

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Physics

Physics 8.01X

Fall Term 2002

QUIZ 3

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: (30 points) _____

Problem 3: (20 points) _____

Problem 4: (30 points) _____

Total: (100 points) _____

The following exam consists of four problems on 9 pages including this one. 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.**

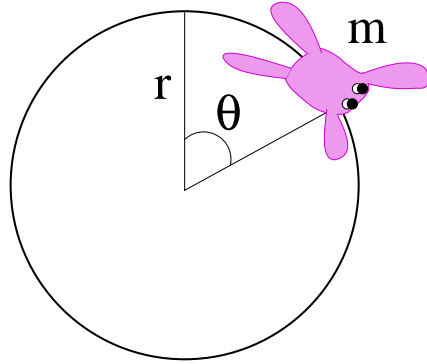
Problem 1:

You have purchased a batch of defective baseballs. For some unknown reason, they tend to explode. You toss one of these balls straight up. While in mid-air, it explodes into two fragments, one of which has mass $m_1 = 0.2$ kg; the other has mass $m_2 = 0.10$ kg. The two fragments land on the ground at the same time. The heavier fragment lands 3.0 m to your left. The lighter fragment lands to your right in some thick grass.

Where should you look for the fragment?

Problem 2:

The Sparkly Frog of mass m starts from rest at the top of a solid sphere of radius r and slides down its frictionless surface. It flies off the sphere at angle θ . The picture shows the sphere and Frog from the side.



- (11 points) What is the kinetic energy of the Frog when it just flies off the sphere, in terms of quantities given, and g ?
- (11 points) Calculate the angle θ .
- (8 points) If friction were present, would the Frog fly off at a greater or lesser angle? Explain.

Problem 3:

You are driving down a steep mountain road at 20 m/s. You and your car have mass 1500 kg. The angle of incline of the road is 30 degrees. Suddenly, a deer bounds out into the road and you slam on the brakes. You skid for 30 m and manage to stop just in time.

By how many degrees do the tires heat up as a result of the skid? Assume that for each joule of energy absorbed by one tire, it heats up by 4×10^{-5} degrees Celsius, and that 50% of the heat energy generated by the skid is absorbed by the tires.

Problem 4:

The rubber bands in experiment VS have spring constant k and are attached to a mass m . The rubber bands are initially stretched a distance y from the equilibrium position and the mass is released from rest. Answer in terms of the quantities given. Assume no friction and that the rubber bands themselves are massless.

- a. (6 points) What is the period of oscillation of this system?
- b. (6 points) What is the velocity of the mass when it reaches the equilibrium position?
- c. (12 points) Write expressions for the position, velocity and acceleration of the mass as a function of time t , assuming the mass is released at $t = 0$.
- d. (6 points) When the mass has sprung up to the top of its trajectory, a second mass $m_2 = 2m$ is attached to the first mass, completely inelastically. What is the new period of the system?