MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Physics

Physics 8.01X Fall Term 2002

# QUIZ 2

**Name:** _____

**Recitation Section:** _____

| **Recitations:** | | | |
|---|---|---|---|
| | R01 TR 10-11 | 26-168 | D. Litster |
| | R02 TR 11-12 | 26-168 | D. Litster |
| | R03 TR 1-2 | 24-402 | G. Roland |
| | R04 TR 2-3 | 24-402 | G. Roland |
| | R05 TR 3-4 | 24-402 | F. Zhou |
| | R06 TR 10-11 | 26-210 | M. Borthwick |
| | R07 TR 11-12 | 26-210 | M. Borthwick |

**Problem 1:** (20 points) _____

**Problem 2:** (25 points) _____

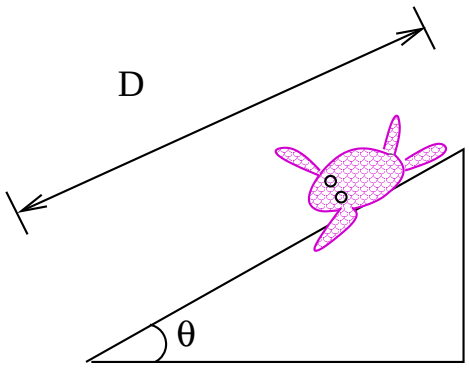
**Problem 3:** (25 points) _____

**Problem 4:** (30 points) _____

**Total:** (100 points) _____

The following exam consists of four problems on 9 pages including this one, plus one page of log-log paper. Answers without work will not be given any credit. **Please check every page of this exam and make sure you do every part of every problem.**

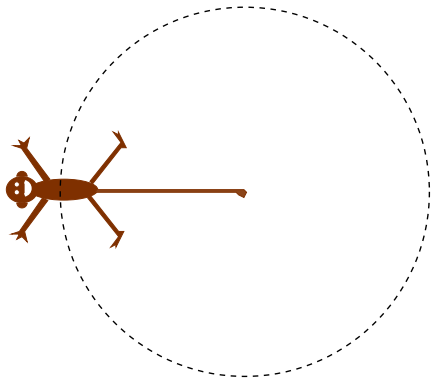
**Problem 1:**




The Sparkly Frog slides down a ramp angled at $\theta = 25°$ to the floor. The ramp is $D = 1.5$ m long and is coated with a gooey substance that provides friction. What is the smallest coefficient of static friction $\mu_s$ such that the Frog will not slide down the ramp?

**Problem 2:**

A child swings her stuffed monkey toy by the tail in a counter-clockwise horizontal circle of radius 0.5 m. The monkey's mass is 0.5 kg. The tail is a bit chewed-on and frayed and can only withstand a tension of about 20 N.



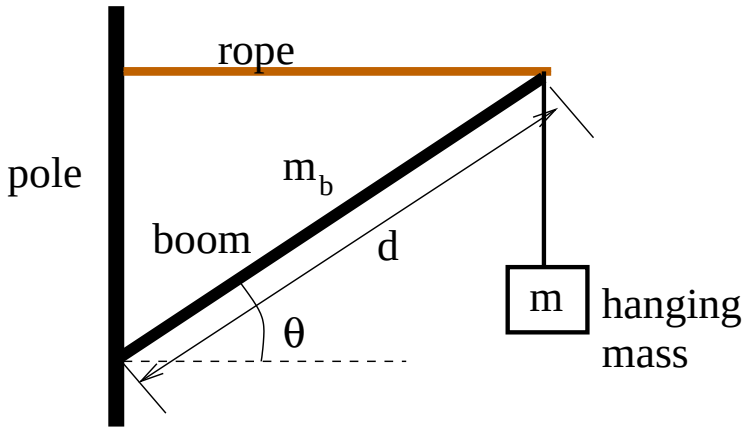
a. (9 points) What is the maximum speed with which the child can swing the monkey so that the tail does not break?

b. (8 points) What are the magnitude and direction of the angular velocity $\vec{\omega}$ corresponding to that maximum speed?

c. (8 points) Suppose the monkey is initially in uniform circular motion and then starts slowing down. What is the direction of the angular velocity after it starts slowing down (but before the monkey stops?) Sketch the acceleration vector $\vec{a}$ of the monkey just before it starts slowing down. Then, sketch the acceleration vector as it is slowing down.

**Problem 3:**

Consider the crane shown in the figure. A boom of length $d$ and mass $m_b$ is hinged to a pole making an angle $\theta$ with the horizontal. A horizontal rope attached to the pole under tension supports the end of the boom. A mass $m$ is hanging downward from the end of the boom (on a different rope). You may assume that the center of gravity of the boom is at the middle of the boom. Assume that the hinge where the boom is attached to the pole applies a force to the boom at an angle $\alpha$ with respect to the horizontal. Express your answers in terms of $g$, $\theta$, $m$, $m_b$.




a. (9 points) What is the tension in the rope?

b. (8 points) What is $\alpha$?

c. (8 points) What is the magnitude of the force of the hinge on the boom?

**Problem 4:**

For this problem you may use the log-log paper provided but you are not required to. In Experiment FM, the following data were taken:

| Center to center distance $S_c$ between magnets (mm) | Force $F_m$ on upper magnet (N) |
|---|---|
| 25 | 0.055 |
| 20 | 0.086 |
| 10 | 0.34 |

a. (15 points) Calculate the power law dependence of the force between the magnets as a function of distance between the centers of the faces, i.e. calculate the power $b$ in the expression $F_m = aS_c{}^b$.

b. (15 points) If you place $N_1$ pennies in the cup to balance the magnets at $S_c = 20$ mm, how many are needed to balance it at $S_c = 10$ mm? (You can ignore the mass of the cup and magnets.)