PHYSICS 1005: Course Syllabus

Physics 1005 (MT) Physics: The Simple Laws that Govern the Universe Spring 2024

Prof. Raymond Tung
Office: 1415 Ingersoll
Phone from outside 718 951-5807
rtung@brooklyn.cuny.edu (For emergencies only. Ask all questions in class or during office hours.)
Office Hours: Mon. & Wed. 12:00 – 12:30

Lectures: Mon. & Wed. 12:50 – 13:40 IH 2143
Lab: Mon. 2:15 – 4:05 PM IH 3414

Textbook: **Physics Matters (recommended)** An Introduction to Conceptual Physics, Trefil and Hazen, Wiley. In addition: Lab Manual may be purchased from physics department.

Some Relevant Information on this Course can be Found at:
http://academic.brooklyn.cuny.edu/physics/tung/phys1005S24

Goals Of This Course

Identify the fundamental concepts and methods of a life or physical science.

The basic science needed to understand the present understanding of the laws that govern the Universe in its various scales and the history of this understanding will be introduced through textbook, problem solving and laboratory experiments. Students will learn how the scientific method and its reliance on observation and refutability is applied to gain a consistent understanding of the laws that govern the physical environment and the processes that take place there. Covered topics include the laws of motion, gravitational and electromagnetic forces, energy in its various forms and some sense of modern physics.

Apply the scientific method to explore natural phenomena.

Students will learn how the scientific method and its reliance on observation and refutability is applied to gain a consistent understanding of the laws that govern the physical environment and the processes that take place there.

Goals Of This Course

Use scientific equipment to carry out laboratory investigations.

Students will perform laboratory experiments in teams weekly involving measurements, data analysis, graph plotting, calculations. Students will learn about the inherent uncertainty in the measurement process. Students will directly compare theory such as laws of motion and gravitational forces that account for the structure of the universe with simple laboratory experiments and in the process will learn that laws that govern the Universe can be tested in the laboratory.

Gather, analyze, and interpret data and present it in an effective written laboratory report.

Students will directly compare theory such as laws of motion, gravitational forces, and conservation of energy in its various forms in specific cases that require exact numerical solutions.

Syllabus (Cont.)

Textbooks:

- **Physics Matters An Introduction to Conceptual Physics, Trefil and Hazen, Wiley. (optional)**
- **Lab Manual may be downloaded from physics department.**

General Comments: Basic concepts of mechanics and thermodynamics are covered. Students will be asked not only to understand basic concepts but also to be able to apply them to solve standard problems.

.

Attendance: Will be taken regularly during lecture classes. No points will be deducted from scores of students with poor attendance. However, students with good attendance and good participation records may be put on a more favorable distribution "curve" for their semester scores.

HOMEWORK: Homework for each chapter is assigned, but need not be submitted.

Syllabus (Cont.)

Exams: **There will be 2 lecture exams and a final exam. No makeup exams will be given. Absences from exams must be excused by the lecturer or a grade of zero will be assigned. Generally, a doctor's note is required for an absence due to illness.**

Grades: **Will be based on lecture exams (20% + 20%), final exam (35%), and laboratory work (25%). However, to pass this course a passing grade for laboratory is required. Note: in order to pass the laboratory component, a student is not allowed to miss more than 3 labs.**

Syllabus: (Cont.)

Jan. 29, Chap 1 Science	Jan. 31, Chaps 1 & 2
Feb 5, Chap 2 The Language of Science	Feb. 7, Chap3 Motions in the Universe
---	Feb. 14, Chap3 Motions in the Universe
Feb. 22 (Thu), Chap 4 Newton Laws	Feb. 21, Chap 4 Newton Laws
Feb. 26, Chap 5 Laws of Gravitation	Feb. 28, Chap 5 Laws of Gravitation
Mar. 4, Chap 6 Linear Momentum	Mar 6, Chap 6 Linear Momentum
Mar. 11, Chap 7 Rotational Motion	Mar. 13, Chap 7 Rotational Motion
Mar. 18, Exam #1, (Ch 1-6)	Mar. 20, Chap 8 Kinetic and Potential Energy
Mar. 25, Chap 8 Kinetic and Potential Energy	Mar. 27, 2, Heat and Temperature
Apr. 1, Chap 11 Heat and Temperature	Apr. 3, Chap 14 Vibrations and Waves
Apr. 8, Chap 14 Vibrations and Waves	Apr. 10, Chap 16 Electric and Magnetic Force
Apr. 15, Chap 16 Electric and Magnetic Forces	Apr. 17, Chap 18 Electric Circuits
---	---
---	May 1, Chap 18 Electric Circuits
May 6, Exam #2 (Ch. 7,8,11,14,16,18)	May 8, Chap 20 Optics
May 13, Review	May 15, Review
May 20, 10:30 – 12:30, Final (incl.Exams1&2)	

Lab Schedule

PHYSICS 1005 LAB SCHEDULE **SPRING 2024**

		Monday	Tuesday	Wenesday	Thursday		Room #
Online sections are highlighted in yellow			TEAB 8:55am-10:45am Uddin, M.		TEBB 8:55am-10:45am Uddin, M.		(for in person sections, only)
		MTAB 2:15pm-4:05pm Tung, R.	T2AB 3:15pm-5:05pm Malikova, L.	MTBB 2:15pm-4:05pm Siddique, M.			
		W6AB 5:05-6:55pm Khotyanov, S.	T6AB 8:00pm-9:50pm Delicia-King, S.	W6BB 7:25pm-9:15pm Khotyanov, S.	T6BB 8:00pm-9:50pm Delicia-King, S.		
1	Introduction to Measurement and Error	29-Jan	30-Jan	31-Jan	25-Jan		3408
2	Constant speed & graphs	5-Feb	6-Feb	7-Feb	1-Feb		3414
3	Speed and constant Acceleration	**22-Feb**	13-Feb	14-Feb	8-Feb		3414
4	Range and the Dynamics of Free Fall	26-Feb	20-Feb	21-Feb	15-Feb		3414
5	Newton's Second Law	**28-Feb**	27-Feb	6-Mar	29-Feb		3408
6	Kinetic and Potential Energy	4-Mar	5-Mar	13-Mar	7-Mar		3408
7	Simple Pendulum	11-Mar	12-Mar	20-Mar	14-Mar		3414
8	Heat and Temperature	18-Mar	19-Mar	27-Mar	21-Mar		3408
9	Calorimetry and Latent Heat	25-Mar	26-Mar	3-Apr	28-Mar		3408
10	Radioactivity	1-Apr	2-Apr	10-Apr	4-Apr		4420
11	Reflection and Image Formation Plane Mirror	8-Apr	9-Apr	17-Apr	11-Apr		3414
12	Refraction	15-Apr	16-Apr	1-May	18-Apr		3414
13	Electrical Measurements	6-May	7-May	8-May	2-May		3408
14	Lab Exam	13-May	14-May	15-May	9-May		3414

Conversion days: Thursday February 22 follows a Monday schedule

Lab Regulations

Physics 1005 Lab

This laboratory is part of the PHYS1005 course, and is required for any credit to be given for that course. Regular attendance at laboratory is therefore vital. For each lab or lab report missed you will points from your total (including lecture portion) score. If you miss more than three labs and/or lab reports, you will get an F for the course. Lab reports are due at the beginning of the lab class following the date the experiment was performed. Late lab reports lose points, more for each additional week of lateness. Reports more than four weeks late will not be accepted. You are considered to be absent from a lab if you are physically absent, leave early, or do not submit the lab report by the above deadlines. One missed lab may be made up in a different section if that instructor gives you permission and if the same experiment is being done (see lab schedule).

Lab reports must have a cover sheet with your name, your partner's (if any) name, the experiment title, the date performed, and the purpose of the experiment (in your own word in one or two sentences. Before coming to laboratory, be sure you have read and digested all the material in the lab manual referring to the experiment which you are to perform. Before leaving the laboratory at the end of the period you must put your desk and apparatus in neat order. The laboratory starts promptly. You are responsible for following the instructor's directions. Beginning with the second lab, you will be barred from the lab if you arrive more than 10 minutes after the scheduled start of the lab class.

Chap1. Science: A Way of Knowing

Science is a discipline that asks and answers questions about nature.

Scientific investigations are conducted through steps comprising the "scientific method".

Investigations are always ongoing.

Scientific Method

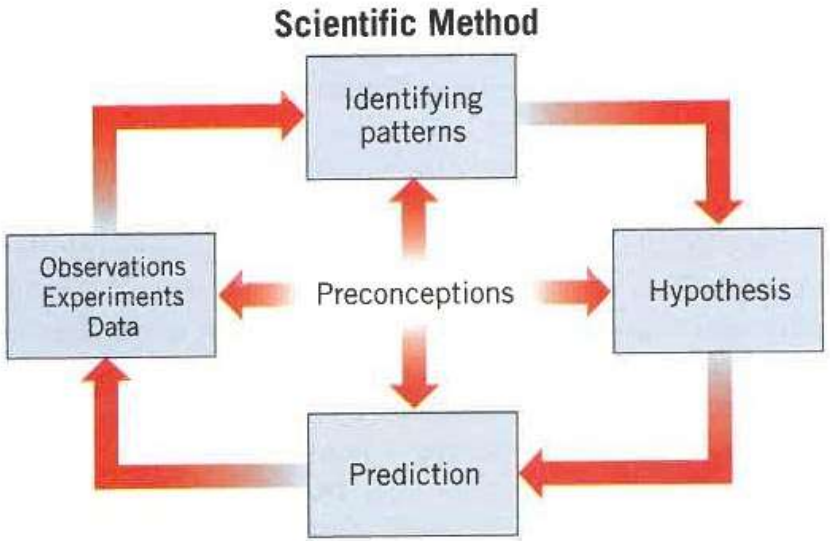
Scientific method involves the interplay of :

OBSERVATION

IDENTIFYING PATTERNS AND REGULARITIES

HYPOTHESIS AND THEORY

PREDICTION AND TESTING



Scientific Method

OBSERVATION

Historical Development:

Plato: Cannot trust own senses in understanding world.

Oxford scholars: how many teeth does a horse have?

Observation <-> Experiment

Scientific Method

Patterns and Regularities Example

The distance traveled by a falling object is proportional to the square of the time of fall.

Distance = constant * time * time = constant * (time)^2

$d = k\ t^2$

TABLE 1-1 Measurements of a Falling Object

Time of fall (seconds)	Distance of fall (meters)
0	0
1	4.9
2	19.6
3	44.1
4	78.4

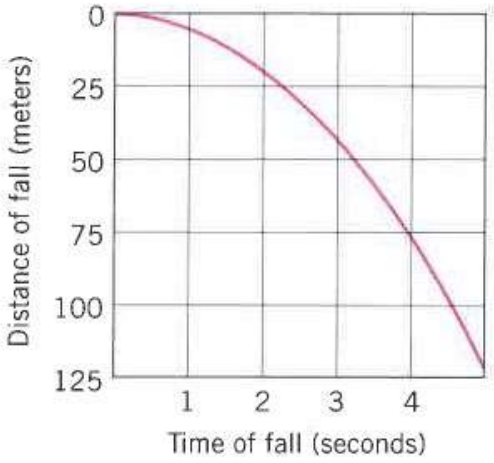


FIGURE 1-2. Measurements of a falling object can be presented visually in the form of a graph. Time of fall (on the horizontal axis) is plotted versus distance of fall (on the vertical axis).

Pattern Recognition

Mendeleev and the Periodic Table

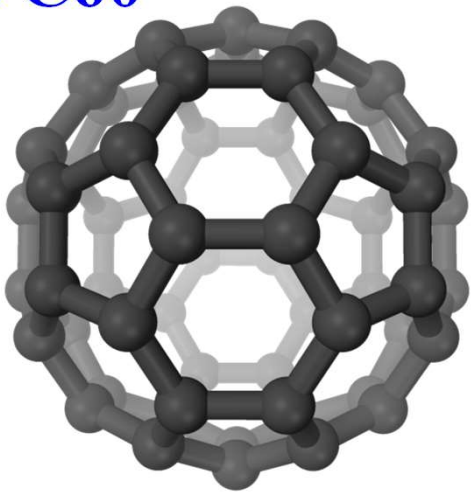
Science, Technology, and Society

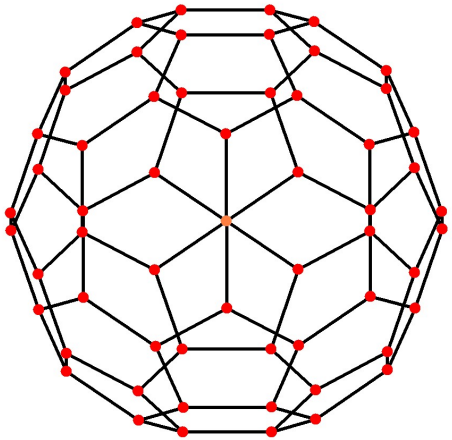
Applied research and development in all disciplines of science.

Argonne National Laboratory	Govt/Univ	near Chicago, IL
Bell Laboratories	Industrial	Middletown, NJ
Brookhaven National Laboratory	Government	Upton, NY
DuPont Central Research & Development	Industrial	Wilmington, DE
Fermi National Accelerator Laboratory	Govt/Univ	Batavia, IL
IBM Watson Research Center	Industrial	Yorktown Hts, NY
Keck Observatory	University	Kamuela, HI
Los Alamos National Laboratory	Government	Los Alamos, NM
National Institutes of Health	Government	Bethesda, MD
Oak Ridge National Laboratory	Government	Oak Ridge, TN
Stanford Linear Accelerator Center	Govt/Univ	Menlo Park, CA
Texas Center for Superconductivity	University	Houston, TX
United States Geological Survey	Government	Reston, VA
Woods Hole Oceanographic Institution	University	Woods Hole, MA

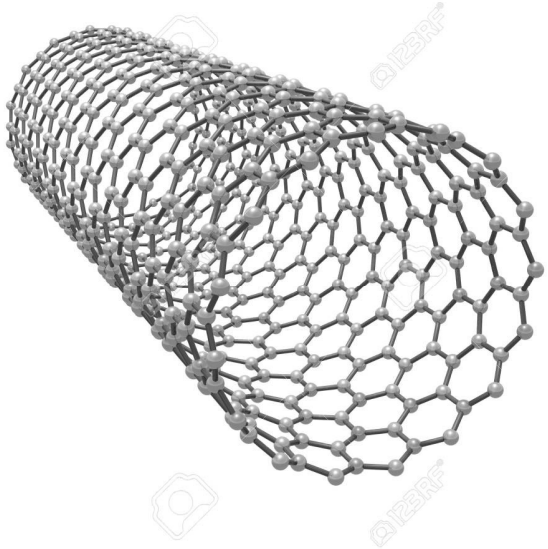
Technology Example: Buckyballs (and company)

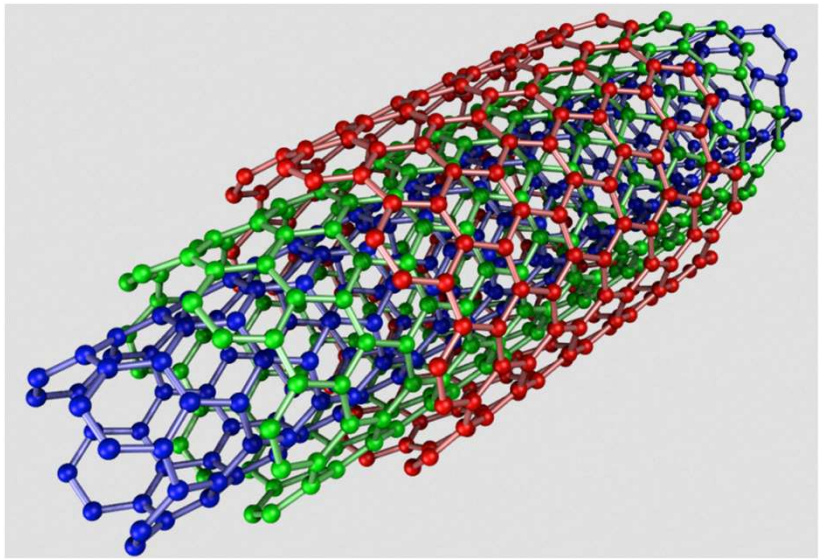
Buckminsterfullerene C60





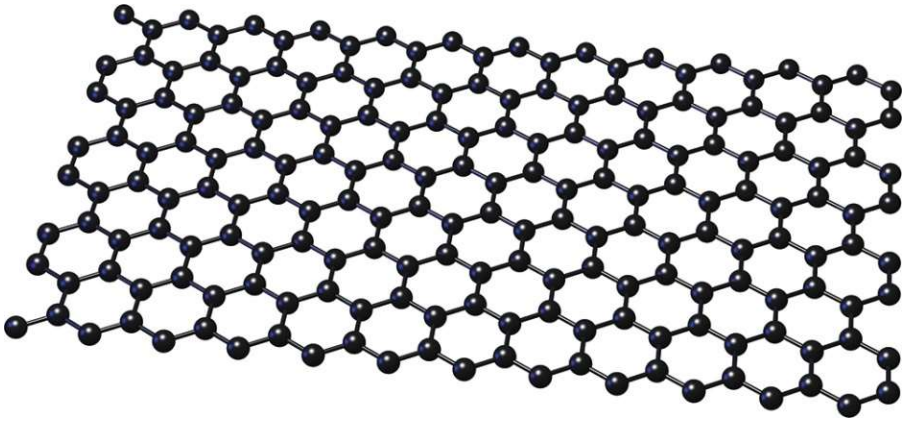
Carbon Nanotubes



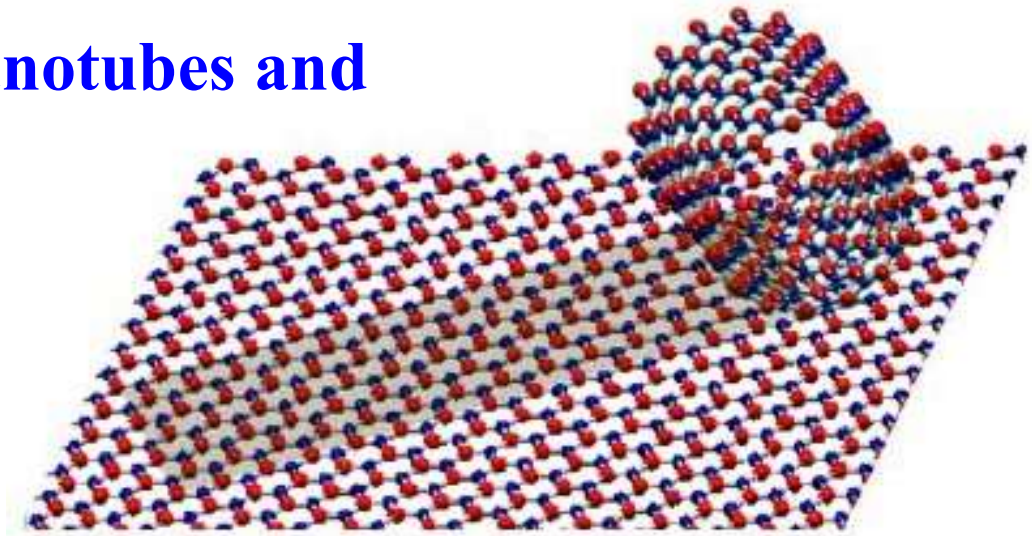


Nanostructures

Graphene



Boron Nitride Nanotubes and Nano-sheets



Obviously, our knowledge and control of nanostructures will continue to expand rapidly!

Exercise #1

a. Your friend is at a stop sign on the way to the pizza shop. You record the speedometer readings every 2 seconds as she travels to the next stop sign. The following table gives the times and speedometer readings for her car.

Time (seconds)	Speed (miles per hour)
0	0
2	10
4	20
6	30
8	40
10	50
12	50
14	50
16	50
18	35
20	20

Describe and identify in words the pattern that you observe.

Using a graph, plot the data that will best illustrate this pattern.

What will the speed of your friend's car be at 22s? 24s?

Exercise #2

b. The following table gives the measured times for a simple pendulum (a washer at the end of a string) to complete one full oscillation (one period), depending on the length of the string. (*Hint:* Try graphing the string length against the square of the period and see if you get a pattern.)

String length (centimeters)	Period (seconds)
5	0.45
10	0.63
15	0.78
20	0.90
25	1.00
50	1.42

Describe and identify in words the pattern that you observe.

Using a graph, plot the data that will best illustrate this pattern.

What will the period of the simple pendulum be for a string of length 75 cm?

What is the length of the string if the period is 2s?

Exercise #3

c. An exercise therapist has recorded the maximum heart rate for a sample of typical human beings. A table of the maximum heart rate and age of this sample of human beings is given in the following table.

200	20
195	25
190	30
180	40
170	50
155	65
140	80

Describe and identify in words the pattern that you observe.

Using a graph, plot the data that will best illustrate this pattern.

What is the maximum heart rate for a 90-year-old woman? A 15-year-old boy?

Exercise #4

d. While waiting for the gas station attendant to fill up your car's 10-gallon tank, you record the time it takes for the pump to reach every 2 gallons. A table of your findings is given next.

Volume (gallons)	Time (seconds)
0	0.0
2	2.5
4	5.0
6	7.5
8	10.0
10	12.5

Describe and identify in words the pattern that you observe.

Using a graph, plot the data that will best illustrate this pattern.

How long will it take to pump 15 gallons?

Exercise #5

Describe and identify in words the pattern that you observe.

Using a graph, plot the data that will best illustrate this pattern.

How long will the shadow be on May 1?

What will the altitude of the Sun be on August 1?

e. Every day, Cowboy Joe used to set his clock to noontime by noting the time when the shadow of the corral gate was the shortest during the day. Cowboy Joe, taking a keen interest in geometry, used this information to calculate the altitude of the Sun at noon (i.e., the angle above the horizon that the Sun is at noon). Joe also noticed that the length of this noontime shadow and the altitude of the Sun changed throughout the year. The table here gives the noontime altitude of the Sun and the length of the corral gate's shadow during the year.

Date	Altitude of Sun (degrees)	Shadow of corral gate (feet)
January 22	19	29
February 20	28	19
March 21	39	12
April 21	51	8
May 20	58	6
June 21	62	5
July 21	59	6
August 21	50	8
September 21	39	12
October 24	27	19
November 22	19	29
December 21	16	35

Exercise #6

f. The estimated world population is given in the following table.

Decade (AD)	Population (in billions)
1650	0.5
1850	1.0
1920	2.0
1990	5.5

Describe and identify in words the pattern that you observe.

Using a graph, plot the data that will best illustrate this pattern.

What will be the world population in 2010 AD?