Oscillatory motion

Prob.1

A 200g block is connected to a spring with force constant K=5N/m is free to oscillate on a frictionless horizontal surface. The block is displaced by 5 cm from its equilibrium position and released from rest.

1) Determine the motion equation

2) Find the period of its motion

3) Determine the maximum speed

4) Calculate the maximum acceleration

5) Express the position, the velocity and the acceleration as function of time

6) Answer the parts 1) 2) 3) and 4) if this ascillator was released from the same initial position $x_i = 5cm$ but with an initial velocity $V_i = -0.1\ m/sec$.

Prob.2

A 50 g object connected to a spring with a force constant of 35 N/m oscillates with an amplitude of 4 cm on a frictionless, horizontal surface. Find:

a) the total energy of the system

b) the speed of the object when its position is 1 cm.

c) find the kinetic energy

d) the potential energy when its position is 3 cm

Prob.3

A 2 Kg object is attached to a spring and placed on a frictionless, horizontal surface. A horizontal force of 20 N is required to hold the object at rest when it is pulled 0.2 m from its equilibrium position (the origin of the x axis). The object is now released from rest from this stretched position, and it subsequentlu undergoes simple harmonic oscillations. Find

a) the force constant of the spring

b) The frequency of the oscillations,

c) the maximum speed of the object

d) Where does this maximum speed occur?

e) Find the maximum acceleration of the object

f) Where does the maximum accelaration occur?

g) Find the total energy of the oscillation system

Find (h) the speed and (i) the accelaration of the object when its position is equal to one-third the maximum value.

Prob. 4

A simple pendulum has a mass of 0.25 Kg and a length of 1 m. It is displaced through an angle of 15° and then released. Using the analysis model of a particle in simple harmonic motion, what are (a) the maximum angular speed of the bob, (b) its maximum angular acceleration, and (c) the maximum restoring force on the bob?

Prob.5

A simple pendulum consists of a bob of mass m=50g attached to a negligible mass string of length L. The bob is dispaced to the right by an angle of 8° and then released from rest. At the bottom of its path the bob has a maximum speed of 0.44 m/s.

a) Deduce the period of oscillation T

b) Calculate the maximum kinetic energy of the bob

c) Claculate the maximum restoring force

d) Write an expression for the angular displacement as function of time, $\theta(t) = \theta_{max}\cos(wt + \varphi)$

Prob.6

The displacement of a particle at t=0.25 s is given by the expression $x(t) = (4m)\cos(3\pi t + \pi)$ where x is in meters and t in seconds.

Determine:

a) the frequency and period of the motion

b) The amplitude of the motion

c) The phase-constant

d) The displacement of the particle at t=0.25 s.