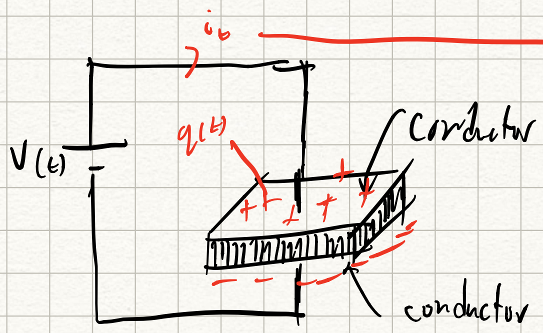
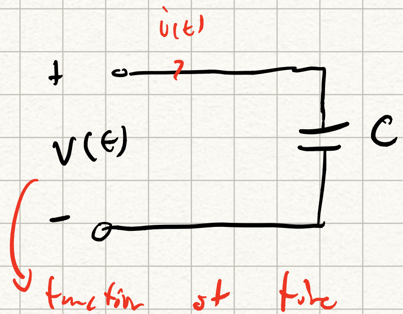
CAPACITOR



there is no current between conductors, but there is always current!

ideal linear capacitor



$$\boxed{q(t) = C\, V(t)}$$

capacitance $\frac{\text{Coulombs}}{\text{volt}}$ = farad (F)

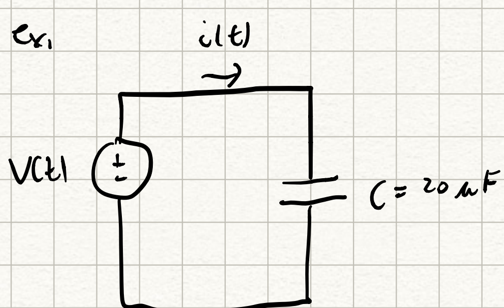
→ how do we compute charge?

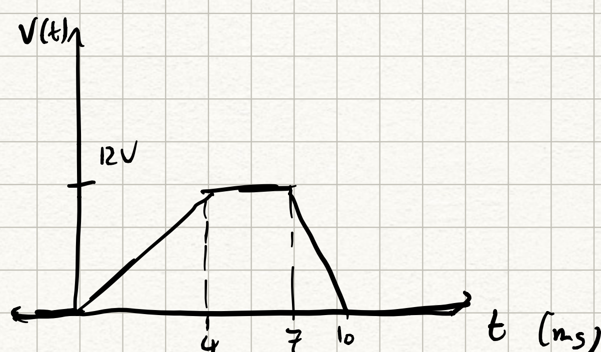
$$\boxed{i(t) = C \frac{dv(t)}{dt}}$$

! if $V(t)$ = constant, $i(t) = 0$.
↳ open circuit!!!!

! $V(t)$ cannot have a jump
→ must be continuous :/
→ derivative not defined
→ physically, can't <u>instantly</u> transfer charge

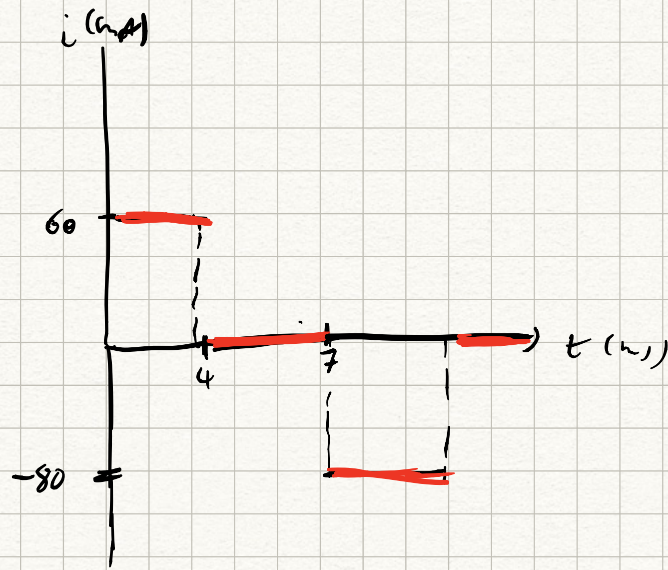
ex.





For $0 \le t < 4$ ms

$$i = (20 \times 10^{-6})\left(\frac{12}{4 \times 10^{-3}}\right) = 60 \text{ mA}$$



For $4 \le t < 7$ ms:

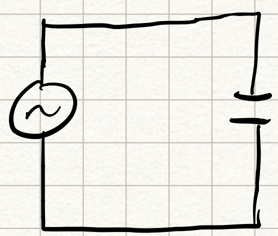
$i = 0$

For $7 \le t < 10$ ms:

$$i = (20 \times 10^{-6})\left(\frac{-12}{3 \times 10^{-3}}\right) = -80 \text{ mA}$$

$$\boxed{V(t) = V(t_0) + \frac{1}{C}\int_{t_0}^{t} i(t)\, dt}$$

CAPACITORS IN AC



$V(t) = V_0 \sin(wt)$ (voltage generator)

$V_c(t) = V_0 \sin(wt)$ (voltage across cap.)

how to find current across capacitor?

$i = \frac{dQ}{dt}$ and $Q = CV$

$i(t) = C\frac{dV}{dt} = \underbrace{CV_0 w}_{I_0} \cos(wt)$

$\phi_I - \phi_V = 0 - (-\frac{\pi}{2}) = \frac{\pi}{2}$

↳ cos and sin always off by $\frac{\pi}{2}$, regardless of w.

capacitive reactance

Since $I_0 = CV_0 w$

$V_0 = \underbrace{\frac{1}{Cw}}_{X_c} I_0$

X_c = capacitive reactance (equiv. to resistance, Ω).

when $w \downarrow$, open circuit. when $w \uparrow$, short circuit.