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

Simple Harmonic Oscillators/Waves/

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

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

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 = 2$\pi f$
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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*



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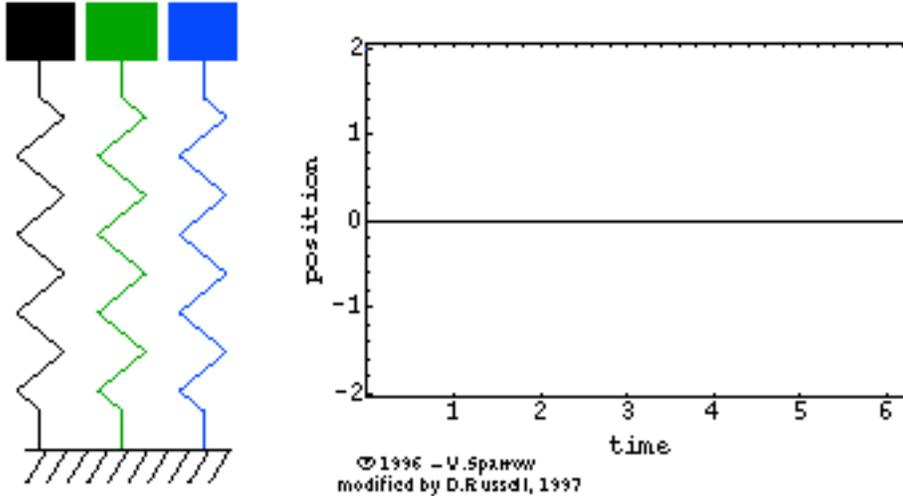
2. A child swings on a playground swing with a 2.5 m long chain.



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?
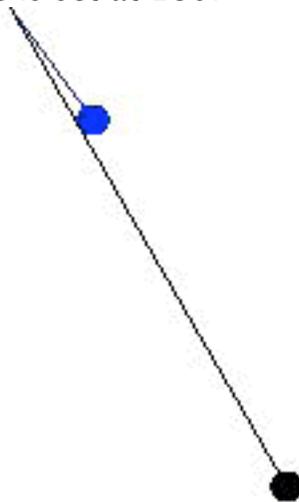*Amplitude = 12 °*
Sketch a graph of how the horizontal displacement and velocity would change over time. *Displacement = cos curve, Vel= sin curve*
**Honors* Find the equation that shows this.

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?