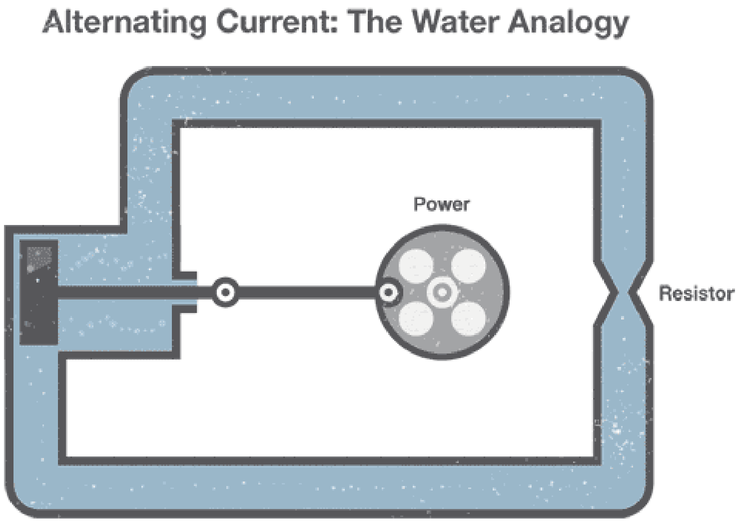


Oscilaciones Forzadas Corriente Alterna

Fuente de CA

R en circuito de CA

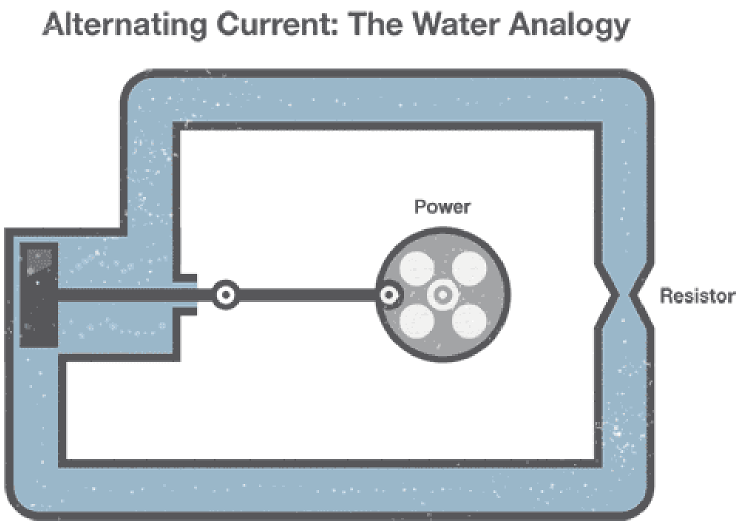
C en circuito de CA

L en circuito de CA

Circuito RLC en alterna

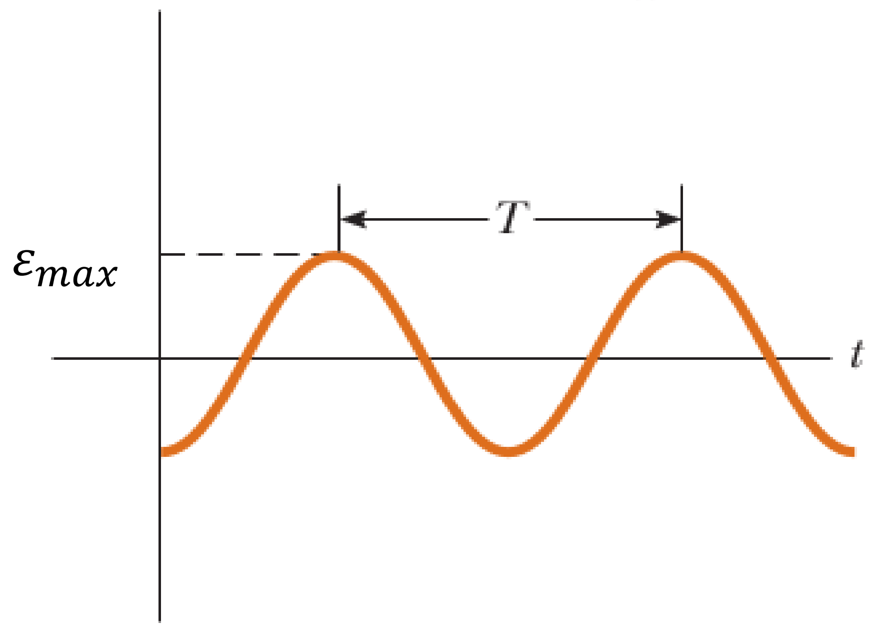
- Impedancia
- Potencia
- Resonancia

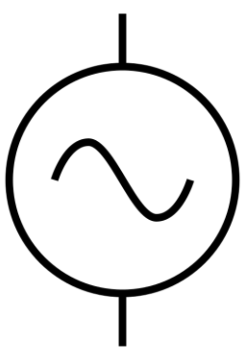
Fuente de CA



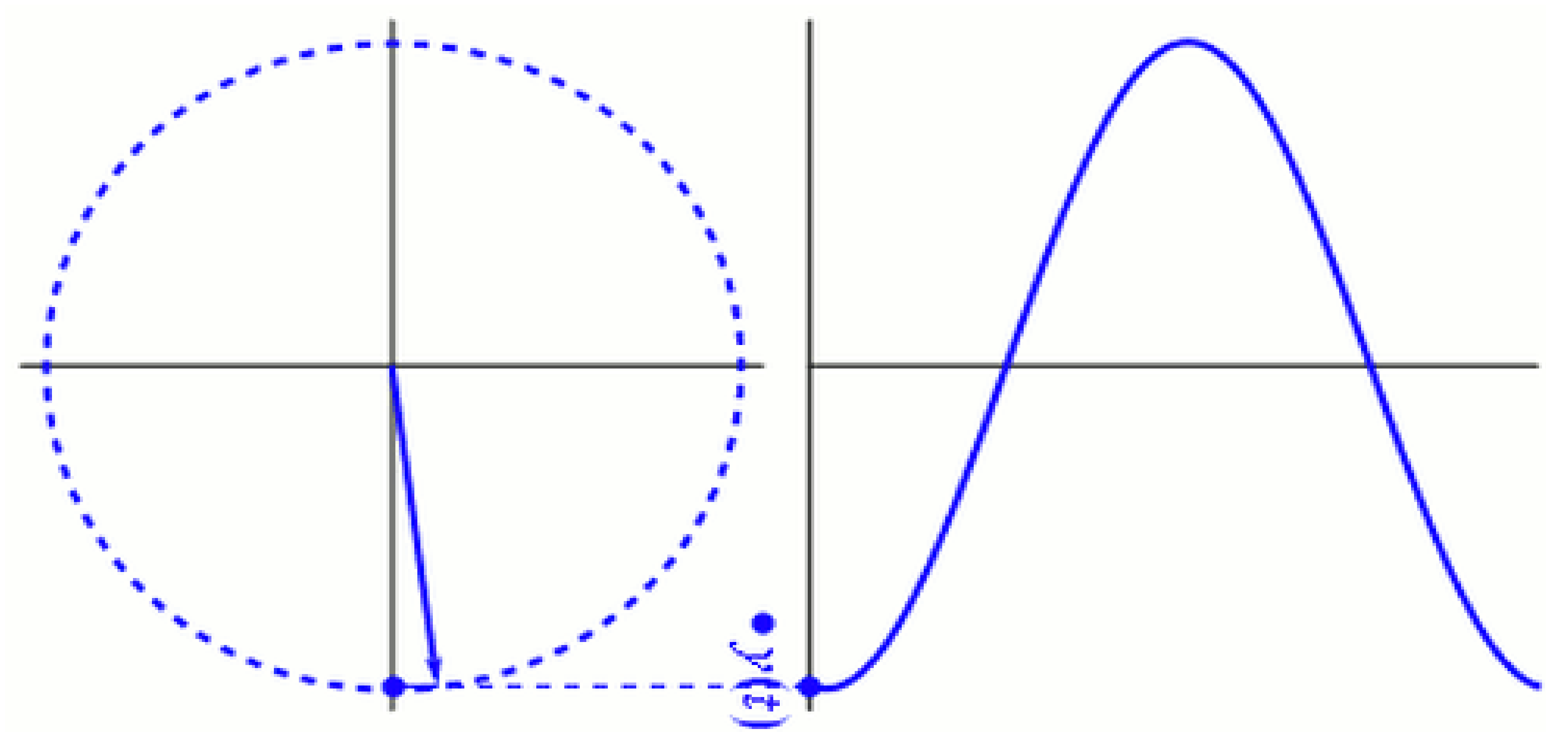
$$\varepsilon(t) = \varepsilon_{max}\, sen(\omega t)$$

$$\omega = 2\pi f = \frac{2\pi}{T}$$



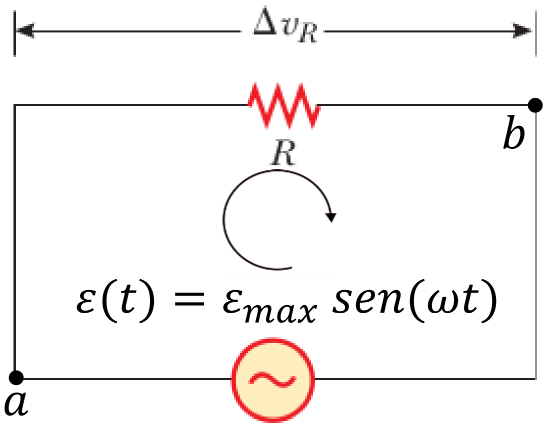


Fasores – Diagrama de Fasores



- Vector que rota en sentido anti-horario.
- Representación abreviada de una función sinusoidal, con una determinada frecuencia
- Su modulo es el valor máximo de la magnitud representada.
- Su componente y da el valor instantáneo de la magnitud.
- 2 magnitudes en fase giran juntas
- Al ángulo de desfasaje es el ángulo entre los 2 vectores

R en circuito de CA

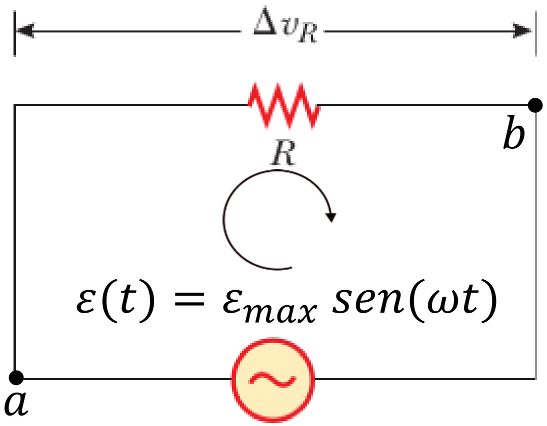


$$(V_a - V_b) + (V_b - V_a) = \varepsilon(t) - iR(t)\, R = 0$$

$$i_R(t) = \frac{\varepsilon(t)}{R} = \frac{\varepsilon_{max}}{R} sen(\omega t) = I_{max}\, sen(\omega t)$$

$$\Delta v_R(t) = iR(t)\, R = I_{max}\, R\, sen(\omega t) = \Delta, max\ sen(\omega t)$$

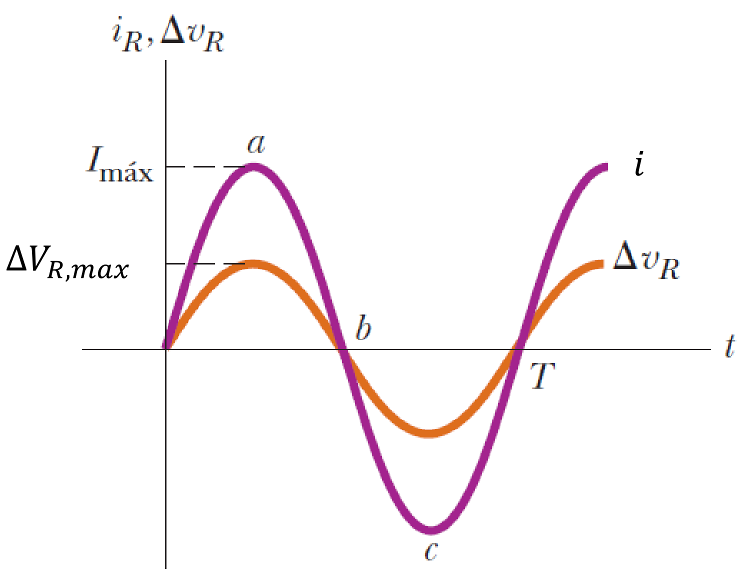
R en circuito de CA

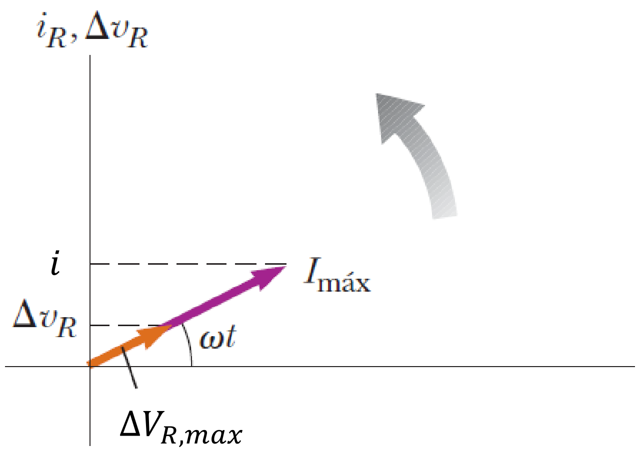


$$\Delta v_R(t) = \Delta V_{R,max}\; sen(\omega t)$$

$$i_R(t) = I_{max}\; sen(\omega t)$$

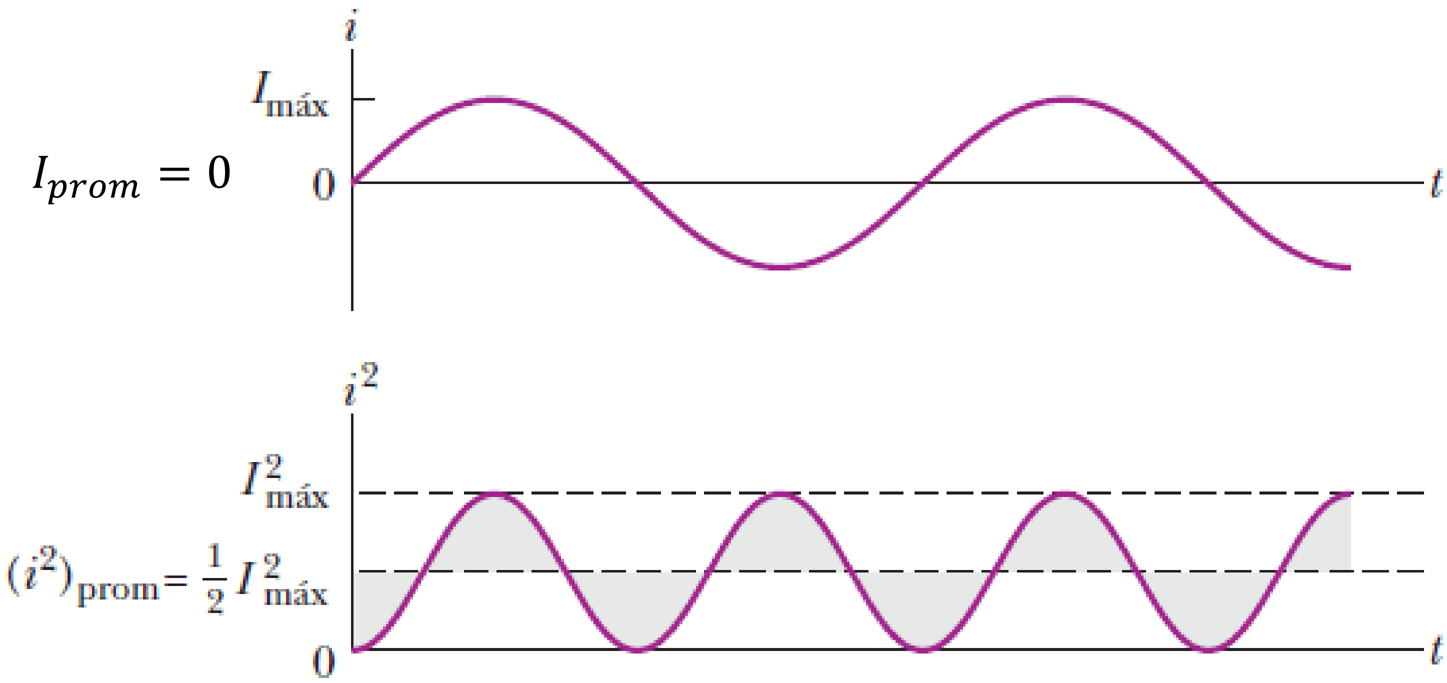
$$\Delta V_{R,max} = I_{max} R$$





Valores eficaces

$I_{prom} = 0$

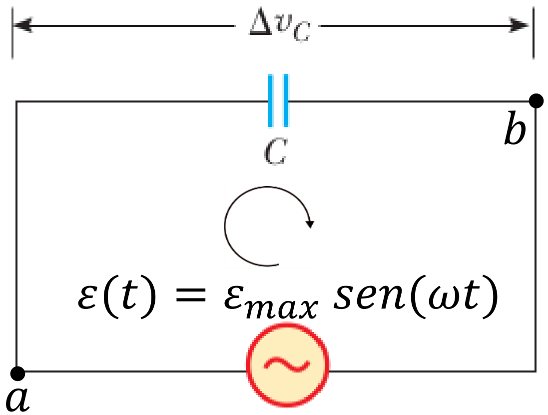


$$I_{ef} = \sqrt{(i^2)_{prom}} = \sqrt{\frac{I_{max}^2}{2}}$$

$$I_{ef} = \frac{I_{max}}{\sqrt{2}}$$

$$\Delta V_{ef} = \frac{\Delta V_{max}}{\sqrt{2}}$$

C en circuito de CA



$$(V_a - V_b) + (V_b - V_a) = \varepsilon(t) - \Delta v_C(t) = 0$$

$$\Delta v_C(t) = \varepsilon_{max} sen(\omega t) = \Delta V_{C,max} sen(\omega t) = \frac{q(t)}{C}$$

$$\text{como: } i_C(t) = \frac{dq}{dt}$$

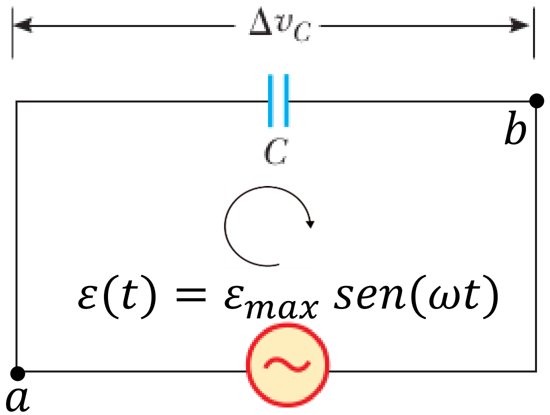
$$i_C(t) = \frac{d}{dt}\left(C\Delta V_{C,max} sen(\omega t)\right) \qquad iC(t) = \boxed{C\omega\Delta V_{C,max}}\cos(\omega \mathrm{t})$$

$$\downarrow I_{max}$$

$$\mathrm{i}_C(t) = I_{max}\ cos(\omega t) = I_{max}\ sen\left(\omega t + \frac{\pi}{2}\right)$$

$$\Delta V_{C,max} = \frac{1}{\omega C} I_{max} = X_C I_{max} \qquad X_C = Reactancia\ capacitiva$$

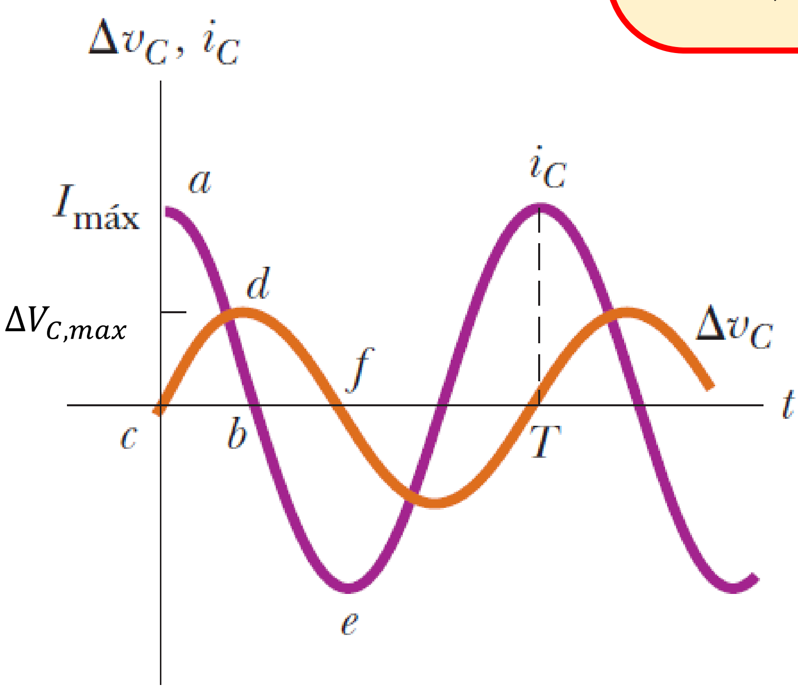
C en circuito de CA

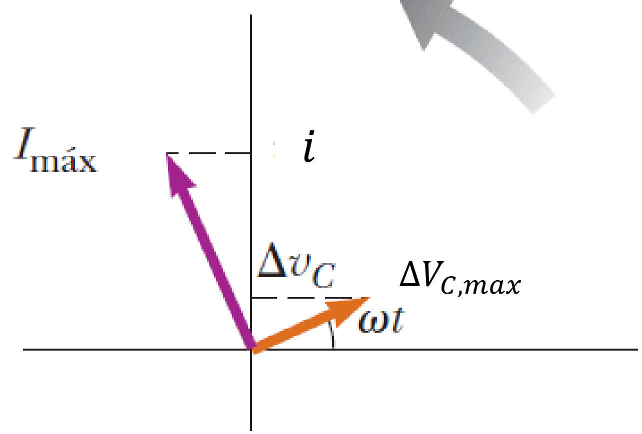


$$\Delta v_C(t) = \Delta V_{C,max} sen(\omega t)$$

$$i_C(t) = I_{max}\, sen\left(\omega t + \frac{\pi}{2}\right)$$

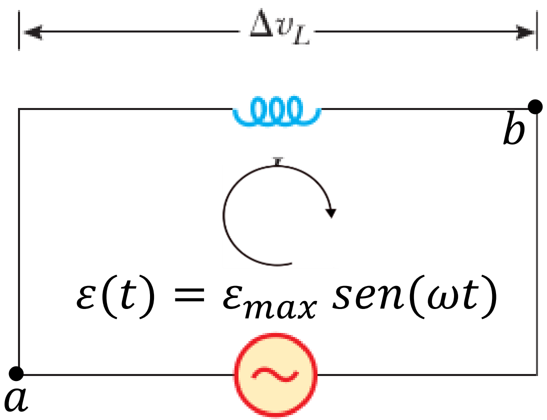
$$\Delta V_{C,max} = I_{max} X_C \quad con \quad X_C = \frac{1}{\omega C}$$





En C, la tensión se atrasa $\frac{\pi}{2}$ respecto a la corriente

L en circuito de CA



$$(V_a - V_b) + (V_b - V_a) = \varepsilon(t) - \Delta v_L(t) = 0$$

$$\Delta v_L(t) = \varepsilon_{max} sen(\omega t) = \Delta V_{L,max} sen(\omega t)$$

$$\Delta v_L(t) = L\frac{di_L}{dt} \quad \Rightarrow \quad \int di_L = \frac{1}{L}\Delta V_{L,max}\int sen(\omega t)dt$$

$$i_L(t) = -\boxed{\frac{\Delta V_{L,max}}{\omega L}}\cos(\omega t)$$

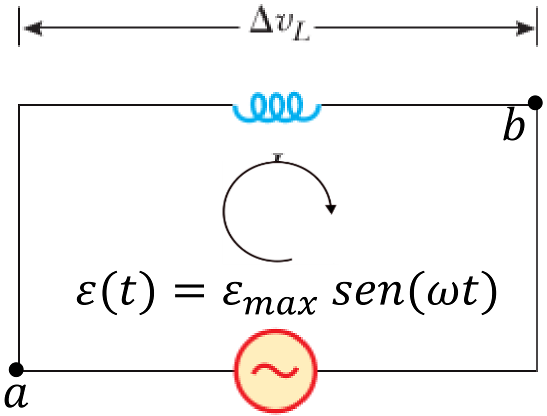
$\boxed{\frac{\Delta V_{L,max}}{\omega L}} \rightarrow I_{max}$

$$\mathrm{i}_L(t) = -I_{max}\, cos(\omega t) = I_{max}\, sen\left(\omega t - \frac{\pi}{2}\right)$$

$$\Delta V_{L,max} = \omega L\, I_{max} = X_L I_{max}$$

$X_L = Reactancia\ inductiva$

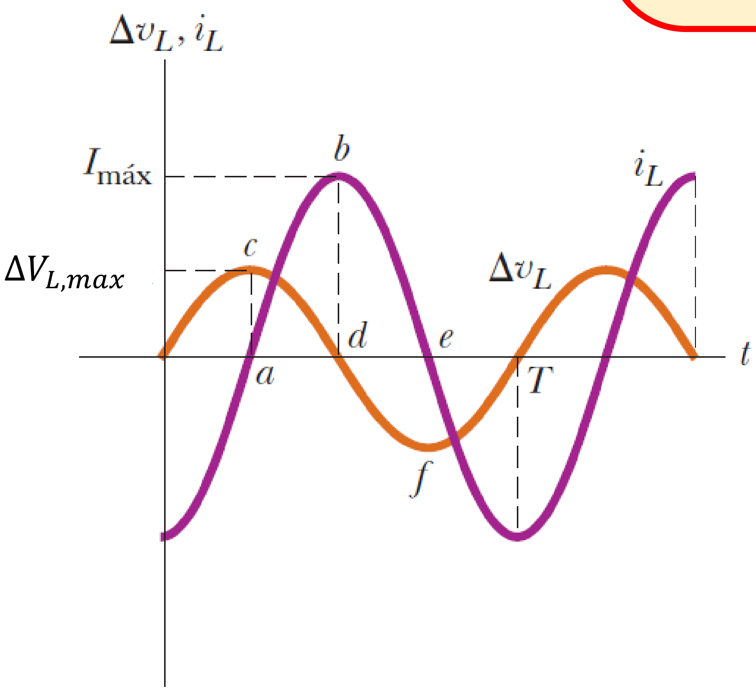
L en circuito de CA

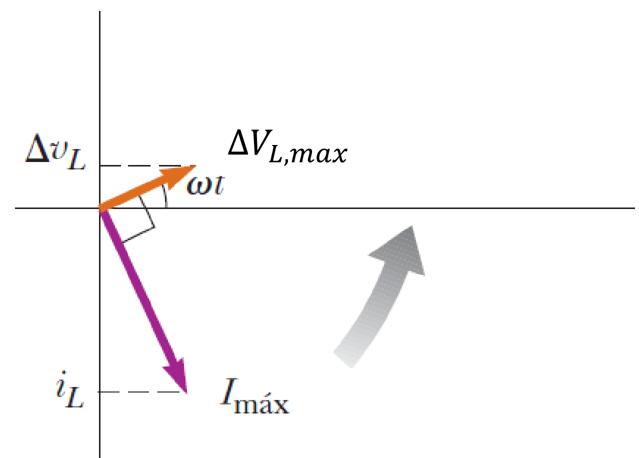


$$\Delta v_L(t) = \Delta V_{L,max} sen(\omega t)$$

$$i_L(t) = I_{max}\, sen\left(\omega t - \frac{\pi}{2}\right)$$

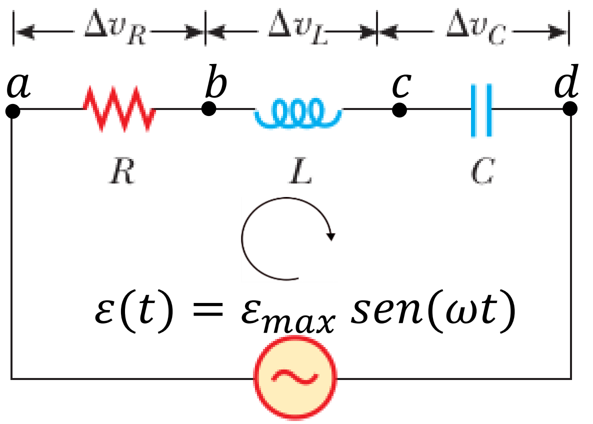
$$\Delta V_{L,max} = I_{max} X_L \quad con \quad X_L = \omega L$$

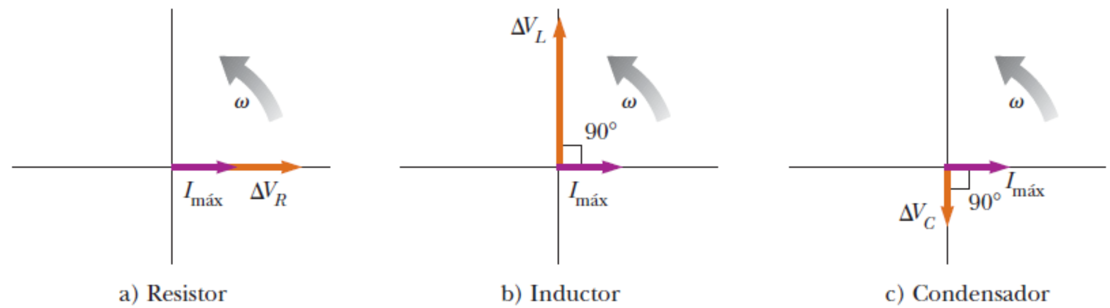




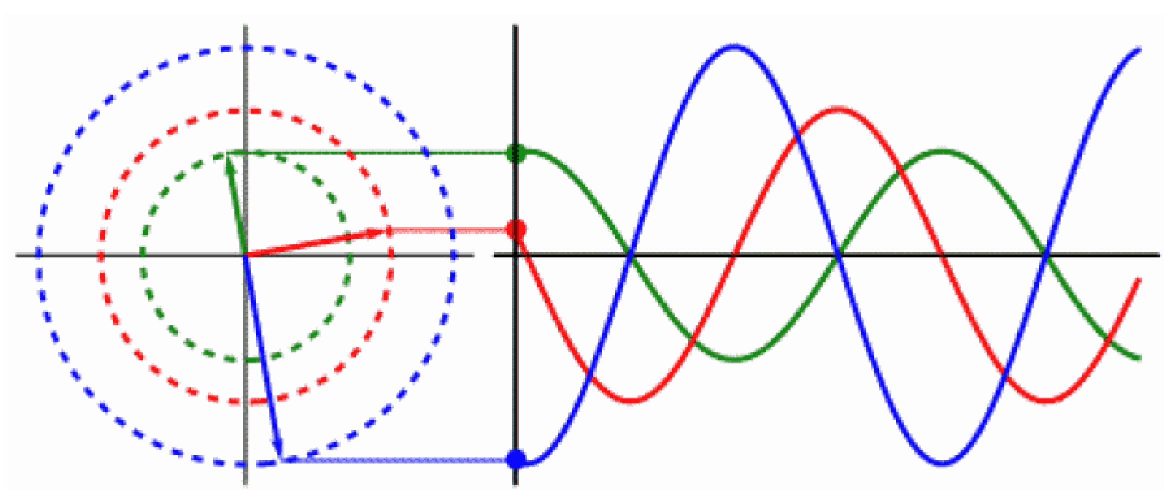
En L, la tensión se adelanta $\frac{\pi}{2}$ respecto a la corriente.

Circuito RLC en CA





$$(V_a - V_d) + (V_b - V_a) + (V_c - V_b) + (V_d - V_c) = 0$$
$$\varepsilon(t) - \Delta v_R(t) - \Delta v_L(t) - \Delta v_C(t) = 0$$
$$\varepsilon(t) = \Delta v_R(t) + \Delta v_L(t) + \Delta v_C(t)$$

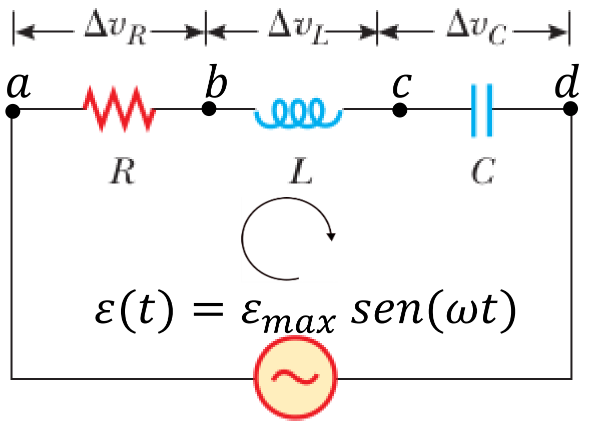


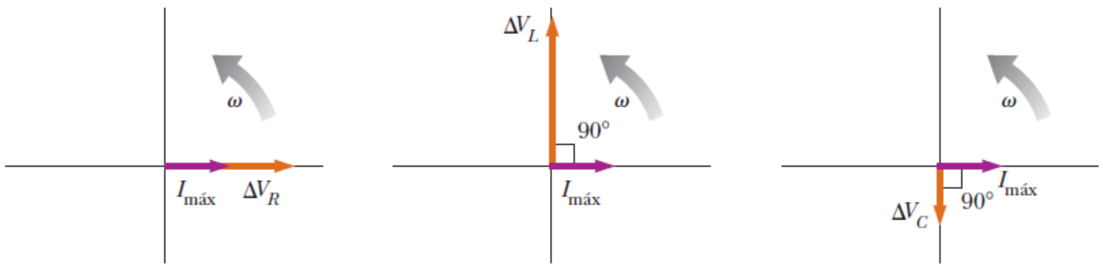
Δv_L

Δv_R

Δv_C

Circuito RLC en CA





a) Resistor b) Inductor c) Condensador

$$\varepsilon(t) = \varepsilon_{max}\ sen(\omega t)$$

$$\Delta v_R(t) = \Delta v_{R,max}\ sen(\omega t) \rightarrow \Delta v_{R,max} = I_{max}R$$

$$\Delta v_L(t) = \Delta V_{L,max}\ sen\left(\omega t + \frac{\pi}{2}\right) \rightarrow \Delta v_{C,max} = I_{max}X_L$$

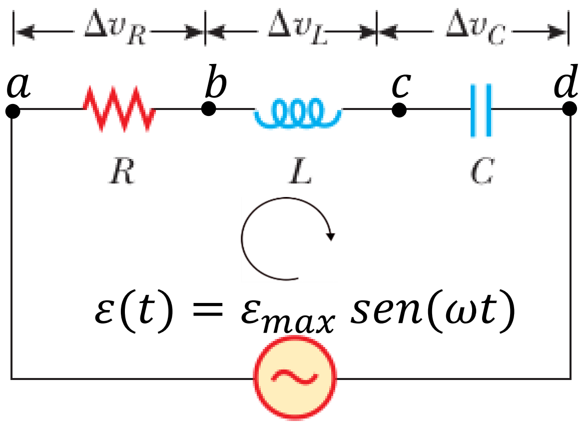
$$\Delta v_C(t) = \Delta V_{C,max}\ sen\left(\omega t - \frac{\pi}{2}\right) \rightarrow \Delta v_{L,max} = I_{max}X_C$$

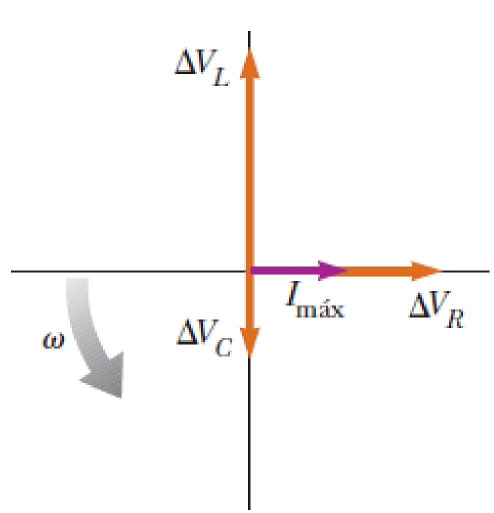
$$i(t) = I_{max}sen(\omega t + \phi)$$

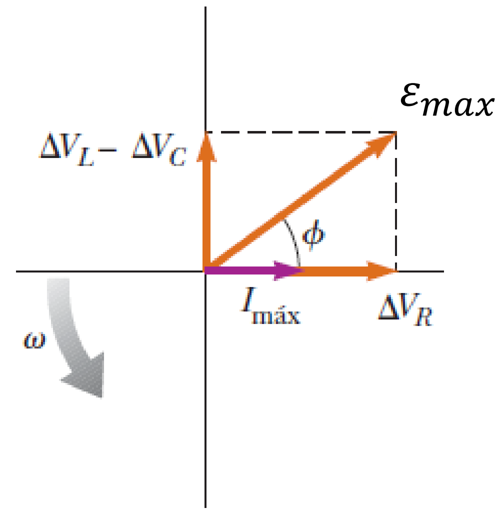
$$I_{max} = ?$$
$$\phi = ?$$

La corriente $i(t)$ va a ser la misma en todos los elementos, ya que están en serie.

Circuito RLC en CA - Impedancia







$$\varepsilon_{max} = \sqrt{\left(\Delta V_{R,max}\right)^2 + \left(\Delta V_{L,max} - \Delta V_{C,max}\right)^2} = \sqrt{(I_{max}R)^2 + (I_{max}X_L - I_{max}X_C)^2}$$

$$\varepsilon_{max} = I_{max}\sqrt{R^2 + (X_L - X_C)^2}$$

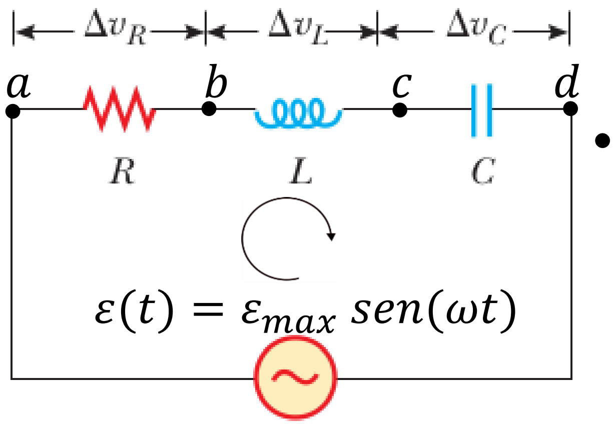
$$Z = \sqrt{R^2 + (X_L - X_C)^2} = Impedancia$$

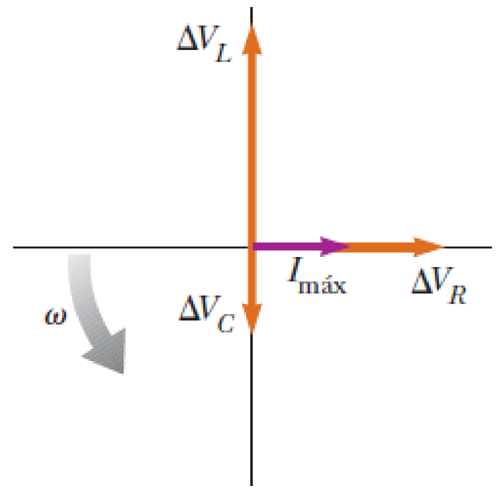
$$I_{max} = \frac{\varepsilon_{max}}{Z}$$

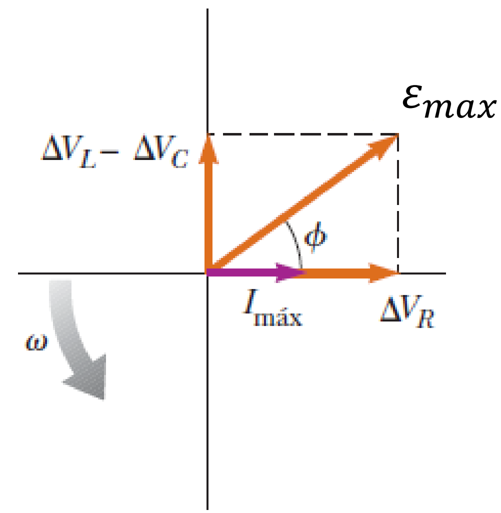
o

$$I_{ef} = \frac{\varepsilon_{ef}}{Z}$$

Circuito RLC en CA – Angulo ϕ







$$\tan(\phi) = \frac{\Delta V_{L,max} - \Delta V_{C,max}}{\Delta V_{R,max}} = \frac{I_{max}X_L - I_{max}X_C}{I_{max}R} = \frac{X_L - X_C}{R}$$

$$\phi = tan^{-1}\left(\frac{X_L - X_C}{R}\right)$$

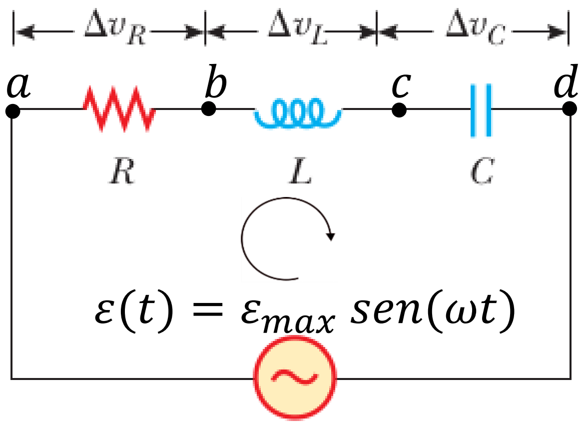
De esta forma ϕ esta definido desde la corriente hacia la tension

$\phi > 0 \Rightarrow X_L > X_C$ → Circuito Inductivo

$\phi < 0 \Rightarrow X_L < X_C$ → Circuito Capacitivo

$\phi = 0 \Rightarrow X_L = X_C$ → Circuito totalmente Resistivo o en Resonancia

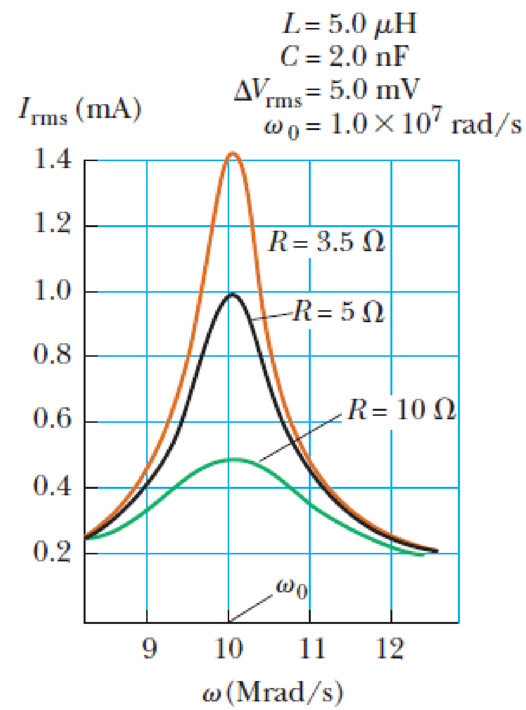
Circuito RLC en CA en resonancia



$$\varepsilon(t) = \varepsilon_{max}\ sen(\omega t)$$

Circuito en resonancia:

$$X_L = X_C$$
$$\Delta V_{L,max} = \Delta V_{C,max}$$
$$\phi = 0$$
$$Z = R$$



Resonancia:

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

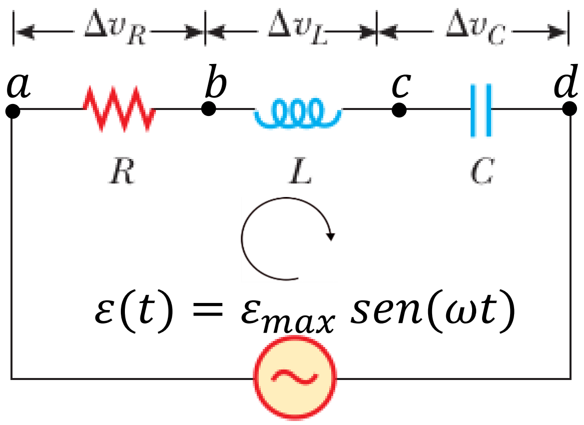
$$Cambiando\ L \ \rightarrow \ L = \frac{1}{\omega^2 C}$$

$$Cambiando\ C \ \rightarrow \ C = \frac{1}{\omega^2 L}$$

$$Cambiando\ \omega \ \rightarrow \ \omega_0 = \frac{1}{\sqrt{LC}}$$

Frecuencia de resonancia

Circuito RLC - Potencia



L y C no disipan energía, solo la almacenan y la devuelven.

Potencias instantáneas:

$$P_\varepsilon(t) = \varepsilon(t) i(t)$$

$$P_R(t) = \Delta v_R(t) i(t)$$

No es practico su uso

Lo conveniente es el uso de los valores promedio de potencia en termino de los valores eficaces de corriente y tensión

$$\overline{P_R} = R\frac{I_{max}^2}{2}$$

$$\overline{P_\varepsilon} = \frac{\varepsilon_{max} I_{max}}{2} cos(\phi)$$

$$\overline{P_R} = R I_{ef}^2 \qquad \overline{P_L} = 0$$

$$\overline{P_\varepsilon} = \varepsilon_{ef} I_{ef}\ cos(\phi) \qquad \overline{P_C} = 0$$

$$\cos(\phi) = \frac{R}{Z}$$