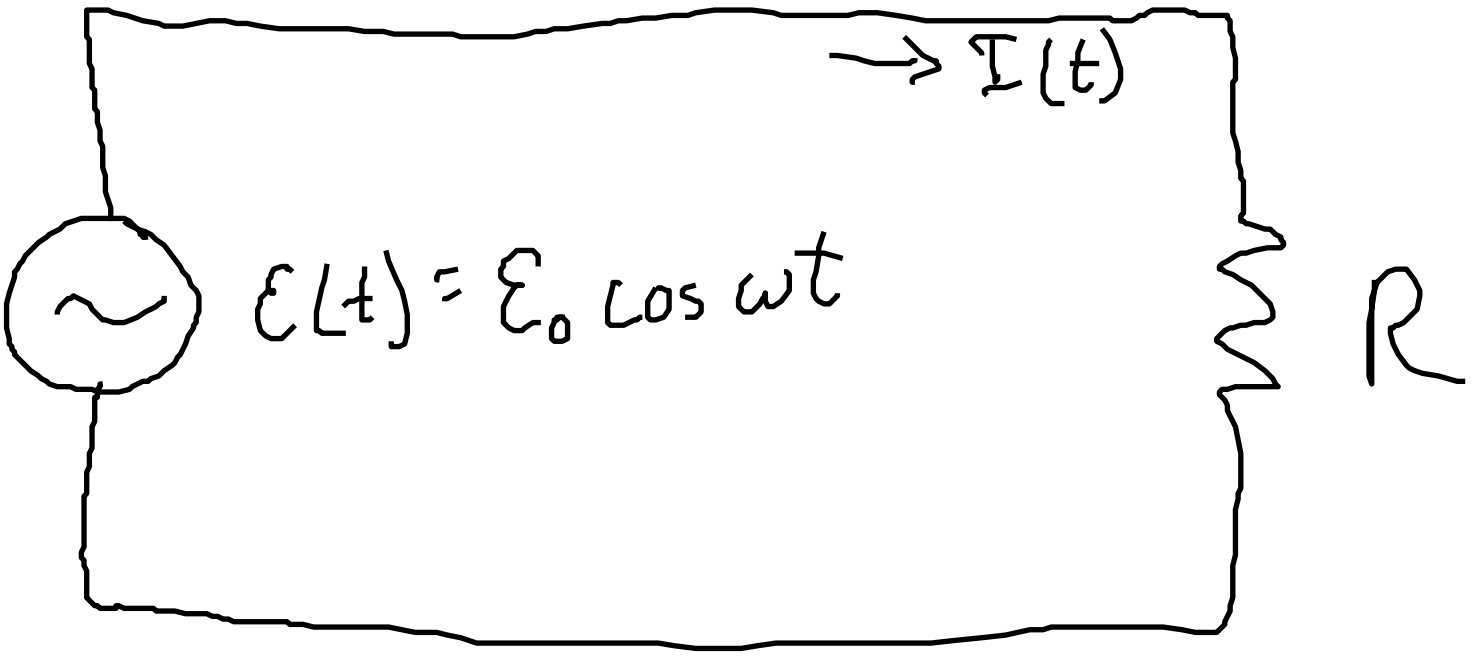
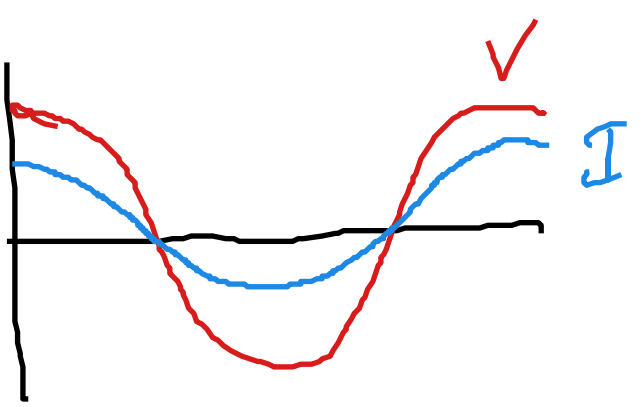
Driven AC Circuits



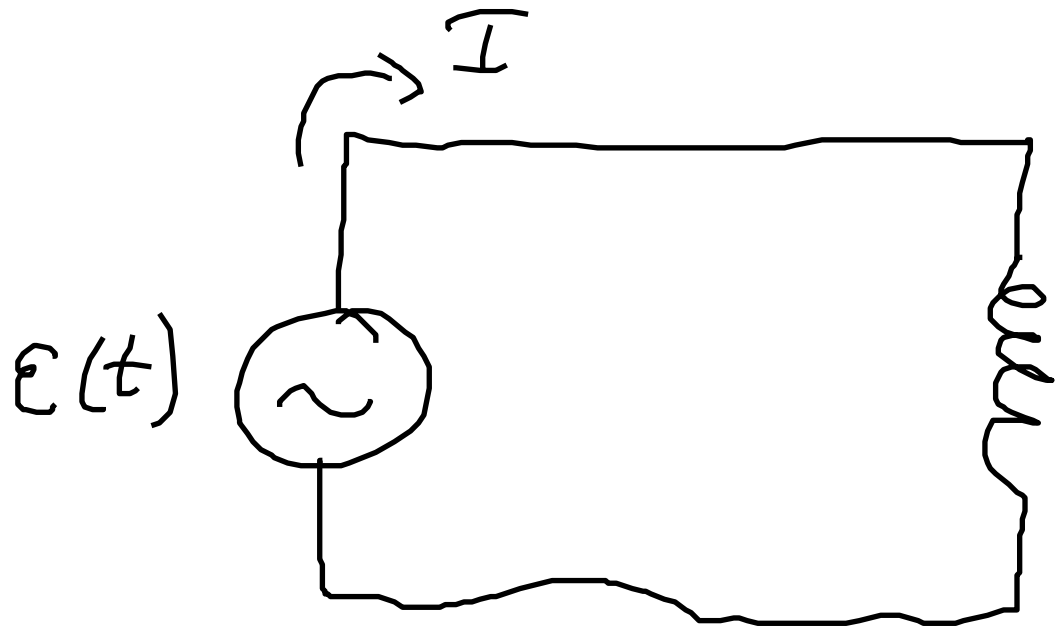
$$\Delta V = I R$$

$$I = \frac{\Delta V}{R}$$

$$I(t) = \frac{\varepsilon_0}{R} \cos \omega t$$



in phase



$$\Delta V = L \frac{dI}{dt}$$

$$\int \varepsilon_0 \cos\omega t = L \frac{dI}{dt} \times dt$$

$$\int \varepsilon_0 \cos\omega t \, dt = \int L \, dI$$

$$\varepsilon_0 \frac{1}{\omega} \sin\omega t = L I$$

$$\frac{\varepsilon_0}{L\omega} \sin\omega t = I(t)$$

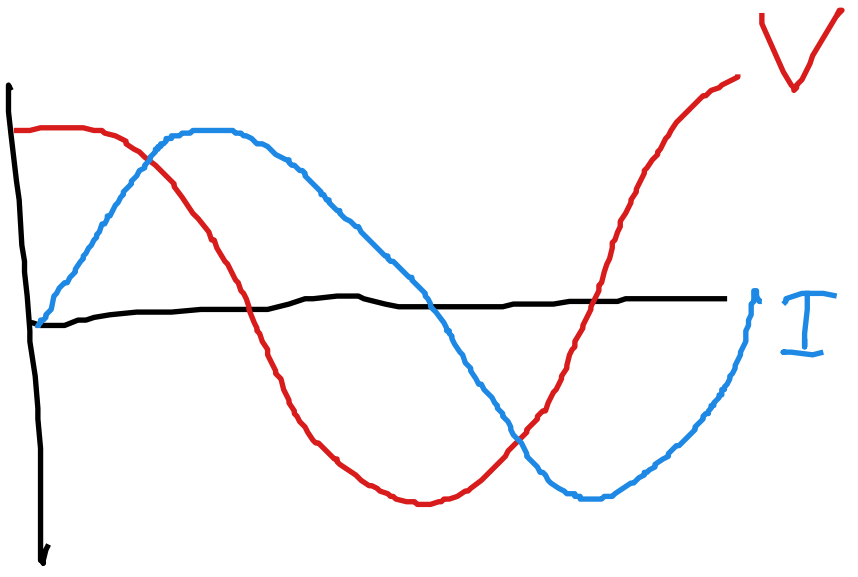
reactance of inductor

$$X_L = L\omega \quad \text{in ohms}$$

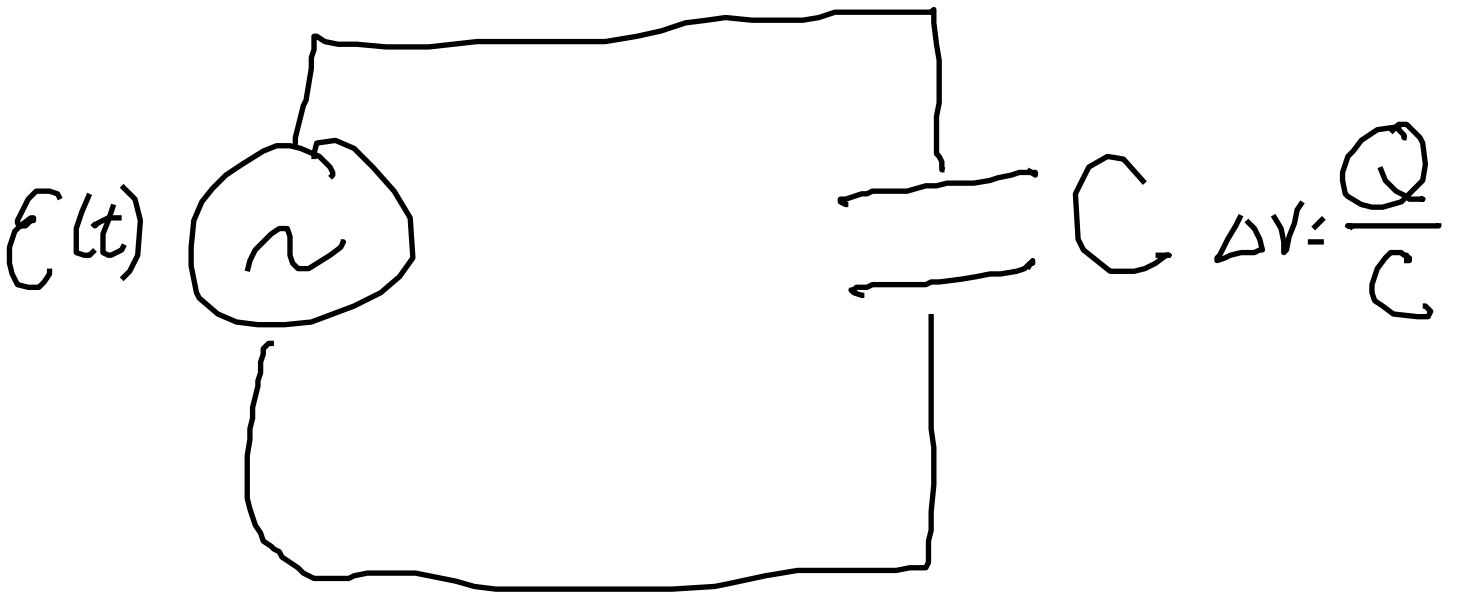
Big X_L, small current

high frequency ω, big X_L,
small current

(L fights harder
against quick changes)



current lags the voltage
out of phase by $\frac{\pi}{2}$



$$\mathcal{E}_0 \cos \omega t = \frac{Q}{C}$$

$$Q = C\mathcal{E}_0 \cos \omega t$$

ignore right now

$$I(t) = \frac{dQ}{dt} = -C\omega \mathcal{E}_0 \sin \omega t$$

reactance of capacitor

$$X_C = \frac{1}{C\omega}$$

$$I(t) = \frac{\mathcal{E}_0}{X_C} \sin \omega t$$

↑ high ω, low reactance

capacitor doesn't fill up