MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Department of Physics

Physics 8.01 Fall 2003

EXAM 2

Friday, October 24, 2003

FAMILY (Last) NAME

GIVEN (First) NAME

Student ID Number

Your Recitation (check one)

→

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

Name: _____

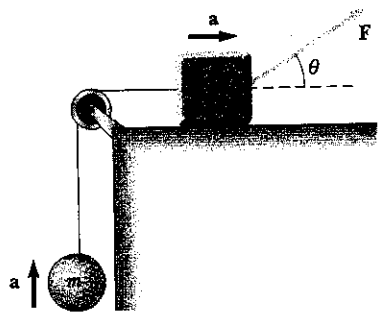
Problem 1: Dynamics (15 points)

A block of mass 3M on a rough, horizontal surface is connected to a ball of mass M by a massless cord passing over a massless, frictionless pulley. A force of magnitude F = 4Mg at an angle θ to the horizontal is applied to the block as shown. The coefficient of kinetic friction between the block and the surface is $\mu = 1/3$. Assume $\sin\theta = 3/5$ and $\cos\theta = 4/5$. Give all your answers in terms of M and g.

a) Draw free-body diagrams for the block, ball and the pulley.

b) What is the acceleration $\vec{a}$ (magnitude AND direction) of the blocks?

c) What is the tension in the string?



Name: _____

Problem 2: Circular Motion (15 points)

A ball of mass M is attached to a vertical rod by two massless strings of length 5L. The ball rotates about the rod in a horizontal circle. The time for one complete rotation is P. Give all your answers in terms of M, g, L and P. Assume both strings are under tension.

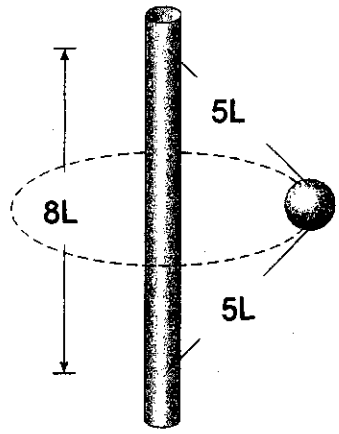
a) Draw a free-body diagram showing all forces acting on the ball.

b) What is the speed of the ball?

c) What is the acceleration $\vec{a}$ of the ball when it is located as shown in the plane of the page.

d) What is the tension T_1 in the upper string?

e) What is the tension T_2 in the lower string?



Name: _____

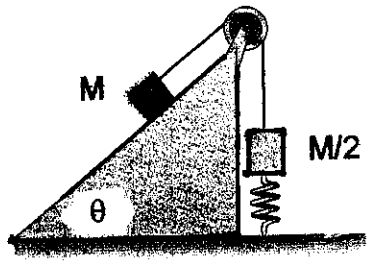
Problem 3: Energy (15 points)

A block of mass M is connected to a block of mass M/2 by a massless string that passes over a massless pulley. Ignore friction. The block M/2 is connected to a spring with spring constant k which is anchored to the floor. The spring is initially unstretched. The block M is pulled down a distance L stretching the spring the same amount. The block M is released from rest. Assume $\sin\theta = 1/2$ and $\cos\theta = \sqrt{3}/2$. Give all your answers in terms of M, L, g and k.

a) Draw a free-body diagram for each block showing all the forces acting.

b) What is the speed of each block when the masses move a distance L and the spring is again unstretched?

c) How high up the plane measured from the unstretched position will the block move until its velocity is zero? Assume that the tension in the string vanishes after the blocks have moved a distance L.



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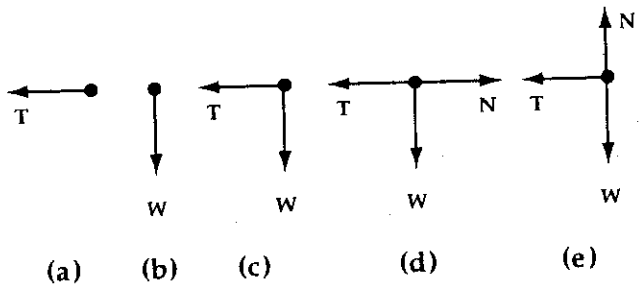
Problem 4: (15 Points)

Circle the correct answer for parts a, b, c, d and e.

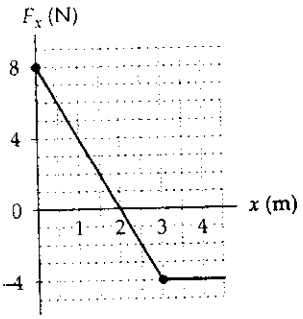
a)

A rock attached to a string swings in a vertical circle. Which free body diagram could correctly describe the force(s) on the rock when the string is in one possible horizontal position?



b)

A 1.5-kg object moving along the x axis has a velocity of +4.0 m/s at $x = 0$. If the only force acting on this object is shown in the figure, what is the kinetic energy of the object at x = +3.0 m?



a. 18 J
b. 21 J
c. 23 J
d. 26 J
e. 8 J

c)

Two clowns are launched from the same spring-loaded circus cannon with the spring compressed the same distance each time. Clown A has a 40-kg mass; clown B a 60-kg mass. The relation between their speeds at the instant of launch is

a. $v_A = \frac{3}{2} v_B$.

b. $v_A = \sqrt{\frac{3}{2}} v_B$.

c. $v_A = v_B$.

d. $v_B = \sqrt{\frac{3}{2}} v_A$.

e. $v_B = \frac{3}{2} v_A$.

d)

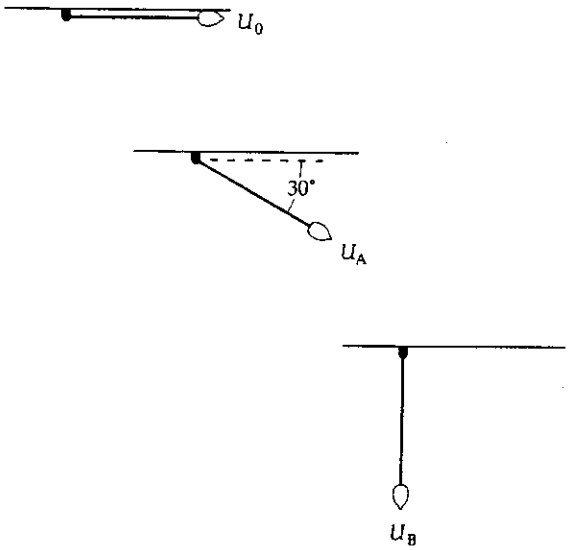
The force a spring exerts on a body is a conservative force because

a. a spring always exerts a force opposite to the displacement of the body.
b. a spring always exerts a force parallel to the displacement of the body.

d. the work a spring does on a body is equal and opposite for compressions and extensions of equal magnitude.
e. the net work a spring does on a body is zero when the body returns to its initial position.

e)

A pendulum bob has potential energy U_0 when held taut in a horizontal position. The bob falls until it is 30° away from the horizontal position, when it has potential energy U_A. It continues to fall until the string is vertical, when it has potential energy U_B. Compare its potential energies at O, A, and B.



a. $U_0 = U_A = U_B$.
b. $U_A - U_B = 2U_0$.
c. $U_A - U_B = U_0 - U_A$.
d. $U_0 = U_B = 2U_A$.
e. $U_0 - U_A = 2(U_A - U_B)$.

Sin 30° = ½

Cos 30° = $\sqrt{3}$ / 2