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General Physics I, Midterm 2
PHYS10400, Class year 99
12-02-2010

SN:_____, Name:_____

*Note: This is an **OPEN BOOK** examine. You can bring any materials into the classroom in examine. However, you should work on your examine sheet using your own materials, and no discussion with others are allowed.*
ABSOLUTELY NO CHEATING!

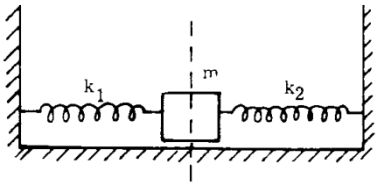
Problems (5 Problems, total 100%)

1. Imagine that a hole is drilled through the center of the Earth to the other side. An object of mass *m* at a distance *r* from the center of the Earth is pulled toward the center of the Earth only by the mass within the sphere of radius *r*. (a) Write Newton's law of gravitation for an object at the distance *r* from the center of the Earth and show that the force on it is of Hooke's law form, $F=-kr$, where the effective force constant is $k = \frac{4}{3}\pi\rho G m$. Here ρ is the density of the Earth, assumed uniform, and *G* is the gravitational constant. (b) Show that a sack of mail dropped into the hole will execute simple harmonic motion if it moves without friction. When will it arrive at the other side of the Earth? (20%)

2. A steel bar, 20 ft long and of rectangular cross-section 2.0 by 1.0 inches, supports a load of 2.0 tons. How much is the bar stretched?

3. A satellite of mass $\mathbf{M_s}$ is placed in a stable circular orbit of Radius **R** around the earth. What is its angular momentum about an axis through the earth perpendicular to the plane of its orbit? Assume that **R**>> radius of the satellite.

4. Refer to the figure on the right; a mass m is confined between two springs of spring constants $\mathbf{k_1}$ and $\mathbf{k_2}$. Assuming all surfaces are frictionless, what is the frequency of the configuration?



5. A pendulum with a bob of mass **M** is raised to height **H** and released. At the bottom of its swing, it picks up a piece of putty whose mass is **m**. To what height **h** will the combination (**M+ m) rises**?