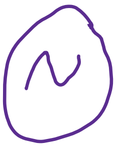
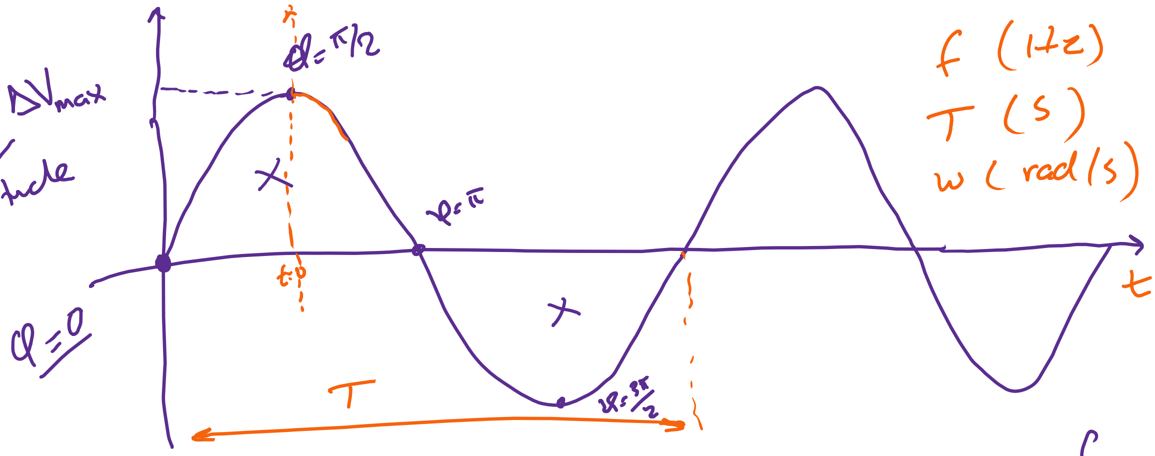
periodic





f (Hz)
T (s)
ω (rad/s)

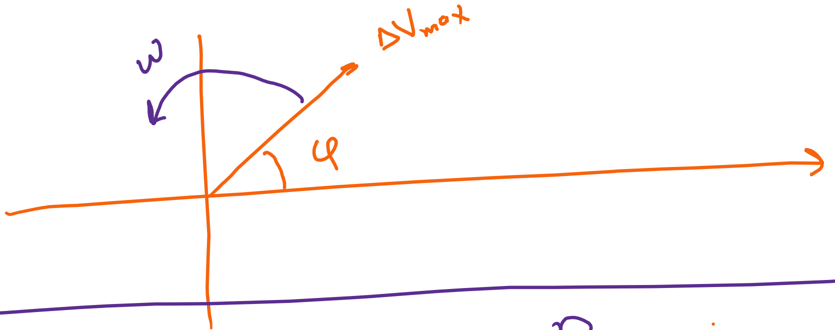
$$\Delta v = \Delta V_{max} \sin(\omega t + \varphi)$$

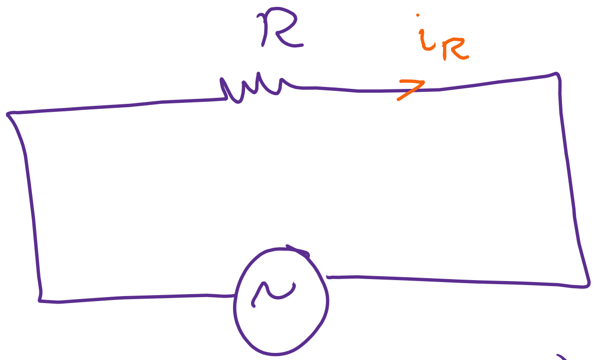
time-domain

ΔV_{max} → amplitude; ω → frequency; φ → phase

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

Phasors:





$$i_R = \frac{\Delta v}{R} = \frac{\Delta V_{max}}{R} \sin(\omega t)$$

$$\boxed{i_R = I_{max} \sin(\omega t)} \quad \varphi = 0$$

$$\boxed{\Delta v_R = i_R R = I_{max} R \sin(\omega t)} \quad \varphi = 0$$

$\Delta v = \Delta V_{max} \sin(\omega t)$

Δv → alternating value; ΔV_{max} → constant

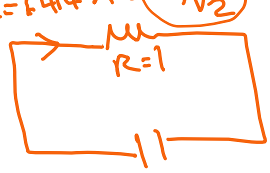
Current & voltage for a resistor are always in phase!

$$\boxed{P_{av} = I_{rms}^2 R}$$

I_{rms} → root mean square

$$\boxed{I_{rms} = \frac{I_{max}}{\sqrt{2}}} \qquad \boxed{\Delta V_{rms} = \frac{\Delta V_{max}}{\sqrt{2}}}$$

$I = 1.414\ A = 2/\sqrt{2}$



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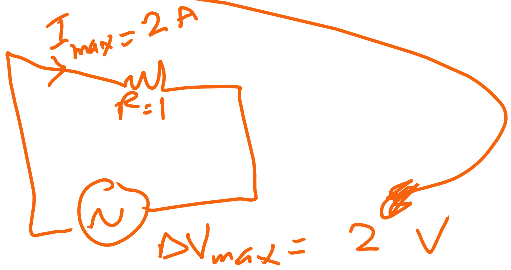
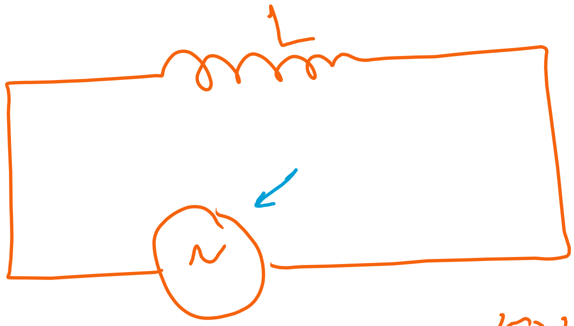


$\Delta v_L = \Delta V_{max} \sin(\omega t)$

$\varphi = 0$



$i_L = \boxed{\dfrac{\Delta V_{max}}{X_L}} \sin\left(\omega t - \dfrac{\pi}{2}\right)$

$\varphi = -\dfrac{\pi}{2}$

I_{max}

current always lags the voltage by $\pi/2$

$\Delta v = \Delta V_{max} \sin(\omega t)$

$X_L = \omega L = 2\pi f L \Rightarrow$ inductive Reactance (Ω)

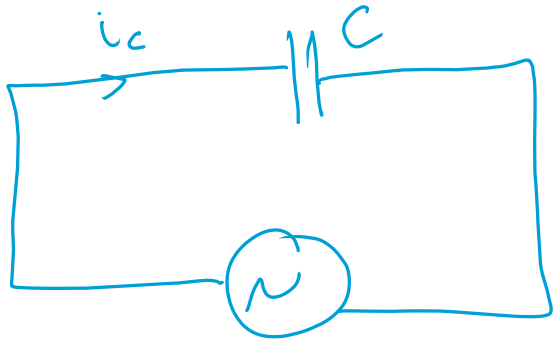
$f \uparrow$ $X_L \uparrow$ $L \rightarrow$ open circuit

$f \downarrow$ $X_L \downarrow$ $L \rightarrow$ short circuit

$DC \rightarrow f = 0$

$X_L = 0$

$\Delta v_C = \Delta V_{max} \sin(\omega t)$ $\quad \varphi = 0$



$i_C = \dfrac{\Delta V_{max}}{X_C} \sin\left(\omega t + \dfrac{\pi}{2}\right)$ $\quad \varphi = \dfrac{\pi}{2}$

current always leads the voltage by $\pi/2$

$\Delta v = \Delta V_{max} \sin(\omega t)$

$X_C = \dfrac{1}{\omega C} = \dfrac{1}{2\pi f C} \quad (\Omega)$

$f \uparrow$ $X_C \downarrow$ short circuit

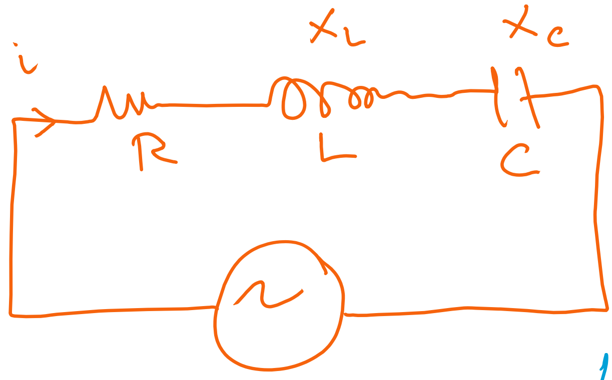
$f \downarrow$ $X_C \uparrow$ open circuit

$DC \rightarrow f = 0$

$X_C = \infty$

$$i = \frac{\Delta v}{Z} = \frac{\Delta V_{max} \sin(\omega t - \varphi)}{Z}$$

$$i = I_{max} \sin(\omega t - \varphi)$$



$$\Delta v = \Delta V_{max} \sin(\omega t)$$

$Z \Rightarrow$ impedance (Ω)

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

φ : phase angle (degree) $= \boxed{\tan^{-1}\left[\frac{X_L - X_C}{R}\right]}$

$X_L = X_C \Rightarrow i$ & Δv in phase

$\Rightarrow Z = \sqrt{R^2 + 0^2} = \boxed{R} \Rightarrow$ purely resistive

$\Rightarrow \varphi = 0$

$X_L > X_C \Rightarrow$ more inductive than capacitive

$\Rightarrow \varphi$ is positive

$\Rightarrow$ current lags the voltage

$X_L < X_C \Rightarrow$ more capacitive than inductive

$\Rightarrow \varphi$ is negative

$\Rightarrow$ current leads the voltage

$$X_L = X_C \Rightarrow \omega L = \frac{1}{\omega C} \Rightarrow \omega = \frac{1}{\sqrt{LC}}$$

resonance

The maximum current in the circuit $\Leftarrow$ resonant frequency

In RLC $\Rightarrow P_{av} = \frac{1}{2} I_{max} V_{max} \cos\varphi$

$$= I_{rms} V_{rms} \cos\varphi$$

$$= I_{rms}^2 R \checkmark$$

$\cos\varphi \Rightarrow$ power factor