# UNIVERSITY OF MARYLAND

## Department of Physics

University of Maryland — M. Laurenzi
Physics 161
10-28-05 — Name______________________________
Exam II
Chapters 5, 6 and 7

Each question is worth a total of 100 pts. The points will be distributed evenly by dividing 100 by the number of sub-questions. The grade you receive will be a percent grade. *For problems which involve numbers use only one significant figure.* For all the problems, your answers will be evaluated in part on how you arrived at them. Little or no credit will be given for answers that do not show how you got them. Partial credit will be considered when the steps to the answer are correct, even if the final solution is wrong. More partial credit will be given for clear, neat logical attempts at solutions and less to those that are hard to understand.

Solve the following problems completely for full credit. **Please do your work under the problem on the exam page NEATLY.** Please do not write on backs of pages there is a blank sheet after each problem if you need more space. **Please make a box around your final answer.** The test is closed books, notes and classmates. Do the questions that you find less challenging first. Then follow up with those that seem to be more difficult. Best of Luck…..

At the end of the exam, write and sign the honor pledge in the space below: " I pledge to my honor that I have not given nor received any unauthorized assistance on this examination."

$$x_f - x_i = v_0 t + \frac{1}{2}at^2$$

$$v_f^2 = v_0^2 + 2a(x_f - x_i)$$

$$v_f = v_0 + at$$

$$v_y = v_o \sin\theta$$

$$v_x = v_0 \cos\theta$$

$$\int \frac{du}{u} = \ln u \Big|_{u_i}^{u_f}$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$W_c = \vec{F} \bullet \Delta\vec{X} = F \bullet \Delta X \bullet \cos\vartheta$$

$$\left|\vec{F}_f\right| = -\mu_k \left|\vec{N}\right|$$

$$W_{nc} = \Delta KE + \Delta PE_g + \Delta PE_s = \vec{F}_f \bullet \Delta\vec{X}$$

$$\Delta KE = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

$$\Delta PE_g = mgy_f - mgy_i$$

$$\Delta PE_s = \frac{1}{2}kx_f^2 - \frac{1}{2}kx_i^2$$

1. At constant velocity, a 10kg block is pushed from the ground up a wall that has a coefficient of kinetic friction $\mu_k = 0.3$ by a force of magnitude F applied to the left side of the block at an angle of $30^\circ$ relative to the horizontal. After the block travels 4m up the wall *the force vanishes*.

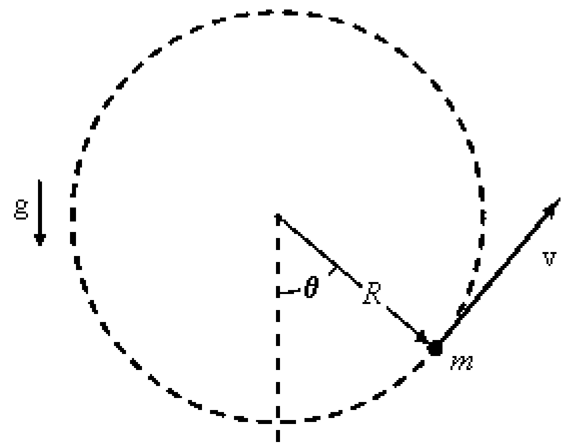
*a) Draw a free body diagram and find the net force in the x and y directions.*
*b) What is the force of gravity?*
*c) What is the magnitude of the normal force between the block and the wall?*
*d) Determine the work done by the force in moving the block 4m up the wall.*
*e) How much potential energy is transferred to the block after being pushed up the wall?*
*f) When the force vanishes will the block remain touching the wall? (yes or no)*
*g) When the force vanishes assume that that block is in a state of free fall. Find the velocity of the block after it has fallen 4m (hits the mathematical ground at y = 0).*

2. A block situated on a rough incline is connected to a mass-less spring of having a spring constant of k. The block is released from rest when the spring is in an un-stretched state. The block travels in a direction parallel to the incline a distance d and comes to rest.

a) *Find the coefficient of kinetic friction* $\mu_k$ *as a function of θ.*

b) *Now calculate what is* $\mu_k$ *by using the following constants:*

$$m = 5kg \text{ , } g = 9.8\frac{m}{s^2}\text{, } \theta = 45°\text{, } k = 1\frac{kg}{s^2} \text{ and } d = 1m \text{ .}$$




3. Consider a 5kg mass attached to a mass-less string where the motion is circular and confined to a circular plane vertical plane. There are no resistive forces acting on the mass gravity is the only external force that acts on the system. Use the appropriate Law of Newton to find:

a) The tension in the string as function of θ.

Now assume that the Radius R=1m and the velocity is $2\frac{m}{s}$.

b) Find $T_{max}$ (the maximum tension) and $T_{min}$ (the minimum tension) of the string.

4. Consider the motion of an object moving through a viscous medium. The object falls from $y_{max}$ with an *initial velocity of zero* for some time t. The air resistance term in the force equation is –bv. Where b is a constant of proportionality and v is the velocity of the object.

$$-m\frac{dv}{dt} = -mg + bv$$

Solve the following equation of motion to find the velocity of the object as time. Use the following steps to make your job easier.

a) *Separate the variables of velocity and time.* $\int_0^{v_f} \frac{dv}{g - \frac{b}{m}v} = \int_0^t dt$ *(given)*

b) *Use u substitution and integrate both sides of the equation.*

c) *Now multiply both sides of the equation by a minus one so you can flip the terms in the argument of the natural log.*

d) *Now use the inverse natural log function e to bring the final velocity out of the argument of the natural log.*

e) *Solve the equation by isolating the final velocity.*

f) *Return to the original equation of motion and set the acceleration to zero and find the terminal velocity.*

g) *Insert the terminal velocity into the equation for final velocity that you got from part e).*

h) *Now finally consider velocity of the object in the limit that time travels to infinity. Compare this result to the result from f).*