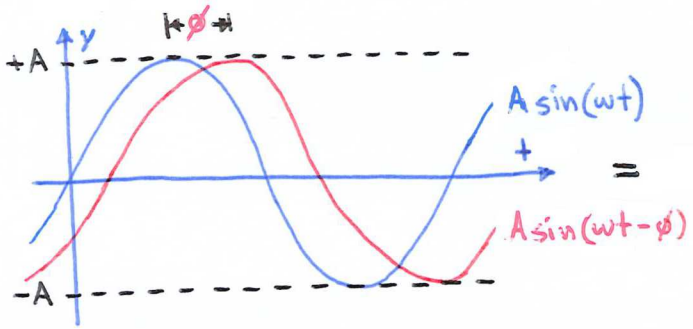
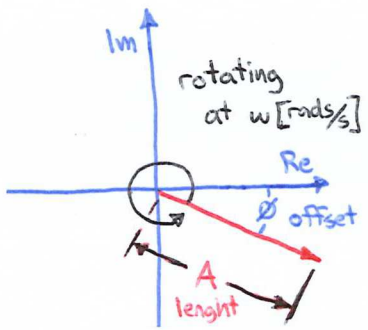
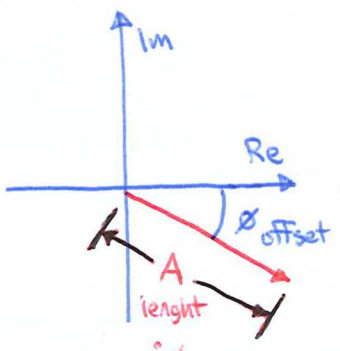
Phasors







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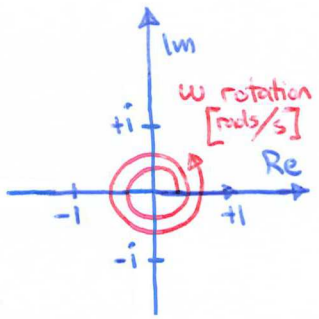

$y(t) = A\sin(\omega t - \phi)$ = $y(t) = \mathrm{Im}\left(A e^{i(\omega t - \phi)}\right)$ = $A e^{-i\phi}$ * $e^{i\omega t}$

time domain equation = complex domain vector phasor * rotation

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Phasor Ohm's Law:

$$\tilde{V} = \mathcal{Z}\tilde{I}$$

where:

$$\tilde{V} = V_p e^{-i\phi_V}$$ ← reference voltage (usually set to $\phi_V = 0$)

$$\tilde{I} = I_p e^{-i\phi_I}$$

$$\mathcal{Z} = |\mathcal{Z}| e^{-i\phi_Z} = R + iX$$

$\mathcal{Z}_{Real}$ (real component)

$\mathcal{Z}_{imag}$ (imaginary component)

solve for $\tilde{I}$:

$$\tilde{I} = \tilde{V}/\mathcal{Z}$$

substitute phasors:

$$I_p e^{i\phi_I} = \frac{V_p e^{i\phi_V}}{|\mathcal{Z}| e^{i\phi_Z}}$$

$$= \frac{V_p}{|\mathcal{Z}|} e^{i(\phi_V - \phi_Z)}$$

seperate into

magnitude:

$$I_p = \frac{V_p}{|\mathcal{Z}|}$$

where:

$$|\mathcal{Z}| = \sqrt{R^2 + X^2}$$

angle:

$$\phi_I = \phi_V - \phi_Z$$

where:

$$\phi_Z = \tan^{-1}\left(X/R\right)$$

if $\phi_V = 0$ (reference voltage)

$$\phi_I = -\phi_Z$$