

Problem 1.12 Given two waves characterized by

$$\begin{aligned}y_1(t) &= 3 \cos \omega t \\ y_2(t) &= 3 \sin(\omega t + 60^\circ),\end{aligned}$$

does $y_2(t)$ lead or lag $y_1(t)$ and by what phase angle?

Solution: We need to express $y_2(t)$ in terms of a cosine function:

$$\begin{aligned}y_2(t) &= 3 \sin(\omega t + 60^\circ) \\ &= 3 \cos\left(\frac{\pi}{2} - \omega t - 60^\circ\right) = 3 \cos(30^\circ - \omega t) = 3 \cos(\omega t - 30^\circ).\end{aligned}$$

Hence, $y_2(t)$ lags $y_1(t)$ by 30° .
