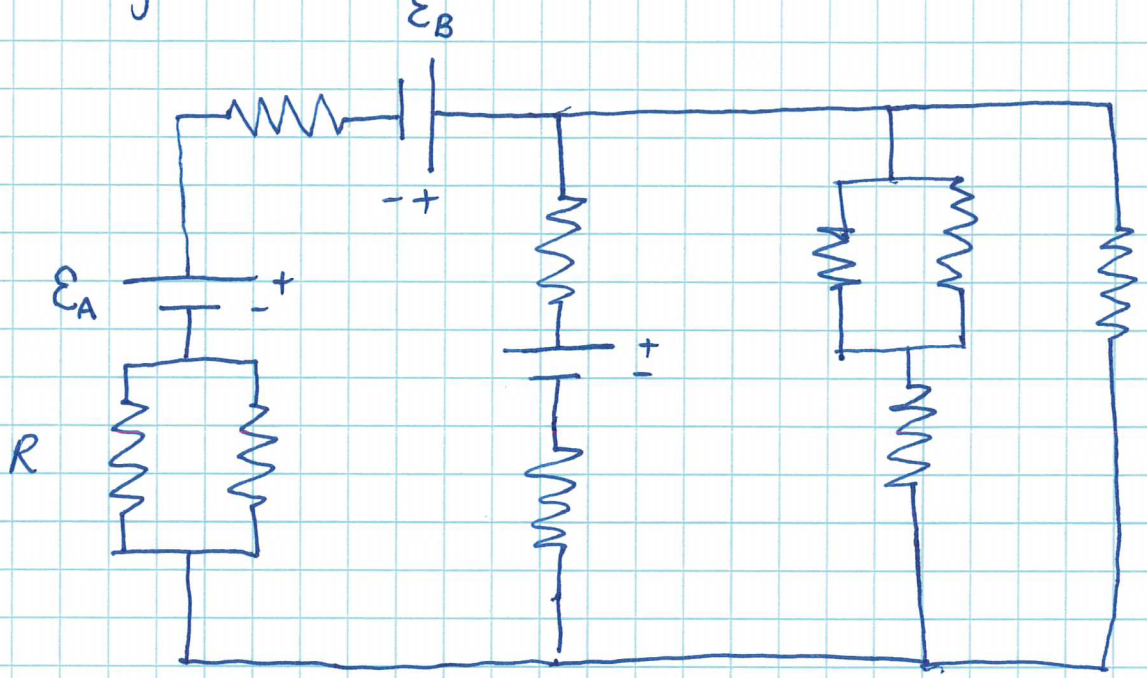

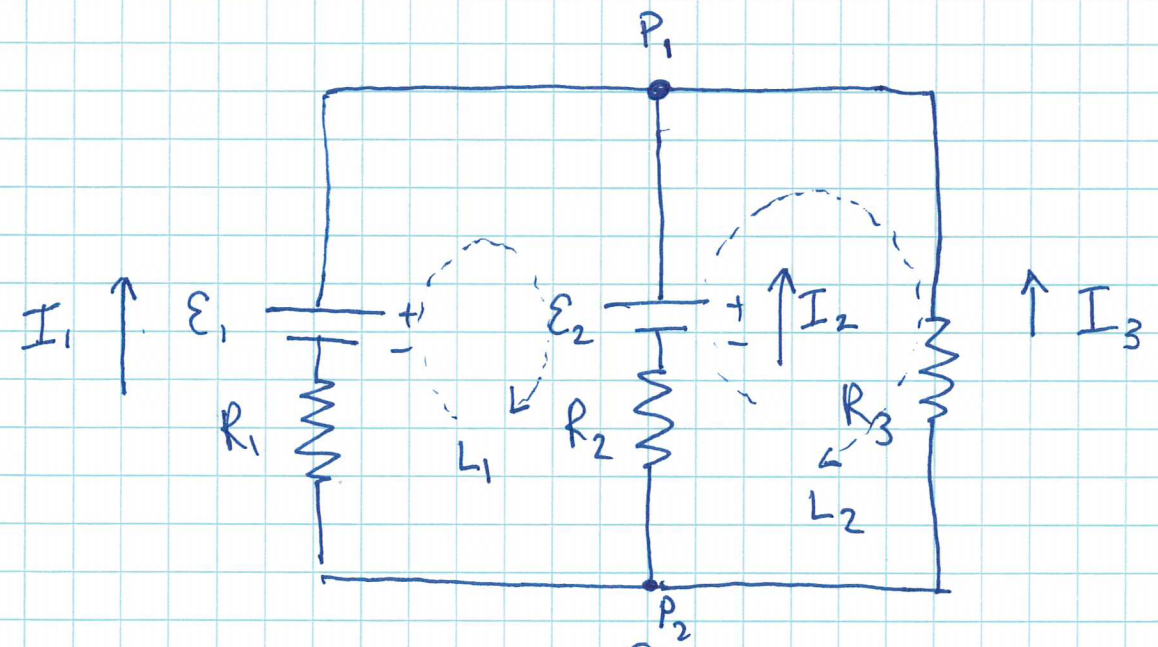

~~Voltage drop: $\oint dV = 0$~~

Kirchhoff Current Law: $I_1 + I_2 + I_3 = 0$

Direction of current arrows matters.

@ Point P_1

Kirchoff Voltage Law:

Sum of voltage drops = 0.

Direction of current & Loop orientation both matter.

$$L_1: \quad R_1 I_1 - \mathcal{E}_1 + \mathcal{E}_2 - R_2 I_2 = 0$$

- $R_1 I_1$: current arrow aligned with loop direction
- $-\mathcal{E}_1 + \mathcal{E}_2$: signs different due to orientation versus loop orientation.
- $-R_2 I_2$: current arrow not aligned w/ loop direction

$$L_2: R_2 I_2 - \mathcal{E}_2 - R_3 I_3 = 0$$

what happens if we add L_1 & L_2 Eqn's ?

Solve: $I_3 = -I_1 - I_2 \rightarrow$ "L_2"

$$R_2 I_2 - \mathcal{E}_2 + R_3 I_1 + R_3 I_2 = 0$$

$$(R_2 + R_3) I_2 = \mathcal{E}_2 - R_3 I_1$$

$$I_2 = \frac{1}{(R_2 + R_3)} \mathcal{E}_2 - \frac{R_3}{R_2 + R_3} I_1 \rightarrow \text{"}L_1\text{"}$$

$$R_1 I_1 - \mathcal{E}_1 + \mathcal{E}_2 - \frac{R_2}{R_2 + R_3} \mathcal{E}_2 + \frac{R_2 R_3}{R_2 + R_3} I_1 = 0$$

$$\left(R_1 + \frac{R_2 R_3}{R_2 + R_3}\right) I_1 = \mathcal{E}_1 - \mathcal{E}_2 \left(1 - \frac{R_2}{R_2 + R_3}\right)$$

$$I_1 = \frac{1}{\left(R_1 + \frac{R_2 R_3}{R_2 + R_3}\right)} \left[\mathcal{E}_1 - \mathcal{E}_2 \left(1 - \frac{R_2}{R_2 + R_3}\right)\right]$$

all resistors are $1\,\Omega$ and $\mathcal{E}_1 = 10\,V$ $\mathcal{E}_2 = 5\,V$.

$$I_1 = \left(\frac{1}{1+\frac{1}{2}}\right)\frac{5\,V}{\Omega}\left[2-\left(1-\frac{1}{2}\right)\right]$$

$$= A\left(\frac{2}{3}\right)5\left(\frac{3}{2}\right) = 5\,A$$

$$I_2 = \frac{1}{2\,\Omega}\,5V - \frac{1\,\Omega}{2\,\Omega}\,5\,A = 0\,A$$

$$I_3 = -5\,A.$$