PHYSICS 218 Final Exam

Fall, 2007 STEPS

Name:_____
Signature:_____
Student ID:_____
E-mail:_____
Section Number: _____

- No calculators are allowed in the test.
- Be sure to put a box around your final answers and clearly indicate your work to your grader.
- **All work must be shown to get credit for the answer marked. If the answer marked does not obviously follow from the shown work, even if the answer is correct, you will not get credit for the answer.**
- Clearly erase any unwanted marks. No credit will be given if we can't figure out which answer you are choosing, or which answer you want us to consider.
- Partial credit can be given only if your work is clearly explained and labeled. **Partial credit will be given if you explain which law you use for solving the problem.**

Put your initials here after reading the above instructions:

For grader use only:

Problem 1 (15) _____
Problem 2 (20) _____
Problem 3 (20) _____
Problem 4 (20)_____
Problem 5 (20) _____
Problem 6 (10)_____

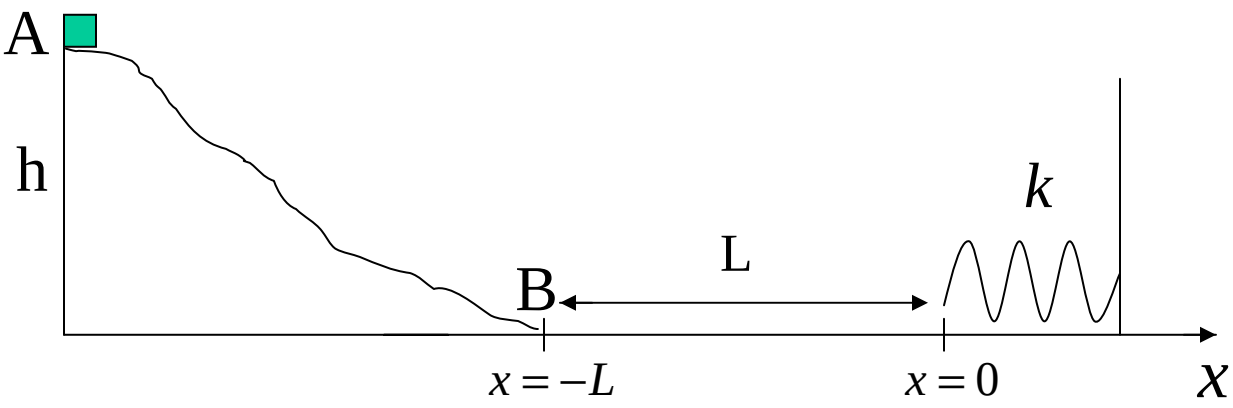
Total (105) _____

Problem 1: (15 points)

An object with mass *m* initially at rest is acted on by a single force $\vec{F} = k_1\vec{i} + k_2 t^2 \vec{j}$, where k_1 and k_2 are known constants. Calculate the velocity of the object as a function of time.

Problem 2: (20 points)

A block of mass *m* slides down a snow-covered hill, height *h*, starting at point A from rest. There is no friction between points A and B, but there is friction on the level ground at the bottom of the hill, between B and the wall. The coefficient of friction is $\mu = \mu_0(1+\alpha x)$, where μ_0 and α are known constants. After entering the rough horizontal region, the stone travels distance *L* and then runs into a very light spring with constant *k*.

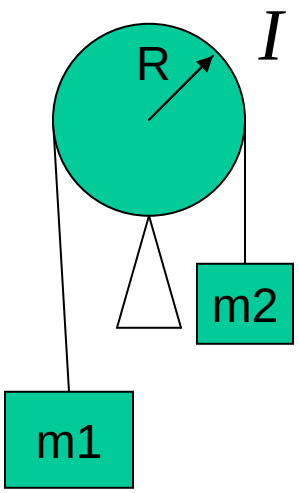


a) Find the velocity of the block at point B.

b) How far will the stone compress the spring if the origin is at the unstretched position? Indicate the method you use to solve the problem. Write the correct equation. Do not solve it.

Problem 3: (20 points)

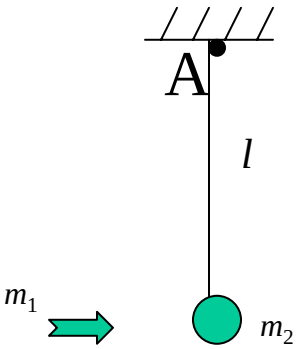
A pulley with radius *R* and moment of inertia about its central axis, *I*, is mounted on frictionless bearings. A massless cord is wrapped around the axle with two masses attached to it. Assuming the cord does not slip, find the acceleration of mass m_1.



Problem 4: (20 points)

A dart, mass m_1, moves horizontally with a velocity of magnitude v_0. It strikes a simple pendulum, a small object, mass m_2, suspended from a massless string of length l. Assume the collision of the dart and the small object takes place so quickly that the string remains vertical during the collision.

a) Find the velocity of the pendulum and embedded dart right after the collision.



b) Find the angular momentum of the pendulum and embedded dart about the point A right after the collision.

c) Find the dependence $\theta(t)$ if the displacement is small ($\sin\theta \approx \theta$).
How long will it take for the pendulum to return to the equilibrium.

Problem 5: (20 points)

An object of mass *m* circles the earth and is **attracted** to it with a force whose magnitude is given by

$$\left|\vec{F}\right| = G\frac{m_E m}{r^2}$$

1) Show that this force is conservative.

2) Find the angular velocity if the radius of the orbit is R.

3) Find the work done by this force if the radius of the orbit is changed from R to 1.5R.

Problem 6: (10 points)

An object with mass m is acted by two forces, both in x direction: $F_1 = -\alpha x$ and $F_2 = -\beta x$. Find the position of this object as a function of time, $x(t)$, if initially the object was at rest at distance x_0 from the origin.