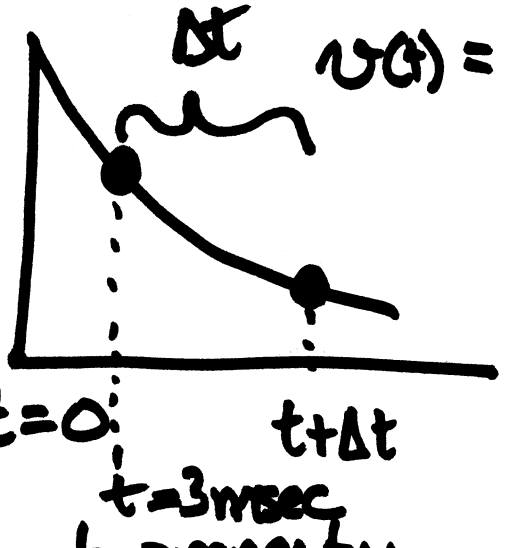
Exponential waveform



$$v(t) = V_A e^{-\frac{t}{T_c}} u(t)$$

decrement property

$$\frac{v(t+\Delta t)}{v(t)} = \frac{V_A e^{-\frac{t+\Delta t}{T_c}}}{V_A e^{-\frac{t}{T_c}}} = e^{-\frac{\Delta t}{T_c}}$$

then $v(t=3msec) = V_A e^{-\frac{t}{T_c}}$ ← 3msec

$$v(t) = V_A \cos(\omega_0 t + \phi)$$

$$\omega_0 = \frac{2\pi}{T_0} = 2\pi f_0$$

$$f_0 = \frac{1}{T_0} \qquad \text{linear frequency}$$

Fourier coefficients

$$\cos(x+y) = \cos x \cos y - \sin x \sin y$$

$$v(t) = V_A \left[\cos\omega_0 t \cos\phi - \sin\omega_0 t \sin\phi \right]$$

$$= \underbrace{V_A \cos\phi}_{a} \cos\omega_0 t \; \underbrace{- V_A \sin\phi}_{b} \sin\omega_0 t$$

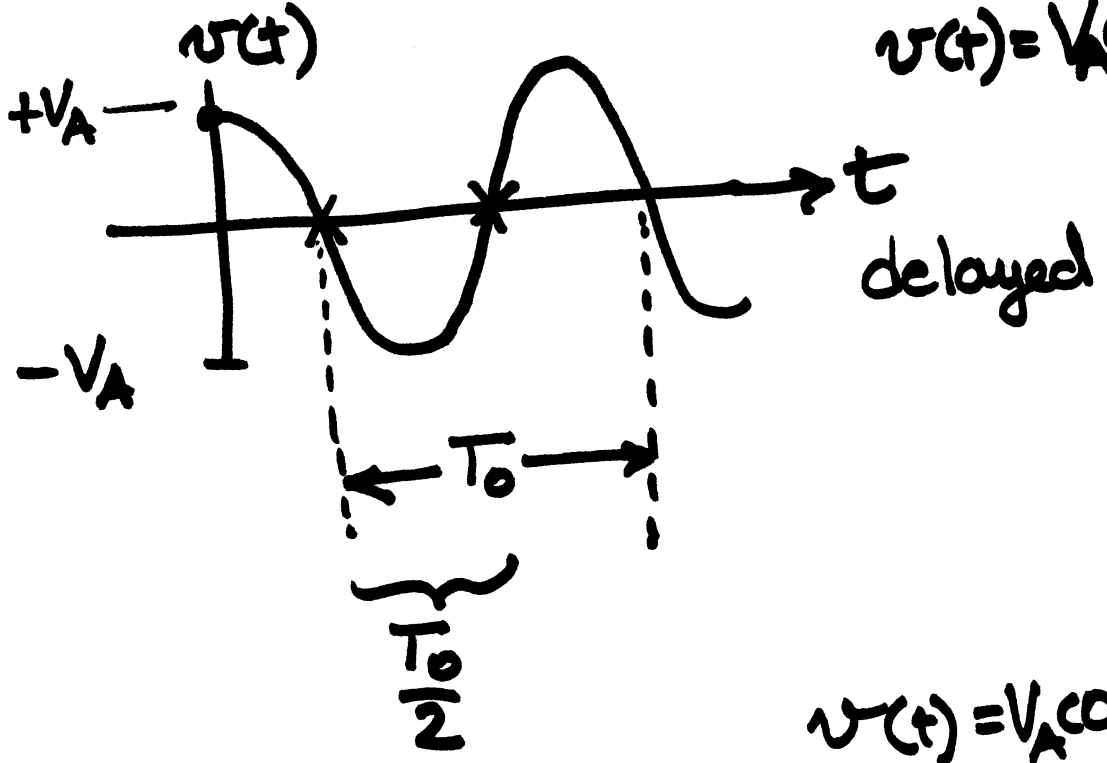
$$= a\cos\omega_0 t + b \sin\omega_0 t$$

$$V_A = \sqrt{a^2 + b^2}$$

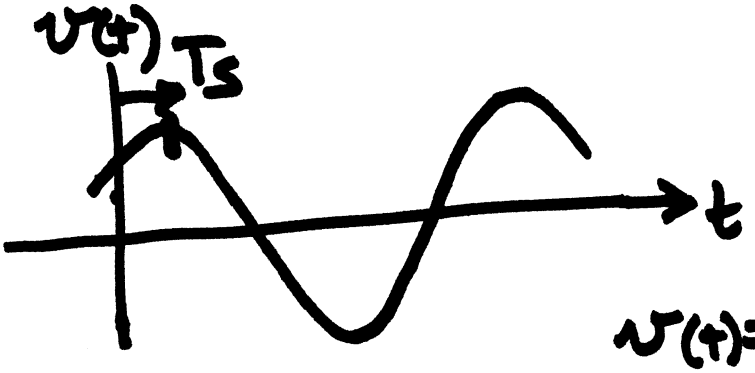
$$\frac{b}{a} = \frac{-V_A \sin\phi}{+V_A \cos\phi} = -\tan\phi \quad \text{or} \quad \phi = \tan\left(\frac{-b}{a}\right)$$

phasors

Sinusoidal waveforms



$$v(t) = V_A \cos\left(\frac{2\pi t}{T_0}\right)$$



$$v(t) = V_A \cos\left(\frac{2\pi (t - T_s)}{T_0}\right)$$

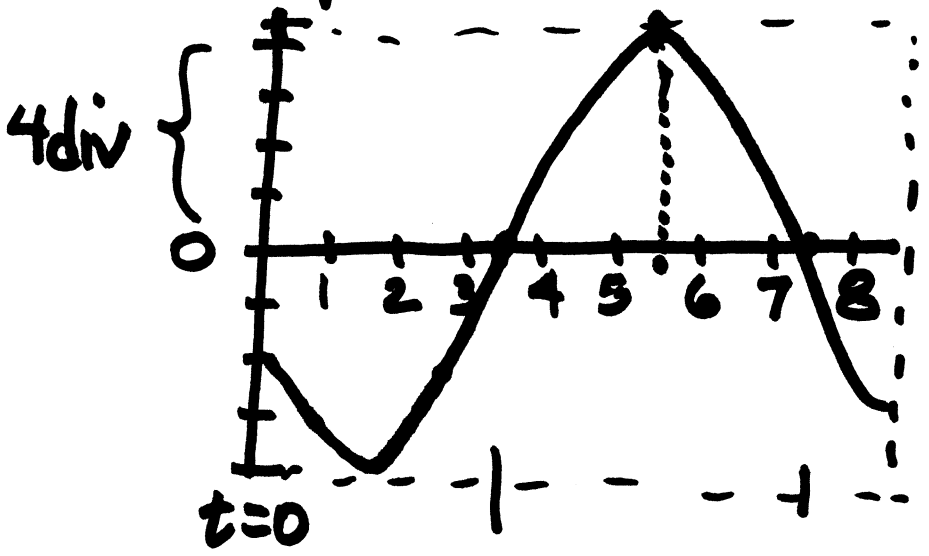
$$v(t) = V_A \cos\left(\frac{2\pi}{T_0} t - \frac{2\pi T_s}{T_0}\right)$$

$$\omega_0 = \frac{2\pi}{T_0}$$

$$v(t) = V_A \cos\left(\frac{2\pi}{T_0} t + \phi\right)$$

$$v(t) = V_A \cos\left(\omega_0 t + \phi\right)$$

Example 5-7



V: 5 Volts/div

H: 0.1ms/div

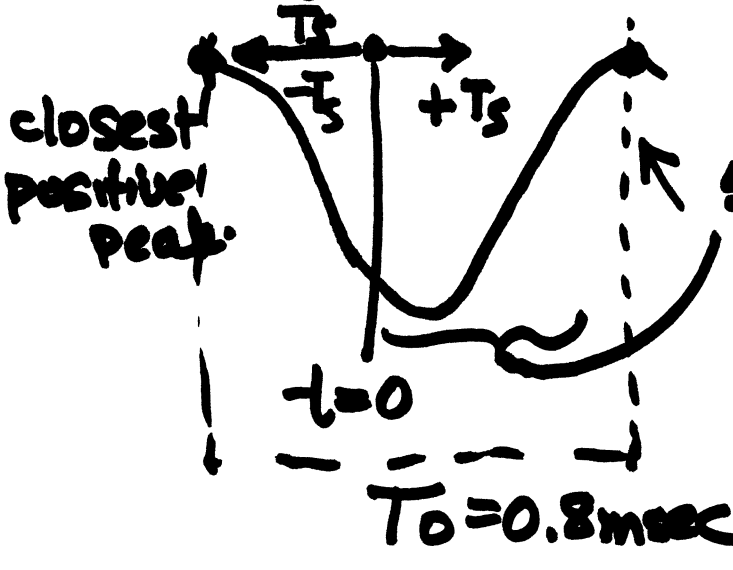
V_A (peak) $\quad 4\text{div} \times 5\frac{\text{volt}}{\text{div}} = 20$ Volts

T_0 3.5 to 7.5 $\quad 4\text{div} \times 0.1\frac{\text{msec}}{\text{div}} = 0.4\text{msec}$

$T_0 = 0.8$ msec.

$$f_0 = \frac{1}{T_0} = \frac{1}{.8\times10^{-3}} = 1250 \text{ Hz}$$

$$\omega_0 = 2\pi f_0 = 2\pi(1250) = 7854 \text{ radians/sec.}$$



$5.5\text{div} \times 0.1\frac{\text{msec}}{\text{div}} = 0.55\text{msec.}$

$-T_5 + 0.55\text{msec} = 0.8\text{msec}$