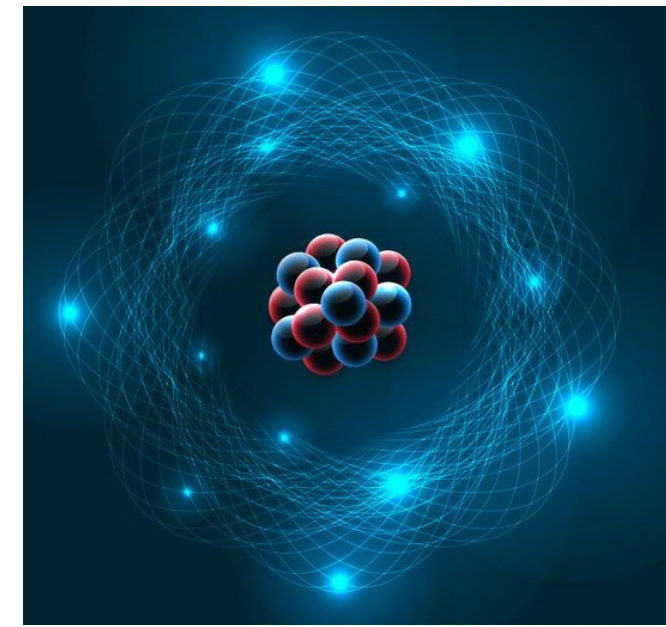


Physics 111: Mechanics

Chapter 1

Junjie Yang
Department of Physics, NJIT



Course Information: Instructor

- Course: PHYS111-010
- Class: 11:30 pm – 12:50 pm, Tuesday & Thursdays in KUPF207
- Instructor: Prof. Junjie Yang
- Office: Tiernan Hall, Room 460
- Office hours (in-person): Thursdays 2:00 PM - 3:00 PM.
Other time by appointment.
- Email: jyang@njit.edu

Course Information: Materials

- Primary Textbook: **Mastering Physics with Pearson eText -- Standalone Access Card -- for University Physics with Modern Physics (by Young & Freedman), 15th edition, ISBN: 0135491193.** Note: only the card for the 15th edition will allow you the access eText and **homework**; similarly, you must login through **Pearsonmastering.com** (other addresses, even from the same publisher, can bring you to the wrong course). *available via NJIT Bookstore*
- For your own reference, record your login ID and password. Instructors cannot access forgotten logins or passwords.
- Details for enrolling in the Pearson Mastering (PM) homework system can be found in the **PDF titled "Student Registration Handout yang55505."** This document is available on the Canvas course (Syllabus).

Course Information: Materials

- **Verify Enrollment Duration:** During the registration process, double-check the duration of your enrollment to ensure that it covers the entire duration of the semester.
- **Attendance** will be taken at all classes and exams. More than 3 unexcused absences (in total) is excessive. If you have excusable absences contact your instructor or the Dean of Students (973.596.3466, Central King Building, Room L71 (Lower Level)). Students may sign in only for themselves on attendance sheets; do not sign in for absent students.
- Attendance sheets are the official university documents; signing the attendance sheet on behalf of another student is considered as “Misuse of Documents”. No student shall intentionally furnish false information nor shall a student forge, alter, destruct, or misuse any university documents or data.

Course Information: Materials

☰ SP26-PHYS111010 > Syllabus

Spring 2026

Course Syllabus

[Jump to Today](#)

Home

Syllabus 

[Approved Calculator Policy- Physics Department, Spring 2026-1.pdf](#) 


Announcements

[Physics 111 Course Outline, Spring 2026-1.docx](#) 

Grades

[Student Registration Handout yang55505.pdf](#) 

Assignments

[LockDown Browser Requirement for Quiz.docx](#) 

Gradescope

Course Summary:

Quizzes



People

Files 

Lecture PPT

Access Pearson 

Homework Enrollment.

Date	Details	Due
Sat Jan 31, 2026	 Academic Engagement: Spring 2026 	due by 11:59pm

Verification of Presence

Course Information: Materials

☰ SP26-PHYS111010 > Quizzes

Spring 2026

Home

Syllabus

Announcements

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Access Pearson

Respondus LockDown Browser Required

This quiz requires Respondus LockDown Browser. Please launch Respondus LockDown Browser to take this quiz or view your quiz results.

If you have not already installed the browser, please download it from here: [[Download Respondus LockDown Browser](#)] ↗

**First Quiz on Jan. 22th, Thursday.
Make sure your LockDown Brower works.**

Course Information: Remarks

- This is one of the difficult 100-level courses.
- To succeed, spending **time/effort** is crucial.
- Taught at a **much much faster pace** than your high school.
(**Suggestion: read the chapter in textbook before our class**)
- Do not hesitate to get help!

My office hours (extra points)

Go to Phys Dept. tutoring sessions

<https://physics.njit.edu/physics-tutoring-sign-sheet>

Course Information: Remarks

- Learning physics needs a lot of practice!
- **Homework/examples/quiz:** Gives you a chance to review the textbook
- Practice helps you understand the course material
- The **best** way to get a good grade!

Roughly **half** of the exam questions (which are worth 80% of your total grade) are based on the homework/example/quiz questions!

- *Please register and login as soon as possible.*
- **NO extension of the due date of homeworks.**

Course Information: Grading

- Three common Exams (54%): (18% each)
4:15 - 5:45 pm on Feb. 23, March. 23 and April. 20
- Final Exam (32%): TBA
- Homework (5%)
- In-class Quizzes (9%)

Percentage	Letter Grade
$\geq 85\%$	A
≥ 80	B+ 84.99%
≥ 70	B
≥ 65	C+
≥ 55	C
≥ 50	D
< 50	F

Physics and Mechanics

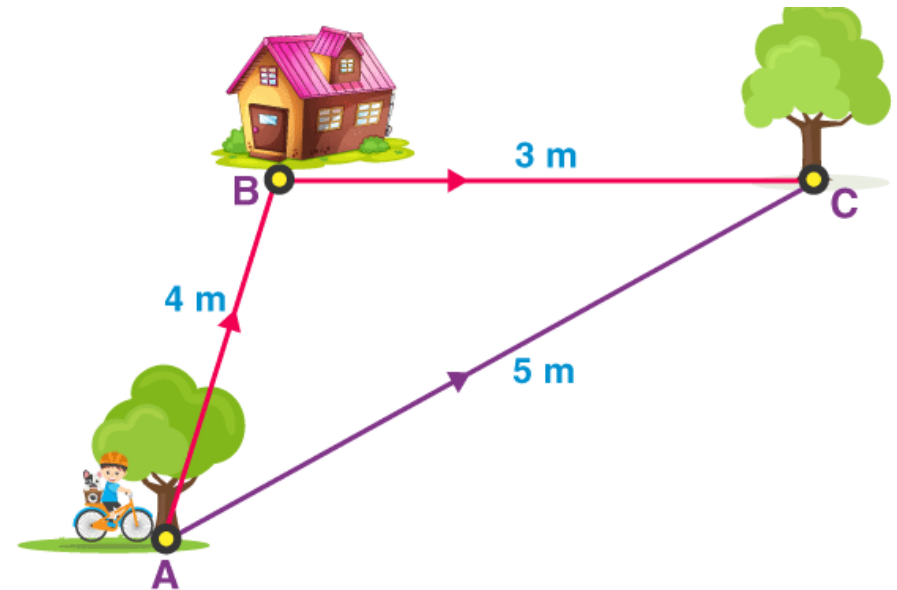
- **Physics** deals with the nature and properties of **matter** and **energy**.
Common language is **math** (Co-Reqs: **Math 111**).
- Physics is based on *experimental observations* and *quantitative measurements*.

- What is a quantitative measurement?

Number + Unit: 3 meters

Both numbers and **units** necessary for any meaningful physical quantities.

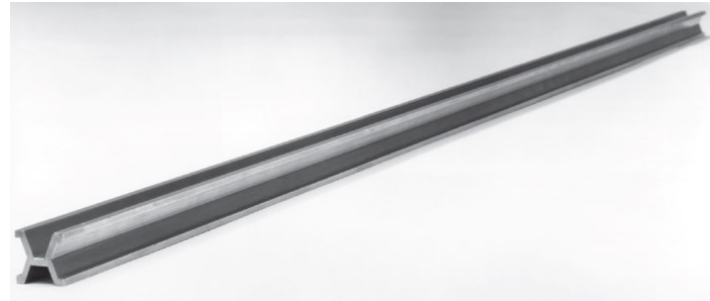
Examples of physical quantities?



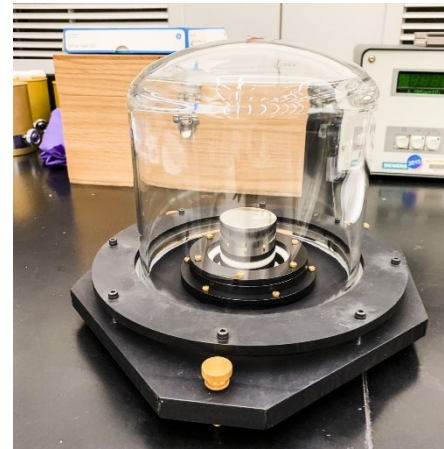
SI units for 3 Basic Quantities

- We have three basic physical quantities: **length**, **mass** and **time**.
- But we have many possible choices for each unit: 1 inch or 2.5 cm.
- In 1960, standards bodies control and define System International (SI) unit as

Length: **Meter**
Mass: **Kilogram**
Time: **Second**



platinum-iridium meter bar



International Prototype Kilogram



Atomic clock

Prefixes for SI Units

➤ Very often the numbers may be very large...

Marathon Running: 42,000 meters

➤ 42,000 meters = 42×10^3 m = 42 km

➤ 1,000 = 10^3 = 1 k

➤ 1,000,000 = 10^6 = 1 M

➤ 1,000,000,000 = 10^9 = 1 G

➤ 3 kg = ? g

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

Prefixes for SI Units

- Sometimes the numbers may be very small...
Dimeter of a molecule: 0.0 000 000 05 meters
- 0.0 000 000 05 meters = 5×10^{-9} m = 5 nm
- 0.000 000 001 = 10^{-9} = nano
- 0.01 = 10^{-2} = centi (such as cm)
- 0.001 = 10^{-3} = milli (such as mg)
- 0.000 001 = 10^{-6} = micro (such as μm)
- 3 cm = ? mm = ? m

10^x	Prefix	Symbol
$x=-1$	deci	d
-2	centi	c
-3	milli	m
-6	micro	μ
-9	nano	n
-12	pico	p
-15	femto	f
-18	atto	a

Quantities and Units

- Operations of physical quantities: **add**, **subtract**, **multiply** and **divide**.

$$3 \text{ m} + 3 \text{ m} = ?$$

$$3 \text{ m} - 1 \text{ m} = ?$$

$$3 \text{ m} \times 3 \text{ m} = ?$$

$$10 \text{ m} \div 2 \text{ s} = ?$$

- Add, subtract, multiply and divide units just like numbers

- Multiply/divide units gives derived quantities, e.g, area, speed, volume and density.

$$\text{Area} = \text{Length} \times \text{length}$$

$$\text{SI unit} = \text{m}^2$$

$$\text{Volume} = \text{Length} \times \text{length} \times \text{length}$$

$$\text{SI unit} = \text{m}^3$$

$$\text{Speed} = \text{Length}/\text{time}$$

$$\text{SI unit} = \text{m/s}$$

$$\text{Density} = \text{Mass}/\text{volume}$$

$$\text{SI unit} = \text{kg/m}^3$$

Other Unit System

- U.S. customary system (or imperial units): foot, slug, second
- **CGS** system: cm, **gram**, **second** (another variant of the metric system, heavily used in **physics**)
- We will use **SI units** in this course, but it is useful to know conversions between systems.

$$\begin{array}{lll} 1 \text{ mile} = 1609 \text{ m} = 1.609 \text{ km} & & 1 \text{ ft} = 0.3048 \text{ m} = 30.48 \text{ cm} \\ 1 \text{ m} = 39.37 \text{ in} = 3.281 \text{ ft} & & 1 \text{ in} = 0.0254 \text{ m} = 2.54 \text{ cm} \\ 1 \text{ lb} = 0.465 \text{ kg} & 1 \text{ oz} = 28.35 \text{ g} & 1 \text{ slug} = 14.59 \text{ kg} \end{array}$$

More can be found in Appendices in your textbook.

Unit Conversion: Example

- A car is traveling at a speed of 38.0 **m/s**. What is the speed in unit of **miles/hour**?

We need to convert the units of m/s to mph. Take it in two steps.

- **Step 1:** Convert **m** to **miles**, 1 mile = 1609 m, so 1 m = 6.215×10^{-4} mile,

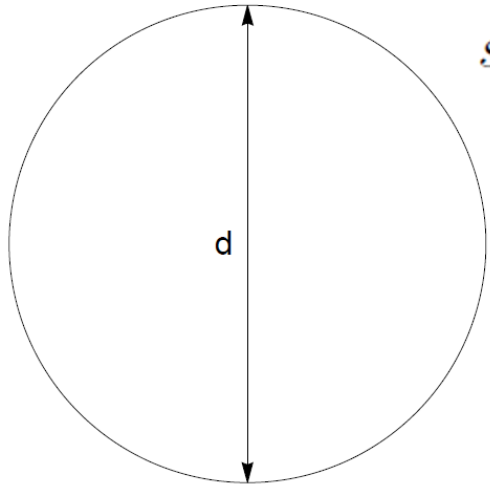
$$38 \frac{m}{s} = 38 \frac{6.215 \times 10^{-4} \text{ mile}}{s}$$

- **Step 2:** Convert **s** to **hours**, 1 hour = 3600 s, so 1 s = 2.778×10^{-4} hour

$$38 \frac{m}{s} = 38 \frac{6.215 \times 10^{-4} \text{ mile}}{s} = 38 \frac{6.215 \times \cancel{10^{-4}} \text{ mile}}{2.778 \times \cancel{10^{-4}} \text{ hr}} = 85 \frac{\text{mile}}{\text{hr}}$$

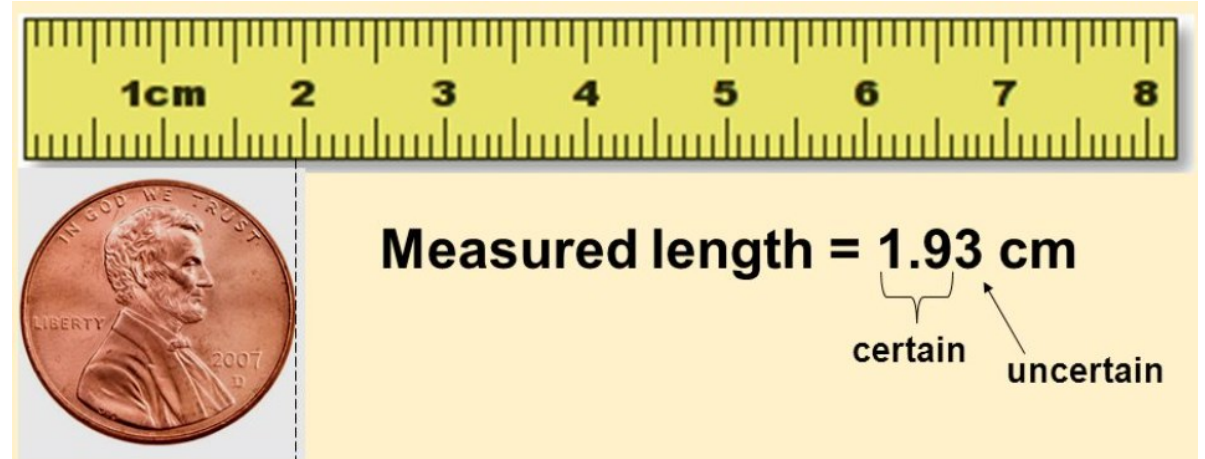


Uncertainty and significant figures



$$s = \pi d$$
$$= 3.141592654 \dots \text{ cm}$$

Correct? Wrong?



A solid disk has a diameter of 1 cm. Find the circumference.

- A measured physical quantity has “uncertainty”.
- The uncertainty is indicated by its number of *significant figures*.

just to look nice
not significant (any zero at start)

0.0560

1st significant digit *2nd significant digit* *3rd significant digit*

Example:

A mini sugar cube has side length **5 mm**. A larger gift box is a cube with side length **20 cm**. Assume the sugar cubes packed perfectly with no empty space. **How many** sugar cubes fit in the box?

$$1 \text{ cm} = 10 \text{ mm} \quad 20 \text{ cm} = 200 \text{ mm}$$

A: 40

B: 120

C: 1600

D: 64,000

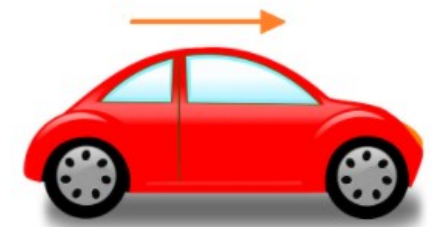
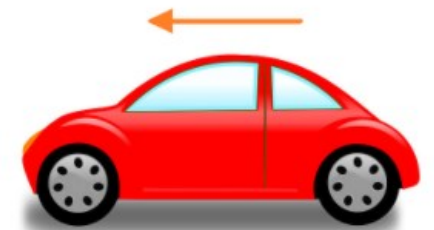
$$\text{Volume of one cube: } 5\text{mm} \times 5\text{mm} \times 5\text{mm} = 125 \text{ mm}^3$$

$$\begin{aligned} \text{Volume of gift box: } 200\text{mm} \times 200\text{mm} \times 200\text{mm} &= 8000000 \text{ mm}^3 \\ &= 8 \times 10^6 \text{ mm}^3 \end{aligned}$$

$$8 \times 10^6 \text{ mm}^3 / 125 \text{ mm}^3 = 64,000$$

Vectors and Scalars

- A car: **mass 1000 kg**, can have a velocity of **20 m/s** toward to West (**-20 m/s**) or East (**+20 m/s**).
- A *scalar quantity* can be described by a *single number*, like mass.
- A *vector quantity* has both a *magnitude* and a *direction* in space, like velocity.
20 m/s is the magnitude, and +/- is its direction.
 - Scalar examples: mass, time, kinetic energy
 - Vector examples: displacement, velocity and force

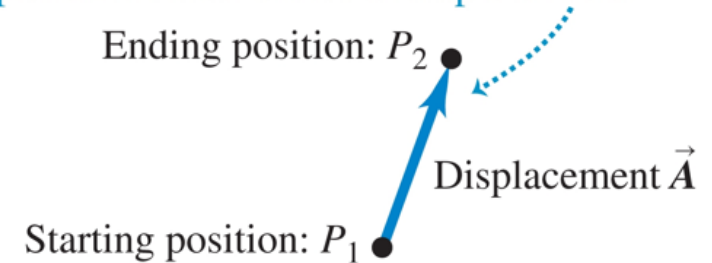


Vectors: Important Notation

- For a more general case, to describe vectors we will use: The bold font: vector \mathbf{A} , and/or an arrow above the vector: \vec{A}
- In the pictures, we will always show vectors as arrows.
- Arrows point the direction.

- To describe the magnitude of a vector we will use the absolute value sign: $|\vec{A}|$ or just A .
- Magnitude is always positive; the magnitude of a vector is equal to the length of a vector.

We represent a displacement by an arrow that points in the direction of displacement.



A displacement is always a straight arrow directed from the starting position to the ending position. It does not depend on the path taken, even if the path is curved.

