MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Physics

Physics 8.01 Fall 2003

MAKE-UP EXAM 2
Tuesday, November 4, 2003

FAMILY (Last) NAME

GIVEN (First) NAME

Student ID Number

Your Recitation (check one)

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Instructions:

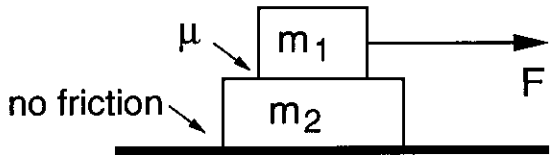
1. SHOW ALL WORK. All work must be done in this booklet. Print your name on each sheet.
2. One 8 ½ x 11 sheet of notes allowed.
3. This is a closed book exam.
4. CALCULATORS, BOOKS, COMPUTERS and CELL PHONE are NOT ALLOWED.
5. Do all FOUR (4) problems.
6. Extra pages provided.
7. Exams will be collected 5 minutes before the hour.

Problem	Maximum	Score	Grader
1	15		
2	15		
3	15		
4	15		
TOTAL	60		

R17	TR 12:00		Maria Chan
R23	TR 11:00		Maria Chan
R12	TR 1:00		Min Chen
R13	TR 2:00		Min Chen
R14	TR 3:00		Min Chen
R01	MW 1:00		Bruno Coppi
R05	MW 2:00		Bruno Coppi
R09	MW 1:00		Qudsia Ejaz
R06	MW 2:00		Paul Joss
R07	MW 3:00		Paul Joss
R08	MW 4:00		Paul Joss
R02	MW 2:00		Young Lee
R03	MW 3:00		Young Lee
R15	TR 10:00		Hong Liu
R16	TR 11:00		Hong Liu
R21	TR 2:00		David Pritchard
R22	TR 3:00		Gunther Roland
R25	TR 1:00		Gunther Roland
R04	MW 1:00		Brian Ross
R19	TR 10:00		Brian Ross
R10	MW 2:00		Senthil Todadri
R11	MW 3:00		Senthil Todadri
R18	TR 9:00		Vladan Vuletic
R24	TR 12:00		Vladan Vuletic
R20	TR 11:00		Xiao-Gang Wen

Problem 1: Dynamics (15 pts)

Two blocks of mass m_1 and m_2 are put on a frictionless level surface as shown in the figure below. The static coefficient of friction between the two blocks is μ. A force F acts on the top block m_1.



(a) When the force F is small, the two blocks move together. Draw the free-body diagrams of the block m_1 and the block m_2.

(b) Find the acceleration of the two blocks for small F.

(c) Find the magnitude of the force F above which the block m_1 starts to slide relative to the block m_2.

Problem 2: Circular motion (15 pts)

A car of mass $m = 1000kg$ is traveling around a flat circular race track of radius $100m$. The static coefficient of friction between the tire and the road (against transverse motion) is $\mu = 0.5$. (Assume $g = 10m/s^2$)

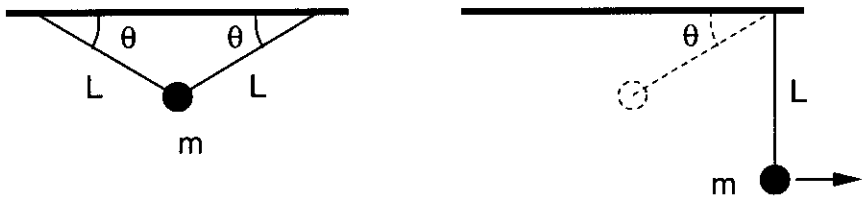
(a) How fast can the car travel before it starts to skid? Express the speed in the units of m/s.

(b) What is the angular velocity ω of the car at the speed calculated in (a).

(c) The driver of the car wants to drive faster. He loads $500kg$ of weight into the car to increase the friction force. Now how fast can the car travel without skidding?

Problem 3: Balance and energy (15 pts)

A block of mass m is tied to two strings as shown in the figure below. Each string has a length L. The angle $\theta = 30°$. ($\sin\theta = 1/2$ and $\cos\theta = \sqrt{3}/2$.) Assume the strings are massless.



(a) Draw the free-body diagram of the block.

(b) Find the tension of each string.

(c) We cut one string and the block starts to swing down. Find the speed of the block when it reaches the lowest point.

(d) Find the tension in the string when the block reaches the lowest point.

Problem 4: Power

A small car's engine can deliver $90kW$ of power (about 120hp). The car's mass is $1000kg$. (Assume $g = 10m/s^2$)

(a) (b)

(a) Assume the total resistive force is proportional to the velocity: $F_{friction} = \alpha v$. The drag coefficient α is $\alpha = 100Ns/m$. How fast can the car move on a level road? Express the speed in the units of m/s.

(b) How fast can the car travel up a slope if we ignore all friction? The angle of the slope is θ ($\sin(\theta) = 3/5$ and $\cos(\theta) = 4/5$). Express the speed in the units of m/s.