Simple Harmonic motion

1. A butcher throws a cut of beef on spring scales which oscillates about the equilibrium with a period of *T* = 0.500 s. The amplitude of the vibration is *A* = 2.00 cm (path length 4.00 cm). Find:

a. frequency

b. the maximum acceleration

c. the maximum velocity

d. the acceleration when the displacement is 1.00 cm

a. The frequency *f* = 1/*T* = 1/0.500 = 2.00 hertz (vibrations/s)

b. The angular velocity is given by

ω = 2π*f* = 4.00 π rad/sec = 12.6 rad/s

Then by the Equation

*ax* = ω2 *A* cos ωt

The maximum acceleration occurs when *A* cos (ω *t*) is equal to -*A*, or -2.00 for this problem.

*a*max = -( 4.00 π)2 (-2.00) = + 32.0 π2 cm/s2 = 316 cm/s2

*v* = - ω *A* sin (ω*t*)

c, The velocity will be maximum when *A* sin (ω *t*) is equal to

– *A*; so

*v*max = ω A = 4.00π x 2.00 = 8.00πcm/s = 25.1 cm/s

The acceleration is given by

*a* = -ω2*x*

When the displacement is 1.00 cm,

*a* = -(4.00π)2 x 1.00 = -16.0π2 = 158 cm/s2

1. In a system undergoing simple harmonic motion, the acceleration is -20.0 cm/s2 for a displacement of 5.00 cm. What is the frequency and period of motion? What is the maximum velocity obtained by the mass?
2. A building in Chicago is 100 stories high and on windy days it will oscillate with an amplitude of 40.0 cm and a period of 7.7 s. What are the maximum speed and acceleration of the top of the building?
3. A classic Children’s toy consists of a wooden animal suspended from a spring. If you lift the toy up by 10 cm and let it go, it will gently bob up and down, completi8ng four oscillations in 10 seconds. What is the frequency of oscillation? When does the toy first reach its maximum velocity? What is that maximum velocity? What are the position and velocity 4.0 s after you release the toy?
4. A mass on a spring oscillates vertically with an amplitude of 15 cm, a frequency of 0.20 Hz and an equation of position given by x = A cos ω t, with xo = +15 cm at t = 0. What are the position and direction of motion of the mass at t = 3.1 s? How many oscillations (cycles) does the mass make in a time of 12 s?