

PHYSICS 218 Final Exam

Fall, 2008 STEPS

Name: _____

Signature: _____

Student ID: _____

E-mail: _____

Section Number: _____

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- 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 (25) _____

Problem 2 (20) _____

Problem 3 (15) _____

Problem 4 (15) _____

Problem 5 (15) _____

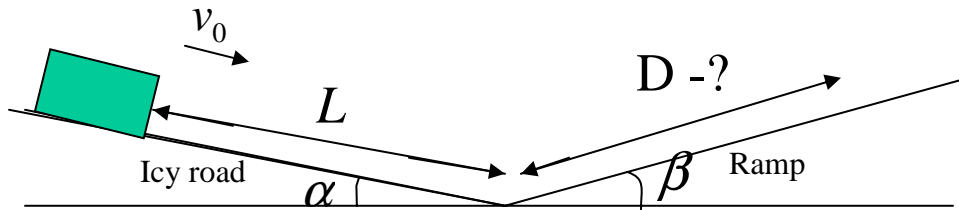
Problem 6 (15) _____

Total (105) _____

Problem 1:

A sled of mass m slides down an icy mountain road of constant downward slope angle α . At $t=0$ the sled starts moving downhill at speed v_0 . After careening downhill a distance L with negligible friction, the sled runs onto a ramp of constant upward slope β .

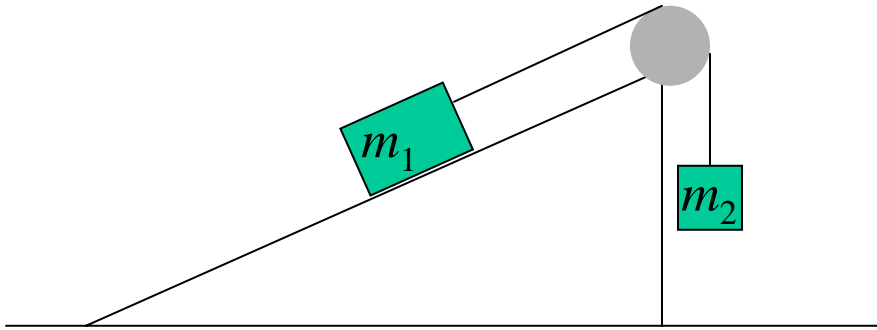
a) If the ramp has a soft sand surface for which the coefficient of friction $\mu = \mu_0(1+x/c)$, where μ_0 and c are known constants, x is the distance along the ramp, what is the distance that the sled moves up the ramp? Do not solve the equation.



b) If the ramp has the coefficient of friction $\mu = \mu_0(1+t/c)$, where t is time, find the distance that the sled moves up the ramp.

Problem 2:

Block of mass m_1 is placed on the frictionless inclined plane of angle θ . It is connected to the block of mass m_2 by unstretchable string of negligible mass. The string pulls without slipping. If the pulley of radius R has moment of inertia I with respect to the axis of rotation, find the acceleration of the block m_1 .



Problem 3:

A block of mass m is connected to a very light spring with constant k . The spring is compressed by amount of L . The surface is frictionless.



a) How far will the block move if it was given initial velocity v_0 ?

b) Show that the motion of the block is described by the equation of harmonic oscillator.

c) Find the period of oscillations.

Problem 4:

A very small object, mass m , is attracted to the origin by a force of magnitude $C \frac{m}{r^4}$, where r is the distance from the origin and C is a known constant.

a) What initial velocity would the object have to be given in order for it to move in a circle if it was originally a distance D from the origin?

b) What is the object's angular momentum about the origin?

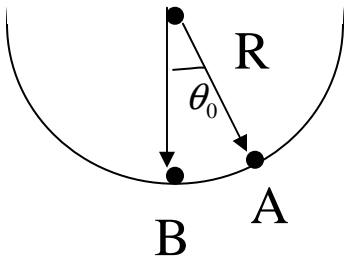
c) What would be the change in the potential energy of the object due to this force if it moved from the point $r=D$ and $\theta=0$ to the point $r=4D$ and $\theta=\pi$?

Problem 5:

Two blocks are sliding on a frictionless table. One, with mass m , has a known velocity of magnitude v_1 in the $+x$ direction. The second, mass $2m$, has a velocity that is at the known angle θ with the x axis and has unknown magnitude, call it v_2 . They collide and stick together and move away from the point of collision with a velocity which makes an angle A with the x axis. What was the original velocity of the second block and the magnitude of the final velocity?

Problem 6

A small rock with mass m is released from rest at point A (angle θ_0 from the vertical). The hemispherical bowl has radius R . Assume that the size of the rock is small compared to R , so that the rock can be treated as a particle, and assume that the rock slides rather than rolling. The surface of the bowl is frictionless. 1) Find the position of the rock as a function of time ($\theta(t)$). (Point A is very close to point B, you can use the small angle approximation $\sin\theta \sim \theta$).



2) How long will it take for the rock to return to the point B at the bottom of the bowl?