

1. An undamped simple harmonic oscillator has a natural frequency of 5.0 rad/sec. The oscillator is displaced 0.030 m from its equilibrium position and released from rest.

- a. (4) Assuming that the oscillator follows the solution  $x = A \cos(\omega t + \phi)$ , what is the amplitude,  $A$ , and the phase,  $\phi$ ?

$$x(t=0) = .03\text{m} = A \cos \phi$$

$$u(t) = -A\omega \sin(\omega t + \phi) \Rightarrow u(t=0) = -A\omega \sin \phi = 0$$

$$\phi = 0, \pi, 2\pi, \dots$$

$$A = \frac{.03\text{m}}{\cos 0} = \boxed{.030\text{m}}$$

- b. (2) What is the initial acceleration?

$$a(t) = -A\omega^2 \cos(\omega t + \phi) = -(0.03\text{m})(5\text{r/s})^2 \cos(0)$$

$$= \boxed{-.75\text{ m/s}^2}$$

- c. (2) What is the maximum speed obtained?

$$u_{\text{max}} = A\omega = (0.03\text{m})(5\text{r/s}) = \boxed{.15\text{ m/s}}$$

- d. (2) When is the first time that the oscillator reaches this speed (in either direction)?

$$u_{\text{max}} \text{ occurs when } \sin(\omega t) = 1$$

$$\omega t = \frac{\pi}{2} = \frac{2\pi}{2\omega}$$

$$t = \frac{\pi}{2\omega} = \frac{\pi}{2(5\text{r/s})}$$

$$= \boxed{.314\text{ s}}$$