Welcome to

Physics 105

Summer 2006

Instructor:

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423E Tiernan

Office hours: After the classes M. – R.
or by appointment
973-596-5342

- 105 Physics;
  - Course information and Introduction
- Introduction and Measurements
  - (HR&W, Chapter 1)

Course Elements:

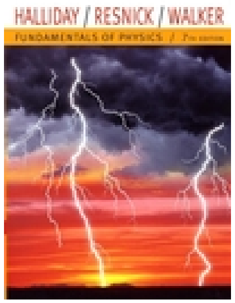
- Textbook
- Lectures
- Recitations
- Homework **Utexas** (class 11611)
- Exams (3 Common QZs, Final Exam)

Do not forget about the **Lab !!!**

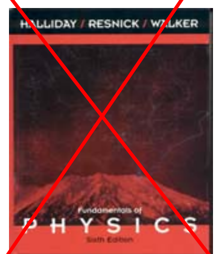
Textbook:

Halliday, Resnick, and Walker (HR&W)
Fundamentals of Physics, 7th edition
Chapters 1-9th (Part 1)

7th edition:



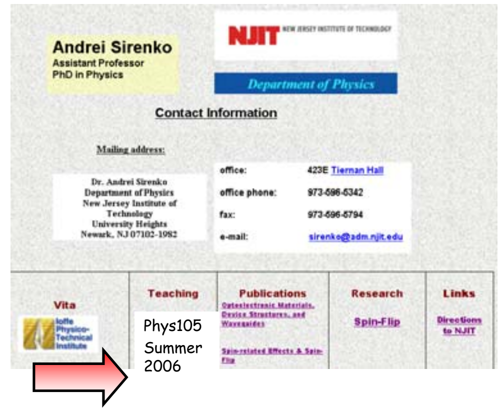
~~6th edition:~~



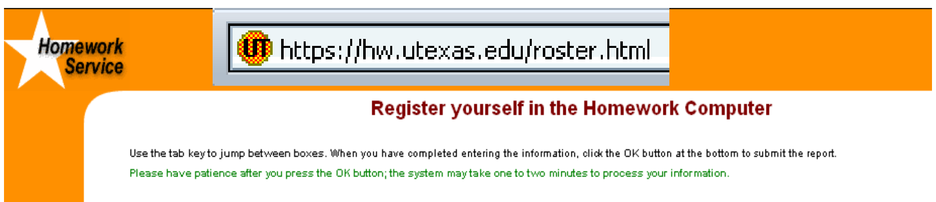
Web Page:

http://web.njit.edu/~sirenko/

and click "Phys 105 Summer 2006"



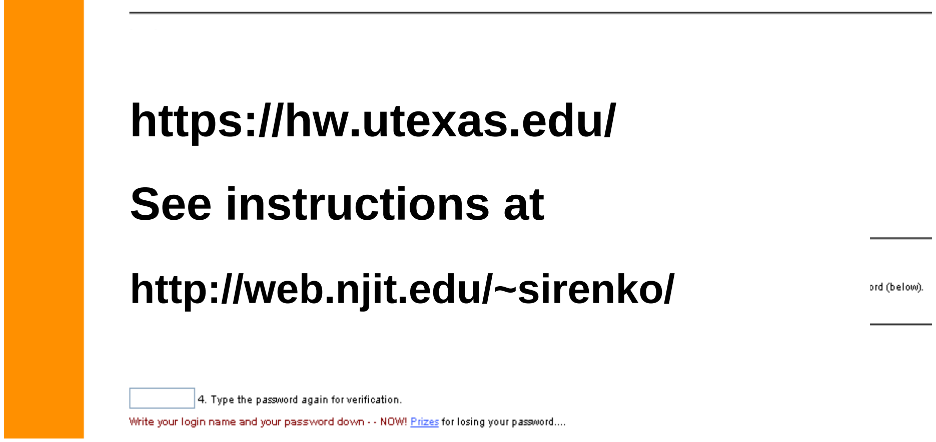
- Syllabus
- HW enrolment info
- Exam Examples
- HW results
- Exam Results
- Your Grades, etc



https://hw.utexas.edu/

See instructions at

http://web.njit.edu/~sirenko/



Lectures and Recitations: (**TIER 106**)

- Presentation of the concepts and techniques of Physics.
- Demonstrations of Physics in action.
- Lecture quiz at the end of every lecture
- Lectures are not a substitute for reading the text!
  Text chapters are listed on the lecture schedule.
  Read ahead; you'll get more from lecture.
- Slides will be posted on the course web.
  Use these as a study guide/note taking aid.
- Recitations provide an opportunity to do a group activity relevant to the topic being studied, and to ask homework questions.
- The scenarios presented in the recitation group activities will be on the exams.

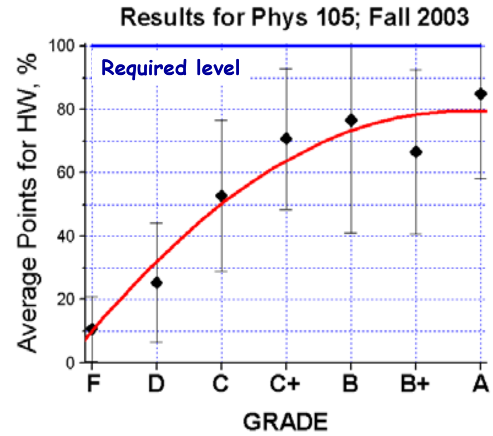
Grade Components

- **Common Exams 45% total (15% each)**
- **Lecture Quizzes 10%**
- **Homework 15%**

A	80+
B+	75-79
B	70-74
C+	65-69
C	55-64
D	50-54
F	< 50

How to Do Well

- Keep up!
- Do the homework carefully and understand the reason for each step.
- Form a study group to discuss homework problems.
- Do plenty of extra problems and examples.
- The material gets more difficult through the term. Don't slack off if you are doing well !



Lectures:

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Recitations

- Recitations provide an opportunity to do a group activity relevant to the topic being studied, and to ask homework questions.
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What is Physics?

- **Physics** (n.) - The branch of science that deals with the nature and properties of matter and energy.
- **Mechanics** (n.) - The branch of physics that deals with the motion and equilibrium of material bodies and the action of forces.

Physics is an Experimental Science

Theory (n.)

A system of thoughts or statements explaining something.

Experiment (n.)

An action undertaken to make a discovery or test a hypothesis.

Classical Mechanics

Classical Mechanics is a theory that predicts the results of experiments for objects that are not too:

- Small (Quantum Mechanics)
  - Atoms and subatomic particles
- Fast (Special Relativity)
  - Objects moving near the speed of light
- Dense (General Relativity)
  - Black holes and similar objects; the early Universe

Measurements

(HR&W, Chapter 1 Sections 1–6)

The Standard Kilogram

Courtesy Bureau International des Poids et Mesures, France

- Measuring Things
- International System of Units (SI System)
- Conversion of Units
- Length
- Time
- Mass

Measurement and Units

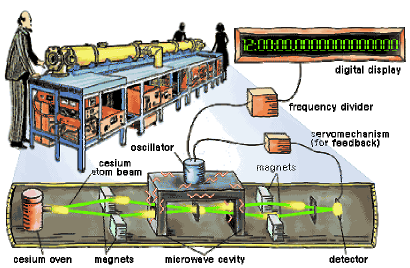
In order to have sensible discussion about experiments, we need to agree on a system of measurement.

This is so important for Science, Engineering, and Commerce that it is done by governments and controlled by international agreements.

Types of Quantities

Many things can be measured:
Position, velocity, energy, time, forces…
These are related to one another
(e.g. velocity = distance / time)
Choose three basic quantities:
LENGTH, MASS, TIME
Define other units in terms of these.

Systems of Units

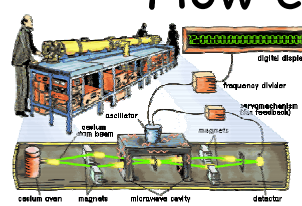


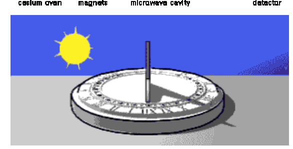
1 meter = |XY|/10000000

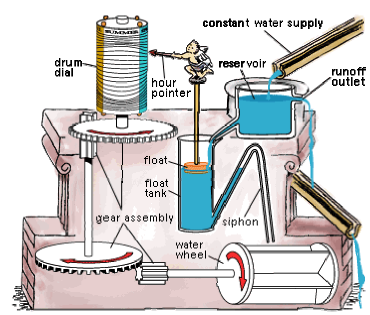
Many choices are possible for three basic units of **LENGTH, MASS, TIME** :

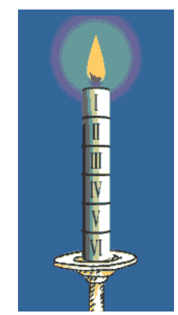
Metric (SI, Système Internationale) **since 1971**
meter, kilogram, second (human scale)

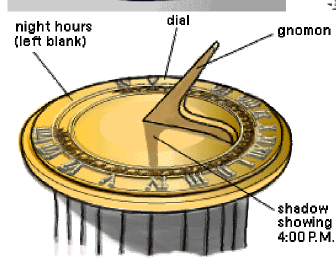
How can we measure time ?

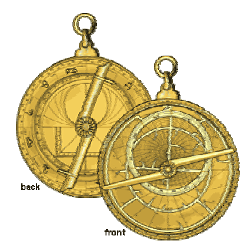


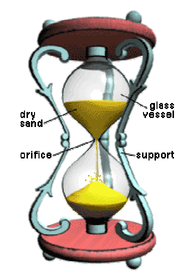












Meter, Second, Kilogram

Meter – distance traveled by light (in vacuum) during the time of 1/299 792 458 second

Second – time taken 9 192 631 770 oscillations of the light (of a specific wavelength) emitted by a cesium-133 atom; (atomic clock).

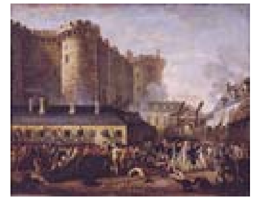
Kilogram – mass of a platinum-iridium cylinder. US kilogram standard is at NIST

1/12 Carbon atom = 1.6605402 10^{-27} kg

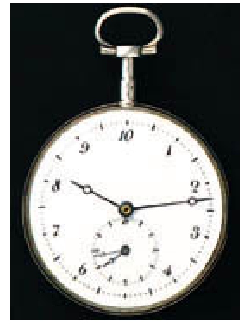
http://www.nist.gov

The Standard Kilogram

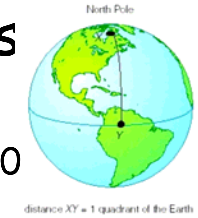
Courtesy Bureau International des Poids et Mesures, France



1792



Systems of Units

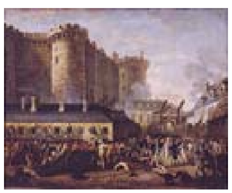


1 meter = |XY|/10,000,000

English

foot, slug (not pound!), second

We will use SI units in this course, but it is useful to know conversions between systems for making estimates from your everyday knowledge.



French Revolution Calendar

1793 –1806

abolished on the 1st of January 1806 by Emperor Napoleon

12 months, no weeks but decades

New Year's Day at autumnal equinox:

1st Vendémiaire = 22nd of September

1. Vendémiaire	7. Germinal
2. Brumaire	8. Floréal
3. Frimaire	9. Prairial
4. Nivôse	10. Messidor
5. Pluviôse	11. Thermidor
6. Ventôse	12. Fructidor

1503-1566

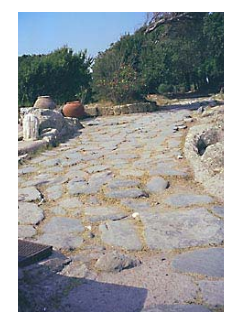
Other Systems of Units:

English: foot, slug (not pound!), second

0.0254 m = 1 inch English System of Units

1 meter = 39.37 inches in the United States (0.02540005 m)
(survey foot)

0.0246 m = 1 *Prussian inch*

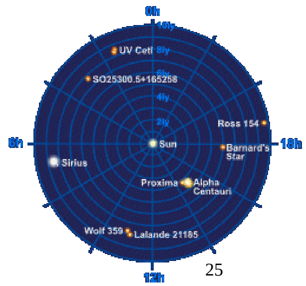


*1 mile = **1609** meters; The nautical mile is **1852** meters*

Funny units of Length:

- "it is 2 hours North from here"
- "water is three handkerchiefs to the sunrise across this desert valley"
- "four light years from our planet"



SI Units (serious ones)

Length	meter	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Meter, Second, Kilogram

TABLE 1-3 Some Approximate Lengths

Measurement	Length in Meters
Distance to the first galaxies formed	2×10^{26}
Distance to the Andromeda galaxy	2×10^{22}
Distance to the nearest star (Proxima Centauri)	4×10^{16}
Distance to Pluto	6×10^{12}
Radius of Earth	6×10^{6}
Height of Mt. Everest	9×10^{3}
Thickness of this page	1×10^{-4}
Length of a typical virus	1×10^{-8}
Radius of a hydrogen atom	5×10^{-11}
Radius of a proton	1×10^{-15}

TABLE 1-4 Some Approximate Time Intervals

Measurement	Time Interval in Seconds
Lifetime of the proton (predicted)	1×10^{39}
Age of the universe	5×10^{17}
Age of the pyramid of Cheops	1×10^{11}
Human life expectancy	2×10^{9}
Length of a day	9×10^{4}
Time between human heartbeats	8×10^{-1}
Lifetime of the muon	2×10^{-6}
Shortest lab light pulse	6×10^{-15}
Lifetime of the most unstable particle	1×10^{-23}
The Planck time[a]	1×10^{-43}

[a] This is the earliest time after the big bang at which the laws of physics as we know them can be applied.

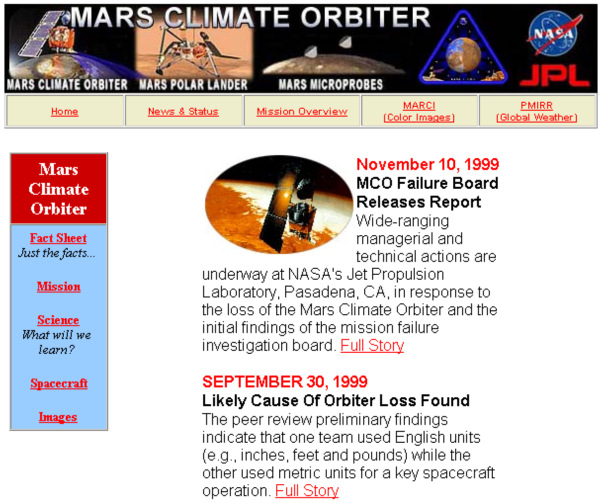
TABLE 1-5 Some Approximate Masses

Object	Mass in Kilograms
Known universe	1×10^{53}
Our galaxy	2×10^{41}
Sun	2×10^{30}
Moon	7×10^{22}
Asteroid Eros	5×10^{15}
Small mountain	1×10^{12}
Ocean liner	7×10^{7}
Elephant	5×10^{3}
Grape	3×10^{-3}
Speck of dust	7×10^{-10}
Penicillin molecule	5×10^{-17}
Uranium atom	4×10^{-25}
Proton	2×10^{-27}
Electron	9×10^{-31}

The value of a physical quantity
is the quantitative expression of a particular physical quantity as the product of a number and a unit, the number being its numerical value. Thus, the numerical value of a particular physical quantity depends on the unit in which it is expressed.

For example, the value of the height h_W of the Washington Monument is h_W = 169 m = 555 ft. Here h_W is the physical quantity, its value expressed in the unit "meter," unit symbol m, is 169 m, and its numerical value when expressed in meters is 169. However, the value of h_W expressed in the unit "foot," symbol ft, is 555 ft, and its numerical value when expressed in feet is 555.

Why should we care about SI units?



http://mars.jpl.nasa.gov/msp98/orbiter

Prefixes for SI Units

10^x	Prefix	Symbol	
x=18	exa	E	
15	peta	P	
12	tera	T	
9	giga	G	GPascal
6	**mega**	M	MVolt
3	**kilo**	k	kWatt
2	hecto	h	
1	deca	da	

Prefixes for SI Units

10^x	Prefix	Symbol	
x = –1	deci	d	
–2	centi	c	cm
–3	milli	m	mm
–6	**micro**	µ	µA
–9	**nano**	n	nm
–12	pico	p	pm
–15	femto	f	fm
–18	atto	a	

Useful conversions:

1 inch = 0.0254 meters (exactly)
1 meter = 39.37 inches
1 foot = 1200/3937 meter (1959).
(ft - international foot)

1 kg corresponds to ~2.2 lbs. weight
1 lb. weight corresponds to
about 0.454 kg
(this is called an 'improper conversion')

http://physics.nist.gov/Pubs/SP811/appenB.html

Unit Conversions

Multiply quantities and units:

$$60\frac{\cancel{mi}}{\cancel{hr}}\bullet 5280\frac{\cancel{ft}}{\cancel{mi}}\bullet 12\frac{\cancel{in}}{\cancel{ft}}\bullet 0.0254\frac{m}{\cancel{in}}\bullet\frac{1}{3600}\frac{\cancel{hr}}{s}$$

$$26.8\frac{m}{s}$$

Dimensional Analysis

Basic Quantities	Derived Quantities	
Length [L]	Velocity	[L]/[T]
Time [T]	Acceleration	$[L]/[T]^2$
Mass [M]	Density	$[M]/[L]^3$
	Energy	$[M][L]^2/[T]^2$

Precision

- Measurements
  - Uncertainties
    - Absolute
    - Percent
  - Calculation
    - Result can not be better than data
    - Use scientific notation to show significant figures
  - Examples
    - 3.14 micron + 0.5 micron = 3.6 micron (physics)
    - 3.14 micron + 0.50 micron = 3.64 micron (physics)
    - 123,400,000 km = 1.234×10^8 km
    - 0.003 m = 3×10^{-3} m

QZ1

write your name, ID#, Section #

What is the volume of the book in cm^3.

(hint: 1 inch = 2.54 cm)