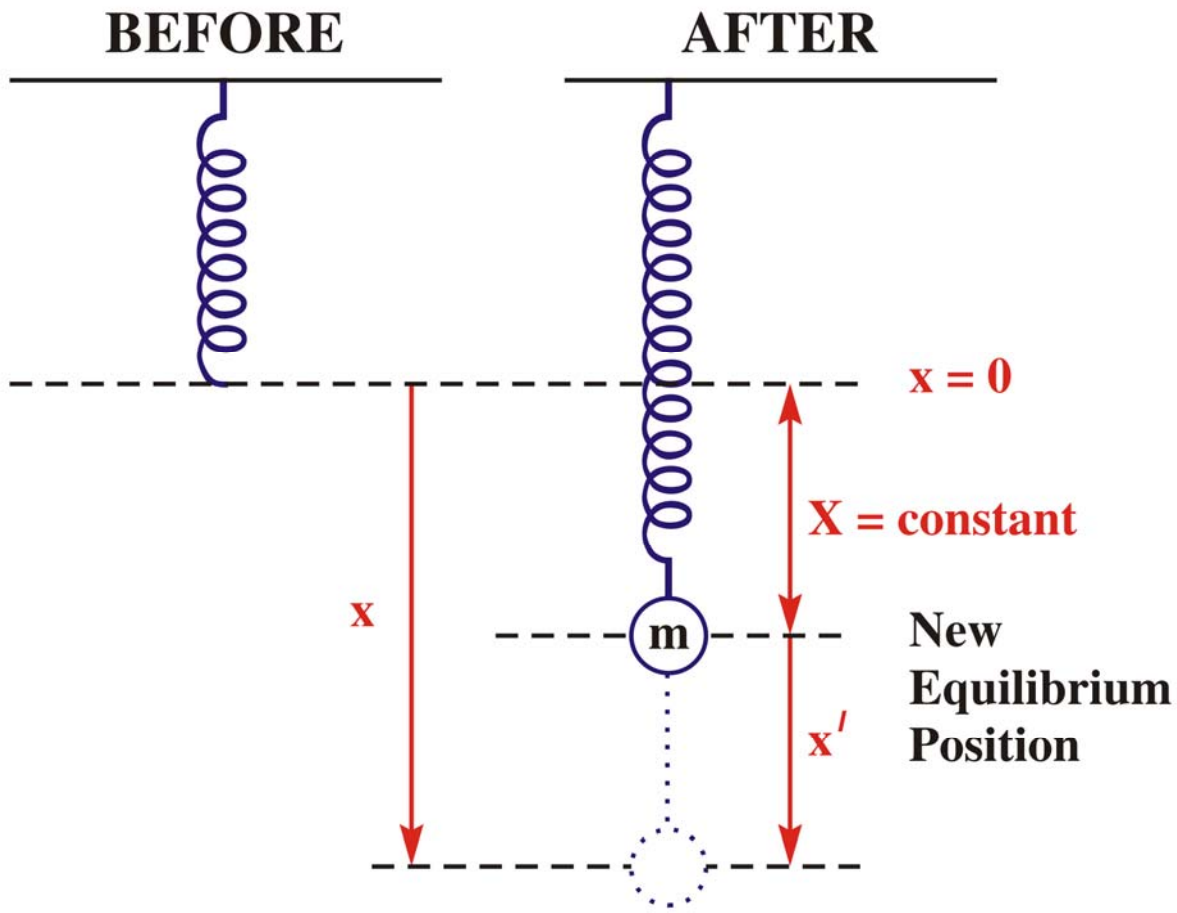
**PHY180F ASSIGNMENT 2 2005**

**Due When: Thursday September 29 by 4:00 P.M.**
**Due Where: In your tutor's drop box in the basement of the Physics building (tower) opposite the elevators. (NOT IN YOUR TUTORIAL)**
**Please include your name, student ID, tutorial section and assignment number.**




1. In class I showed you the diagram above when I explained that the constant force of gravity does not affect the form of the oscillatory motion when a mass hangs on a spring. The reasoning was that a constant force like gravity cannot induce an oscillatory motion and the only effect it has, is to create a new equilibrium position. The conclusion was that the mass **m** executes simple harmonic motion about the new equilibrium position. This was a hand waving argument and not a formal mathematical proof. Your task is to prove mathematically that the mass **m** executes simple harmonic motion about the new equilibrium position. You may use without proof anything that we developed in class. You should start this problem in the same way that we solved the problem of mass and spring on a frictionless table. We wrote down all the forces on the mass and said that the total force must be the force in Newton's second law.

**(OVER)**

2. To answer this question you might like to look at the information the web site:
**http://www.upscale.utoronto.ca/PVB/Harrison/ErrorAnalysis/**
Now answer this question which was actually generated by ERRTST.
You have repeated the measurement of the time for a metal hoop to swing through 20 oscillations 10 times.
The numbers, for each trial, in seconds are:

| | | | | |
|---|---|---|---|---|
| [1] | 31.77 | [6] | 31.56 | Average = 31.91 s. |
| [2] | 31.54 | [7] | 31.84 | |
| [3] | 33.91 | [8] | 31.57 | Std. dev. = 0.69 s. |
| [4] | 31.91 | [9] | 31.58 | |
| [5] | 32.03 | [10] | 31.43 | |

The result for measurement 3 appears to be out of line since without it the average would be 31.69 seconds, and the standard deviation would be 0.20 seconds.

Are you justified in throwing out the third value. Answer with yes or no.

Of course in this assignment you must not only answer with yes or no but you must justify your answer in order to get full marks.

3) a) Consider an arbitrary point (x,y) in the first quadrant. Using a diagram, express $\hat{r}$ in terms of $\hat{i}$ and $\hat{j}$ and express $\hat{\theta}$ in terms of $\hat{i}$ and $\hat{j}$.

b) Convert the vector $\vec{A} = \sin\theta\,\hat{r} - r\cos\theta\,\hat{\theta}$ to Cartesian coordinates.

c) Using a diagram, express $\hat{i}$ in terms of $\hat{r}$ and $\hat{\theta}$ and express $\hat{j}$ in terms of $\hat{r}$ and $\hat{\theta}$.

d) Convert the vector $\vec{B} = x\,y^2\,\hat{i} + x^2\,y\,\hat{j}$ to cylindrical coordinates.

4) Serway, Chapter 4; Number 18