Massachusetts Institute of Technology - Physics Department

Physics - 8.01 **Assignment #3** September 24, 1999.

It is strongly recommended *that you read about a subject* ***before*** *it is covered in lectures.*

Lecture Date	Material Covered	Reading
#9 Mon 9/27	Exam Review **This lecture will be on *PIVoT* Mon evening 9/27.**	Lectures #1 – #5
Wed 9/29	**Exam #1**	**Handout of 9/22**
#10 Fri 10/1	Hooke's Law - Springs Simple Harmonic Motion Pendulum - Small angle Approximation **Watch *PIVoT* under** *Hooke's Law, Pendulum, Simple Harmonic Motion, Spring.*	Page 140 – 142 Page 379 – 387
#11 Mon 10/4	Work - Kinetic Energy - Potential Energy Conservative Forces Conservation of Mechanical Energy Newton's Universal Law of Gravity ***PIVoT*****:** *potential energy, conservative force, conservation of mechanical energy.*	Page 160 – 176 Page 185 – 190 Sect. 9.1, 9.2 and 9.5 (excluding orbits)
#12 Wed 10/6	Non-Conservative Forces - Resistive Forces Air Drag - Terminal Velocity **Watch *PIVoT* under** *resistive force, terminal velocity, air resistance.*	Page 142 – 146, 190 ***Take Notes!***

Due Wednesday, Oct 6, before 4 PM in 4-339B. Solutions will be posted on the Web on Oct 7.

3.1 *Superposition of Forces* – page 119, problem 17.

3.2 *Tension in String* – page 120, problem 26.

3.3 *Tension in String* – page 121, problem 29.

3.4 *Crate hanging from Crane* – page 121, problem 31.

3.5 *Two Chandeliers* – page 153, problem 4.

3.6 *Free-body Diagram* – page 153, problem 13.

3.7 *Minimum Tension in Rope* – page 156, problem 40.

3.8 *Measurements of Friction Coefficient*
Use the two independent measurements made in lectures to calculate the static friction coefficient; include all uncertainties (in the mass and angles) in your answers. One measurement was made without the use of the pulley (the block was sliding down hill); the other was made with the pulley (the block was sliding up hill). Compare the results of the two measurements. If the two values are not the same within the accuracy of the measurements, give some reasons to explain the difference. You may assume that the gravitational acceleration is 10 m/s^2.

3.9 *Pushing a Book against the Wall.*
You are holding a book against a vertical wall by pushing upwards with your hand. The angle between your force and the vertical is α ($< 90°$). The mass of the book is m and the coefficient of static friction is μ. If you push too hard, the book will start to slide upwards, if you don't push hard enough, the book will slide down.

a) Draw "free-body" diagrams for these two cases when the book is just about to start sliding.

b) Calculate the magnitude of your force (as a function of α) to just prevent slipping, in both cases.

c) Calculate the force (as a function of α) for which the friction becomes zero. Evaluate your result for $\alpha = 0°$ and $90°$.

d) For what values of μ (as a function of α) is it impossible to make the book slide upwards?

3.10 *Brain Teaser I – What's the Use of Wide Tires?*
Race cars have very wide tires. The maximum frictional force exerted by the road on the tires only depends on the weight of the car and on the friction coefficient between the tires and the road; thus it is independent of the width of the tires (as demonstrated in lectures). Why then would race cars have wide tires? *(This problem is from "The Flying Circus of Physics" by Earl Walker, John Wiley & Sons.)*

3.11 *Pushing a Box* – page 154, problem 15.

3.12 *Pulley and Incline* – page 157, problem 43.

3.13 *Sliding Stick Across Fingers – Lecture Demo.*
Hold a yardstick horizontally on your index fingers and slide your fingers together smoothly. The stick slides first on one finger, then on the other and it keeps alternating. This was demonstrated in lectures. Try it for yourself, it's great fun! Why does this happen? *(This problem is from "The Flying Circus of Physics" by Earl Walker, John Wiley & Sons.)*

3.14 *Spring – Oscillations* – page 157, problem 47.
Continue this problem:
We hang an object of mass 3 kg on the spring of problem 47, and we make it oscillate in vertical direction. Assume that the mass of the spring is negligibly small, and that $g = 10\text{m/s}^2$.

a) What is the angular frequency (in rad/sec)?

b) What is the period of the oscillations (in sec)?

c) What is the frequency (in Hz)?

3.15 *Brain Teaser II – Not so Intuitive!*
If you are standing at the equator at sunrise, where must you point a laser cannon to hit the sun dead center? The entire sun has just become visible above the horizon.

Reminder.

There are 26 recitation sections. If you want to change, for whatever reason, please go to the physics education office (4-352).