Assignmnet#2

1. The position of a particle is given by the expression $x = (4.00 \text{ m}) \cos(3.00\pi t + \pi)$, where x is in meters and t is in seconds. Determine (a) the frequency and period of the motion, (b) the amplitude of the motion, (c) the phase constant, and (d) the position of the particle at $t = 0.250$s.
2. A simple harmonic oscillator takes 12.0 s to undergo five complete vibrations. Find (a) the period of its motion, (b) the frequency in hertz, and (c) the angular frequency in radians per second.
3. A 200-g block is attached to a horizontal spring and executes simple harmonic motion with a period of 0.250 s. If the total energy of the system is 2.00 J, find (a) the force constant of the spring and (b) the amplitude of the motion.
4. A 2.00-kg object is attached to a spring and placed on a horizontal, smooth surface. A horizontal force of 20.0 N is required to hold the object at rest when it is pulled 0.200 m from its equilibrium position (the origin of the x axis). The object is now released from rest with an initial position of xi = 0.200 m, and it subsequently undergoes simple harmonic oscillations. Find (a) the force constant of the spring, (b) the frequency of the oscillations, and (c) the maximum speed of the object. Where does this maximum speed occur? (d) Find the maximum acceleration of the object. Where does it occur? (e) Find the total energy of the oscillating system. Find (f) the speed and (g) the acceleration of the object when its position is equal to one third of the maximum value.
5. A 2.00-kg object attached to a spring moves without friction and is driven by an external force $F = (3.00 \text{ N}) \sin(2\pi\, t)$. If the force constant of the spring is 20.0 N/m, determine (a) the period and (b) the amplitude of the motion.
6. An 10.6-kg object oscillates at the end of a vertical spring which has a spring constant of 2.05×10^4 N/m. The effect of air resistance is represented by the damping coefficient b = 3.00 N·s/m. (a) Calculate the frequency of the damped oscillation. (b) By what percentage does the amplitude of the oscillation decrease in each cycle? (c) Find the time interval that elapses while the energy of the system drops to 5.00% of its initial value.
7. What is the phase constant for the harmonic oscillator with the velocity function $v(t)$ given in Fig-1 if the position function $x(t)$ has the form

   $x = x_m \cos(\omega t + \phi)$?

   The vertical axis scale is set by vs _4.0 cm/s.

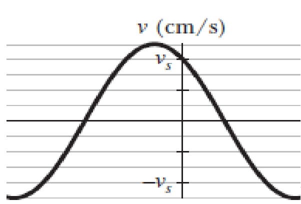

Fig-1

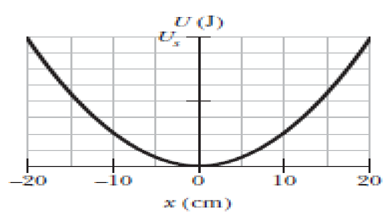

Fig-2

8. Fig-2 gives the one dimensional potential energy well for a 2.0 kg particle (the function $U(x)$ has the form $bx2$ and the vertical axis scale is set by Us =2.0 J). (a) If the particle passes through the equilibrium position with a velocity of 85 cm/s, will it be turned back before it reaches x =15 cm? (b) If yes, at what position, and if no, what is the speed of the particle at x =15 cm?