Welcome to Physics 101!
Lecture 01: Introduction to Forces

- Forces
- Kinematics
- Energy/Momentum
- Rotations
- Fluids
- Waves/Sound
- Thermodynamics

Meet the Lecturer

- Lecturer _____@illinois.edu
- Office Hours _____

- Physics 101 URL:

  http://online.physics.uiuc.edu/ courses/phys101

Course Format
(Spiral Learning)

• Lecture Preflights	25
• iClicker	25
• Homework	100
• Lab	150
• Discussion	100
➔quizzes; drop lowest 1	
• Hour Exams (3 x 100)	300
• Final Exam	300
	1000

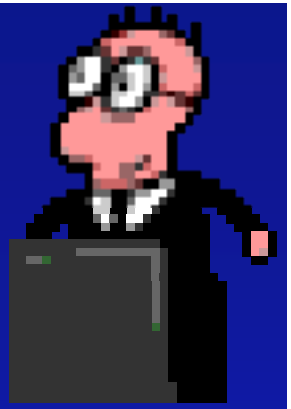
Grading Scale

- 950-1000 A+
- 920-949 A
- 900-919 A-
- 880-899 B+
- 860-879 B
- 835-859 B-
- 810-834 C+
- 780-809 C
- 750-779 C-
- 720-749 D+
- 690-719 D
- 610-689 D-
- <610 F

Reading & Lecture Preflight

- Need to complete PreLecture for Preflight
- Answer preflights 25/1000 points
  - ➔Due 6:00 am day of lecture.
  - ➔1 points for honest attempt at preflight.
  - ➔Everyone gets 2 points for today!

P101 Lectures



"I'm looking forward to a fun … semester"

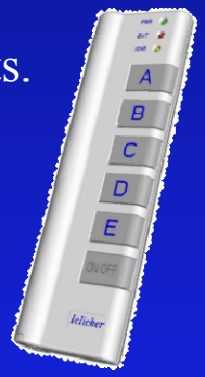
Participation is key!

➔Come to lecture prepared!

➔1 point for each lecture using iclicker

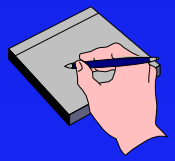
» No EX, 28 Lectures can miss three and still get all 25 points.

» Available at bookstore---register using link on web page.



- Not everything you need for exams!
  - ➔Concepts, Connections, Motivation
  - ➔Comprehensive Text
  - ➔Calculations Homework + Discussion
  - ➔Hands-On Lab

- Taking Notes
  - ➔Lecture notes available for lecture.
  - ➔Some key pieces for you to fill in.



P101 Homework

- All web based, immediate feedback
- 100% if done before 6:00 am deadline
- 90% credit until following Tuesday
- 0% after that
- To be safe, keep 5 significant figures!
- First one is due _____.

P101 Labs

- Director: _____
- First lab is _____ !
- No “dropped” labs….. Don’t miss one!

Discussion Sections

- Director: _____
- Start: Tomorrow: Tuesday Aug 24 !
- Quiz during last 20 minutes of section
- 10 minutes late: ☹
- Drop lowest quiz

Physics Philosophy

- Problem: You are too smart!
- Physics is DIFFERENT
- Describe large number of "complicated" observations with a few simple ideas
- Exams don't have same problems, but do have same IDEAS

Newton's Laws of Motion

1. If the sum of all external forces on an object is zero, then its speed and direction will not change. Inertia

2. If a nonzero net force is applied to an object its motion will change $F = ma$

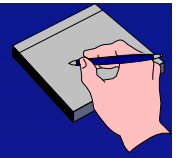
3. In an interaction between two objects, the forces that each exerts on the other are equal in magnitude and opposite in direction.

Forces in P101

- Non-Contact ---- Gravity ($F = G\, m\, M / r^2$)
  - ➔ $G = 6.7 \times 10^{-11}\ m^3 / (kg\ s^2)$
  - ➔ Earth: Mass = 6×10^{24} kg, radius = 6.4×10^6 m.

- Contact (fundamentally E+M)
  - ➔ Normal: Perpendicular to surface
  - ➔ Friction: Parallel to surface
  - ➔ Anything touching the object
    - » Rope: Tension
    - » Spring $F = -kx$

Example Weight of Object



- Calculate the gravitational force on a 3 kg book held 1 meter above the surface of the earth.

  $F = G M m / r^2$

  $=$

Gravitational ACT

- If the book is raised 10 meters above the surface of the earth, the gravitational force on the book will

A) 100 times stronger

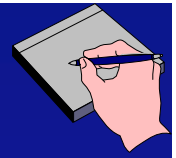
B) 10 times stronger

C) Same

D) 10 times weaker

E) 100 times weaker

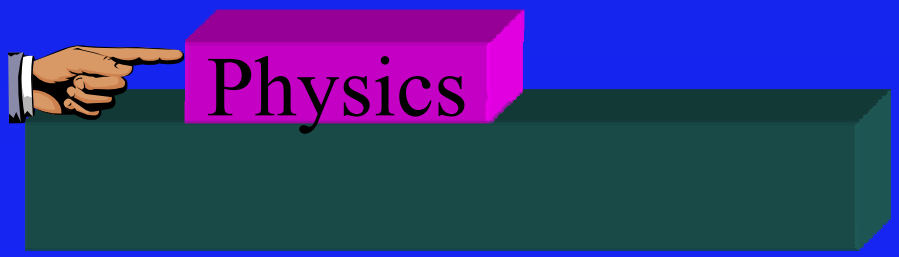
Contact Forces: Friction

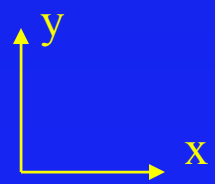


- Magnitude of frictional force (parallel to surfaces) is proportional to the normal force.
  - ➔ $f_{kinetic} = \mu_k N$ μ_k coefficient of Kinetic friction
  - ➔ $f_{static} \leq \mu_s N$ μ_s coefficient of Static friction
- Be Careful!
  - ➔ Static friction ≤, can be any value up to $\mu_s N$
  - ➔ Direction always opposes motion

Free Body Diagrams

- Choose Object (book)
- Label coordinate axis
- Identify All Forces
  - ➔Hand (to right)
  - ➔Gravity (down)
  - ➔Normal (table, up)
  - ➔Friction (table, left)





Summary

- Newton's Laws of Motion
  - ➔Inertia
  - ➔F=ma
  - ➔Pairs
- Forces:
  - ➔Non-Contact: Gravity
  - ➔Contact: Friction and Normal
- Free Body Diagrams
  - ➔Each direction is independent
- Friction opposes motion, parallel to surface
  - ➔Kinetic $f = \mu_k N$
  - ➔Static $f \leq \mu_s N$