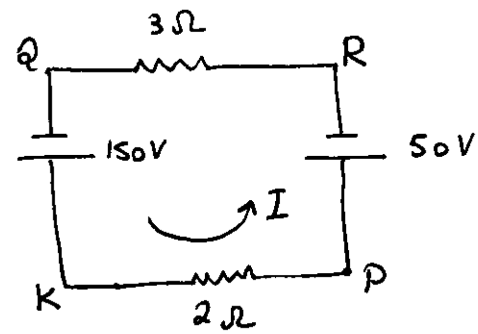
$$I_2 + I_3 + I_4 = 0.05$$
$$= I_1 \checkmark$$

<u>27 – 24</u> Similar to 24 – 11 !

$$R_{tot} = R_1 + R_{234} = R_1 + \left(\frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4}\right)^{-1}$$

$$= 100 + \left(\frac{1}{50} + \frac{1}{50} + \frac{1}{75}\right) \quad . \ . \ .$$

<u>27 – 4</u> $\Delta V_{QP} = V_P - V_Q$



Kirchhoff's law : starting from point Q and moving in counter clockwise direction

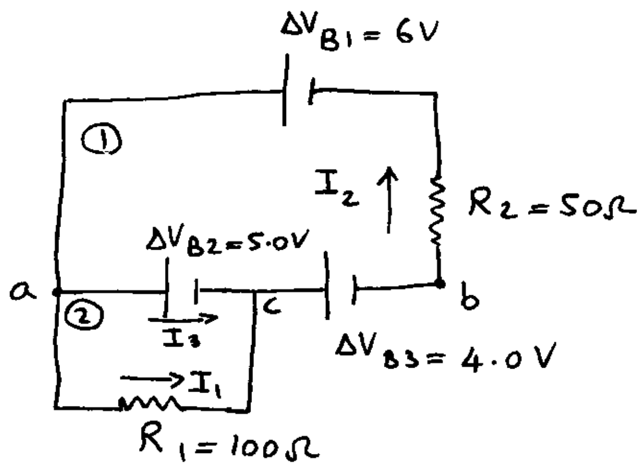
$$\Delta V_{KQ} + \Delta V_{PK} + \Delta V_{RP} + \Delta V_{QR} = 0$$

$$+150 - 2I - 50 - 3I = 0 \Rightarrow \boxed{I = 20 \ A}$$

$$\Delta V_{QP} = \Delta V_{QK} + \Delta V_{KP} = +150 - 2I = 150 - 40 = 110$$

$$\Delta V_{QP} = V_P - V_Q = 100 - V_Q = 110 \Rightarrow \boxed{V_Q = -10 \ V}$$

— 27– 19



loop ① (moving in counter clockwise direction):

$$\Delta V_{B1} - \Delta V_{B2} - \Delta V_{B3} - R_2 I_2 = 0$$

loop ②: $\Delta V_{B2} - R_1 I_1 = 0$

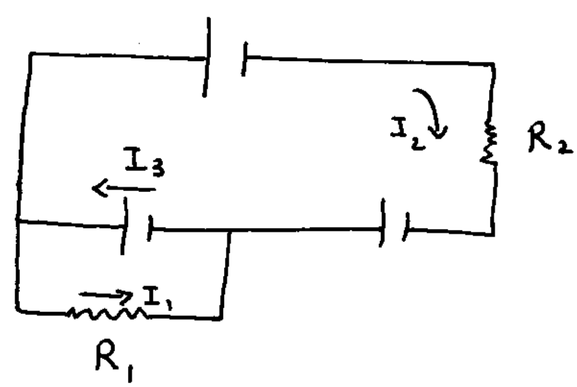
Point a: $I_2 = I_1 + I_3$

$\Rightarrow$ $6 - 5 - 4 - 50\, I_2 = 0 \Rightarrow \boxed{I_2 = -\frac{3}{50}\,A = -0.06\,A}$

the predicted direction for I_2 was not right.

$5 - 100 I_1 = 0 \Rightarrow \boxed{I_1 = 0.05\ A}$

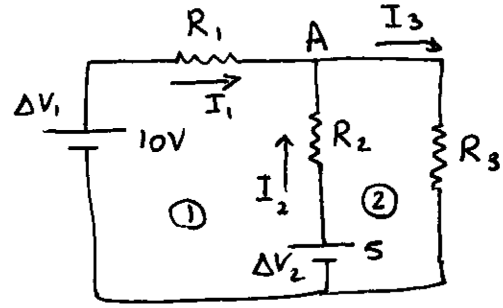
$I_3 = I_2 - I_1 = -0.06 - 0.05 = -0.11\,A$ $\boxed{I_3 = -0.11\ A}$



$$V_a - V_b = (V_a - V_c) + (V_c - V_b) = 5 + 4 = 9.0\ V$$

27 - 9

$R_1 = R_2 = R_3 = 4.0\,\Omega$



First assign a direction for currents through each resistor. (Don't worry about finding the right direction for currents at this step.)

Using Kirchhoff's laws:

loop # 1 : (moving in clockwise direction)

$$\Delta V_1 - R_1 I_1 + R_2 I_2 - \Delta V_2 = 0$$

loop # 2 :

$$\Delta V_2 - R_2 I_2 - R_3 I_3 = 0$$

for point A: $I_1 + I_2 = I_3$

$$\Rightarrow \begin{cases} +10 - 4I_1 + 4I_2 - 5 = 0 \\ +5 - 4I_2 - 4I_3 = 0 \\ I_1 + I_2 = I_3 \end{cases} \Rightarrow \begin{cases} 5 - 4I_1 + 4I_2 = 0 \Rightarrow I_1 = \dfrac{5+4I_2}{4} \\ 5 - 4I_2 - 4I_3 = 0 \Rightarrow I_3 = \dfrac{5-4I_2}{4} \\ I_1 + I_2 = I_3 \end{cases}$$

$$\Rightarrow \left(\frac{5}{4} + I_2\right) + I_2 = \frac{5}{4} - I_2 \Rightarrow \boxed{I_2 = 0\ \text{A}}$$

$$\boxed{I_1 = \frac{5}{4} = 1.25\ \text{A}}$$

$$\boxed{I_3 = 1.25\ \text{A}}$$

Predicted directions were correct!