**Engineering Physics I Fall 2015 – Practice Midterm 2**
**Name:**

*You have 1 hour and 15 minutes to complete this exam.*
*You may not use your notes, textbook, or calculators.*

*Read all questions carefully and show your work as much as possible for partial credit. Circle your final answers. Be careful with units!*

*Remember these problem solving tips:*

- *Include units in your answer and check that your units make sense*
- *Compare your answer to your intuition*
- *Draw a picture of the scenario described in the problem*

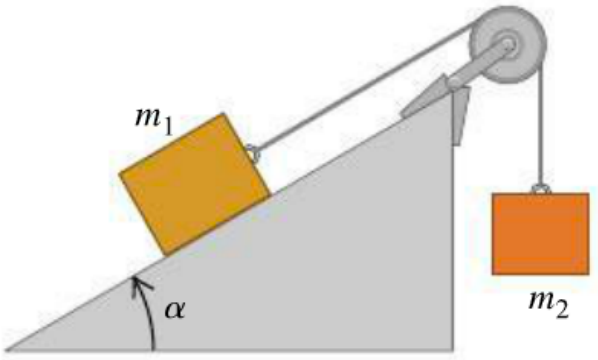
*There are 5 problems. Good luck!*

**Problem 1 (15 points)**


A block of mass 5 kg is moving to the right with an initial velocity of 4 m/s. I apply a force of 10 N for 5 seconds.
Let g = 10 m/s$^2$.

a) Draw a graph of the block's velocity as a function of time. Ignore friction.
b) What is the block's velocity at time 10 seconds? (Again ignoring friction.)
c) If the coefficient of static friction $\mu_k = 0.5$, what is the net force on the block? Draw a graph of the block's velocity as a function of time in the case with kinetic friction.

**Problem 2 (25 points)**



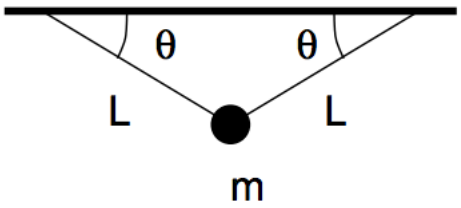

Two blocks are attached by a massless rope as shown in the figure. Block 1 has mass $m_1$ and is located on a ramp that is inclined at an angle α with respect to the horizontal. Block 2 has mass $m_2$ and hangs vertically from a frictionless pulley as shown. Ignore friction.

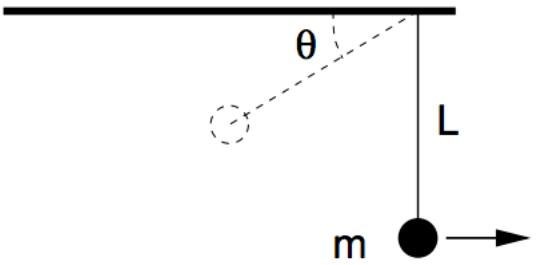
a) Draw the free body diagram for both blocks.

b) If the blocks are in equilibrium, what is the ratio of $m_1$ to $m_2$?

c) If block 1 is sliding down the ramp with an acceleration $a$, what is the *apparent weight* of block 2?

**Problem 3 (20 points)**

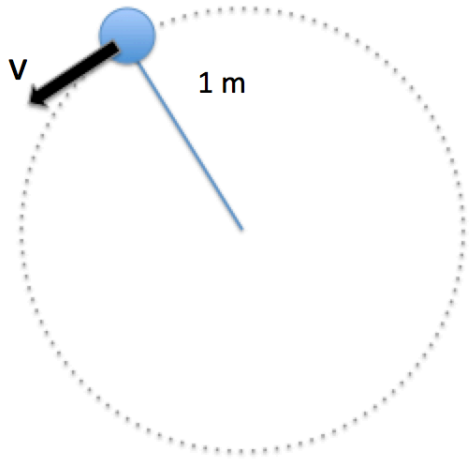



A ball of mass *m* is hanging from two strings of length L as shown in the left figure. The strings make an angle θ = 30° with respect to the ceiling (sin 30° = 1/2, cos 30° = √3/2; tan 30° = 1/√3). The strings are massless.

a) Draw a free body diagram for the mass.
b) Find the tension in each string.
c) At a later time, I cut the string on the left and the ball swings down as shown in the right hand figure. What is the speed of the ball when it reaches its lowest point?

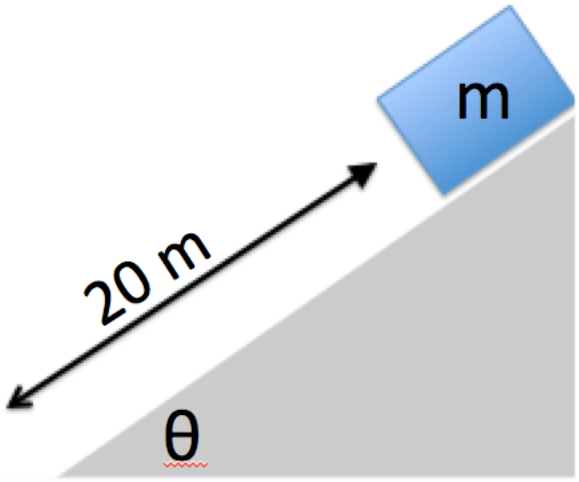
**Problem 4 (10 points)**




A ball of mass 2 kg is attached to a string of length 1 m. The ball is whirled around in a horizontal circle on a frictionless surface. The figure to the left shows the ball and string and the ball's motion as viewed from above.

a) Draw a free body diagram for the ball
b) What is the net force on the ball?
c) If the string can support a maximum tension of 50 N without breaking, what is the ball's maximum speed?

**Problem 5 (30 points)**




A block of mass $m$ = 5 kg sits on a ramp, which is inclined with respect to the horizontal so that the mass just overcomes static friction and begins to slide down the ramp (from rest). The angle $\theta = 60°$ ($\cos 60° = 1/2$, $\sin 60° = \sqrt{3}/2$; $\tan 60° = \sqrt{3} = 1.7$). Use $g = 10$ m/s$^2$.

a) What is $\mu_s$?

b) The block starts from rest and slides a distance of 20 meters down the ramp. How much work does the gravitational force do on the block during its slide down the ramp?

c) If $\mu_k = 0.1$, how much work does friction do on the block during its slide down the ramp?

d) Using the work-energy theorem, what is the block's final speed?