Welcome to Physics 101!
Lecture 01: Introduction to Forces

"Nervous, physics was not my strong subject in high school."

"I'm excited to learn about the laws that govern a lot of daily life."

"I am dreading this course with every fiber of my being"

I am excited to learn about something other than biology, chemistry, and raw mathematics.

"Excited! I love math materials. I do not have any fear yet."

"-Excited about the labs -Fearful of the exams."

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

Meet the Lecturer

- Prof. Taekjip Ha (most people call me TJ so can you)
  TaekjipHa@physics.illinois.edu
- Office Hours

  Monday 10-11

  236 Loomis; start in two wks

- Research
  - ➔Biophysics – Cancer & infectious diseases
- P101 is one of my favorite courses!

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

Course Format

(upward) Spiral Learning

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

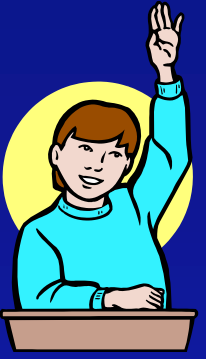
Grading Scale

- 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

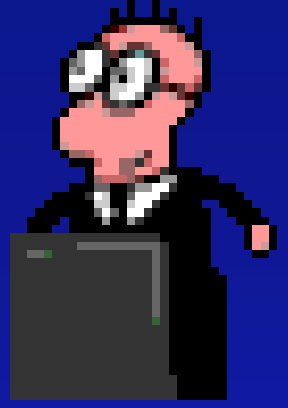
"My goal is to receive an A..."

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 (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

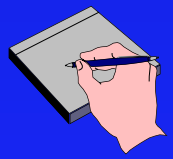


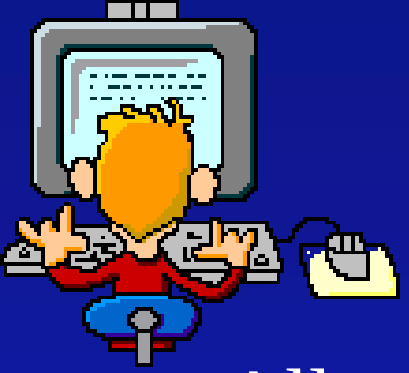
- Participation is key!

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

  - ➔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 our web page*.
    - » Using multiple clickers is an academic integrity violation.

- Not everything you need for exams!
  - ➔Concepts, Connections, Motivation
  - ➔Comprehensive Text
  - ➔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 one is due Tues February 1st !
- TA office hours are on Mondays, start January 31st.

P101 Labs

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

- Director: Professor Paul Selvin

  research: biophysics, molecular motors

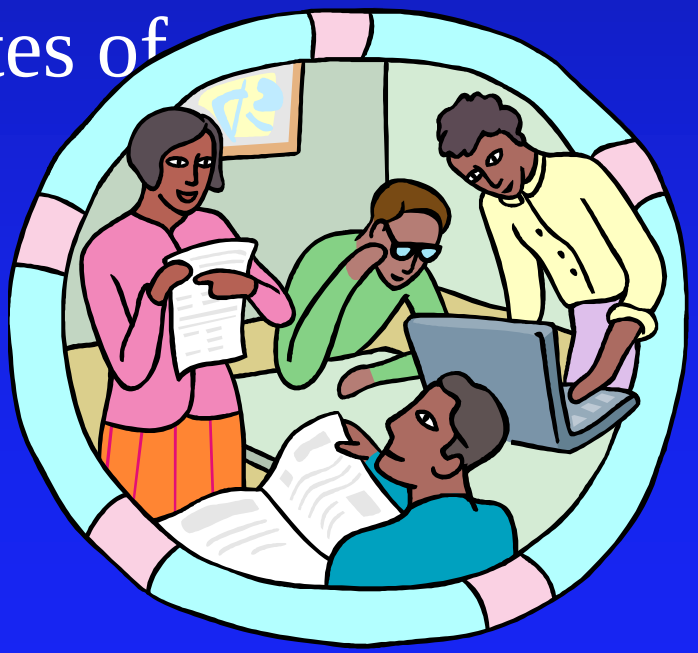
- First Lab is Today!
- No "dropped" labs….. Don't miss one!

Discussion Sections

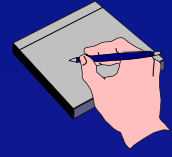
- Director: Professor Yoshi Oono

  research: statistical mechanics

- Start: Yesterday (if you are in Tue session)
- Quiz during last 20 minutes of
- 10 minutes late ☹
- First section: math review, dimensional analysis.

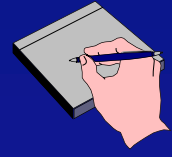


Email policy



1. Read the frequently asked questions on the course web site before emailing course staffs.
2. Please do not email physics or homework questions to professors or TAs. Use Office hours.
3. Send questions on Discussion/Quizzes to Yoshi Oono.
4. Send questions on Labs/Exams to Paul Selvin.
5. Send questions on Lectures and other materials to Taekjip Ha.

Rewards for following the email policy



1. Extra 2 points!

The highest possible overall score is 1002!

To keep extra points

-Do not ask questions already answered in FAQs.

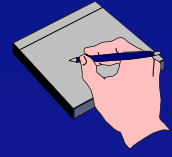
-Do not ask physics or homework questions by email.

-Make sure you send your questions to the right person

Lab/Exams: Paul Selvin

Discussion/Quizzes: Yoshi Oono

Lectures/Others: Taekjip Ha



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 $F = ma$

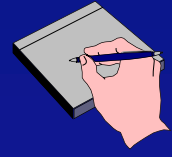
3. In an interaction between two objects, the forces that each exerts on the other are equal in magnitude and opposite in direction.

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



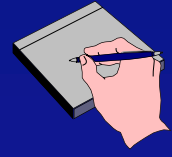
- Calculate the gravitational force on a 3 kg book held 1 meter above the surface of the earth.

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

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

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

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

$F = G M m / r^2$

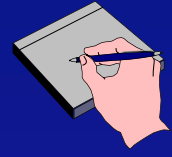
$= (6.7\text{x}10\text{-}11\ m^3 / (kg\ s^2))\ (6\text{x}10^{24}\ kg)\ (3\ kg) / (6.4\text{x}10^6 + 10)^2\ m^2$

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

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

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

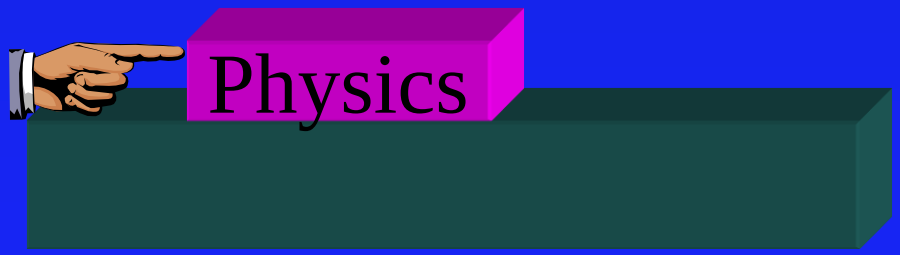
Contact Forces: Friction

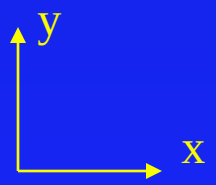


- Magnitude of frictional force (parallel to surfaces) is proportional to the normal force.
  - ➔ $f_{kinetic} = \mu_k N$ — μ_k coefficient of Kinetic friction
  - ➔ $f_{static} \leq \mu_s N$ — μ_s coefficient of Static friction
- Be Careful!
  - ➔ Static friction $\leq$, can be any value up to $\mu_s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

  Labs start today.

- Do lecture preflight before 6:00 am Monday!

- Have a GREAT WEEK!