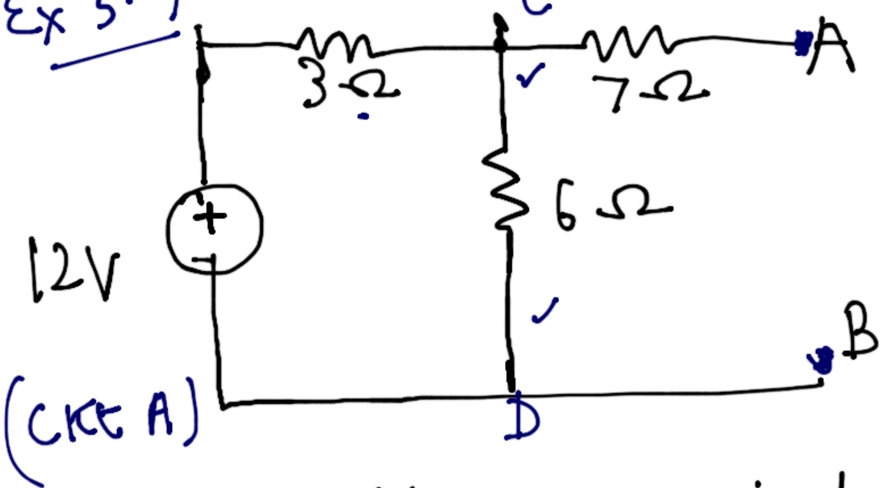
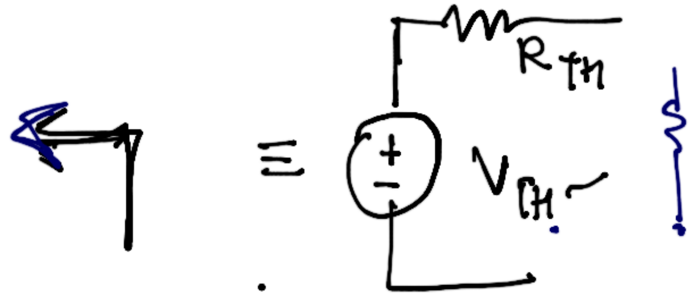
Ex 5.7



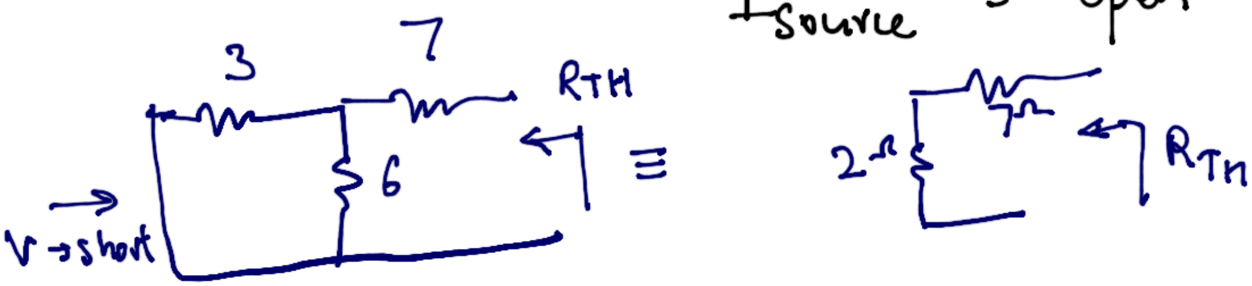




Find Thevenin equivalent between A & B

**Step 1** $R_{th}$ . Make current/voltage source = 0

$V_{source} \rightarrow$ Short Circuit

$I_{source} \rightarrow$ Open Circuit

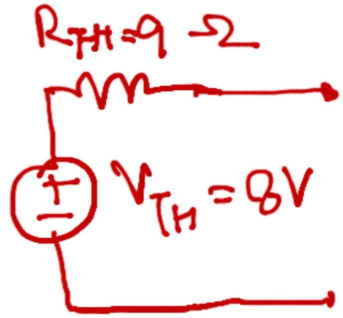



$\Rightarrow R_{TH} = 9\Omega$

**Step 2** $V_{TH}$ . Find $V_{AB}$

In Ckt A $V_{CD} = V_{AB}$ ; $V_{CD} = \frac{6\Omega}{6+3\Omega} * 12$

$V_{AB} = V_{TH} = V_{CD} = \frac{2}{3} \times 12 = 8\text{ V}$




Thevenin Eq.

# Steps : Thevenin Eq.

1(a) Know the terminals (AB) across which Equivalent has to be calculated.

1(b) Removes the load part

2 $R_{TH}$ All Independent sources $\rightarrow 0$

ie. Voltage Sources $\rightarrow$ Short Ckt. (S.C)

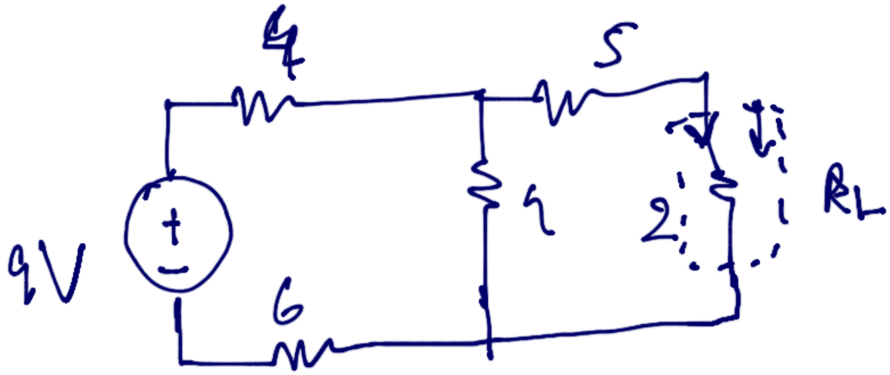
Current Sources $\rightarrow$ Open Ck (O.C)

Leave dependent sources as they are.

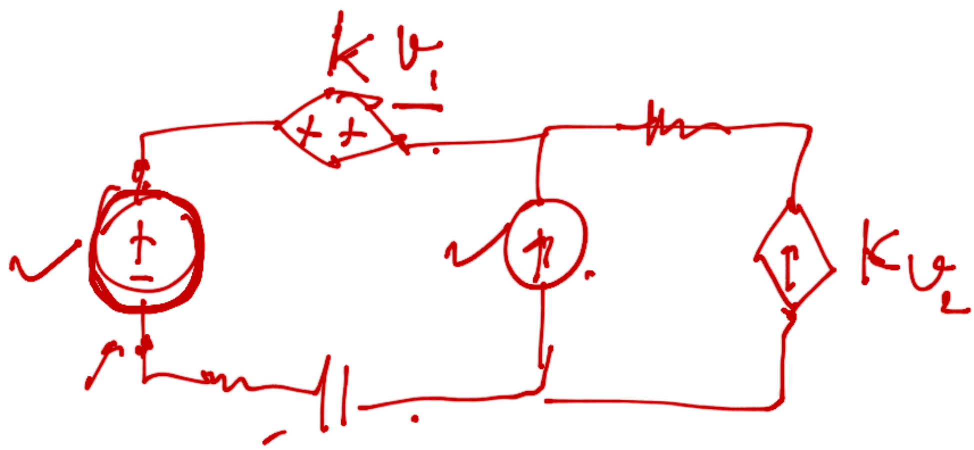
2(b) Find the Equivalent Resistance between A & B.

3. Find voltage $V_{AB}$ across the two terminals.

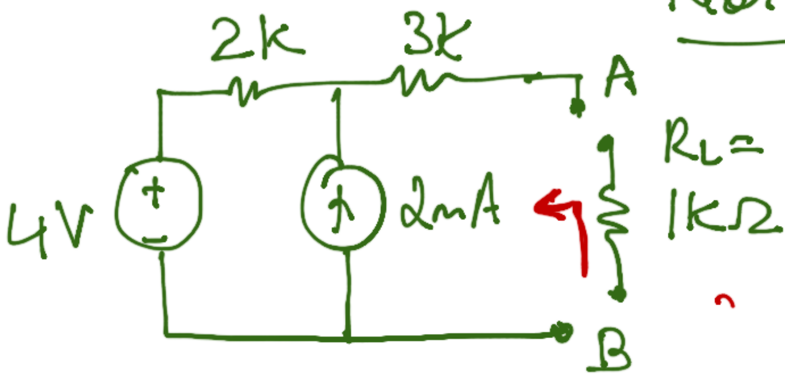
## 5.6 Practice




* In Superposition Theorem, we consider only Independent voltage/current source.



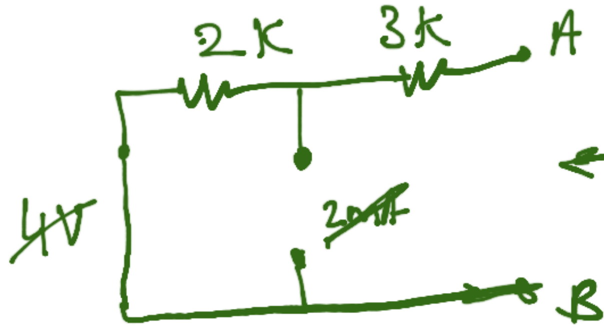

# Norton Equivalent




Step 1 Find $R_N$ : $V_{source} \to$ S.C

$I_{source} \to$ O.P

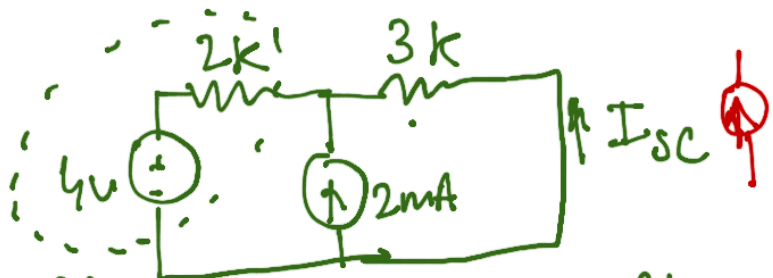
& Solve.




$R_N (= R_{Th}) = 5K$ ✓

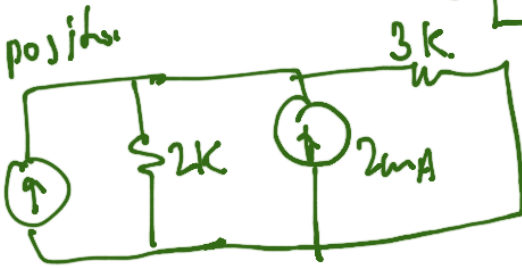
Step 2 $I_N$

S.C Terminals AB

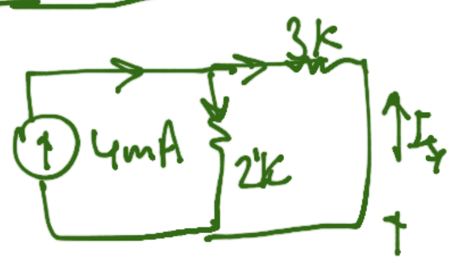



KVL, KCL, Superposition

Source Trans. :




=





$\Rightarrow$

$$I_{sc} = -\frac{2}{5} * 4mA = -\frac{8}{5} mA = -1.6mA$$

# Steps for Norton Equivalent

1(a) Find the terminals across which $R_N$, $I_N$ have to be found.

(b) Remove $R_L$

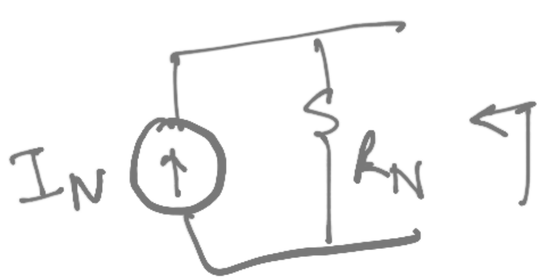
2. $R_N$

(a) Independent $\begin{cases} V_{source} \rightarrow S.C \\ I_{source} \rightarrow O.C \end{cases}$

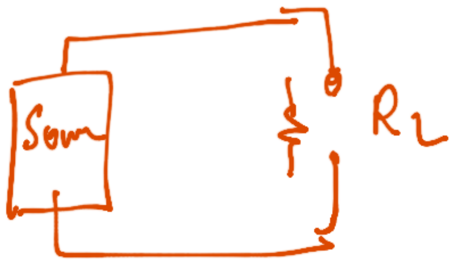
(b) Find Equivalent Resistance across the terminals

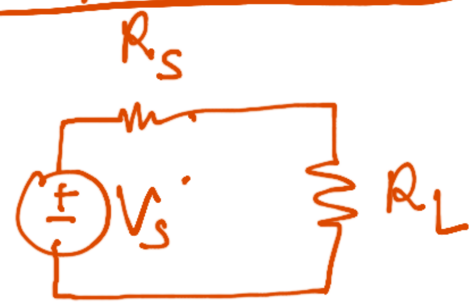
3 $I_N$

Short circuit the terminals & find the short circuit current $I_{SC}$ across the terminals. This is $I_N$



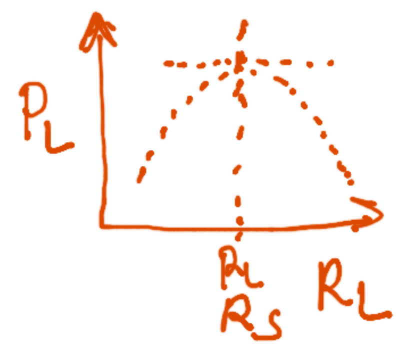
# Maximum Power Transfer Theorem




Power transferred to the load = $\boxed{P_L}$

Plot the power vs $R_L$




$\rightarrow$ $\boxed{\dfrac{\partial P_L}{\partial R_L} = 0}$

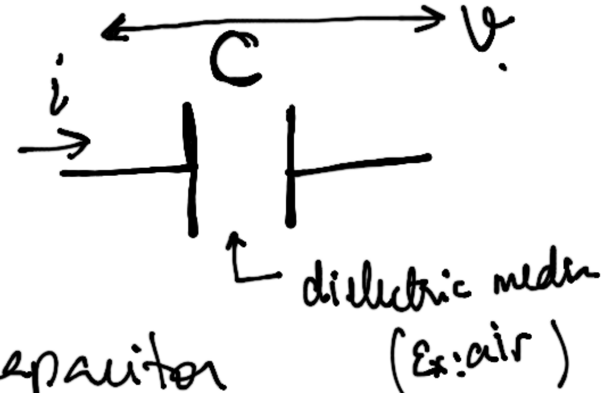
$R_L$ in terms known value.

$R_s = R_L$ :

$\boxed{P_{L_{max}} = \ ?}$

# Chapter 7

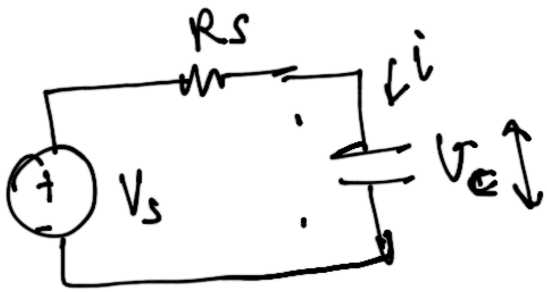
| A | B | C | D |
|---|---|---|---|
| 10 | 10 | 10 | 10 |




## Capacitor

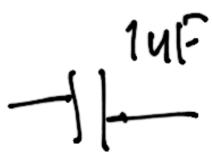
- Stores Charge
- Two parallel metal plates
- Both plates have opp. Charge.

- V is applied across the cap
  What is $i_c = C \frac{dv}{dt}$.




$i = C \frac{dV_c}{dt}$

- Charge stored per unit voltage $C = \frac{Q}{V}$
  Unit: Farad (F)



$$\text{power} = Vi = V_c \, C \, \frac{dv_c}{dt}$$

**Current-Voltge Relationship**

$$i = C \underbrace{\frac{dv}{dt}}$$

$$\int_{t_0}^{t} dv = \frac{1}{C} \int_{t_0}^{t} i \, dt.$$

$$v(t) - v(t_0) = \frac{1}{C} \int_{t_0}^{t} i \, dt$$

$t_0 \rightarrow$ starting / initial time

**Q-V relationship**

$$Q = CV$$

$C \downarrow$ Capacitance

Ex 7.1, 7.2.

Practice $\rightarrow$ 7.2

## Energy & Power of a Cap

$$\text{Power} = C v_c \frac{dv_c}{dt}.$$

$$\text{Energy} = \int_{t_0}^{t} p \cdot dt$$

$$= C \int_{t_0}^{t} v_c \frac{dv_c}{dt} \cdot dt$$

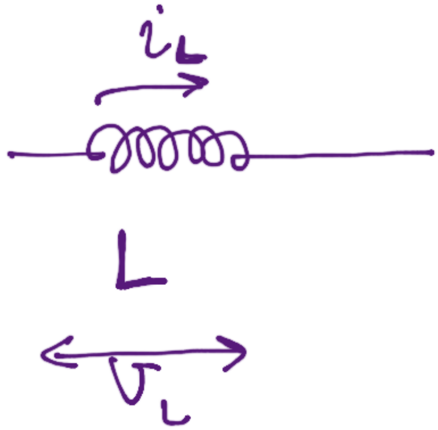
$$= C \int_{t_0}^{t} v_c \, dv_c = C \left[ \frac{v_c^2}{2} \right]_{v_c(t_0)}^{v(t)}$$

$$\boxed{\text{Energy} = \frac{C}{2} \left[ v_c^2(t) - v_c^2(t_0) \right]}$$

If initial $v_c$ at $t_0$ ($v_c = 0$)

$$\text{Energy} = \frac{1}{2} C v_{(t)}^2$$

# Inductor




$$v_L = L\frac{di_L}{dt}$$

$L \rightarrow$ inductor

'Inductance' . Units : Henry (H)

## Current ~ Voltage Relation

$$\int_{t_0}^{t} di_L = \frac{1}{L}\int_{t_0}^{t} v_L \, dt$$

$$\boxed{i_L(t) - i_L(t_0) = \frac{1}{L}\int_{t_0}^{t} v_L \, dt}$$

# Energy Storage

$$\text{Power} = p = v \cdot i$$

$$p_L = v_L \, i_L$$

$$= L \frac{di_L}{dt} \cdot i_L$$

$$\text{Energy} = \int_{t_0}^{t} p_L \cdot dt = L \int_{t_0}^{t} i_L \frac{di_L}{dt} dt$$

$$= L \left[ \frac{i_L^2}{2} \right]_{i_L(t_0)}^{i_L(t)}$$

$$\boxed{\text{Energy stored in an inductor} = \frac{L}{2} \left( i_L^2(t) - i_L^2(t_0) \right) \qquad w_L = \frac{1}{2} L i \text{ (if initial condition is zero)}}$$

7.5, 7.6