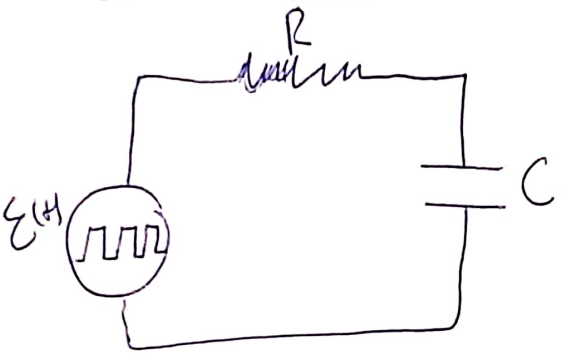
Exp 6: Capacitors and Inductors

Theory: RC circuit



1. charging:-

$$Q(t) = C\varepsilon(1 - e^{-t/RC})$$

$$V_C = \frac{Q}{C}$$

$$\boxed{V_C = \varepsilon(1 - e^{-t/RC})}$$

$\boxed{RC = \tau}$ → time constant: is measure how fast the voltage across the capacitor rises

⟶ at $t = \tau$ $V_C = 0.63\varepsilon$

which means that the voltage across the capacitor rises to 0.63 of it's max value at $t = \tau$

$$I(t) = \frac{dQ}{dt} = \frac{\varepsilon}{R} e^{-t/RC}$$ Current passing through the circuit

$$V_R = I(t)R = \varepsilon e^{-t/RC}$$ Voltage across the resistor.

Discharging

$$Q(t) = C\varepsilon e^{-t/RC}$$

$$V_c = \varepsilon e^{-t/RC}$$

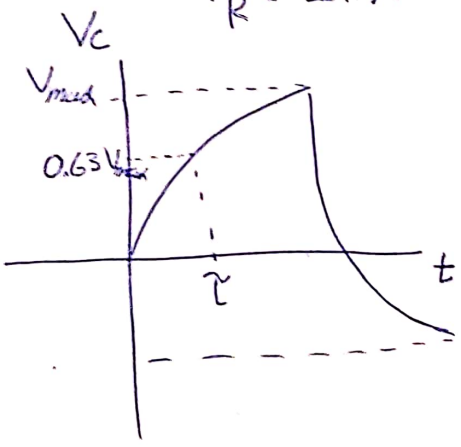
$\boxed{\tau = RC}$ time constant: which means here [measure of how the fast the voltage across the capacitor plates decreases]

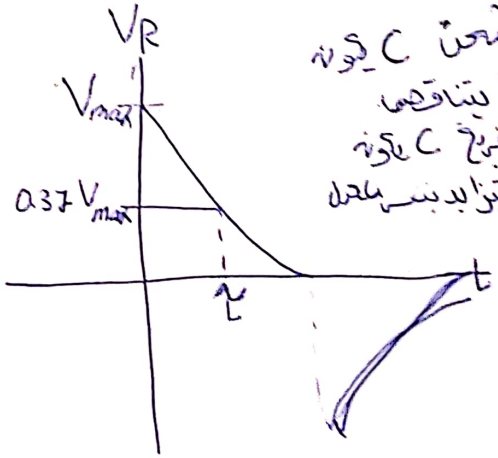
at $t = \tau$ $V_c = 0.37\varepsilon$ → the voltage across the capacitor plates decays to 0.37 of the max value within a time τ

$$I(t) = \frac{dQ}{dt} = -\frac{\varepsilon}{R} e^{-t/RC}$$

current passing through the circuit

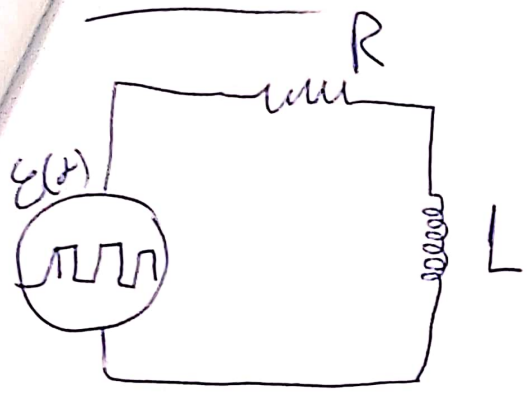
$$V_R = I(t)R = -\varepsilon e^{-t/RC}$$





عند شحن C يزيد
VR يتناقص
عند التفريغ C يقل
VR يتزايد بنفس المعدل

RL Circuit:



$$I(t) = \frac{\varepsilon}{R}\left(1 - e^{-\frac{Rt}{L}}\right)$$

- Current passing through

$$V_R = IR = \varepsilon\left(1 - e^{-Rt/L}\right)$$

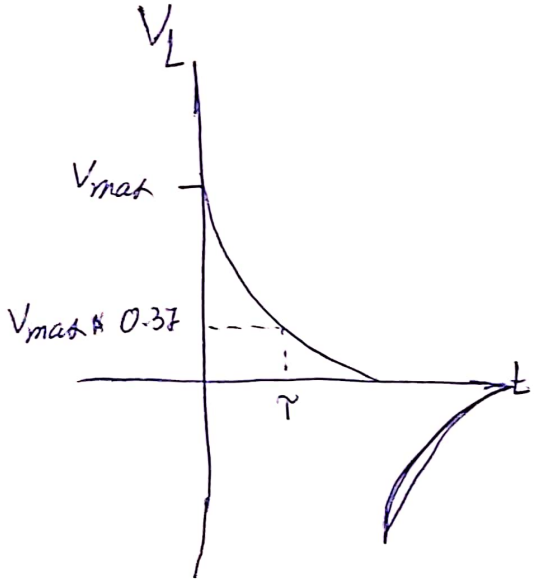
- Voltage across the resistor

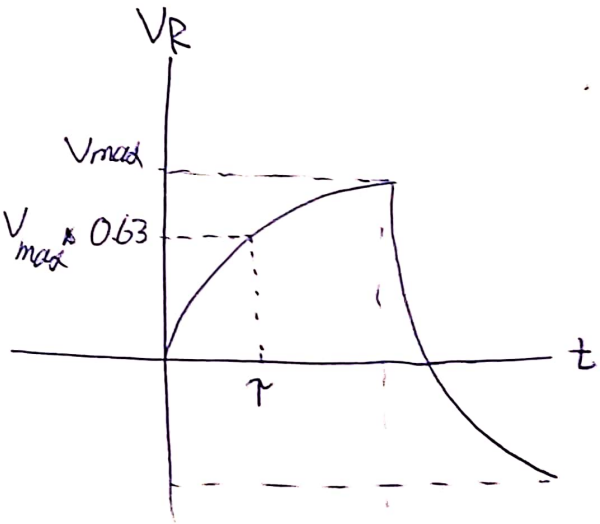
$$V_L = I\,\mathcal{L}\frac{dI}{dt} = \varepsilon\, e^{-Rt/L}$$

$\frac{L}{R}$ = time constant = measure how fast the current rises in the circuit.

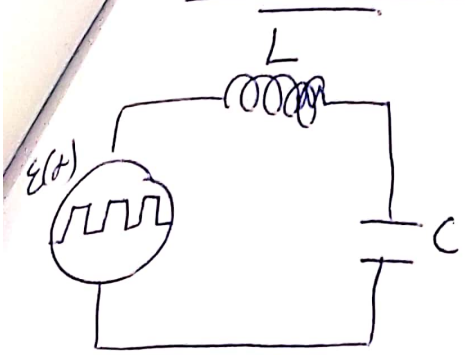
at $t = \tau$ $\quad V_R = 0.63\,\varepsilon$

$V_L = 0.37\,\varepsilon$





L C circuit



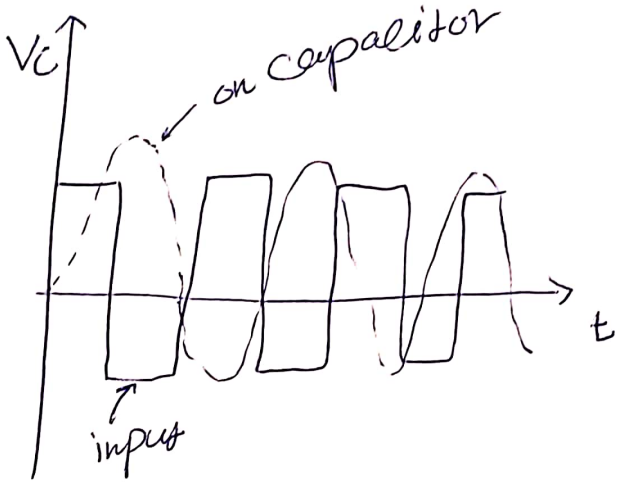
in this circuit the voltage across the capacitor

$$V_C = V_{Co} \cos(\omega t + \phi)$$

V_{Co} : the amplitude [const]

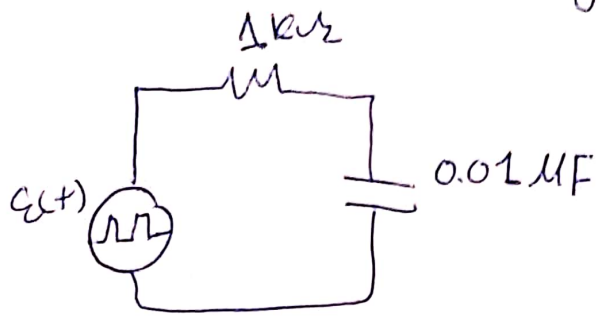
$$\omega = \frac{1}{\sqrt{LC}}$$

angular freq



RC - circuit :

1. Connect the following circuit.



2. Use square wave from the ~~signal~~ signal generato

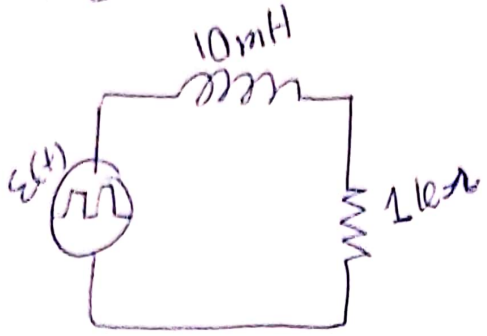
3. Display V_C on the oscilloscope screen
   Measure τ for both Charging and discharging

4. Display V_R on Oscill ... Measure τ for both charging and discharging.

→ You have to exchange the places of R and C why?!

RL Circuit:

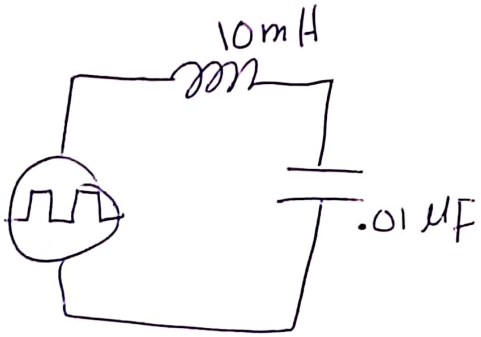
1. Connect the following circuit.



2. Display V_R and V_L on the oscilloscope screen, measure τ in Both Cases.

LC Circuit:

1. Connect the following Circuit.



2. Display V_C on the oscillscope screen, measure the amplitude A and the angular freq ω