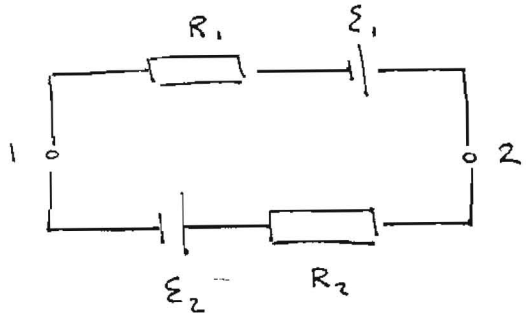
3.174)



$R_1 = 10\Omega$
$R_2 = 20\Omega$
$\mathcal{E}_1 = 5\,V$
$\mathcal{E}_2 = 2\,V$

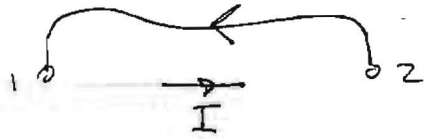
find $\varphi_1 - \varphi_2$ (potential difference between points 1 and 2)

from Kirkoff Loop 

$$-\mathcal{E}_1 + IR_1 + IR_2 + \mathcal{E}_2 = 0$$

$$I = \frac{\mathcal{E}_1 - \mathcal{E}_2}{R_1 + R_2}$$

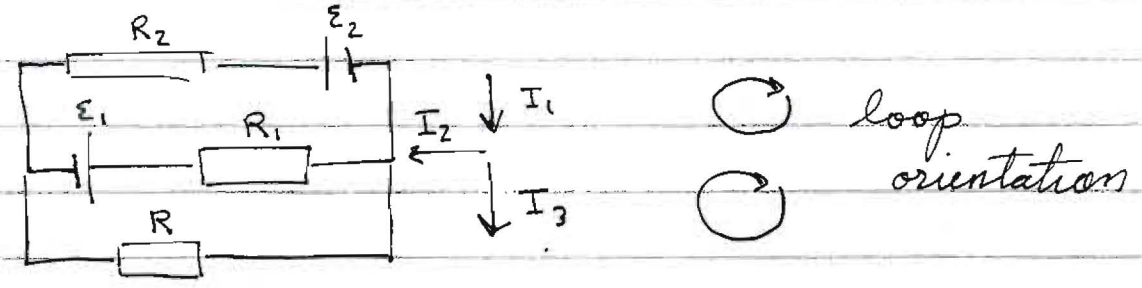
$\varphi_1 - \varphi_2$ draw path from 1 → 2 and calculate drop across path



$$\Delta\varphi = IR_1 - \mathcal{E}_1 = \left(\frac{\mathcal{E}_1 - \mathcal{E}_2}{R_1 + R_2}\right) R_1 - \mathcal{E}_1$$

$$\Delta\varphi = -4\,V$$

3.18)



① $-I_1R_2 + \mathcal{E}_2 - I_2R_1 + \mathcal{E}_1 = 0$

② $-I_2R_1 + \mathcal{E}_1 + I_3R = 0$

③ $I_1 = I_3 + I_4$

③ → ① $-I_2R_2 - I_3R_2 + \mathcal{E}_3 - I_2R_1 + \mathcal{E}_1 = 0$ ④

$-I_2R_1 + \mathcal{E}_1 + I_3R = 0$

from second equation $I_2 = \dfrac{RI_3 + \mathcal{E}_1}{R_1}$ put that into ④, solve for I_3

$$-\frac{R_2}{R_1}\mathcal{E}_1 + \mathcal{E}_2 = \left(\frac{R_2R}{R_1} + R_2 + R\right) I_3$$

$$\boxed{I_3 = \frac{\mathcal{E}_2R_1 - \mathcal{E}_1R_2}{R_2R + R_2R_1 + R_1R}}$$

$$\boxed{I_3 = 0.02\blacksquare\ A}$$

$\mathcal{E}_1 = 1.5$

$\mathcal{E}_2 = 3.7$

$R_1 = 10$

$R_2 = 20$

$R = 5$