SIMPLE HARMONIC MOTION PROBLEMS (RD SEC 12-1, 12-2 first)

Simple Harmonic Oscillators/Waves/

Pendulum Period= $T = 2\pi\sqrt{\frac{L}{g}}$

Spring: Period= $T = 2\pi\sqrt{\frac{m}{k}}$

where k is the spring constant k= Force/distance = ma/x

Period T =1/f , f = 1/T, v = f * WL for any wave

***x = A_0 sin ω t where ω^2 = k/m , ω= angular frequency = 2πf

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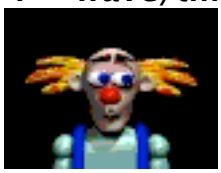
1 A clown is rocking on a rocking chair in the dark. His glowing red nose moves back and forth a distance of 0.42 m exactly 30 times a MINUTE, in

a simple harmonic motion.
Draw a picture

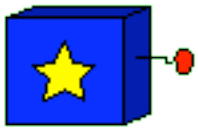
a) What is the amplitude of this motion? ***Amplitude is .21 m***

b) What is the period of this motion? ***30 times a minute…***
Period (T) = time/wave
= 1 min/30 times = 60 sec/30 times = 2 sec/wave

c) What is the frequency of this motion?
f = wave/time = 1 wave/2sec=.5 Hz



d. The top of the clown's hat contains a small light bulb that shines a narrow light beam. The beam makes a spot on the wall that goes back and forth between two dots placed 1.00 m apart as the clown rocks. What are the amplitude, period, and frequency of the motion?
Period and Frequency are the same! (T = 2 sec, f= .5 Hz)
Amplitude is 0.5 m



2) a 5.00 kg block hung on a spring causes a 10.0 cm elongation of the spring.

a) What is the restoring force exerted on the block by the spring?

F restoring = Weight = mg = 5 (9.8) = 49 N

b) What is the spring constant? ***K = F/x = 49 / (.1 m) = 490 N/m***

c) What force is required to stretch this spring 8.5 cm horizontally?

F=kx = 490 (.085)=41.65 N

d) What will the spring's elongation be when pulled by a force of 77.7 N?

F= k x

77.7 = 490 x

x = .1586 m = 15.86 cm

e) According to Section 12-2, what is the period of this oscillation?

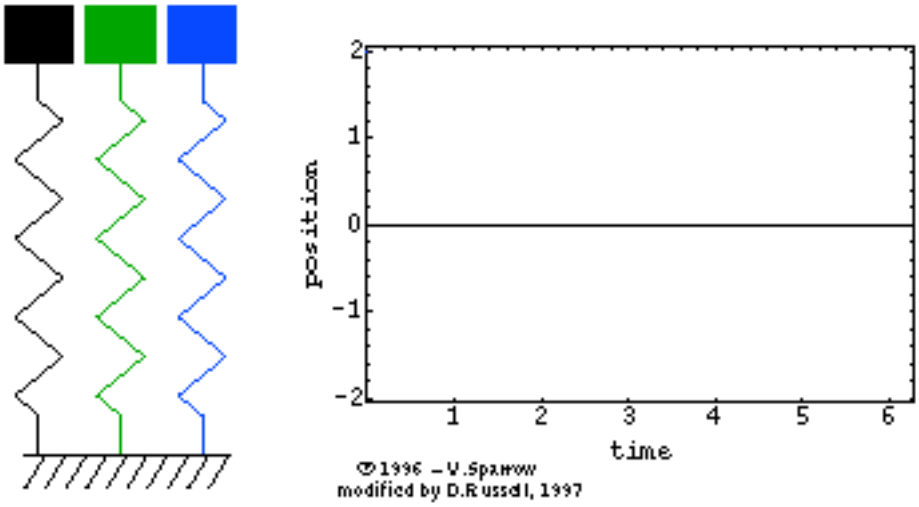
T = 2pi sqrt (m/k)

T = 2 * 3.14159* sqrt (5 / 490) = .6347 sec

Pg. 451 Sec Review:

1) Two mass-spring systems vibrate with simple harmonic motion. If the spring constants of each system are equal and the mass of one is twice that of the other, which system has a greater period?

The one with twice the mass has a greater period by sqrt(2) =1.41 times



2. A child swings on a playground swing with a 2.5 m long chain.

a) What is the period of the child's motion?

for a pendulum T = 2*pi*sqrt (l/g)
= 2*3.14*sqrt(2.5/9.8)
T=3.1735 sec/swing

b) What is the frequency of the vibration?

f = 1/T = 1/3.17=.315 swings/sec=.315 Hz

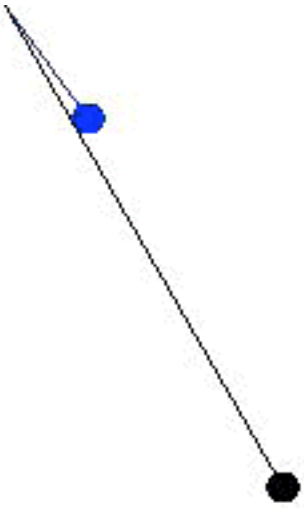
3. A pendulum swings from maximum displacement on one side of equilibrium to maximum displacement on the opposite side of equilibrium. If the pendulum swings through a total of 24°, what is the amplitude of this vibration?

Amplitude = 12 °

Sketch a graph of how the horizontal displacement and velocity would change over time. ***Displacement = cos curve, Vel= sin curve***

**Honors* Find the equation that shows this.

4. The reading on a metronome indicates the number of oscillations per minute. What are the period and frequency of the metronome's vibration when the metronome is set at 180?



180 beats/min = 180 beats/60sec = 3 beats/sec = 3 Hz

By what factor should the length of a simple pendulum be changed if the period of vibration were to be tripled?
A) 3 B) 1/3 ***C) 9*** D) 27

A pendulum with a mass of 0.1 kg was released. The string made an angle of 7 ° with the vertical. The bob of the pendulum returns to its lowest point every 0.1 seconds.

What is the period, frequency, amplitude?

Amplitude = 7°, T = 0.2 seconds, f = 1/.2=5 Hz

The pendulum is replaced by one with a mass of 0.3 kg and set to swing at a 15 ° angle. How do the period and frequency change? Why or why not?
T and f do not change…. Period of a pendulum is NOT affected by mass or amplitude….

If this pendulum was set to keep time and then brought to the moon (gravity is $1/6^{th}$ of Earth), what property would you have to change to make sure it kept the same accurate time? ***Period is affected by length, you would need to change the length by 6 (longer)***

*** Honors**By how much?