steady-state

$$\sum_{i=0}^{N} b_i \frac{d^i}{dt^i} v_o(t) = \sum_{i=0}^{M} a_i \frac{d^i}{dt^i} v_i(t)$$

$v_i(t) = \underline{\underline{V_I \cos(\omega t)}}$ → if inputs are sinusoids @ ω
outputs are sinusoids @ ω

let's guess $v_o(t) = A\cos(\omega t + \varphi)$

$$\frac{d}{dt} v_o(t) = v_o'(t) = -A\omega \sin(\omega t + \varphi)$$

$$v_o''(t) = -A\omega^2 \cos(\omega t + \varphi)$$

$$v_o'''(t) = A\omega^3 \sin(\omega t + \varphi)$$

$$v_o''''(t) = A\omega^4 \cos(\omega t + \varphi)$$

$$\vdots$$

Trig Identities (Review)

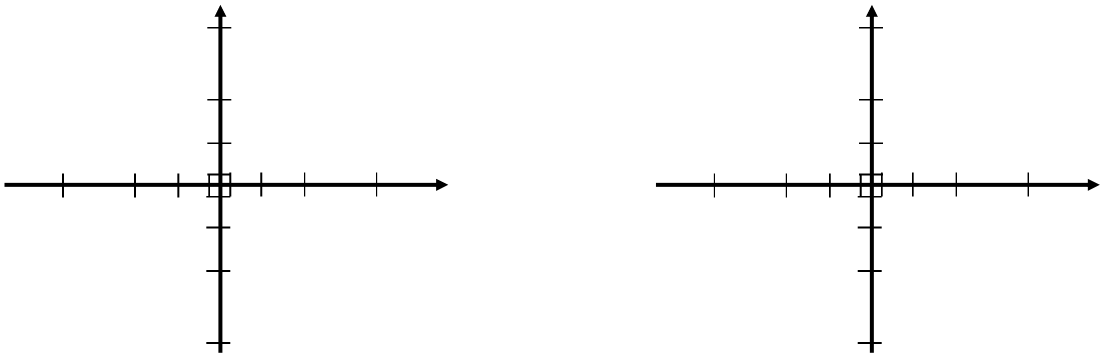
$$\sin(\theta) = \cos(\theta - 90°)$$
$$-\cos(\theta) = \cos(\theta \pm 180°)$$

$$A\cos(\omega t) + B\sin(\omega t) = \sqrt{A^2 + B^2}\cos\left(\omega t - \tan^{-1}\left(\frac{B}{A}\right)\right)$$

$$Ae^{j\theta} = A\cos(\theta) + jA\sin(\theta)$$

Sinusoidal Steady State

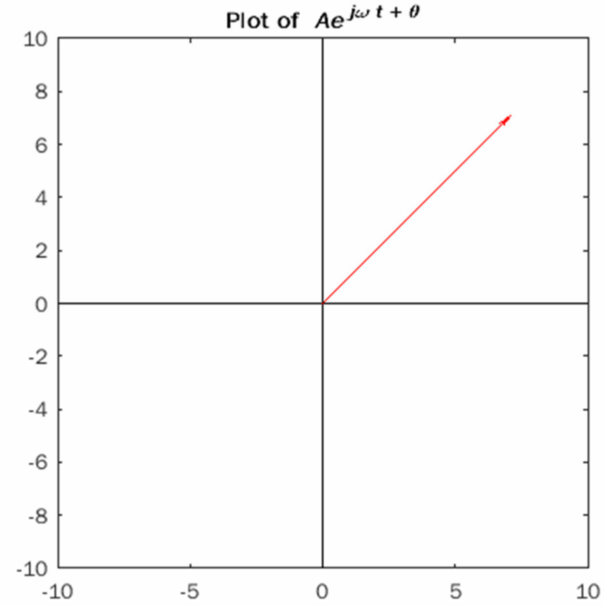
$$\begin{aligned}
v(t) &= A\sin(\omega t + \varphi) &&= A\cos(\omega t + \varphi - 90°) \\
v'(t) &= A\omega\cos(\omega t + \varphi) &&= A\omega\cos(\omega t + \varphi) \\
v''(t) &= -A\omega^2\sin(\omega t + \varphi) &&= A\omega^2\cos(\omega t + \varphi + 90°) \\
v'''(t) &= -A\omega^3\cos(\omega t + \varphi) &&= A\omega^3\cos(\omega t + \varphi + 180°) \\
v'''(t) &= A\omega^4\sin(\omega t + \varphi) &&= A\omega^4\cos(\omega t + \varphi + 270°)
\end{aligned}$$



Complex Numbers (Review)

Complex Number Arithmetic

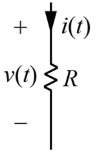
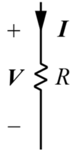
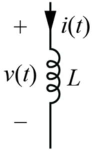
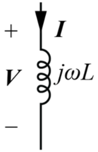
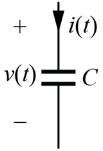
Sinusoids as Complex Numbers


Plot of $Ae^{j\omega t + \theta}$
10
8
6
4
2
0
-2
-4
-6
-8
-10
-10
-5
0
5
10

Phasor Transformation

Phasor Notation

Phasor Circuit Elements

Time Domain	**Phasor Domain**
 $v(t) = i(t)R$	
 $v(t) = L\dfrac{di}{dt}$	
 $i(t) = C\dfrac{dv}{dt}$