Welcome to Physics 101!
Lecture 01: Introduction to Forces

"I am very excited about taking Physics 101!"

"I look forward to taking the physics labs"

"Im so nervous.. dude so nervous"

"Anxious" "very scared" "honestly terrified"

"worried about my grade" "worried about math"

"I am excited to learn about something other than biology."

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

Physics 101 covers…

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

Meet the Lecturer

- Prof. Taekjip Ha

  tjha@illinois.edu

- Office Hours

  Monday 10-11am

  32 Loomis; start January 30

- Research

  » Biophysics of Cancer and Infectious Diseases

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

Course Format

- Lecture Preflights 25
  (1 pt per lecture, 28 lectures, no EX)
- iClickers 25
  (1 pt per lecture, 28 lectures, no EX)
- Homework (no EX) 100
- Lab 150
- Discussion 100
  - ➔quizzes; drop lowest 1
- Hour Exams (3 x 100) 300
- Final Exam 300

1000

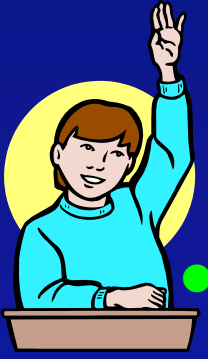
Grading Scale

- 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

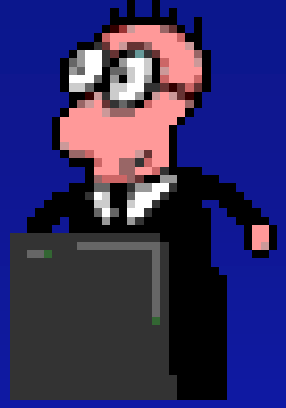
"My goal is to receive an A..."

Reading & Lecture Preflight

- Read the Textbook first!
- 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 (lose points for nonsense – and I read these!).
  - ➔No EX, 28 Lectures can miss three and still get all 25 points.
- Everyone gets 1 point for today!



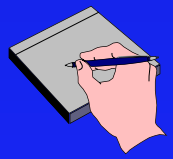
P101 Lectures

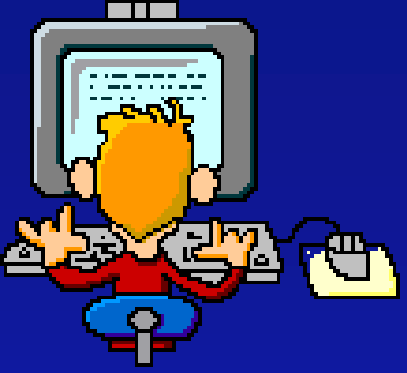


- Participation is key!
  - ➔Come to lecture prepared!
  - ➔1 point for each lecture using iclicker
    - » No EX, 28 Lectures can miss three or have iclicker problems for three lectures and still get all 25 points. Everyone gets a point today!
    - » No credit for a malfuctioning iClicker or if you forgot to bring your iClicker. You can still get all 25 points.
    - » Available at bookstore---*register using link on our web page*.
    - » Using multiple clickers is an academic integrity violation.

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

- Not everything you need for exams!
  - ➔Concepts, Connections, Motivation
  - ➔Comprehensive Textbook
  - ➔Calculations Homework + Discussion
  - ➔Hands-On Lab
- Taking Notes
  - ➔Lecture notes available.
  - ➔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 on unfinished parts until following Tuesday
- 0% after that
- Always keep 5 significant figures!
- First and second ones are due Tues Jan 31!
- No EX

P101 Labs

"I'm looking forward to the labs because I learn better with hands-on activities."

- Director: Professor Liang Yang

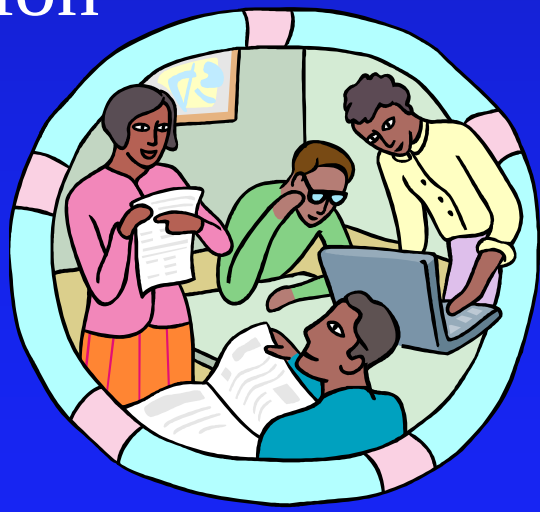
  research: Nuclear Physics

- First Lab is Next Week!
- No "dropped" labs….. Don't miss one!

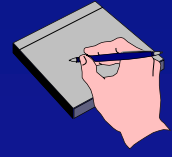
Discussion Sections

- Director: Professor David Ceperley

  research: Theoretical Condensed Matter Physics
- Started: Yesterday!
- Bring your Discussion Booklet!
- Quiz during last 20 minutes of section
- First section: math review, dimensional analysis.



Email policy



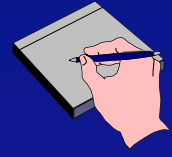
1. Read the frequently asked questions on the course web site before emailing course staffs.
2. Please do not email physics or homework questions. Use Office hours and Google Group.
3. Send questions on Discussion/Quizzes to David Ceperley
4. Send questions on Labs/Exams to Liang Yang.
5. Send questions on Lectures and other materials to Taekjip Ha.
6. Your E-mail should have Physics 101 in the subject line

Physics Philosophy

- Common sense approach to the natural world
- Action/reaction, reproducible experiment, mathematical formulation
- Describe large number of "complicated" observations with a few simple ideas:

  APPROXIMATION
- 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 $F = ma$

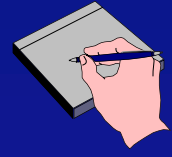
3. In an interaction between two objects, the forces that each exerts on the other are equal in magnitude and opposite in direction.

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



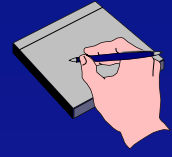
- Calculate the gravitational force on a 3 kg book held 1 meter above the surface of the earth.

$|F| = G\ M\ m / r^2$

$= (6.7\text{x}10^{-11}\ m^3 / (kg\ s^2))\ (6\text{x}10^{24}\ kg)\ (3\ kg) / (6.4\text{x}10^6 + 1)^2\ m^2$

$= 29.4\ kg\ m/s^2$

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) Nearly the same

D) 10 times weaker E) 100 times weaker

$F = G M m / r^2$

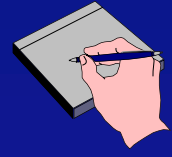
$= (6.7\text{x}10\text{-}11\ m^3 / (kg\ s^2))\ (6\text{x}10^{24}\ kg)\ (3\ kg) / (6.4\text{x}10^6 + 10)^2\ m^2$

$= 29.4\ kg\ m/s^2$

Near surface of earth $r = 6.4\text{x}10^6$ m

$|F| = m\ (G\ M / r^2) = m\ (9.8\ m/s^2)$

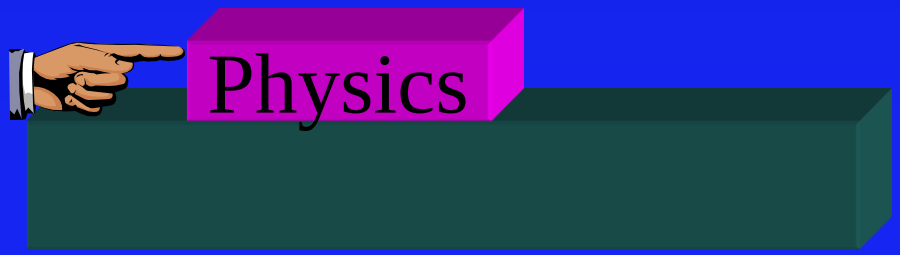
Contact Forces: Friction

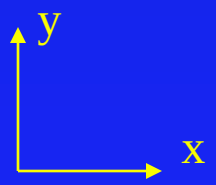


- Magnitude of frictional force (parallel to surfaces) is proportional to the normal force.
  - ➔ $f_{kinetic} = \mu_k N$ — μ_k coefficient of Kinetic friction
  - ➔ $f_{static} \leq \mu_s N$ — μ_s coefficient of Static friction
- Be Careful!
  - ➔ Static friction $\leq$, can be any value up to $\mu_s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

To Do

- Discussions starts this week,

  Labs start next week.

- Do lecture preflight before 6:00 am Monday!

- Have a GREAT WEEK!