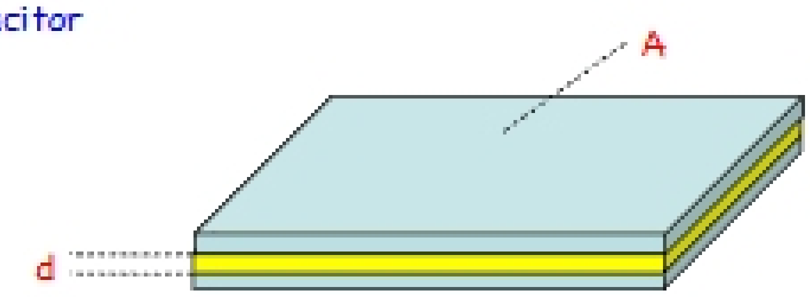
Capacitor

Physical structure :

Two conducting plates separated by dielectric material forms a Capacitor



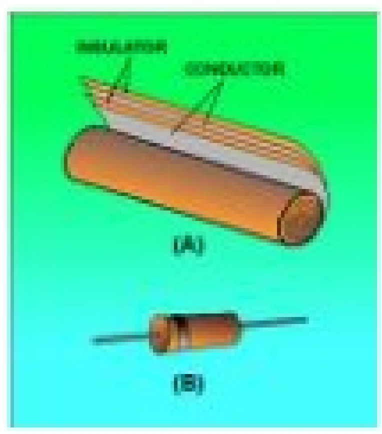
Capacitance :

A: surface area

d: distance between conducting sheets

ε permittivity of dielectric material

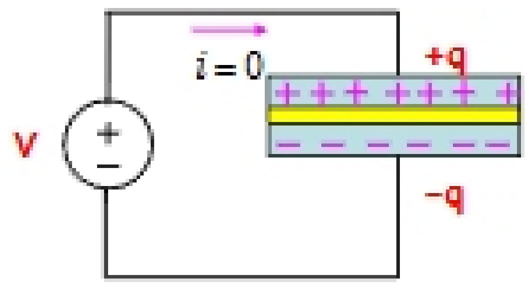
$$C = \frac{\varepsilon A}{d}$$



Connecting Capacitor to voltage source:

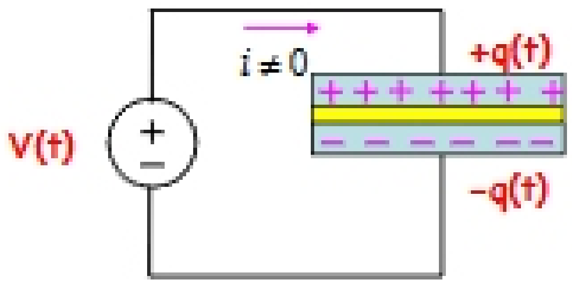
a) V is constant

$$C = \frac{q}{V}$$

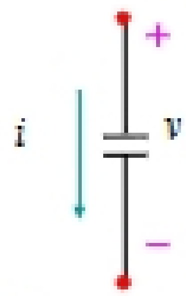


Note : C is constant !

b) $V\,(t)$ is variable



Capacitor symbol:



The (i-v) characteristic:

$C = \frac{q}{V}$ $\qquad q = C\,V$

$$\frac{dq}{dt} = C\,\frac{dv}{dt}$$

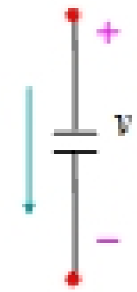
$$i = C\,\frac{dv}{dt}$$

Note: Passive sign convention!

From the above relation the current through the capacitor is proportional to the time rate of change of the voltage across the capacitor

Capacitor (i-v) characteristic:

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



Conclusion (1):

Under steady state , (no variation with time), capacitors are replaced by a open circuit.

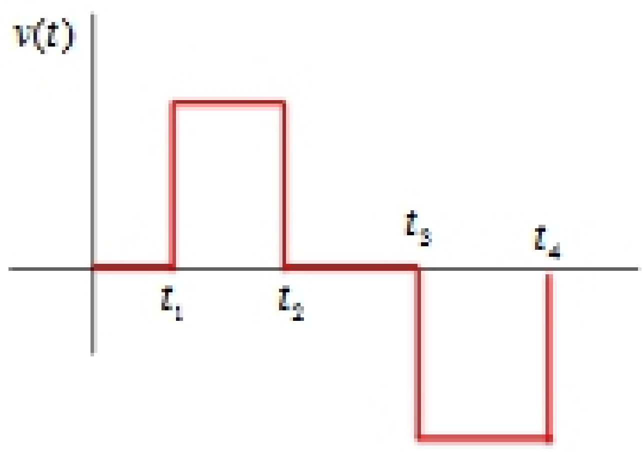
Steady state ⟹ $\frac{dv}{dt} = 0$ ⟹ $i = 0$ ⟹ Open circuit

Conclusion (2):

Capacitor voltage can not change instantaneously.

for $dt \to 0$ ⟹ $i \to \infty$ (impossible)

Voltage across capacitor changes gradually not abruptly!



Capacitor voltage can not change abruptly as shown !!