

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Physics

Physics 8.01T

Fall Term 2004

Problem Set 6: Static Equilibrium and Torque, Work-Kinetic Energy Theorem, Work Done by Friction and other Dissipative Forces

Available on-line October 8; Due: October 19 at 4:00 p.m.

Please write your name, subject, lecture section, table, and the name of the recitation instructor on the top right corner of the first page of your homework solutions. Please place your solutions in your lecture section table box.

Oct 8

Hour One: Problem Solving Session 7: Static Equilibrium and Torque

Oct 11 No class

Problem Set 5: Due Tues Oct 12 at 4:00 pm.

Oct 13

Hour One: The Concept of Energy; Work; Work-Kinetic Energy Theorem

Reading: YF 6.1-6.4

Hour Two: Problem Solving Session 8: Work and the Dot Product

Reading: YF 6.1-6.4

Oct 15

Hour One: Problem Solving Session 9: Work Done by Friction and other Dissipative Forces; Motion With Dissipative Forces

Reading: YF 5.3, 6.1-6.4

Problem Set 6: Due Tues Oct 19 at 4:00 pm.

Oct 18

Hour One: Potential Energy

Reading: YF 7.1-7.5

Hour Two: Problem Solving Session 10: Potential Energy

Reading: YF 7.1-7.5

Oct 20

Hour One: Problem Solving Session 11: Energy Techniques

Reading: YF 7.1-7.5

Hour Two: Experiment 6: Conservation of Energy
Reading: Experiment 6

Oct 22

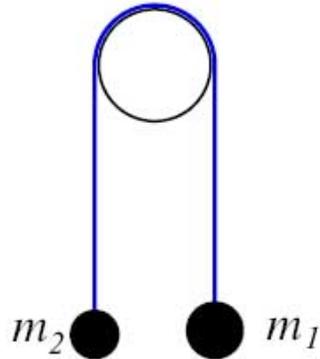
Hour One: Problem Solving Session 12: Conservation of Energy: Restoring Forces and Harmonic Motion
Reading: YF 13.1-13.5

Problem Set 7: Due Tues Oct 26 at 4:00 pm.

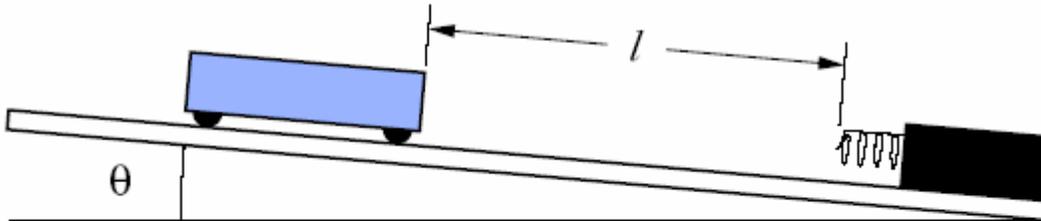
Problem 1: Experiment Five b) Analysis

Two unequal masses ($m_1 > m_2$) are suspended by a string over a rod. The coefficient of static friction between the string and the rod is μ_s , and the coefficient of sliding friction is $\mu_k < \mu_s$. Recall that the tension in the string is not constant (see Problem Set 5: Problem 3 part b).

- What is the largest ratio m_1/m_2 before the string starts to slide?
- What is the magnitude of the acceleration of the masses after sliding has begun.



Problem 2: Experiment 6 Pre-Lab Question

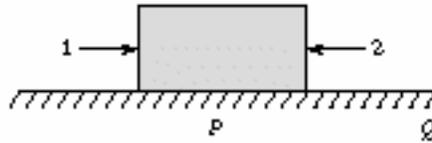


A cart of mass M rolls down a track inclined at an angle θ . The cart starts from rest a distance l up the track from a spring, and rolls down to collide with the spring.

- Assuming no non-conservative work is done, what is the speed of the cart when it first contacts the spring? (Express your answer in terms of the given variables and the gravitational acceleration g .)
- Suppose the spring has a force constant k . What is the peak force compressing the spring during the collision?

Problem 3: Concept Question: Work

Two people push in opposite directions on a block that sits atop a frictionless surface (The soles of their shoes are glued to the frictionless surface). If the block, originally at rest at point P, moves to the right without rotating and ends up at rest at point Q, describe qualitatively how much work is done on the block by person 1 relative to that done by person 2?



Problem 4: Work-kinetic energy

An object of mass $m = 4.0\text{ kg}$, starting from rest, slides down an inclined plane of length $l = 3.0\text{ m}$. The plane is inclined by an angle of $\theta = 30^\circ$ to the ground. The coefficient of kinetic friction $\mu_k = 0.2$. At the bottom of the plane, the mass slides along a rough surface with a coefficient of kinetic friction $\mu_k = 0.3$ until it comes to rest. The goal of this problem is to find out how far the object slides along the rough surface.

- Describe how you will model this motion. Include a free body diagram for the object while it is on the inclined plane and while it is sliding along the horizontal surface. Explain whether Newton's Second Law or the Work-Kinetic Energy Theorem provides an easier approach to this problem.
- What is the work done by the friction force while the mass is sliding down the inclined plane? Is this positive or negative?
- What is the work done by the gravitational force while the mass is sliding down the inclined plane? Is this positive or negative?
- What is the kinetic energy of the mass just at the bottom of the inclined plane?
- What is the work done by the friction force while the mass is sliding along the ground? Is this positive or negative?
- How far does the object slide along the rough surface?