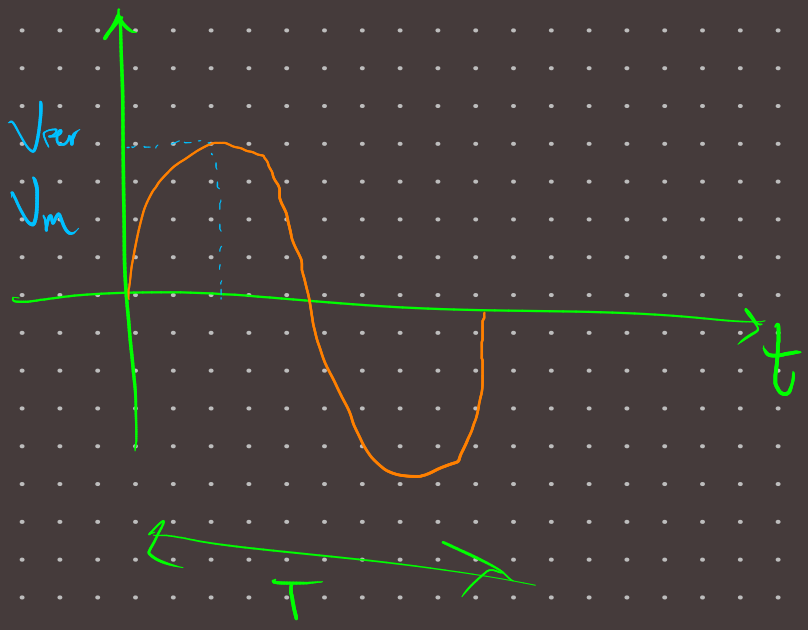
Freq, Period, Angular Velocity



$$f = \frac{1}{T} \text{ Hz}$$

$$W = \frac{V}{t} = \frac{\text{distance}}{\text{time}} \quad \text{Velocity}$$

$$\alpha = wt$$

$$\Downarrow$$

$$(\text{rad}/\text{sec})(\text{sec}) = \text{rad}$$

$$\frac{2\pi}{R} \qquad \frac{360^\circ}{D}$$

$$\frac{D}{360} R = \frac{180}{\pi} R$$

$$2\pi D = 360 R$$

$$R = \frac{\pi}{2} \text{ radians}$$

$$D = 180 \frac{\pi}{\pi} \cdot \frac{\pi}{2} = 90^\circ$$

$$R = \frac{2\pi}{360} D = \frac{\pi}{180} D$$

$$D = 30^\circ$$

$V_{(t)} = 10 \sin(314t + \theta)$

$\omega = 2\pi f$

amplitude $= 10\,V$

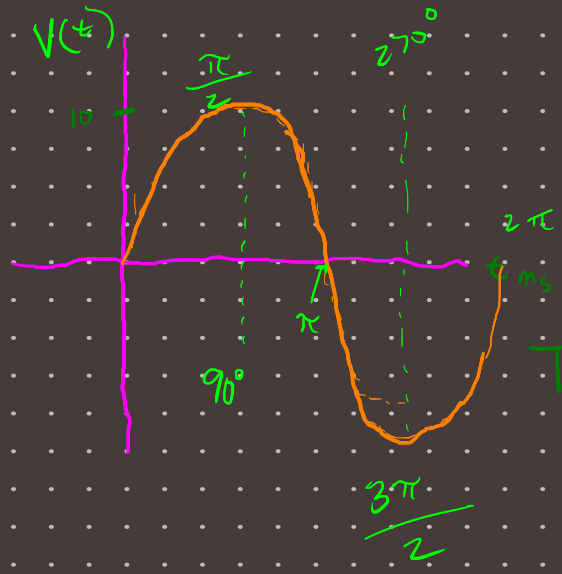
$\omega = 314$

$\theta = 0°$

$f = \frac{\omega}{2\pi} = \frac{314}{2\pi} = 50\,Hz$

$T = \frac{1}{50} = \frac{1000}{50}$

$= 20\,ms$



$V_{(t)} = 10 \sin \alpha$

$\alpha = 0$

$\alpha = 90°$ $V = 10$

Determine the angle at which the magnitude of the sinusoidal function is 4V

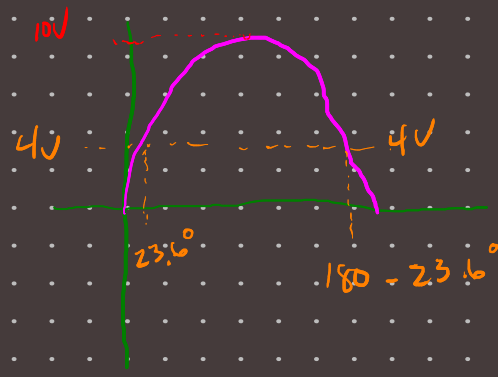
$$V(t) = 10 \sin 377t = 10 \sin \alpha$$

$$\omega = 377 \qquad f = \frac{377}{2\pi} = 60 Hz$$

$$10 \sin \alpha = 4$$

$$\sin \alpha = 0.4$$

$$\alpha = 23.6°$$



Phase relationship

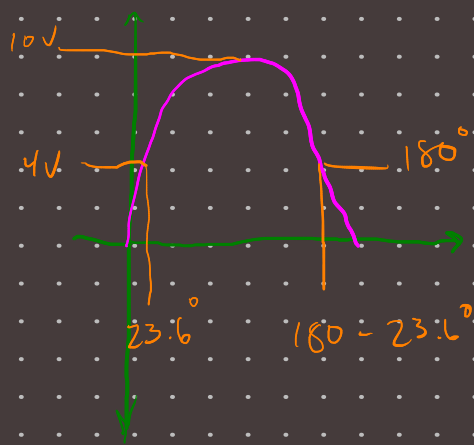
$$V(t) = V_m \sin(\omega t \pm \theta)$$

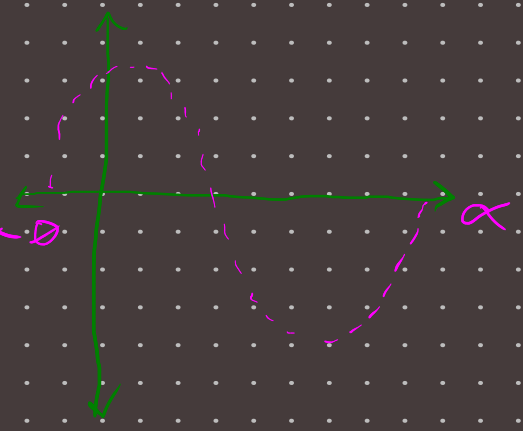
$$V_m \sin(\omega t + \theta)$$

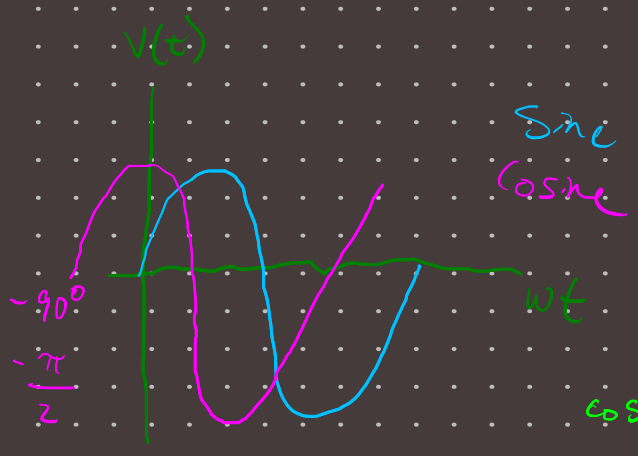
$$V_m \sin(\omega t - \theta)$$

$$V(t) = V_m \sin \omega t \qquad \omega t = 0 \qquad V = 0$$

$$\omega t + \theta = 0 \qquad \omega t = -\theta$$







Cosine = 90° left of Sine

cos(α) leads Sin(α) by 90°

Sin(α) lags cos(α) by 90°

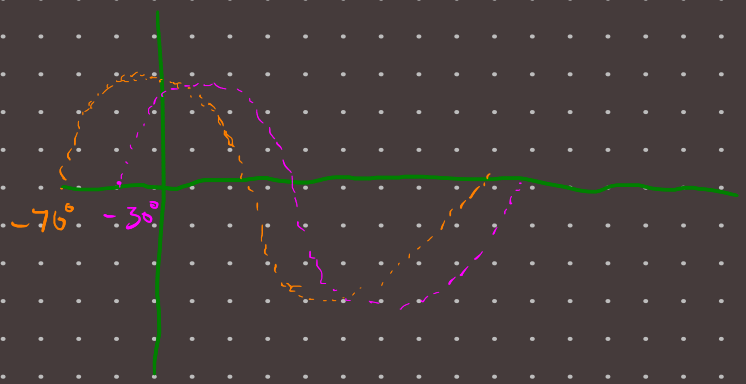
$$\cos(\alpha) = \sin(\alpha + 90)$$

$$\cos(\alpha - 90) = \sin(\alpha + 90 - 90)$$

Example: What is the phase relationship between the following waveform?

$$V(t) = 10\sin(\omega t + 30^\circ)$$

$$i(t) = 5\sin(\omega t + 70^\circ)$$



Example: find the phase relationship

$$V(t) = 10\sin(\omega t - 20^\circ)$$

$$i(t) = 15\sin(\omega t + 60^\circ)$$

i lead V by 80°

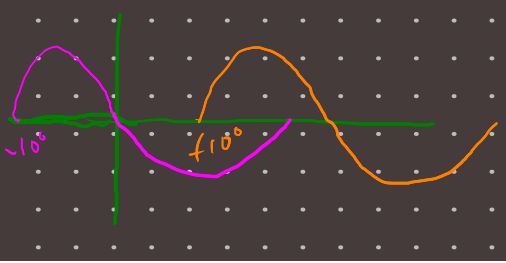
V lag i by 80°

$$i = 2\cos(\omega t + 10^\circ)$$

$$V = 3\sin(\omega t - 10^\circ)$$

$$= 2\sin(\omega t + 10^\circ + 90^\circ)$$

$$= 2\sin(\omega t + 100^\circ)$$



i lead V by 10°

V lag i by 90°