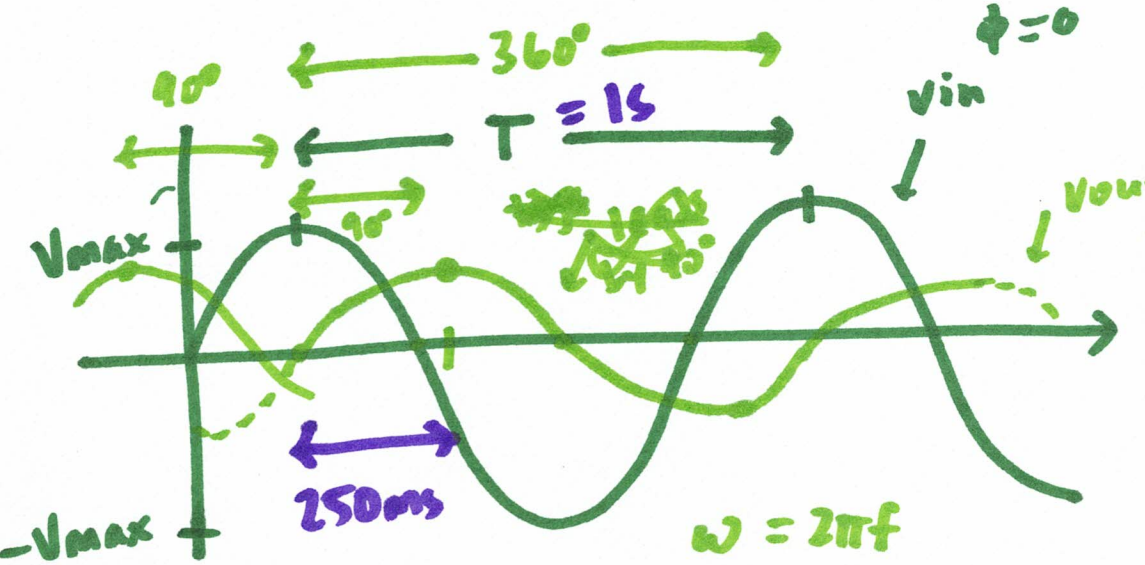
EE 220: Circuits I



$$T = \frac{1}{f} \leftrightarrow f = \frac{1}{T}$$

T (seconds/cycle)

f (cycles/second) (Hz)

$\omega = 2\pi f$

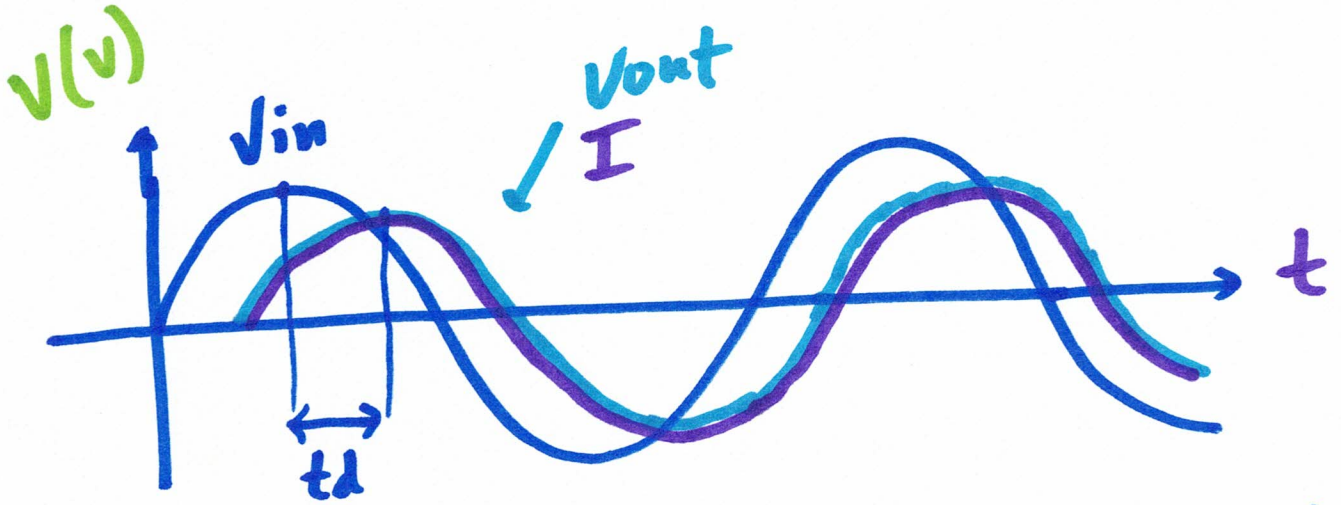
$$v(t) = V_{max} \cdot \sin(2\pi f t + \phi)$$

↑ phase shift ↔ time delay

phase shift → $\frac{\phi}{360^\circ} \cdot T = t_d$ ← time delay

period

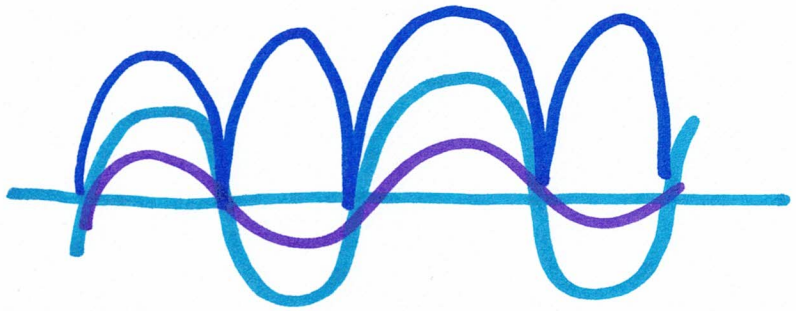
$$\frac{t_d}{T} \cdot 360^\circ = \phi$$

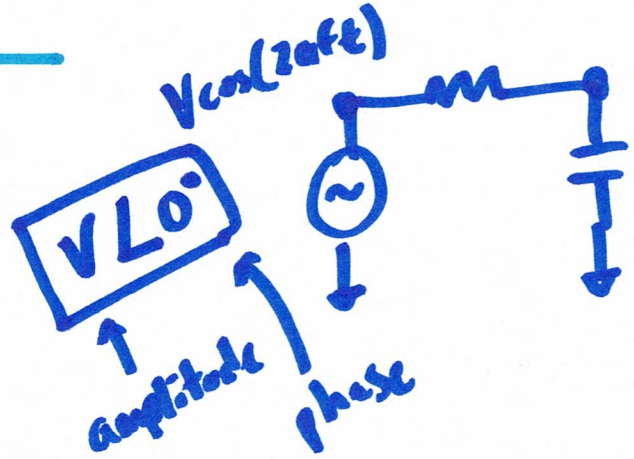


$P = V \cdot I$

$\frac{td}{T} \cdot 360° = \phi$

1.) Vout lags Vin by ϕ
2) Vout lags vin by td
3.) Vin leads Vout by ϕ
4.) Vin leads Vout by td





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phasors

We will use cosine

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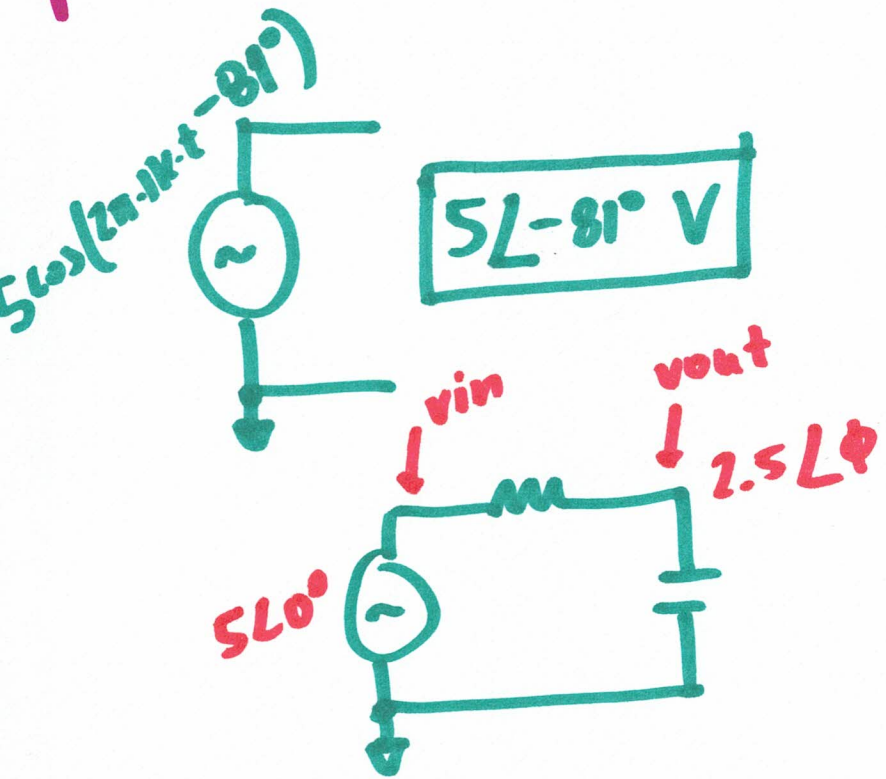
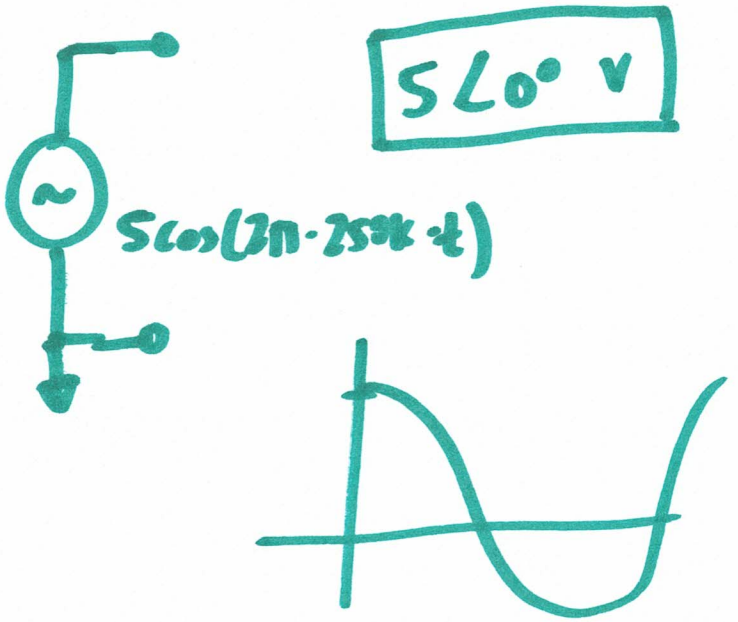
time domain → $V_A \cdot \cos(2\pi f t + \phi)$

↓

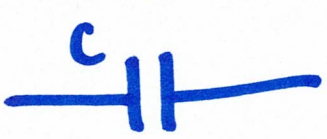
phasor domain → $V_A \angle \phi^\circ$





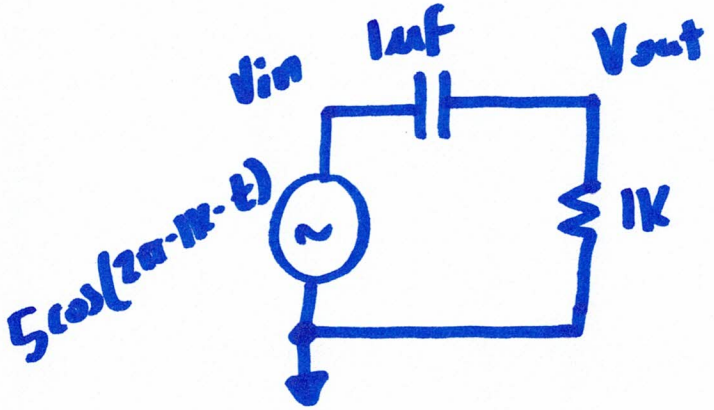
$j = \sqrt{-1}$

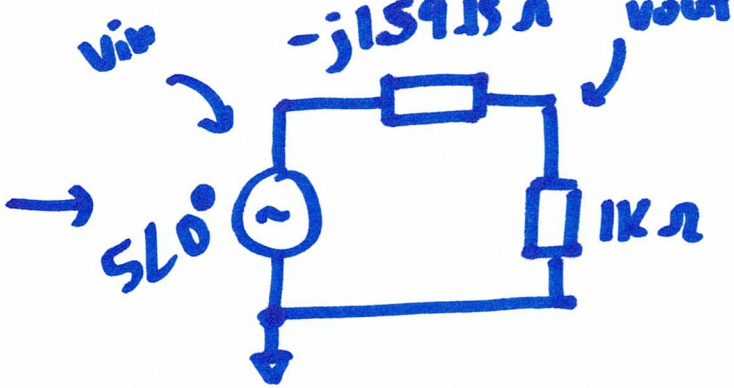
$\rightarrow z_R = R(\Omega)$



$\rightarrow z_C = \frac{1}{j\omega C}$, $\omega = 2\pi f \rightarrow \frac{1}{j2\pi fC}(\Omega)$

$\rightarrow z_L = j\omega L$, $\omega = 2\pi f \rightarrow j2\pi fL(\Omega)$





$\frac{1}{j} = -j$

$$z_C = \frac{1}{j \cdot 2\pi \cdot 1K \cdot 1uf} = \frac{159.15}{j} = -j159.15\,\Omega$$

(2π: 2π, f: f, C: C)

$z_T = 1K + (-j159.15)$

$z_T = 1K - j159.15$

(1K: real, 159.15: imaginary)

$z = x + iy$

$z = x + jy$

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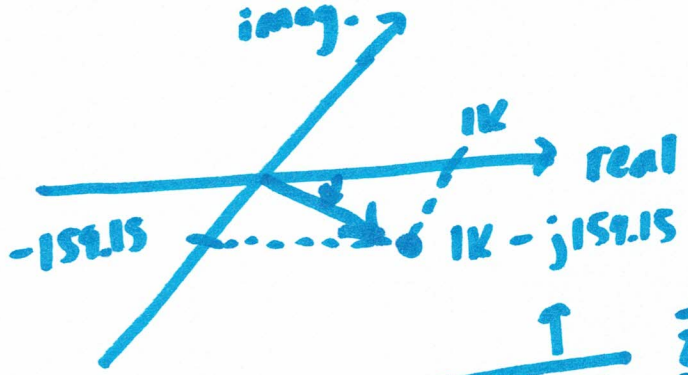

$$\sqrt{(\text{real})^2 + (\text{imag.})^2} = |Z|_{max}$$

$$\text{mag: } \sqrt{x^2 + y^2}$$

$$\text{phase: } \tan(\phi) = \frac{y}{x}$$

$$\text{phase: } \phi = \tan^{-1}\left(\frac{y}{x}\right)$$

$$z = x + jy$$

$$V = I \cdot R \rightarrow I = \frac{V}{R}$$