Introduction to Simple Harmonic Motion (SHM)

Pre-Class Questions

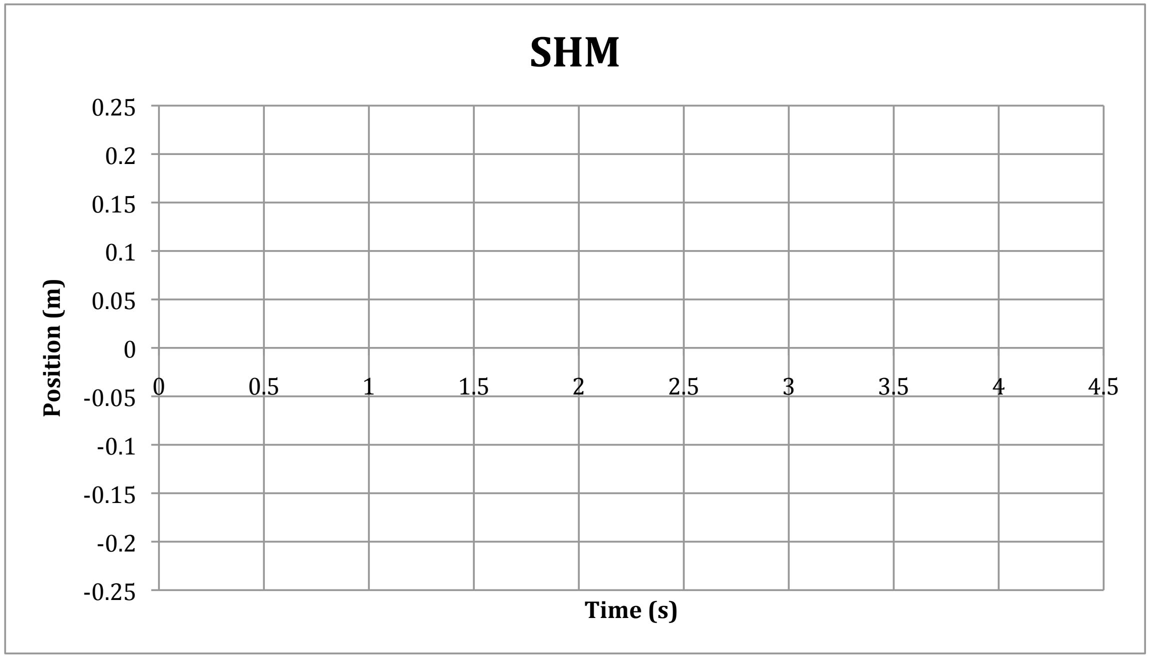
Problem Set (due next time)
Ch 11 - 24, 25, 26, 27

Lecture Outline

1. Describing SHM
2. The Conditions for SHM

Describing Simple Harmonic Motion

1. On the graph below, sketch the position of the mass as a function of time. Be sure the initial position matches the 20cm we started at and that the period agrees with the value we measured.



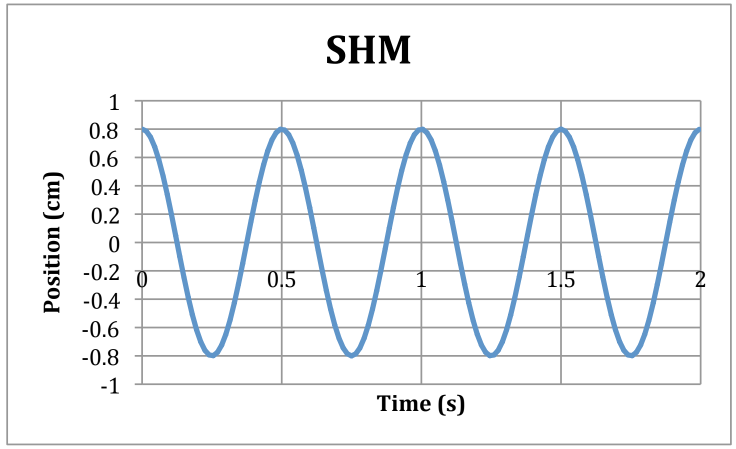
2. Indicate on the graph where the velocity is a maximum with a ☺.

3. Indicate on the graph where the velocity is a minimum with a ☹.

4. Indicate on the graph where the velocity is zero with a ∅.

5. Can you name the mathematical function that has the shape of your graph?

Describing Simple Harmonic Motion II



The toy shown oscillates according to the graph above.

1. The amplitude of the motion is ______________________.

2. The time for the motion to repeat is called the __________________

and for this toy the value is___________________.

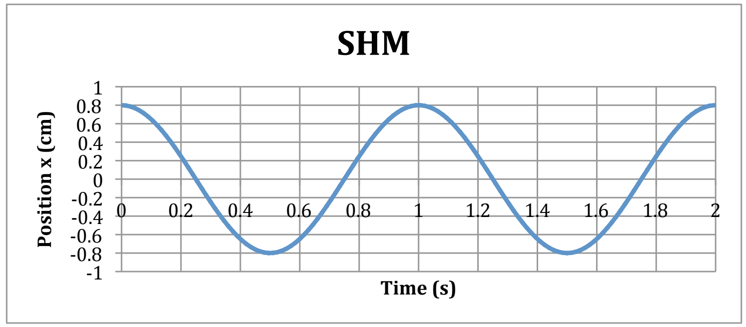
3. The number of times an object oscillates in a given time (such as one

second) is called the _________________________ and for this toy the

value is ____________________.

Example 1: Find the period of rotation of Earth in days, hours, and seconds. Find the frequency in Hertz and rpm.

Understanding Angular Frequency in SHM



The toy shown oscillates according to the graph above.

1. The curve could be described mathematically as $x = A\cos\theta$. Where x represents the (position) (time)

and θ is related to the (position) (time).

2. In general, the maximum value of the cosine function is ___________. The maximum value of x is called the ________________. So the A must represent the ____________________. For this toy the value of A is ___________.

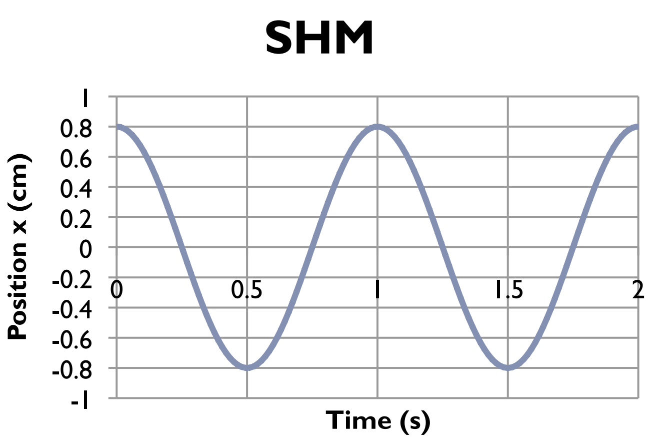
3. If the cos θ must be one at t = 0s, then the value of cos θ must be _____________ after one period. If θ is zero at t = 0s, then θ must be equal to _____________ after one period.

4. If θ=2π corresponds to the period, then θ=π corresponds to _________________.

If θ=2π corresponds to the period, then $\theta = \frac{\pi}{2}$ corresponds to __________________.

For any angle θ at any time t, complete the following ratio, $\frac{\theta}{2\pi} = \frac{\square}{T}$. Solve this equation for θ then rewrite $x = A\cos\theta$ in terms of t:

Example 2: From the graph at the right find the amplitude, period, frequency, and angular frequency that describe the motion.



Example 3: For the mass spring system, compare the square of the angular frequency with the ratio of the spring constant to the mass.

Lecture 27 - Summary

The period is the time to complete one oscillation.
The frequency is the number of complete oscillations per unit of time.
The angular frequency is the equivalent angle per unit of time.

They are related by $f \equiv \frac{1}{T}$ $\omega = 2\pi f$

For a mass on the end of a spring $\omega = \sqrt{\frac{k}{m}}$