20. Eq. 16-12 gives the angular velocity:

$$\omega = \sqrt{\frac{k}{m}} = \sqrt{\frac{100}{2.00}} = 7.07 \text{ rad/s} .$$

Energy methods (discussed in §16-4) provide one method of solution. Here, we use trigonometric techniques based on Eq. 16-3 and Eq. 16-6.

(a) Dividing Eq. 16-6 by Eq. 16-3, we obtain

$$\frac{v}{x} = -\omega \tan(\omega t + \phi)$$

so that the phase $(\omega t + \phi)$ is found from

$$\omega t + \phi = \tan^{-1}\left(\frac{-v}{\omega x}\right) = \tan^{-1}\left(\frac{-3.415}{(7.07)(0.129)}\right) .$$

With the calculator in radians mode, this gives the phase equal to -1.31 rad. Plugging this back into Eq. 16-3 leads to

$$0.129\,\text{m} = x_m \cos(-1.31) \implies 0.500\,\text{m} = x_m .$$

(b) Since $\omega t + \phi = -1.31$ rad at $t = 1.00$ s. We can use the above value of ω to solve for the phase constant ϕ. We obtain $\phi = -8.38$ rad (though this, as well as the previous result, can have 2π or 4π (and so on) added to it without changing the physics of the situation). With this value of ϕ, we find $x_o = x_m \cos\phi = -0.251$ m.

(c) And we obtain $v_o = -x_m \omega \sin\phi = 3.06$ m/s.