Practice Problems Set #1 - Definitions

(1) Define Simple Harmonic Motion
(2) Explain The relationship between Kinectic Energy and Potential Energy in a SHM system.
(3) What is periodic motion?
(4) What is the difference between frequency and angular frequency?
(5) Describe at least 3 situations where an object would experience SHM.
(6) Why does a pendulum only reflect SHM at small angles?
(7) What experimental factors could contribute to a spring experiment not reflecting perfect SHM?

Practice Problems Set #2 - Understanding SHM

1. Given the equation y=A(sin(wt)), derive velocity and acceleration showing all of your work. Does it show SHM? Why or why not? If we imagine that this formula is depicting the displacement of a spring system, what does this mean physically?
2. Consider the equation x = Ae^{wx}. Does this show SHM? Why or why not?
3. Why do we use x=A(cos(wt)) instead of x=A(sin(wt)) to show position of a spring system in time?
4. What happens to the Period of a spring system if we:

i. Increase the mass
ii. Decrease the mass
iii. Increase the spring constant
iv. Decrease the spring Constant
v. Increase the frequency

5. What happens to the Period of a pendulum system reflecting SHM if we:

i. Increase the mass
ii. Decrease the mass
iii. Increase length of the pendulum
iv. Decrease length of the pendulum
v. Increase gravity
vi. Decrease gravity
vii. Decrease the frequency

Practice Problems Set #3

For the following problems, find:

i. Angular Frequency
ii. Frequency
iii. Position at the given time.
iv. Velocity at that same time
v. Acceleration at that same time
vi. Maximum Velocity
vii. Period

(:1:) A mass of 6.75kg is attached to a spring system with a spring constant of 29.0. It is then set to oscillate at an amplitude of 0.68m. Time for (iii.→v.) : t=1.13

(:2:) A mass of 9.25kg is attached to a spring system with a spring constant of 74.0. It is then set to oscillate at an amplitude of 0.47m. Time for (iii.→v.) : t=2.12

(:3:) A mass of 0.25kg is added to a vertical spring system and the spring extends 97.0m. It is then set to oscillate at an amplitude of 0.51m. Time for (iii.→v.) : t=1.81

(:4:) A mass of 1.25kg is added to a vertical spring system and the spring extends 73.0m. It is then set to oscillate at an amplitude of 0.62m. Time for (iii.→v.) : t=1.5

(:5:) A mass of 0.25kg is added to a vertical spring system and the spring extends 19.0m. You observe that the system has a maximum velocity of 5.4m/s. Time for (iii.→v.) : t=0.3

(:6:) A mass of 8.75kg is added to a vertical spring system and the spring extends 65.0m. You observe that the system has a maximum velocity of 8.1m/s. Time for (iii.→v.) : t=2.41

(:7:) A mass of 9.5kg is added to a vertical spring system and the spring extends 37.0m. The system has a maximum kinetic energy of 23.0J. Time for (iii.→v.) : t=1.08

(:8:) A mass of 1.25kg is added to a vertical spring system and the spring extends 65.0m. The system has a maximum kinetic energy of 31.0J. Time for (iii.→v.) : t=2.41

(:9:) A mass of 6.25kg is added to a vertical spring system and the spring extends 20.0m. The system has a maximum potential energy of 35.0J. Time for (iii.→v.) : t=0.05
(:10:) A mass of 5.0kg is added to a vertical spring system and the spring extends 81.0m. The system has a maximum potential energy of 31.0J. Time for (iii.→v.) : t=0.07

Practice Problems Set #4

(:1:) You explore a planet and bring a 35.0cm long pendulum with you. You find that at small angles, it has a period of 1.62seconds.
i. What is the gravity on the planet?
ii. If you had a 1.88m pendulum, what would its period be?
(:2:) You explore a planet and bring a 2.0cm long pendulum with you. You find that at small angles, it has a period of 1.03seconds.
i. What is the gravity on the planet?
ii. If you had a 4.19m pendulum, what would its period be?
(:3:) You explore a planet and bring a 59.0cm long pendulum with you. You find that at small angles, it has a period of 1.77seconds.
i. What is the gravity on the planet?
ii. If you had a 2.37m pendulum, what would its period be?
(:4:) You explore a different planet and bring a 63cm long pendulum with you. Each day at small angle oscillations, it completes 174500 complete oscillations.
i. What is the period?
ii. What is the gravity on the new planet?
(:5:) You explore a different planet and bring a 90cm long pendulum with you. Each day at small angle oscillations, it completes 154300 complete oscillations.
i. What is the period?
ii. What is the gravity on the new planet?
(:6:) You explore a different planet and bring a 76cm long pendulum with you. Each day at small angle oscillations, it completes 198200 complete oscillations.
i. What is the period?
ii. What is the gravity on the new planet?

For problems (:7:) → (:10:) find the gravity in City B
(:7:) A pendulum oscillating at small angles has a period of 1 second in city A, where the acceleration due to gravity is 9.92 m/s^2. It is taken to city B where it is found to lose 321.0 seconds.

(:8:) A pendulum oscillating at small angles has a period of 1 second in city A, where the acceleration due to gravity is 9.67 m/s^2. It is taken to city B where it is found to lose 211.0 seconds.

(:9:) A pendulum oscillating at small angles has a period of 1 second in city A, where the acceleration due to gravity is 9.68 m/s^2. It is taken to city B where it is found to gain 315.0 seconds.

(:10:) A pendulum oscillating at small angles has a period of 1 second in city A, where the acceleration due to gravity is 9.69 m/s^2. It is taken to city B where it is found to gain 171.0 seconds.

Practice Problems Set #5

For problems (:1:) → (:3:) find:
i. What is the total energy?
ii. What is the maximum kinetic energy?
iii. What is the maximum potential energy?
iv. What is the minimum kinetic energy?
v. What is the minimum kinetic energy?

(:1:) A mass of 8kg is added to a vertical spring system and the spring extends 10cm. It is then set to oscillate at an amplitude of 38cm.

(:2:) A mass of 6kg is added to a vertical spring system and the spring extends 18cm. It is then set to oscillate at an amplitude of 31cm.

(:3:) A mass of 7kg is added to a vertical spring system and the spring extends 11cm. It is then set to oscillate at an amplitude of 47cm.

For problems (:4:) → (:8:) find:
i. What is the system's amplitude?
ii. What is the system's total energy?
iii. What is the mass of the object in the system?
iv. What kinetic energy at this observed time?
v. What is the potential energy at this time?
(:4:) At an observed time, you see that a spring system has a velocity of 1.25m/s at a position of 1.4cm from equillibrium. You also observe an angular frequency of 0.3 radians/sec. The spring also has a spring constant, k=8.0.

(:5:) At an observed time, you see that a spring system has a velocity of 0.5m/s at a position of 1.8cm from equillibrium. You also observe an angular frequency of 0.8 radians/sec. The spring also has a spring constant, k=2.0.

(:6:) At an observed time, you see that a spring system has a velocity of 1.5m/s at a position of 1.6cm from equillibrium. You also observe an angular frequency of 0.5 radians/sec. The spring also has a spring constant, k=9.0.

(:7:) At an observed time, you see that a spring system has a velocity of 1.0m/s at a position of 1.0cm from equillibrium. You also observe an angular frequency of 0.3 radians/sec. The spring also has a spring constant, k=4.0.

(:8:) At an observed time, you see that a spring system has a velocity of 0.5m/s at a position of 0.6cm from equillibrium. You also observe an angular frequency of 0.6 radians/sec. The spring also has a spring constant, k=3.0.

Practice Problems Set #6

For all the following problems, find:
i. Amplitude of Oscillation
ii. Angular Frequency
iii. Maximum Velocity
iv. Period
v. Frequency

(:1:) A particle moving with SHM has velocities of 6.0cm/s and 8.0cm/s at distances of 8.0cm and 6.0cm respectively from its equilibrium position.

(:2:) A particle moving with SHM has velocities of 8.0cm/s and 15.0cm/s at distances of 15.0cm and 8.0cm respectively from its equilibrium position.

(:3:) A particle moving with SHM has velocities of 9.0cm/s and 12.0cm/s at distances of 4.0cm and 3.0cm respectively from its equilibrium position.

(:4:) A particle moving with SHM has velocities of 9.0cm/s and 12.0cm/s at distances of 12.0cm and 9.0cm respectively from its equilibrium position.

(:5:) A particle moving with SHM has velocities of 12.0cm/s and 16.0cm/s at distances of 4.0cm and 3.0cm respectively from its equilibrium position.

(:6:) A particle moving with SHM has velocities of 12.0cm/s and 16.0cm/s at distances of 8.0cm and 6.0cm respectively from its equilibrium position.

(:7:) A particle moving with SHM has velocities of 12.0cm/s and 16.0cm/s at distances of 16.0cm and 12.0cm respectively from its equilibrium position.