Expectations

These are some things you can do in this course, if you expect to get a satisfactory grade. **Expect to ...**

- spend **more time** on this course than your other courses.
- read (the assigned sections of either book) **before** lecture.
- **attend** everything and turn in your work **on time**.
- learn some **interesting** things. ☺
- **work with others**, but turn in **your own work**.
- be an **active** participant during class.
- be **confused at first** but then assemble your knowledge.

Overcoming confusion is a key part

of the **learning process**.

Web page	http://blackboard.bu.edu (PY105s A1 Elementary Physics 1)

Calculator	You will need a standard scientific calculator for homework and labs. Calculators are **ALLOWED** on the tests or the final exam.

There are no makeups.

Read the Syllabus for all the details!

Important dates: add/drop period – up to May 29th
last day to withdraw – June 14th

Homework: To pass the course you must get at least 50% of the maximum possible homework score.

All **homework assignment will be accounted for the final grade.**

Discussion sections and traditional laboratories are combined together in 10 Investigative Laboratories (or shortly, IL, or units – 9 best grades are used for the final grade):

These begin on Wednesday, May 23 (Tomorrow!!).

Homework	online assignments delivered via WebAssign (you will need to purchase the access code)
Exams	Test 1 June 1; 9 am, Test 2 June 15; 9 am, Test 3 June 29; 9 am,
Course Grade	14 % homework 16 % unit sections 7 % lecture participation: in-lecture quizzes, class participation 20 % test 1, 21 % test 2, and 22 % test 3

+ 2 pre and 2 post tests

Some helpful questions for solving physics problems

1. What objects are involved?

2. What properties of the objects might be important?

3. How to describe those properties mathematically (by numbers or equations)?

4. What is happening to the objects? (Make a picture showing the objects and the processes they are involved into).

5. What properties of the processes might be important? How can we describe them mathematically (what laws or definitions should we use)?

6. Are all the variables connected? What else should be connected to what?

7. How can I solve my equations mathematically?

8. Does it make a sense?

9. Could I solve a similar problem again? How much time would it take?

10. Who can help me (if I need)?

In PY105 the key subjects are **(Chapters 1 – 10, 12 - 14)**

- forces and motion
- conservation of momentum and energy
- fluids
- rotation
- harmonic motion
- thermodynamics.

This week's topics

What is Physics?

Kinematics of 1 – D motion

Kinematics of 2 – D motion

The list of concepts, definitions, laws and relations to memorize when taking PY 105 course

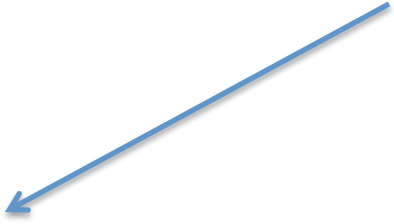
For each physical quantity a students must be able to answer the following questions:

1. **what is its name;**
2. **what is a usual symbol for the quantity;**
3. **what is its unit;**
4. **how to measure the quantity;**
5. **to what other physical quantities is this quantity related;**
6. **how is this physical quantity algebraically related to other physical quantities?**

A scalar, a vector, a component, a right triangle, sin, cos, tan, the Pythagorean theorem, Coordinate system, Cartesian coordinate system, an axis, an origin, a coordinate, Cartesian vector components, linear equation, quadratic equation, quadratic formula, a unit, fundamental (base) units, SI system of units, unit conversion, conversion factor, prefix words, etalon, measurement, significant figures, motion, position vector, displacement, distance, elapsed time, velocity, speed, average velocity, average speed, instantaneous velocity, motion equation, motion diagram, position graph, velocity graph, meaning of the slope, meaning of the area, constant velocity motion (CVM), properties of CVM.

What is Physics?

Physics is the study of how “things work”.



- forces and motion
- conservation of momentum and energy
- fluids
- rotation
- harmonic motion
- thermodynamics.

Physics = applied Math

1. Study Nature via observations, theoretization, and experimentation.

2. Predicting phenomena using laws of Nature.

3. Developing devices using laws of Nature.

Measurement, Etalon, Unit

Measurement (metrology):
Set of operations having the object of determining a value of a quantity.

The units for *length, mass,* and *time* (as well as a few others), are regarded as ***base units***.

These units are used in combination to define additional units for other important physical quantities such as force and energy.

SI units

meter (m): unit of length

kilogram (kg): unit of mass

second (s): unit of time

Units of Measurement

	System		
	SI	CGS	BE
Length	Meter (m)	Centimeter (cm)	Foot (ft)
Mass	Kilogram (kg)	Gram (g)	Slug (sl)
Time	Second (s)	Second (s)	Second (s)

The World's Highest Waterfall

The highest waterfall in the world is Angel Falls in Venezuela, with a total drop of 979.0 m.

Express this drop in feet. (3.281 feet = 1 meter)

1. **3212 feet**
2. **32120 feet**
3. **321200 feet**
4. **None of the above**

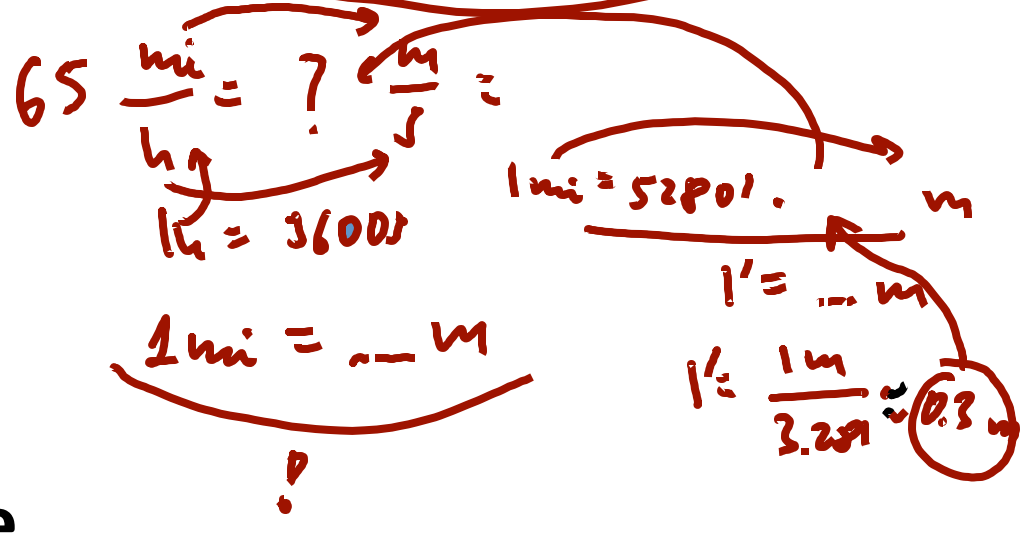
Interstate Speed Limit

Express the speed limit of 65 miles/hour in terms of meters/second.

5280 feet = 1 mile; 3600 seconds = 1 hour

3.281 feet = 1 meter.

1. **0.29 m/s**
2. **2.9 m/s**
3. **29 m/s**
4. **None of the above**



THE CONVERSION OF UNITS

1 cm = (0.01 m)

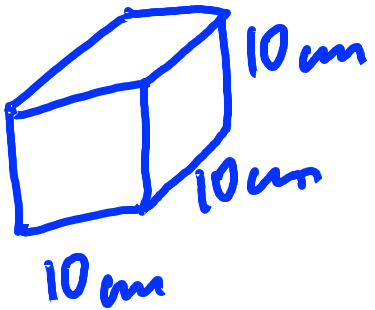
1000 (0.01 m)^3 = 1000 · 0.000001 · m^3 = 0.001 m^3 = 10^{-3} m^3

1 ft = 0.3048 m

1 mi = 1.609 km

1 hp = 746 W

1 liter = ?



1L = 10 cm × 10 cm × 10 cm = 10 · 10 · 10 · cm · cm · cm =

= 1000 cm^3

1. **1 cm**
2. **10 cm**
3. **100 cm**
4. **1000 cm**
5. **1 m**
6. **10 m**
7. **100 m**
8. **1000 m**
9. **None of the above**

Practice at Home

Use the following conversion factors and convert into SI

1 kg = 1000 gram; 1 m = 100 cm; 1 km = 1000 m;

1 mi = 1600 m; 1 L is a cube with a 10 cm side; π rad = 180^0

1. 1gram/cm^3 =

2. 1 L =

3. 10 cm^2 =

4. 72 km/h =

5. 90 mi/h =

6. 30^0 =

Standard Prefixes Used to Denote Multiples of Ten

Prefix	Symbol	Factor[a]
tera	T	10^{12}
giga[b]	G	10^{9}
mega	M	10^{6}
kilo	k	10^{3}
hecto	h	10^{2}
deka	da	10^{1}
deci	d	10^{-1}
centi	c	10^{-2}
milli	m	10^{-3}
micro	μ	10^{-6}
nano	n	10^{-9}
pico	p	10^{-12}
femto	f	10^{-15}

Dimensional Analysis

Is the following equation dimensionally correct?

[L] = Length [T] = Time [M] = Mass

$$x = vt$$

1. **Yes!**
2. **No!**
3. **I have no clicker yet**

Dimensional Analysis

Is the following equation dimensionally correct?

$$x = vt$$

$$[\mathrm{L}] = \left[\frac{\mathrm{L}}{\mathrm{T}}\right][\mathrm{T}] = [\mathrm{L}]$$

[L] = Length [T] = Time [M] = Mass

Dimensional Analysis

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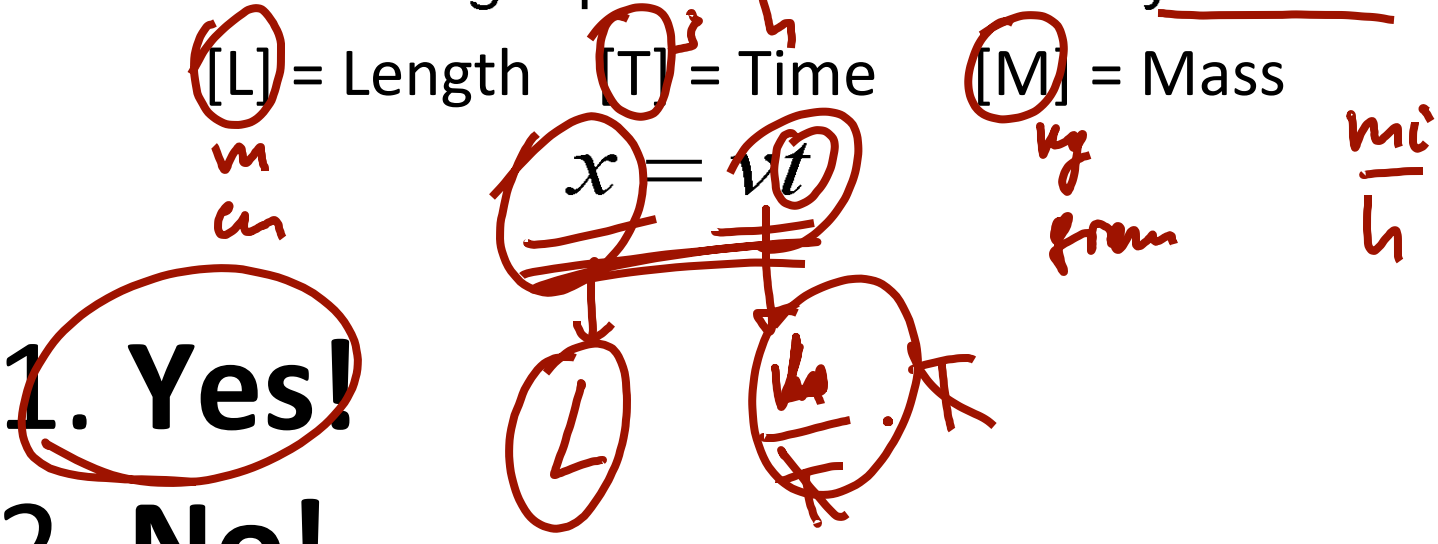

1. **Yes!**
2. **No!**
3. **I have no clicker yet**

DIMENSIONAL ANALYSIS

[L] = length [M] = mass [T] = time

Is the following equation dimensionally correct?

$$x = \frac{1}{2} v t^2$$

1. **Yes!**
2. **No!**
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DIMENSIONAL ANALYSIS

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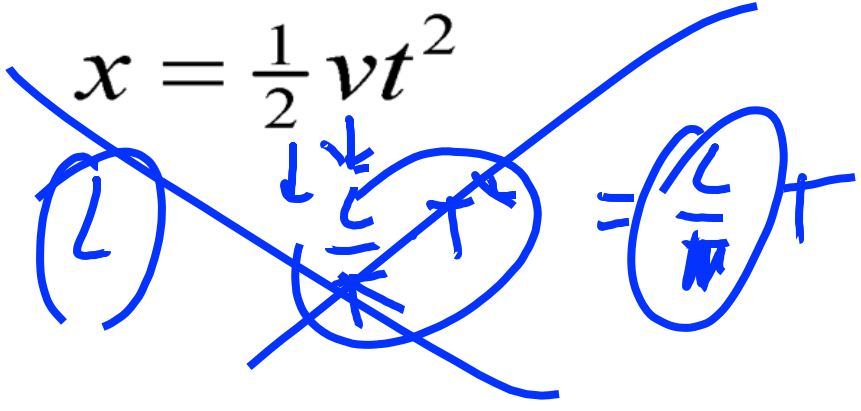


1. **Yes!**
2. **No!**
3. **I have no clicker yet**

DIMENSIONAL ANALYSIS

[L] = length [M] = mass [T] = time

Is the following equation dimensionally correct?

$$x = \frac{1}{2}vt^2$$

$$[\mathrm{L}] = \left[\frac{\mathrm{L}}{\mathrm{T}}\right][\mathrm{T}]^2 = [\mathrm{L}][\mathrm{T}]$$

1 = T

Practice at Home

By the means of unit analysis conclude on which of the expressions below *cannot* be physically correct; check all wrong expressions (the table on the right provide SI units to some of physical quantities).

[ ] $A = \frac{1}{2}LW$ [ ] $\frac{m}{tA} = \rho v$

[ ] $L = 2v^2 t$ [ ] $\frac{F}{A} = \rho \frac{v}{t} L^2$

[ ] $V = vtL^2$

[ ] $F = 5m\frac{v}{t^2}$

[ ] $E = \frac{Lp^2}{2mt}$

L (length)	m
t (time)	s
m (mass)	kg
A (area)	m^2
W (width)	m
v (velocity)	m/s
F (force)	kg m /s^2
E (energy)	kg m^2 /s^2
V (volume)	m^3
p (momentum)	kg m /s
a (acceleration)	m /s^2
ρ (density)	kg / m^3

For all the expressions you checked above as wrong make some modification by using the same variables (or one more variable from the table) so the new expression would have matching units across the "=" symbol.

Motion

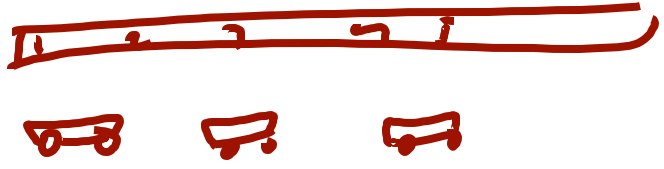
What are some words and/or concepts we use when describing motion?

Was the object moved? What is motion?

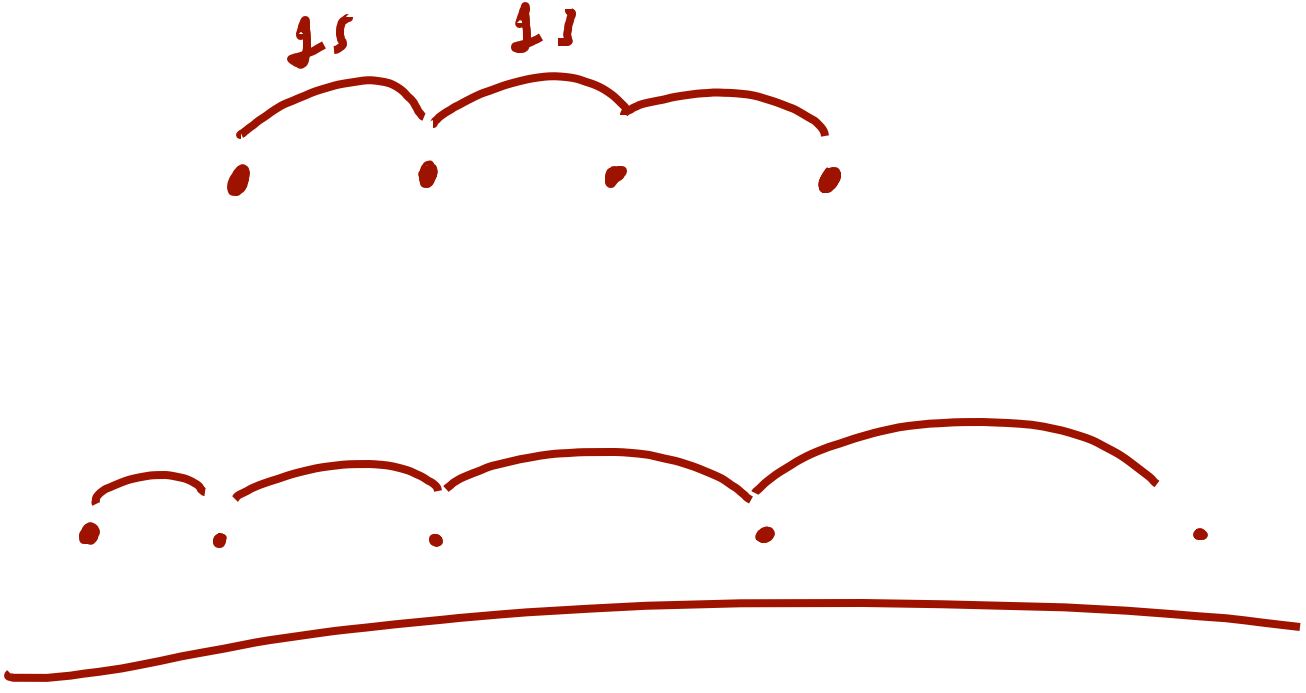
What is a motion diagram? What is a trajectory?

What is the difference between *a* path and the *shortest* path?

What is the difference between distance traveled and displacement?



A motion diagram



Question

If you move 5 meters north, and then go 3 m south.

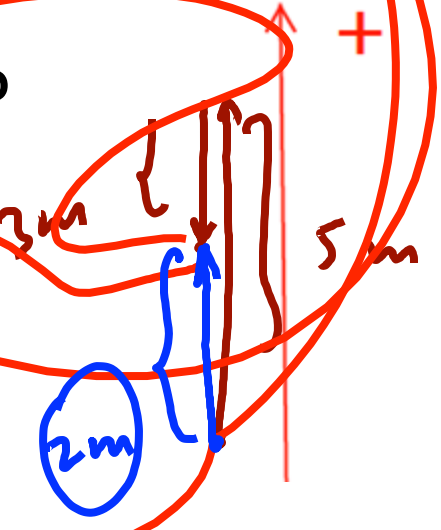
- What is the total distance traveled?

- What is your net displacement?

Question

If you move 5 meters north, and then go 3 m south.

- What is the total distance traveled?
- What is your net displacement?



For multiple displacements, the total distance traveled is the sum of the distances for the individual displacements.

The total distance traveled is 5 m + 3 m = 8 m.

The net displacement is the **resultant** of the individual displacements.

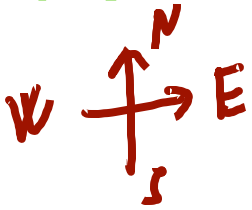
Define north to be the positive direction.

$\Delta\vec{x}_1 = +5$ m north.

$\Delta\vec{x}_2 = +3$ m south = -3 m north.

$\Delta\vec{x}_{net} = \Delta\vec{x}_1 + \Delta\vec{x}_2 = +5 \text{ m north} - 3 \text{ m north} = +2 \text{ m north}$.

Example Problem

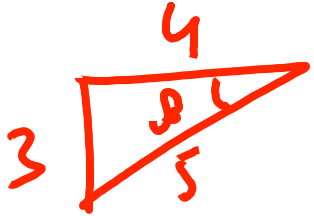


If you move 4 meters west

Now go the other direction, with a displacement of 3 m south.

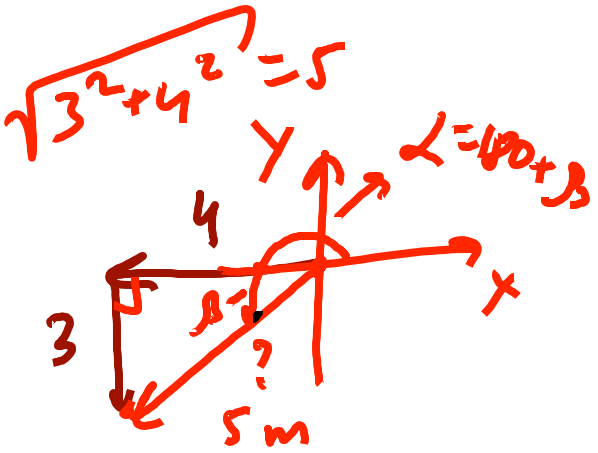
What is the total distance traveled?

What is your net displacement?



$\tan\beta = \frac{3}{4}$ $\sin\beta = \frac{3}{5} = 0.6$

$\beta = \sin^{-1}(0.6)$



Vectors and scalars

1) What is a vector? Give a brief definition in words.

A vector is something that has both a magnitude and a direction.

2) Give some examples of quantities that are vectors.

Displacement, velocity, acceleration, force, ...

3) What is a scalar? Give a brief definition in words.

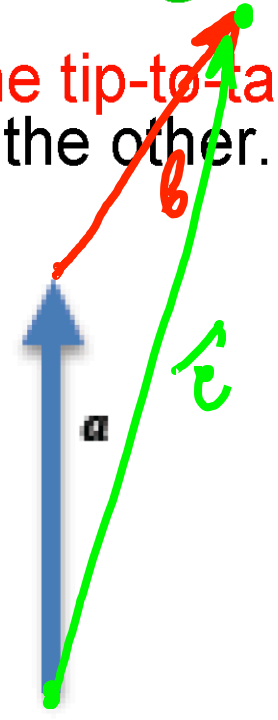
A scalar has only a magnitude (with units).

4) Give some examples of quantities that are scalars.

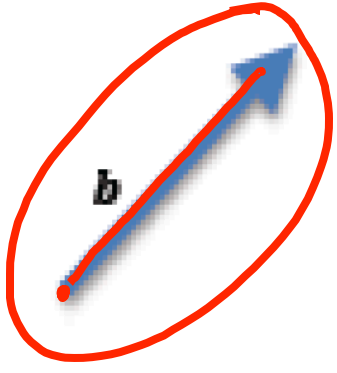
Distance, speed, mass, temperature, ...

Adding the Vectors **A** and **B** geometrically

The tip-to-tail method: move the tail of one vector to the tip of the other. **R** is the "resultant vector".



$\vec{a} + \vec{b} = \vec{c}$



A to tip of **B**

B to tip of **A**