

Prblems - Chapter J

Physics 2425 - Dr. Terry Honan

■ Problem J.1

The position as a function of time for a particle in simple harmonic motion is

$$x(t) = (4 \text{ cm}) \cos[(3 \pi \text{ s}^{-1}) t + \pi].$$

- (a) What are the period and frequency?
- (b) What is the amplitude of the oscillation?
- (c) What is the phase angle?
- (d) What is the maximum speed and maximum acceleration?
- (e) At $t = 0.25 \text{ s}$ what is the position of the particle?
- (f) Suppose this describes the position of a 0.6 kg mass at the end of a spring. What is the spring constant?

■ Problem J.2

When a mass is hung from a spring it stretches it by 15 cm . What is the period of the oscillations of this system?

■ Problem J.3

A $.5 \text{ kg}$ mass oscillates with an amplitude of 10 cm at the end of a spring with spring constant of 8 N/m

- (a) What are the maximum speed and acceleration?
- (b) What are the speed and acceleration of the mass when it is 6 cm from the equilibrium position?
- (c) How long does it take for the mass to move from equilibrium to 6 cm from equilibrium?

■ Problem J.4

A 7 kg mass hanging at the end of a spring with a 2.6 s period. What is the spring constant of the spring?

■ Problem J.5

The bumper on a 1000 kg car is tested by driving it into a brick wall. The bumper is equivalent to a spring with spring constant 5×10^6 N/m and it compresses 3.16 cm to stop the car. Assuming all the energy is absorbed by the bumper elastically, what is the car's speed before it hit?

■ Problem J.6

When a particle move is simple marmonic motion with a 10 cm amplitude, at what distance from equilibrium will the particle have one half its maximum speed?

■ Problem J.7

A simple pendulum has a period of 2.5s on Earth. What would the period of this pendulum be if it were moved to the moon, where the acceleration due to gravity is $1.67 \frac{\text{m}}{\text{s}^2}$?

■ Problem J.8

A uniform solid sphere with a 10 cm radius swings at the end of a 15 cm light rigid rod. (The center of the sphere is 25 cm from the axis.)

(a) What is the period of small oscillations?

(b) Compare this with a simple pendulum with a point mass 25 cm from the axis. Find the period of the simple pendulum? What percent error would be introduced approximating the physical pendulum with the simple one?