

Problem 14

Find the velocity of the steady state response given by Eq. (10). Then show that the velocity is maximum when $\omega = \omega_0$.

Solution

The steady-state response is given by Eq. (10) in the text.

$$U(t) = R \cos(\omega t - \delta) \tag{10}$$

The velocity is obtained by differentiating it with respect to t .

$$U'(t) = -R\omega \sin(\omega t - \delta)$$

Substitute the formula found for R .

$$U'(t) = -\frac{F_0}{\sqrt{m^2(\omega_0^2 - \omega^2)^2 + \gamma^2\omega^2}}\omega \sin(\omega t - \delta)$$

The velocity is maximized when the denominator is minimized, which occurs when $\omega = \omega_0$.