Física IV

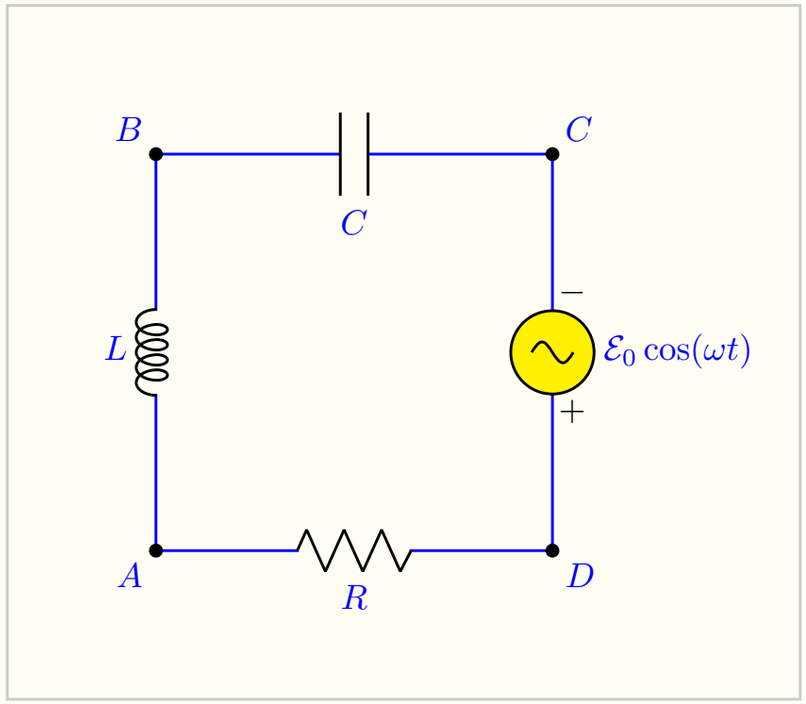
15 setembro 2020

Circuitos de Corrente Alternada

Ressonância

Circuitos de corrente alternada
Corrente no regime estacionário

$$I(t) = ?$$



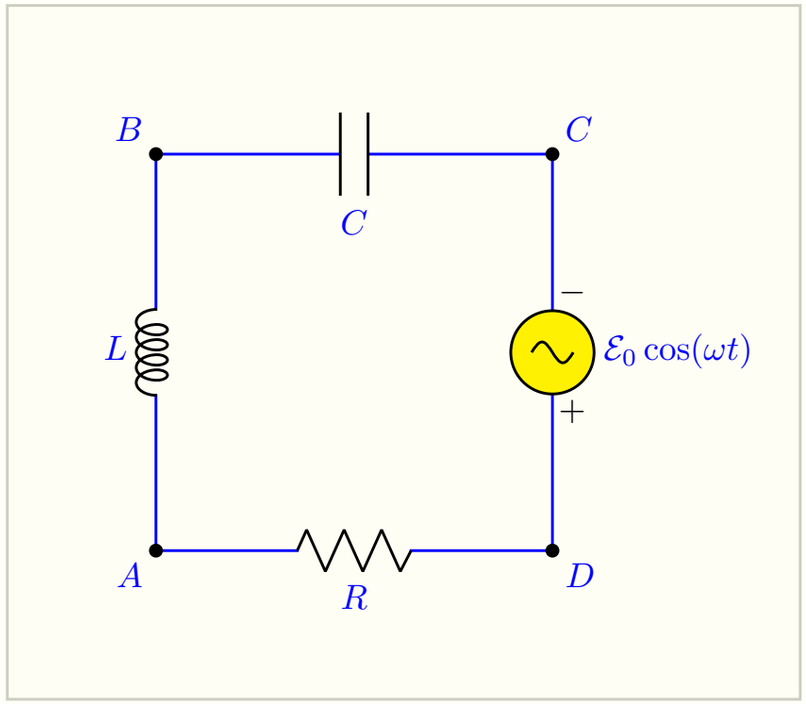
$$Z_L = i\omega L$$

$$Z_R = R$$

$$Z_C = \frac{1}{i\omega C}$$

Circuitos de corrente alternada
Corrente no regime estacionário

$$I(t) = ?$$



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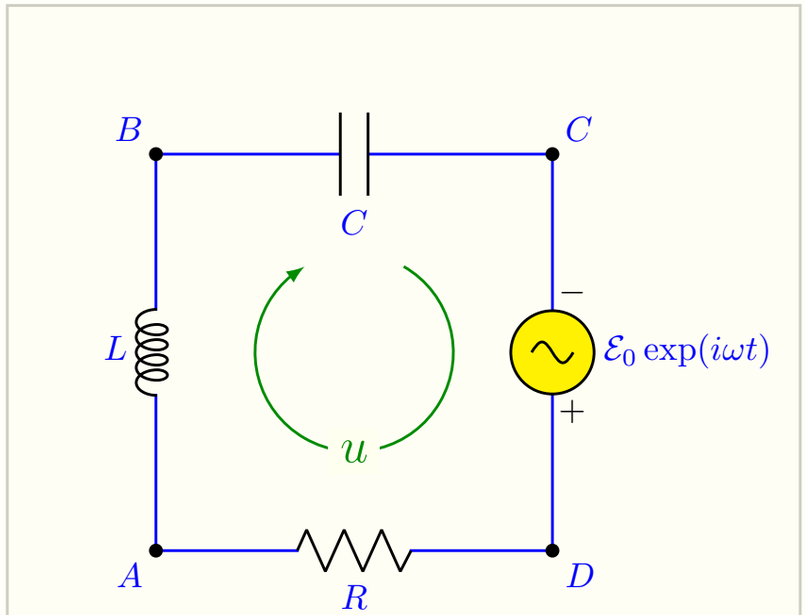
Circuitos de corrente alternada
Corrente no regime estacionário

$$I(t) = \Re u$$



$$Z_L = i\omega L$$

$$Z_R = R$$

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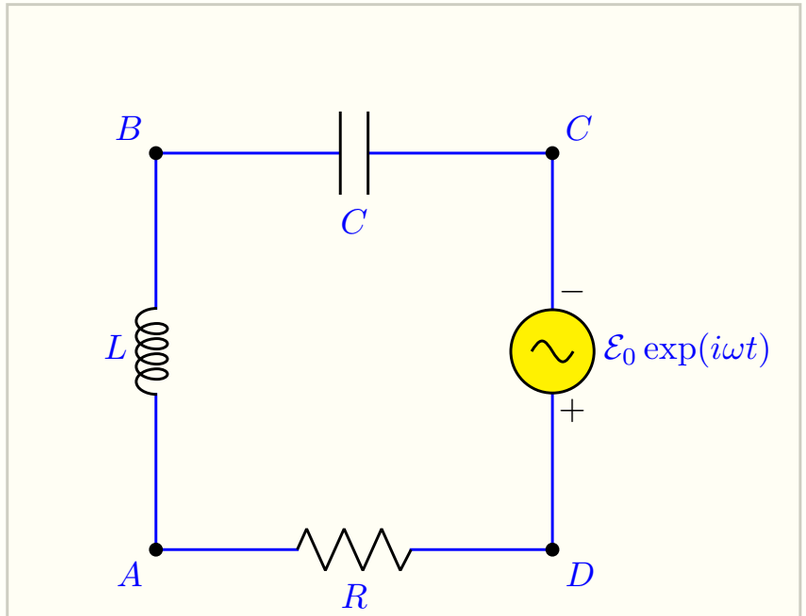
Circuitos de corrente alternada
Corrente no regime estacionário

$$I(t) = ?$$

$$-i\omega L u - \frac{u}{i\omega C} + \mathscr{E}_0 \exp(i\omega t) - Ru = 0$$



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Circuitos de corrente alternada
Corrente no regime estacionário

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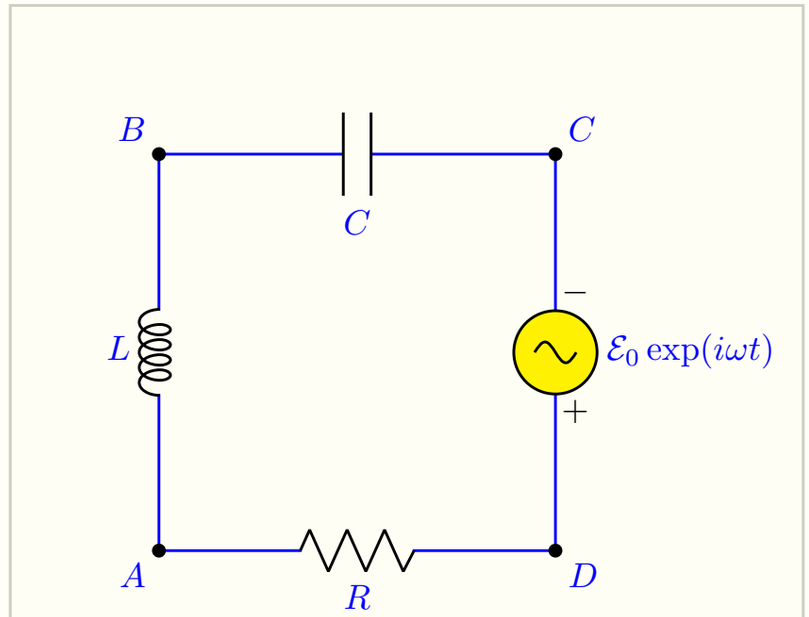

$$-i\omega L u - \frac{u}{i\omega C} + \mathscr{E}_0 \exp(i\omega t) - Ru = 0$$

$$i\omega L u + \frac{u}{i\omega C} + Ru = \mathscr{E}_0 \exp(i\omega t)$$

Circuitos de corrente alternada
Corrente no regime estacionário

$$I(t) = ?$$

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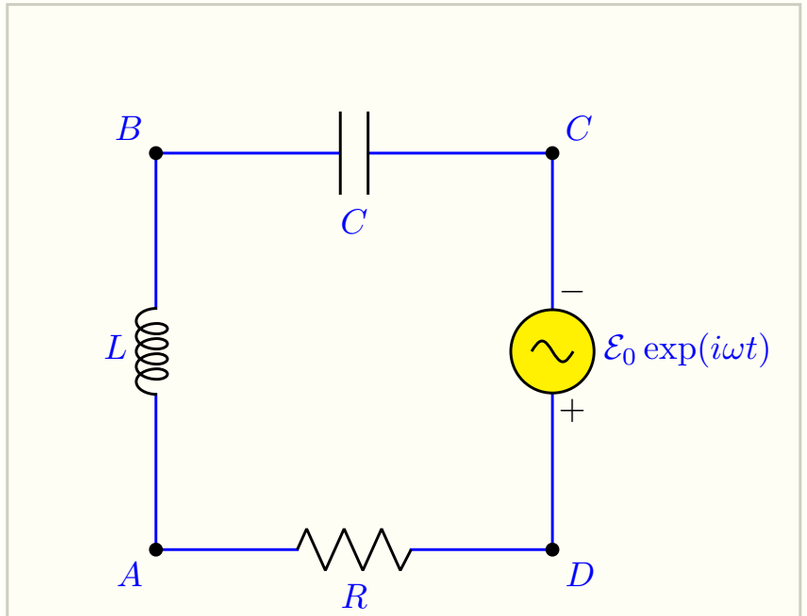
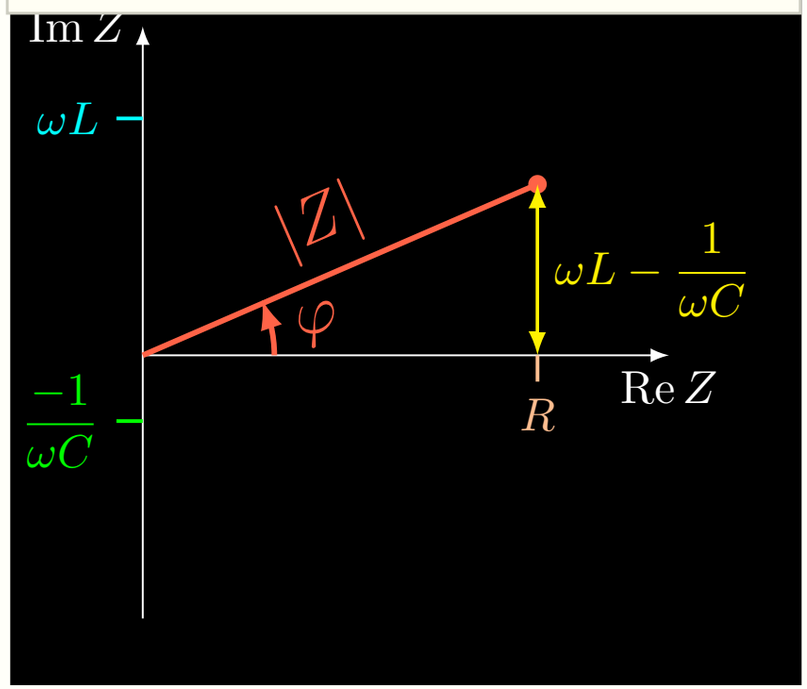
$$u = \mathscr{E}_0 \frac{\exp(i\omega t)}{i\omega L + \dfrac{1}{i\omega C} + R}$$





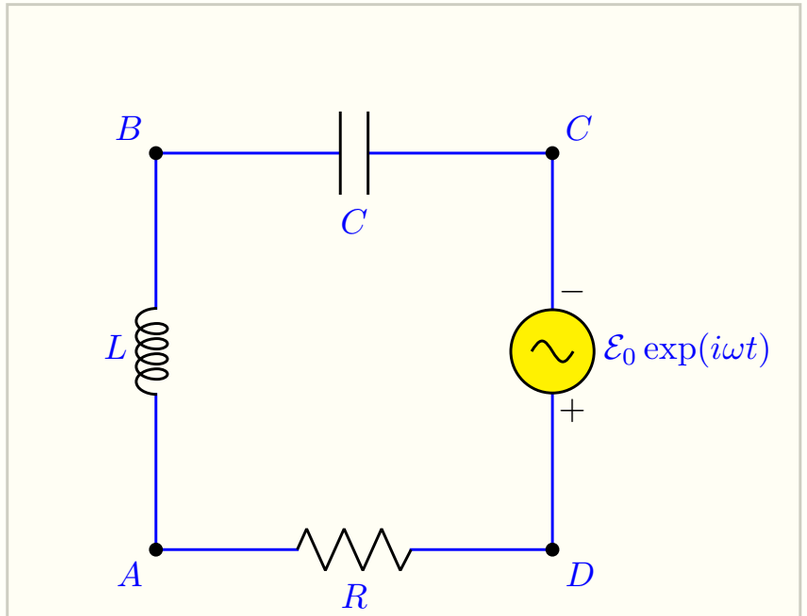
Circuitos de corrente alternada
Corrente no regime estacionário

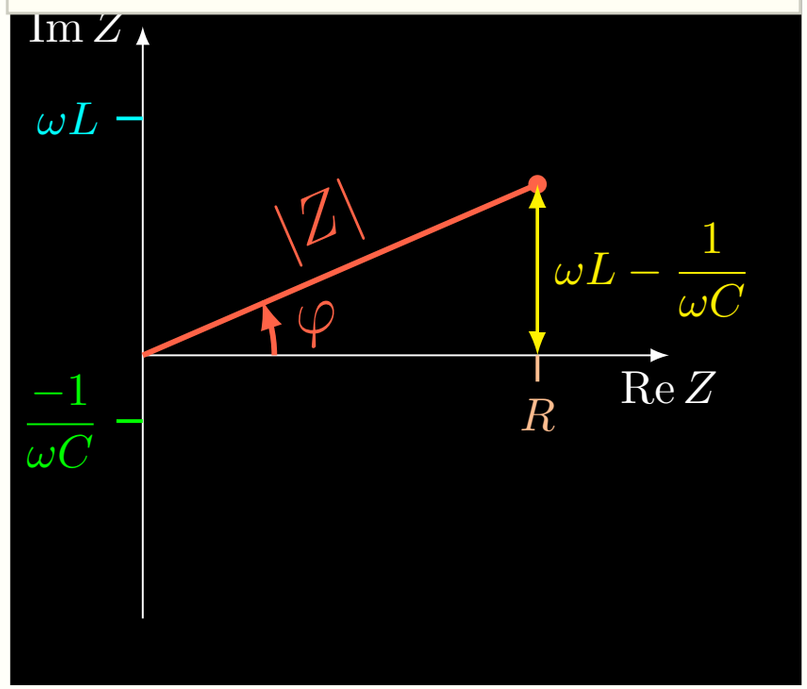
$$I(t) = ?$$

$$-i\omega L u - \frac{u}{i\omega C} + \mathscr{E}_0 \exp(i\omega t) - Ru = 0$$

$$i\omega L u + \frac{u}{i\omega C} + Ru = \mathscr{E}_0 \exp(i\omega t)$$

$$u = \mathscr{E}_0 \frac{\exp(i\omega t)}{|Z| \exp(i\varphi)}$$





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Corrente no regime estacionário

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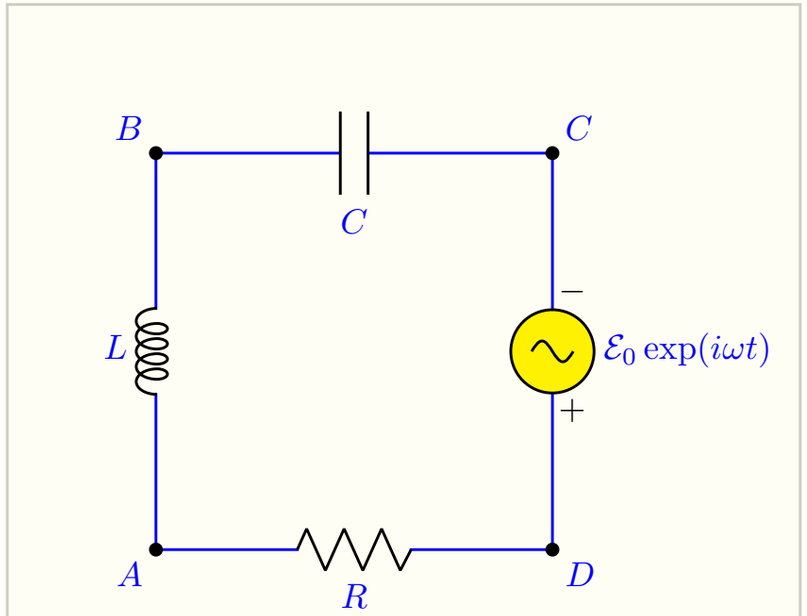
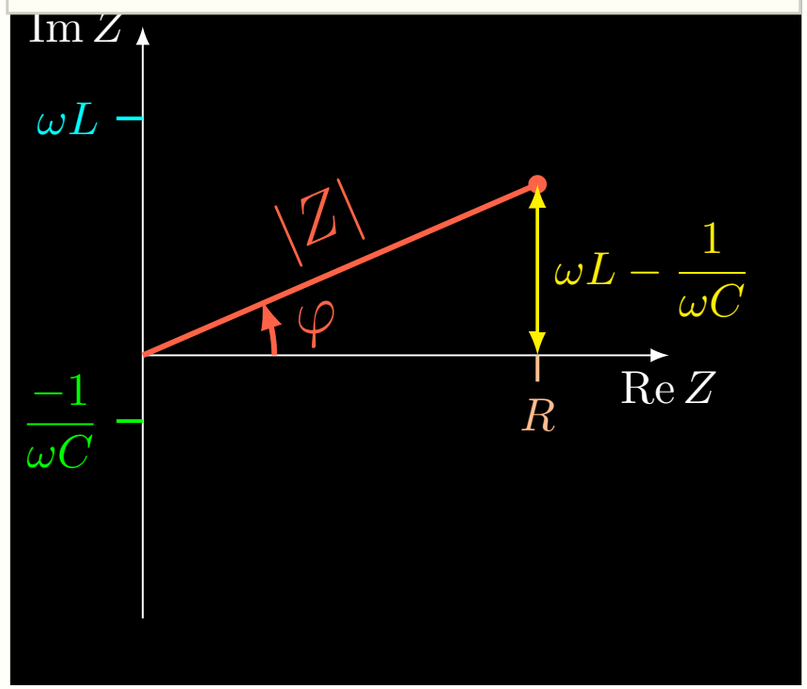
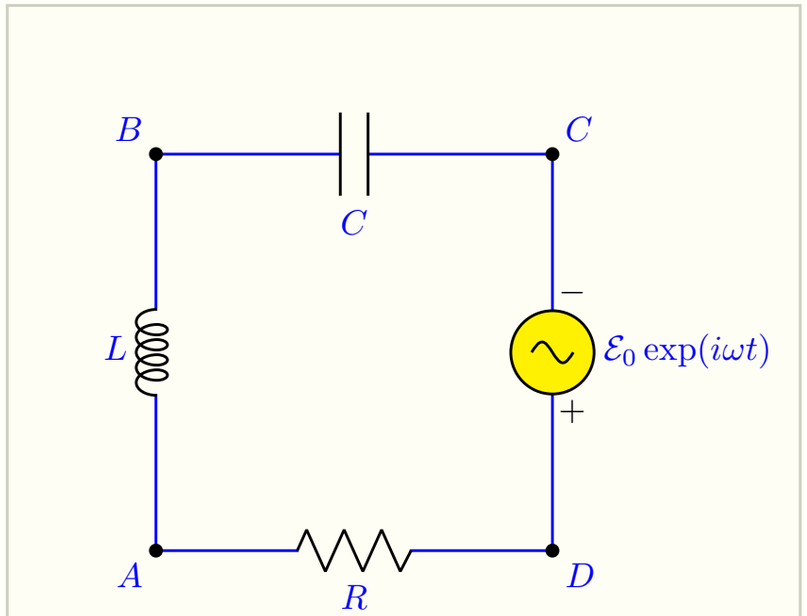


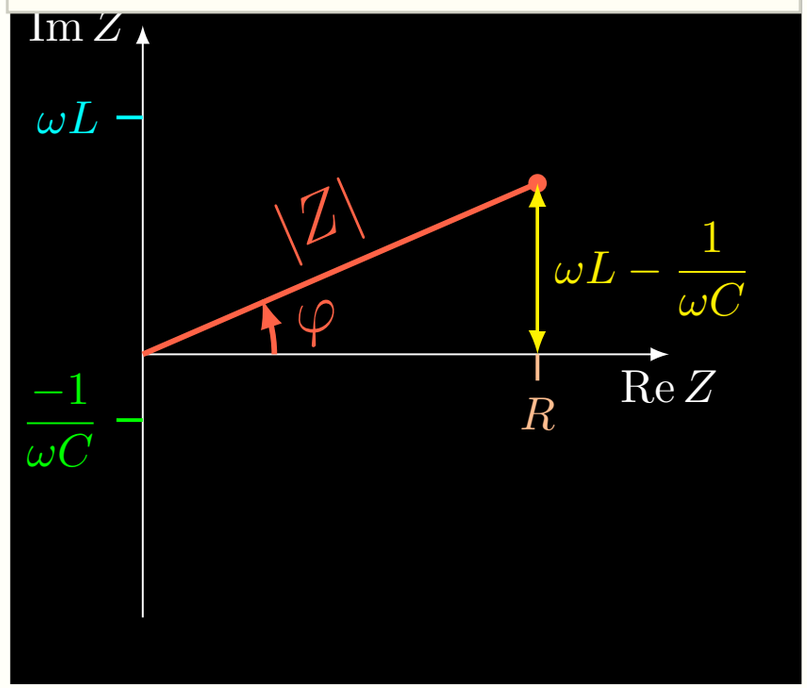


Circuitos de corrente alternada
Corrente no regime estacionário

$$I(t) = \Re u(t)$$

$$u = \mathscr{E}_0 \frac{\exp\Big(\, i(\omega t - \varphi)\Big)}{|Z|}$$



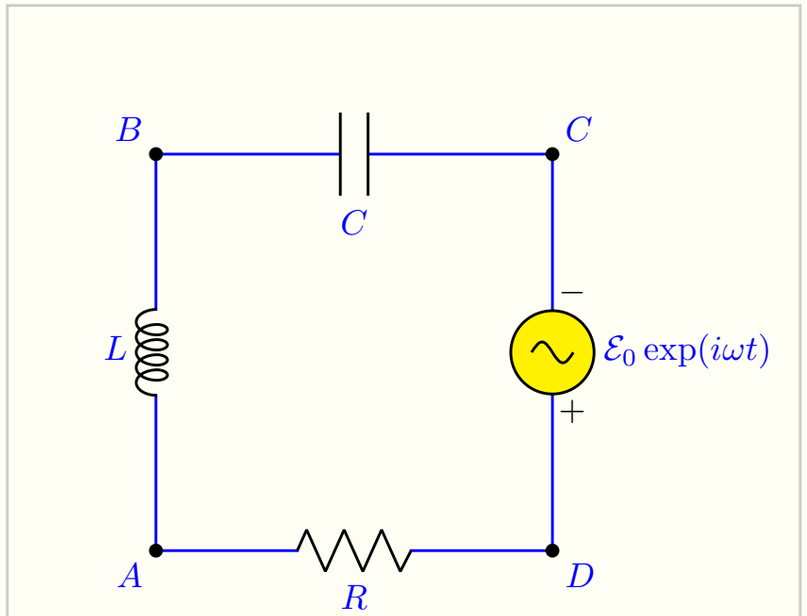


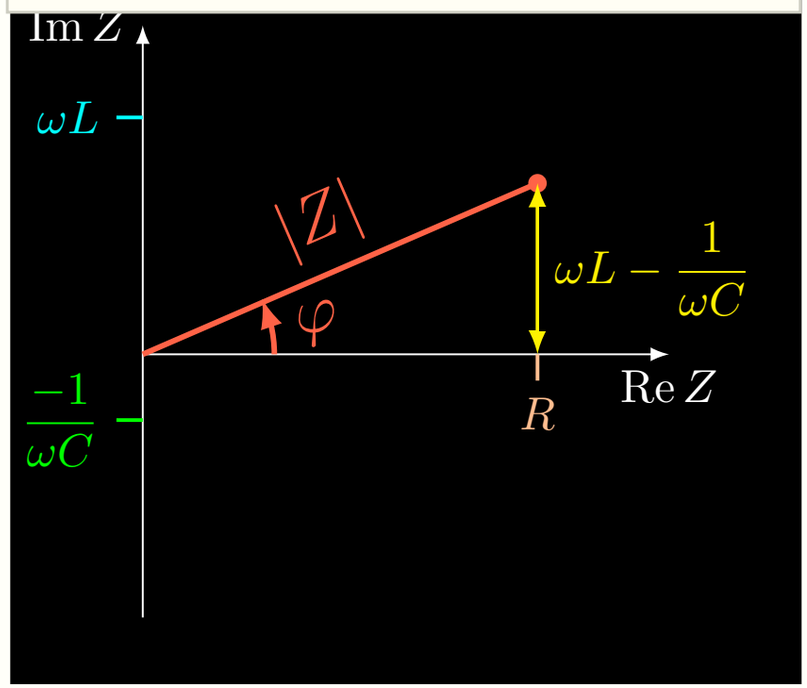
Circuitos de corrente alternada
Corrente no regime estacionário

$$I(t) = \Re u(t)$$

$$u = \mathscr{E}_0 \frac{\exp\Big(\, i(\omega t - \varphi)\Big)}{|Z|}$$

$$I(t) = \frac{\mathscr{E}_0}{|Z|} \cos(\omega t - \varphi)$$





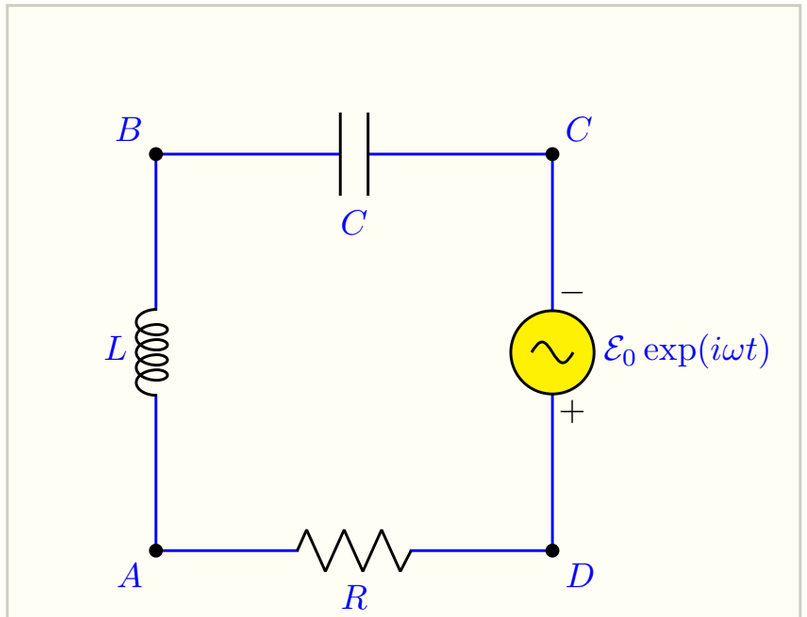
Circuitos de corrente alternada
Corrente no regime estacionário

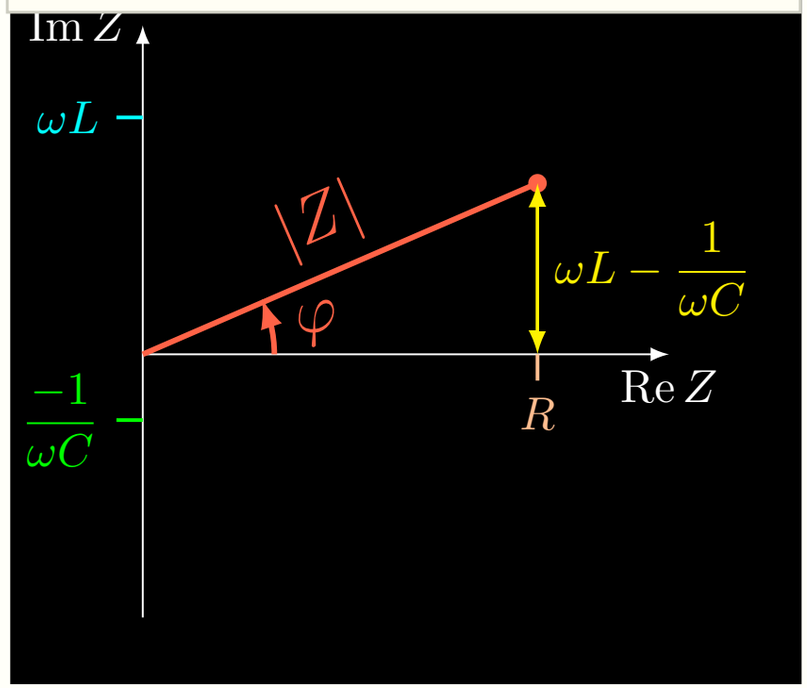
$$I(t) = \Re u(t)$$

$$u = \mathscr{E}_0 \frac{\exp\Big(\, i(\omega t - \varphi)\Big)}{|Z|}$$

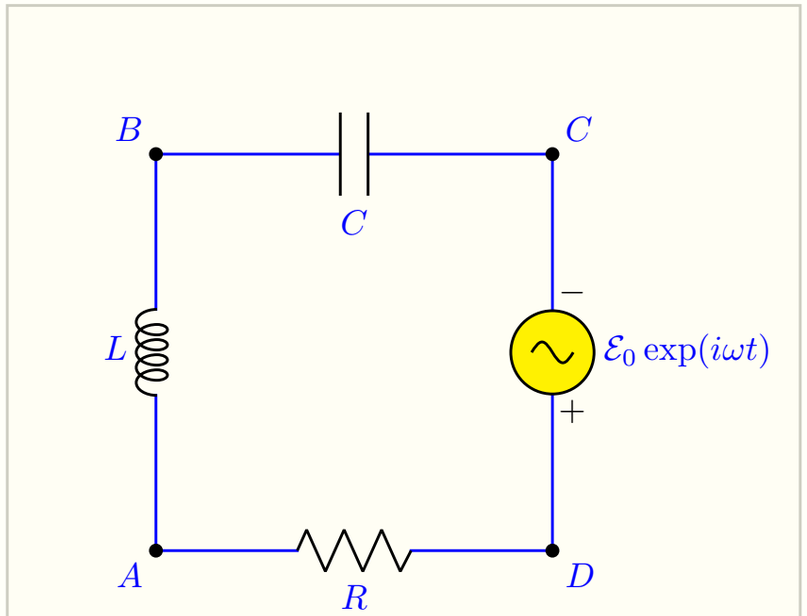
$$I(t) = \frac{\mathscr{E}_0}{|Z|}\cos(\omega t - \varphi)$$

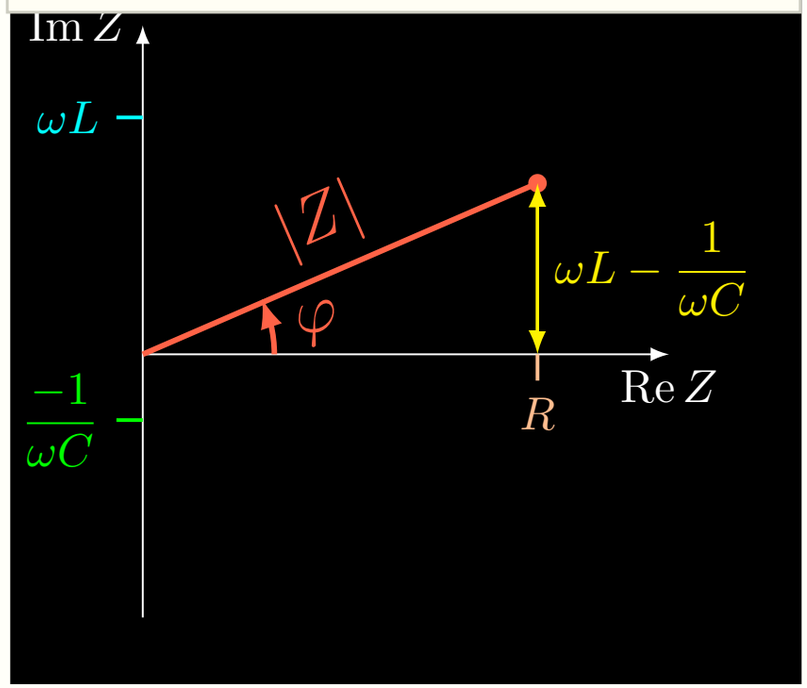
$$I(t) = \frac{\mathscr{E}_0}{|Z|}\Big(\cos(\omega t)\cos(\varphi) + \sin(\omega t)\sin(\varphi)\Big)$$





Circuitos de corrente alternada
Corrente no regime estacionário





$$I(t) = \frac{\mathscr{E}_0}{|Z|}\Big(\cos(\omega t)\cos(\varphi) + \sin(\omega t)\sin(\varphi)\Big)$$

Circuitos de corrente alternada
Corrente no regime estacionário

$$I(t) = \frac{\mathscr{E}_0}{|Z|}\cos(\omega t - \varphi)$$

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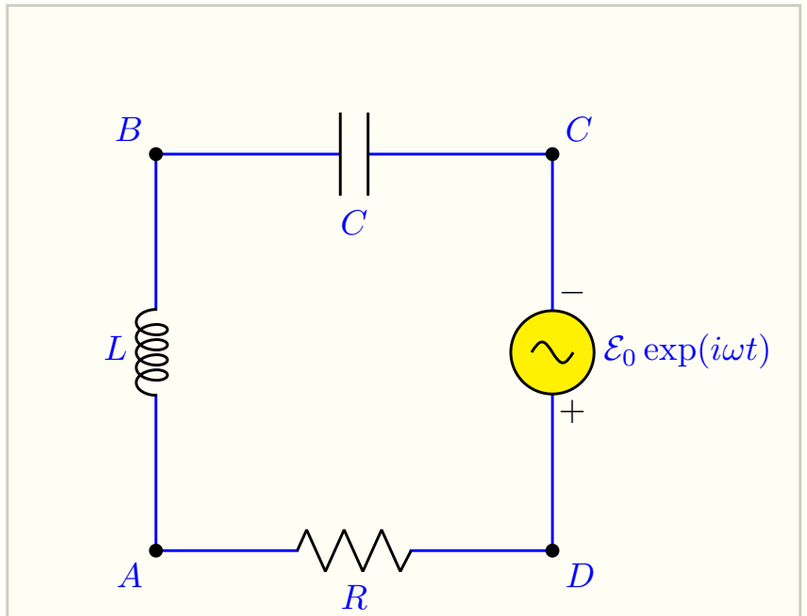

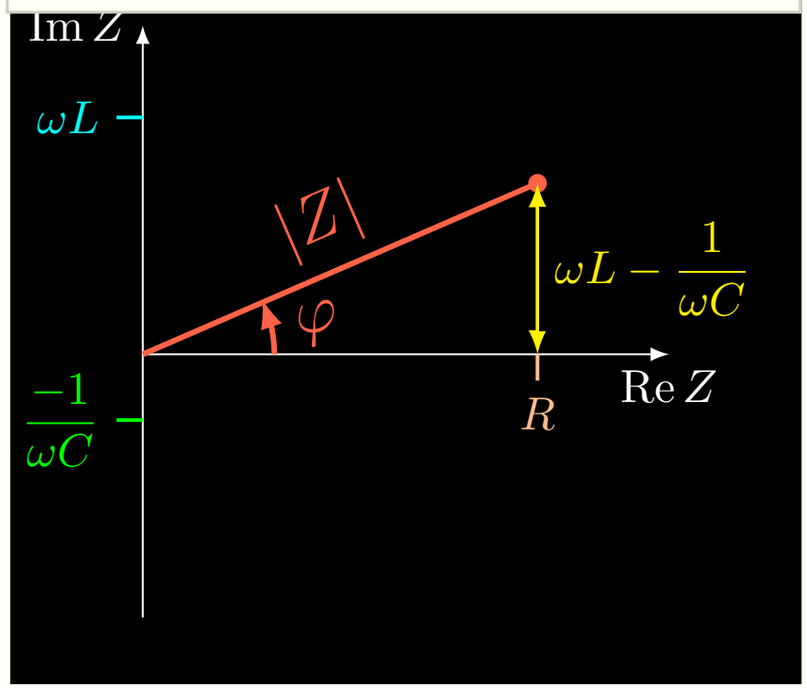

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Corrente no regime estacionário

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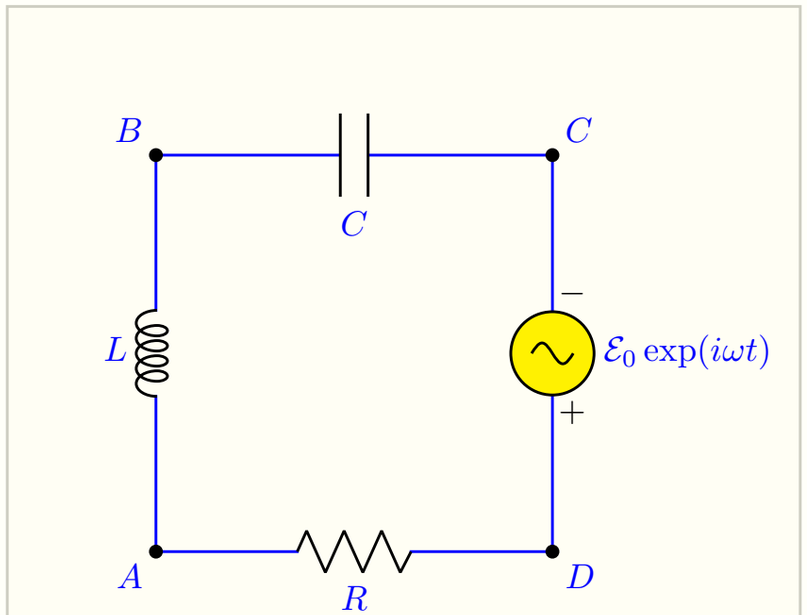
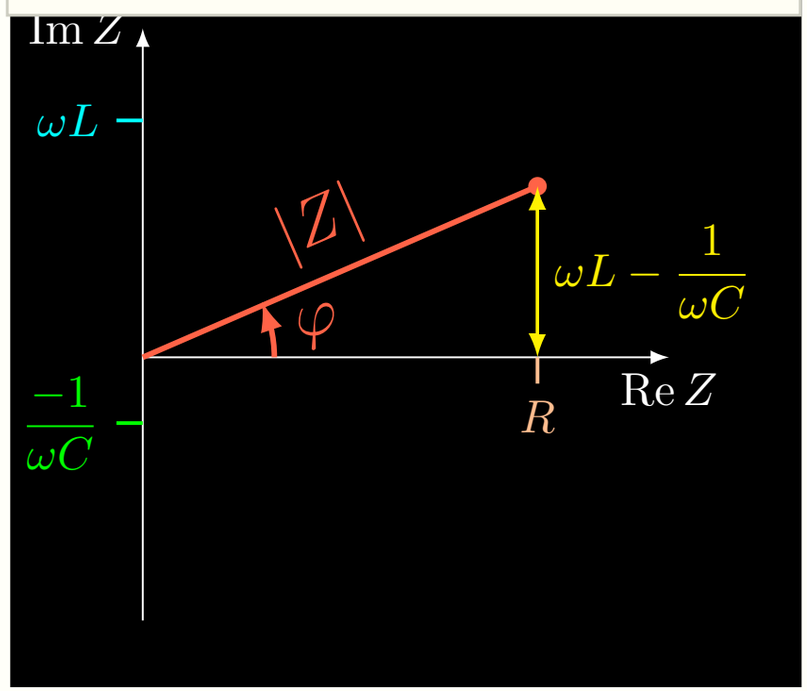
$$I(t) = \frac{\mathscr{E}_0}{|Z|^2}\Big(R\cos(\omega t) + (\omega L - \frac{1}{\omega C})\sin(\omega t)\Big)$$





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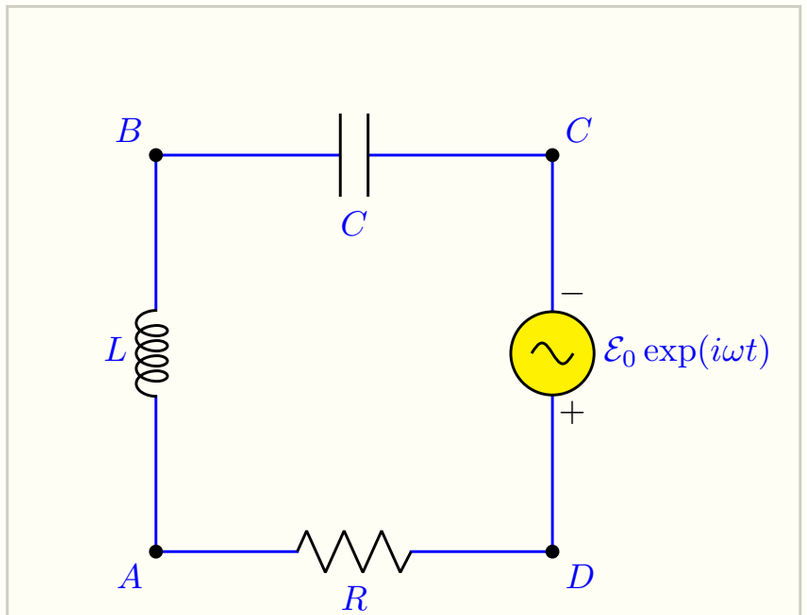
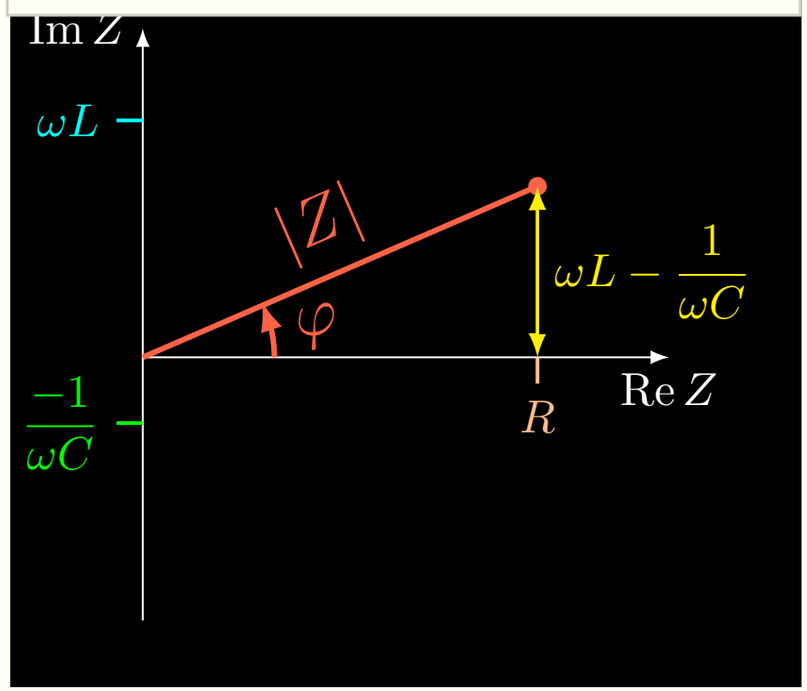
$$|Z|^2 = R^2 + (\omega L - \frac{1}{\omega C})^2$$





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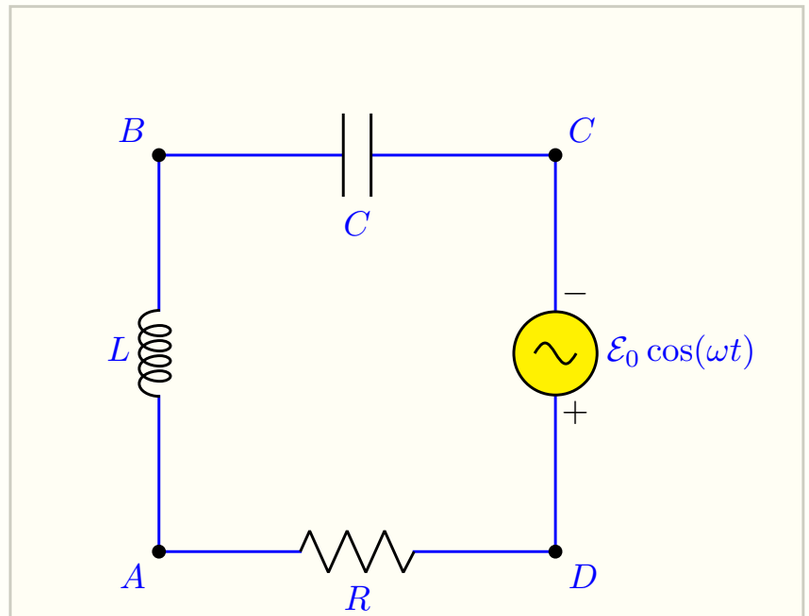

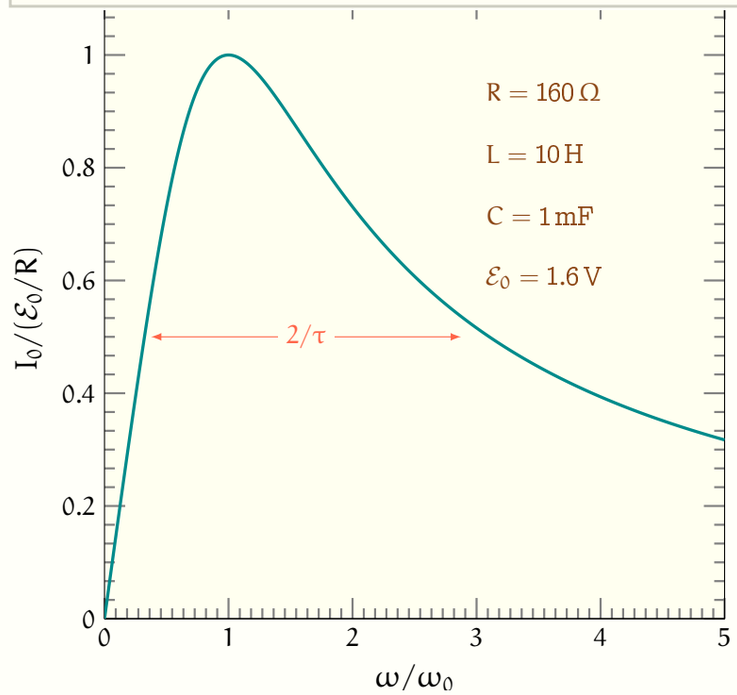

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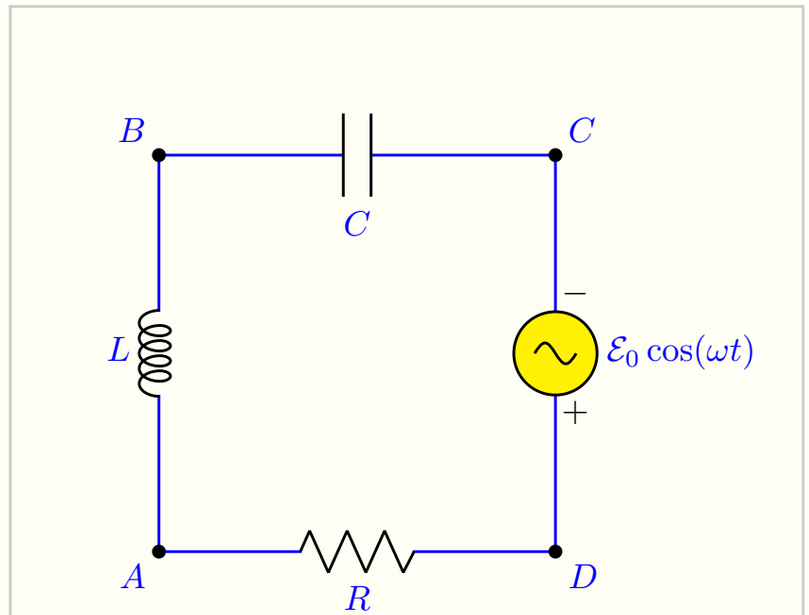
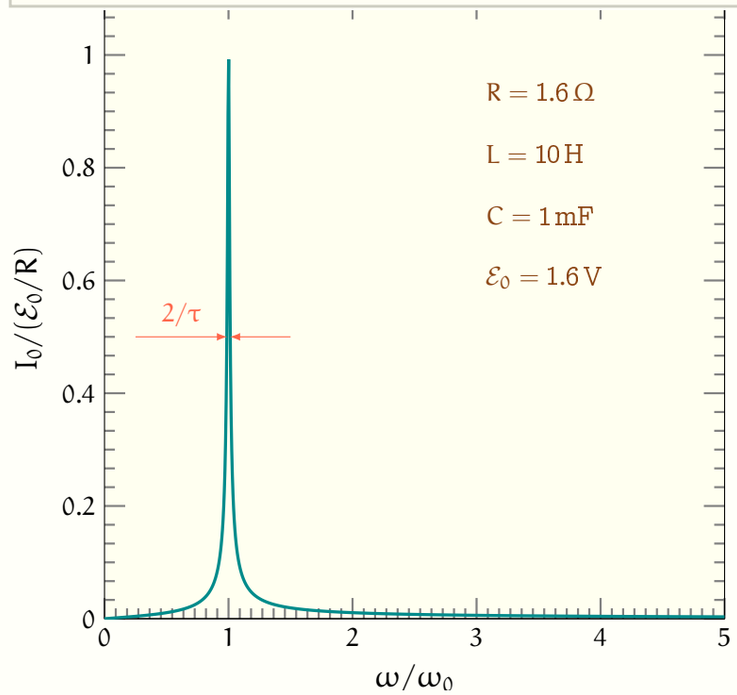
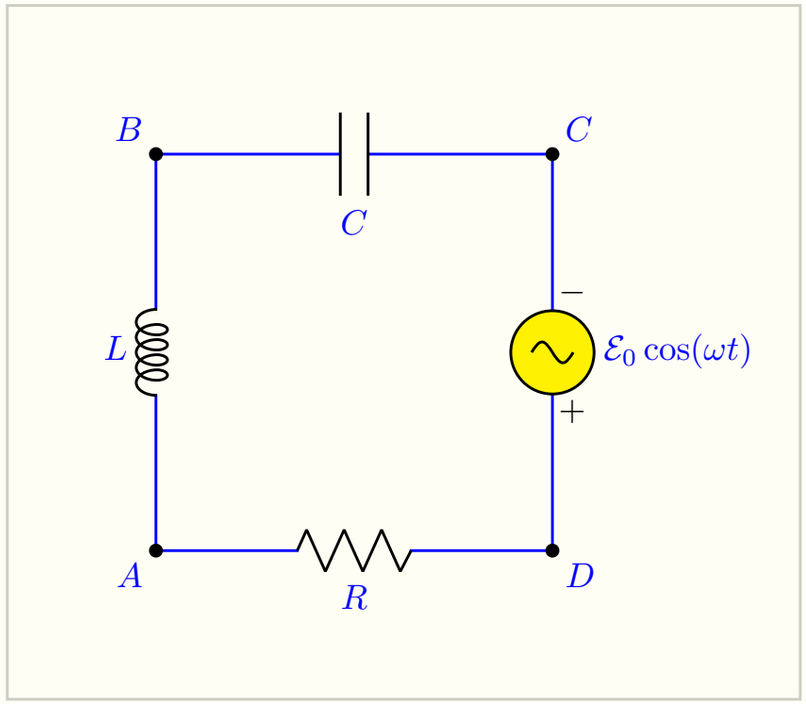




Circuitos de corrente alternada
Corrente no regime estacionário
Potência

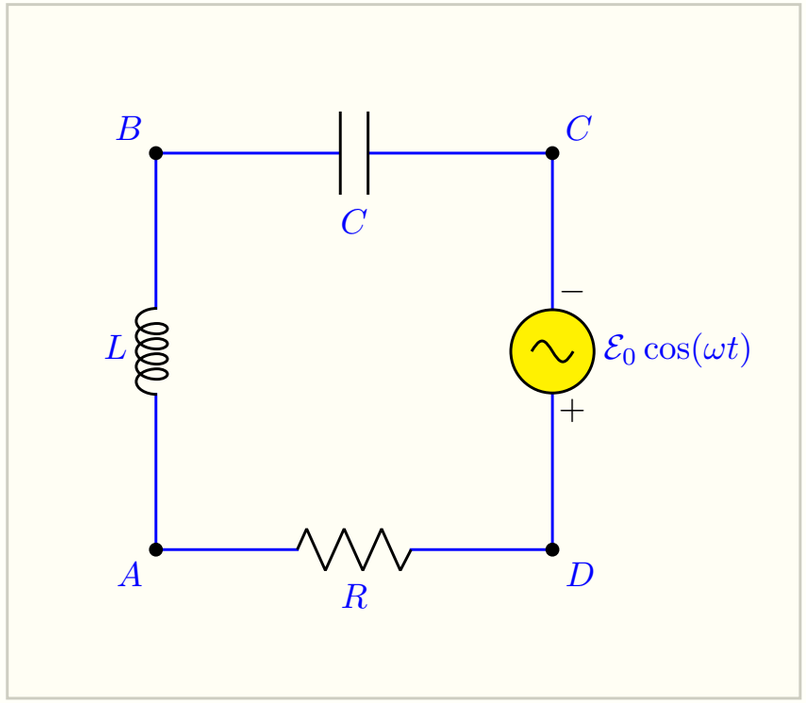
$$\Delta E = \Delta q \Delta V$$



Circuitos de corrente alternada
Corrente no regime estacionário
Potência

$$\Delta E = \Delta q \Delta V$$

$$P \equiv \frac{\Delta E}{\Delta t}$$



Circuitos de corrente alternada
Corrente no regime estacionário
Potência

$$\Delta E = \Delta q \Delta V$$

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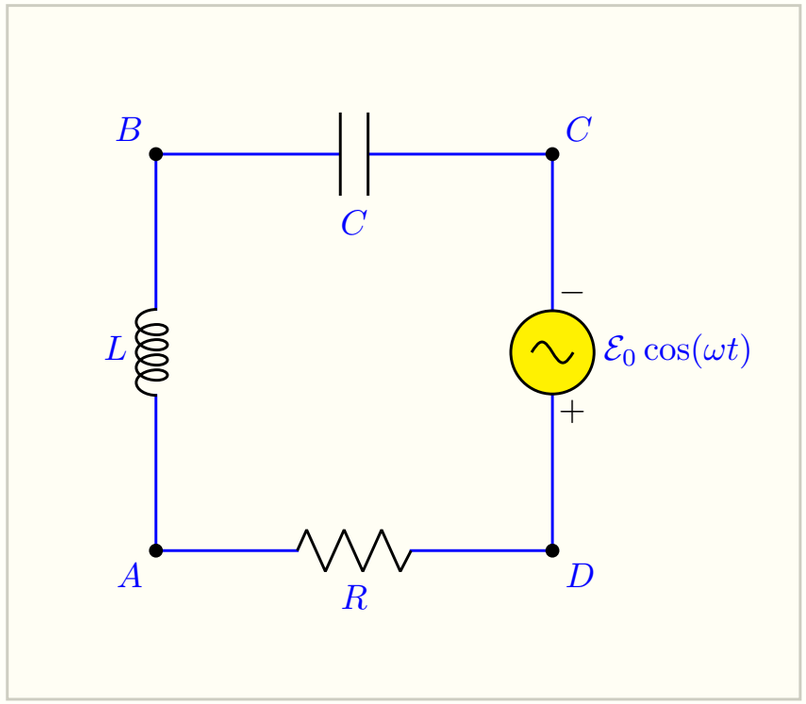
$$\Rightarrow P = \mathscr{E} I$$



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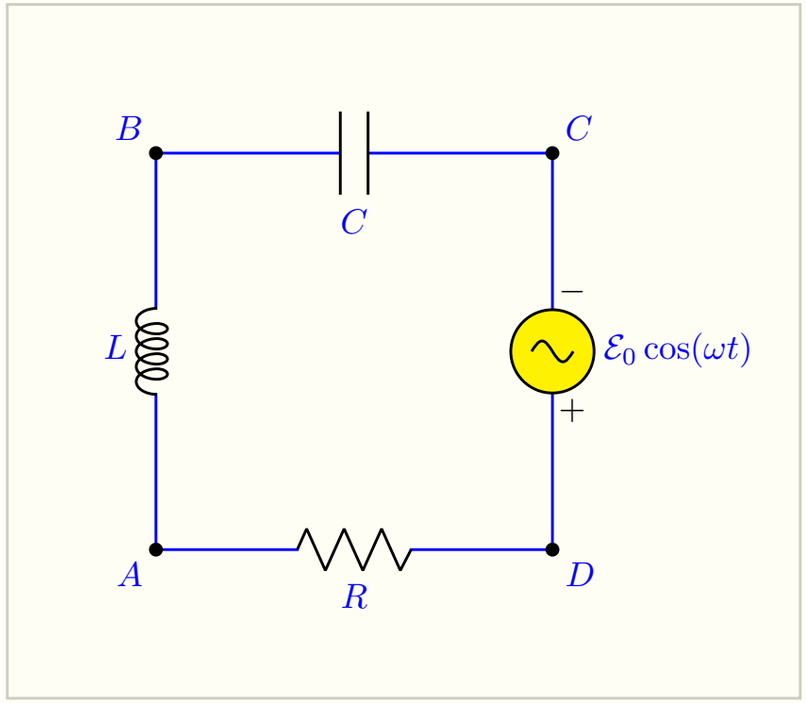
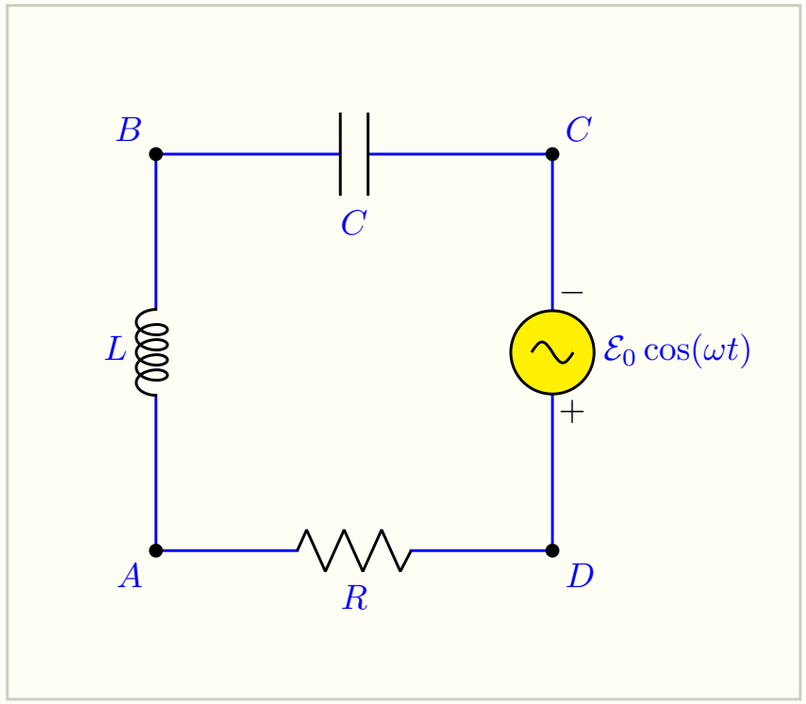


$$\Rightarrow P = \mathscr{E} I = \mathscr{E}_0 \cos(\omega t)\, I$$

$$I = \frac{\mathscr{E}_0}{|Z|^2}\left(R\cos(\omega t) + (\omega L - \frac{1}{\omega C})\sin(\omega t) \right)$$

Circuitos de corrente alternada
Corrente no regime estacionário
Potência



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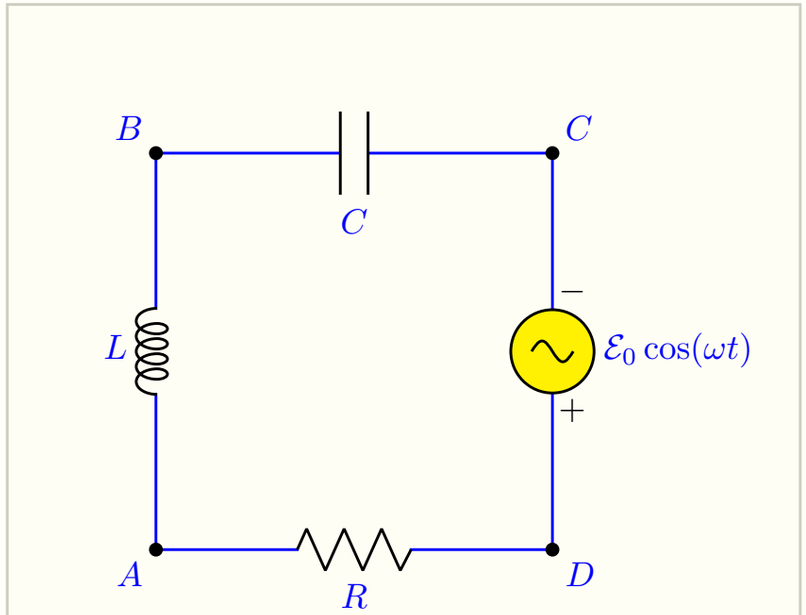

$$\langle P \rangle = \frac{\mathscr{E}_0^2}{2}\frac{R}{|Z|^2}$$

Circuitos de corrente alternada
Corrente no regime estacionário
Potência