# Introduction to Electrical Engineering

Aakash Jog

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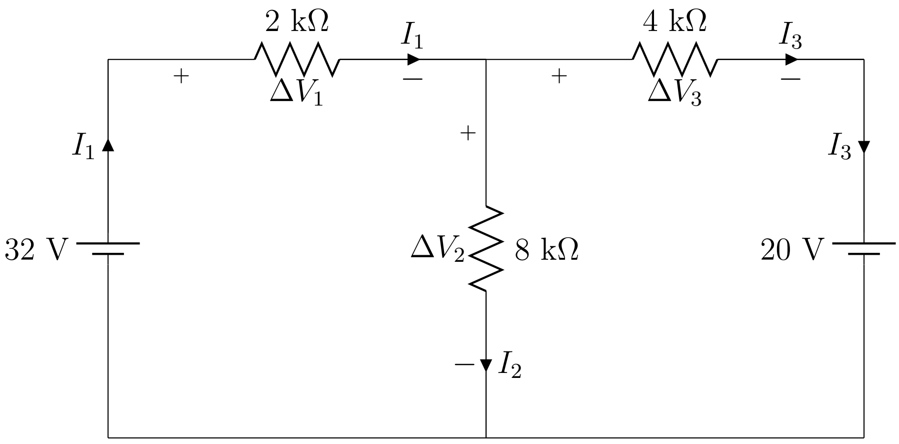
# Part I

## 1

**Recitation 1 – Exercise 1.**




**Recitation 1 – Solution 1.**
By KCL for the upper junction,

$$I_1 - I_2 - I_3 = 0$$

By KCL for the lower junction,

$$-I_1 + I_2 + I_3 = 0$$

By KVL for left loop,

$$-32 + \Delta V_1 + \Delta V_2 = 0$$

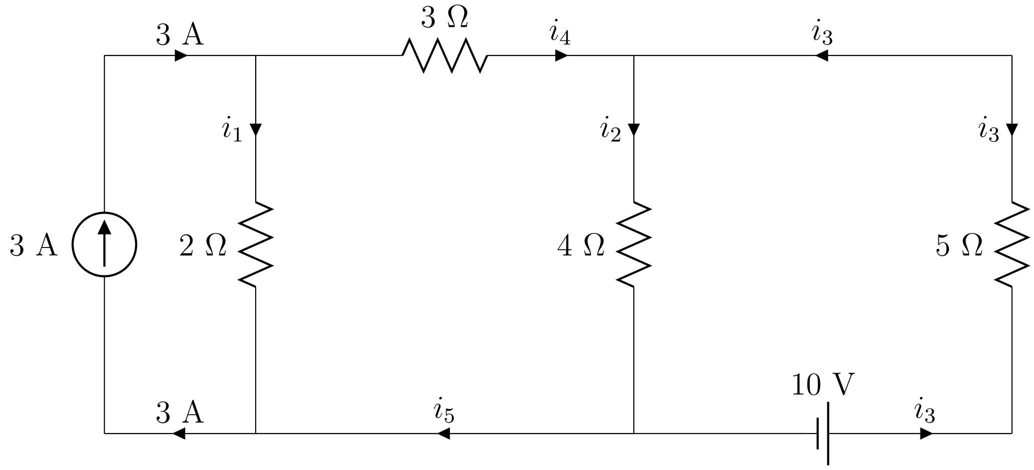
By KVL for right loop,

$$-20 - \Delta V_2 + \Delta V_3 = 0$$

By KVL for the larger loop,

$$32 - \Delta V_1 - \Delta V_2 - 20 = 0$$

**Recitation 1 – Exercise 2.**




**Recitation 1 – Solution 2.**
By KCL at 2,

$$3 - i_1 - i_4 = 0$$

By KCL at 3,

$$i_4 + i + 3 + i_2 = 0$$

By KCL at 6,

$$-i_3 - i_2 - i_5 = 0$$

By KCL at 7,

$$i_5 + i_1 - 3 = 0$$

By KVL in loop A,

$$2i_1 - V_x = 0$$

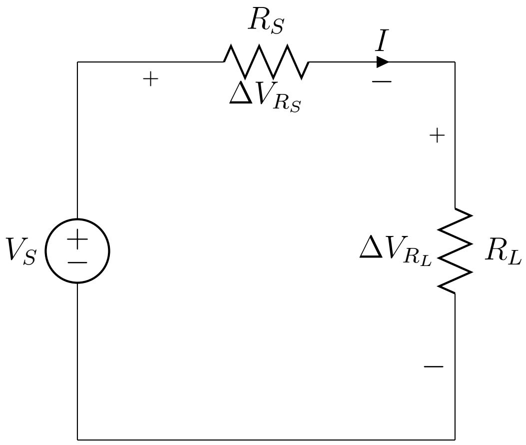
By KVL in loop B,

$$3i_4 - 4i_2 - 2i_1 = 0$$

By KVL in loop C,

$$-5i_3 + 10 + 4i_2 = 0$$

**Recitation 1 – Exercise 3.**




Find $R_L$ so that it would have maximum available power.

**Recitation 1 – Solution 3.**
By KVL,

$$\begin{aligned}\Delta V_{R_S} + \Delta V_{R_L} - V_S &= 0\\ \therefore \Delta V_{R_S} + \Delta V_{R_L} &= V_S\\ IR_S + IR_L &= V_S\\ \therefore I &= I^2 R_L\\ &= \left(\frac{V_S}{R_S + R_L}\right)^2 R_L\end{aligned}$$

The power is maximum if $\dfrac{\mathrm{d}P_L}{\mathrm{d}R_L} = 0$.
Therefore, differentiating and maximizing, $P_L$ is maximum if $R_L = R_S$.
Therefore,

$$\begin{aligned}P_{L\max} &= \frac{{V_S}^2}{(2R_S)^2} \cdot R_S\\ &= \frac{{V_S}^2}{4R_S}\end{aligned}$$