

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Physics

Physics 8.01

Fall 2004

EXAM 2
Friday, October 29, 2004

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FAMILY (Last) NAME

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GIVEN (First) NAME

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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. Please put a box around your final answer.
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. Do not start working until told to do so. Exams will be collected 5 minutes before the hour.

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

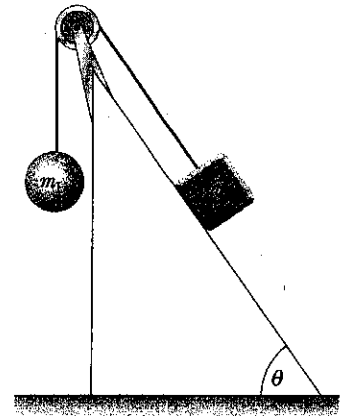
R15	TR 10:00	Roman Barankov
R16	TR 11:00	Roman Barankov
R01	MW 1:00	Wit Busza
R02	MW 2:00	Wit Busza
R03	MW 3:00	Wit Busza
R23	TR 11:00	Serkan Cabi
R24	TR 12:00	Serkan Cabi
R04	MW 1:00	Bruno Coppi
R05	MW 2:00	Bruno Coppi
R11	MW 3:00	Bruno Coppi
R14	TR 3:00	Qudsia Ejaz
R25	TR 1:00	Qudsia Ejaz
R20	TR 11:00	Michael Feld
R21	TR 2:00	Michael Feld
R22	TR 3:00	Michael Feld
R06	MW 2:00	Paul Joss
R07	MW 3:00	Paul Joss
R08	MW 4:00	Paul Joss
R13	TR 2:00	Chris Kouvaris
R09	MW 1:00	Christoph Paus
R10	MW 2:00	Christoph Paus
R12	TR 1:00	Rishi Sharma
R17	TR 12:00	Rishi Sharma
R18	TR 9:00	Vladan Vuletic
R19	TR 10:00	Vladan Vuletic

Name: _____

Problem 1: Dynamics $F=ma$ (15 Points)

Two objects, m_1 and m_2 are connected by a light string that passes over a frictionless pulley. Ignore the masses of the string and the pulley. The coefficient of friction between m_2 and the incline is $\mu = 1/3$. Assume $m_1 = M$ and $m_2 = 3M$. $\sin \Theta = 4/5$ and $\cos \Theta = 3/5$. All answers must be stated in terms of M and g . Hint: Assume m_1 accelerates upwards.

- Draw free-body diagrams for each object showing all forces acting on them.
- What is the tension in the string?
- What are the accelerations of the masses m_1 and m_2 ?

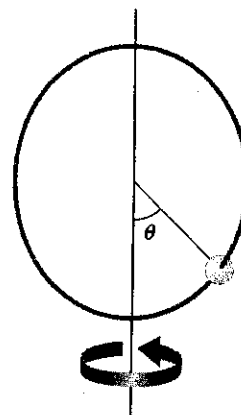


Name: _____

Problem 2: Rotating Bead (15 Points)

A bead of mass, m , can slide with no friction on a wire that is bent into a circular hoop of radius R . The circle is in a vertical plane and rotates steadily about a vertical diameter with a period T . The position of the bead is described by the angle, Θ , that the radial line, from the center of the hoop to the bead, makes with the vertical. All answers must be given in terms of m , R , T , g , and Θ .

- What is the magnitude of the velocity, v , of the bead in its circular motion?
- What is the acceleration, a , of the bead? Show a on your diagram.
- What is the normal force, N , that the wire exerts on the bead? Show N on the figure. Show all other forces acting on the bead.
- At what angle, Θ , does the bead stay motionless relative to the wire?

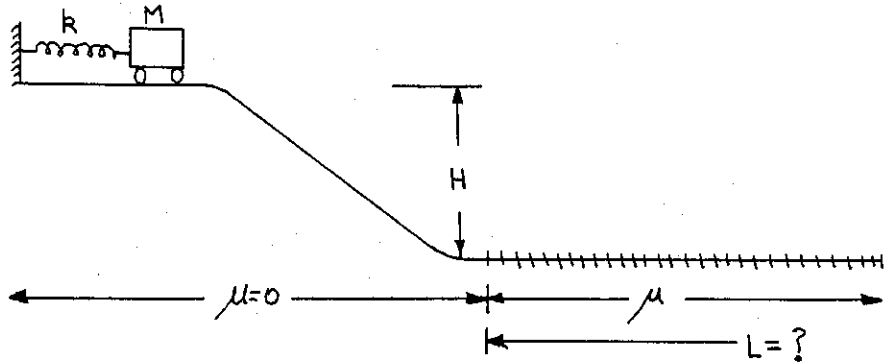


Name: _____

Problem 3: Conservation of Energy/Work (15 Points)

A car of mass M rests on a track as shown in the figure. The track is level at both ends but the left end is H meters higher than the right end. At the left end there is a spring with one end attached to the track. The spring constant is K . The car is not attached to the spring. The car travels without friction on the track until it reaches the horizontal surface at the bottom where there is a braking area with a coefficient of friction, μ , marked with cross-hatch in the figure. Initially the car is just touching the spring. Give all your answers in terms of M , K , H , D , g and μ .

- First the car is pushed into the spring compressing it D meters. How much work is done on the spring in the process?
- Now the car is released. What is the magnitude of the velocity, v_0 , of the car as it leaves the spring?
- What is the magnitude of the velocity of the car, v_F , just before it reaches the braking area?
- How far, L (meters), on the braking area will the car travel before coming to rest?



Problem 4: Multiple Choice (15 Points)

Circle the correct answer for parts a, b, c, and d. If no answer is correct, do NOT circle any part.

- a) A constant force F is applied to a body of mass m that initially is headed east at velocity v_0 until its velocity becomes $-v_0$. The total time of travel is $2t$. The total distance the body travels in that time is

a. $\frac{1}{2} \frac{F}{m} t^2$.

b. $\frac{F}{m} t^2$.

c. $v_0 t - \frac{1}{2} \frac{F}{m} t^2$.

d. $2v_0 t - 2Ft^2/m$.

e. $2v_0 t + 2Ft^2/m$.

- b) A rock attached to a string swings in a vertical circle. At the highest point:

a. Two forces act on the rock, and their resultant is not zero.

b. Only one force acts on the rock.

c. Two forces act on the rock, and their resultant is zero.

d. Three forces act on the rock.

e. No forces act on the rock.

- c) The same constant force is used to accelerate two carts of the same mass on frictionless tracks. The force is applied to cart A twice as long as it is applied to cart B. The work the force does on A is W_A ; that on B is W_B . Which statement is correct?

a. $W_A = W_B$.

b. $W_A = \sqrt{2} W_B$.

c. $W_A = 2 W_B$.

d. $W_A = 4 W_B$.

e. $W_B = 2W_A$.

- d) A large spring is used to stop the cars after they come down the last hill of a roller coaster. The cars start at rest at the top of the hill and are caught by a mechanism at the instant their velocities at the bottom are zero. Compare the compression of the spring, x_A , for a fully loaded car with that, x_B , for a lightly loaded car. $m_A = 2m_B$.

- a. $x_A = \frac{1}{2} x_B$.
- b. $x_A = x_B$.
- c. $x_A = \sqrt{2} x_B$.
- d. $x_A = 2 x_B$.
- e. $x_A = 4 x_B$.