Physics 225

Section 2
Dr. Leigh Hargreaves
Fall 2018
Lecture 1

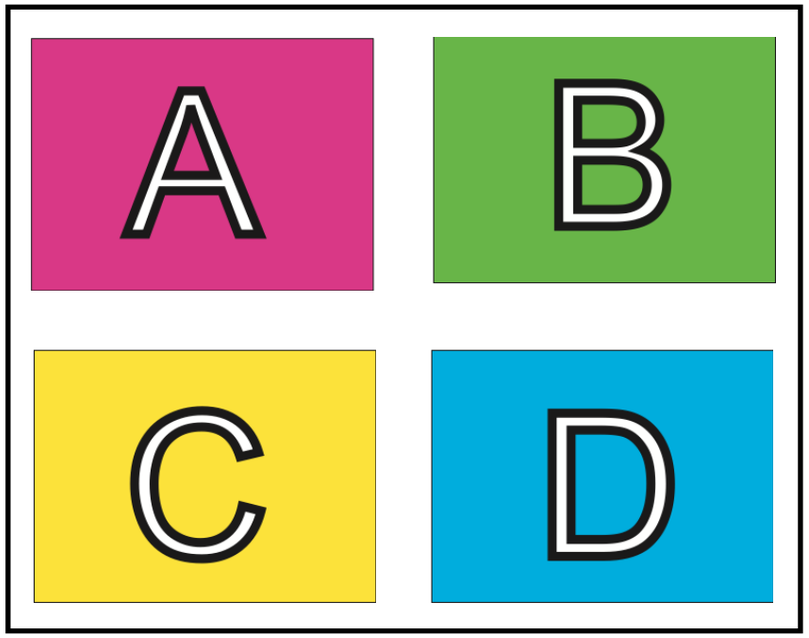
lhargreaves@fullerton.ed

Welcome to PHYS 225

- Instructor: Dr. Leigh Hargreaves
- Please take one each of the following

Syllabus

(online)



Today: Introduction

- We will go over the syllabus
- Introduce instructors
- Talk about measurements

California State University Fullerton
Department of Physics
PHYS 225: Introductory Physics
Fall 2018

Instructor: Dr. Leigh Hargreaves
Office: MH 654
Phone: (657) 278-2261
Email: lhargreaves@fullerton.edu

Course Information

Class hours: 11:00am – 11:50pm on Monday, Wednesday and Friday, McCarthy Hall Room 121
Office hours: Tuesday and Thursday, 10:30am to 12:00pm
Prerequisite: MATH 150A
Corequisite: PHYS 225L

This course covers introductory concepts in physics, particularly mechanics. Mechanics is the study of how and why objects move, such as a ball dropped from a height or a satellite orbiting a planet. This course is intended for students majoring in Physics or in Engineering topics. Topics to be covered are listed on the topic schedule at the end of this syllabus. Exam dates are also shown.

The textbook for this course is "*Fundamentals of Physics 11th Edition*" (Halliday and Resnick). There are several options open to students to obtain the textbook. Minimally, purchase of the registration key for WileyPlus (needed for the online homework) includes an electronic version of the textbook. If students wish to obtain a physical copy of the book, they can purchase the book through the standard textbook retailers. Purchase of the book through the bookstore or from WileyPlus.com should also include registration to WileyPlus, which may not be available from other sellers.

Assumed Knowledge

Physics, rather notoriously, relies heavily on algebraic equations to describe the physical world. One of the goals of this course is to convey that physics equations should not be viewed as complicated strings of letters that one simply plugs numbers into to compute numerical answers, or that memorizing these strings in any way constitutes physics knowledge. Rather, the form of the equations of physics reflect (and reveal) insights into how the natural world behaves. To that end, this course will assume that you are not only familiar, but comfortable, with some basic mathematical techniques necessary for strong symbolic reasoning. Most important are algebra and trigonometry, and some experience in calculus will be valuable.

Minimally, students are expected to be able to rearrange algebraic equations to solve for one of the variables, relate an algebraic equation to its graph and relate the angles of a triangle to the length of the sides. Students should also understand what it means to take the derivative of a function (not just how to compute it, but what "deriving" something tells you).

1

Assessment and Grading

This course will be assessed by homework exercises and in-class examinations.

Homework

Each week, students will be assigned a series of problems covering concepts that were covered in the previous week's class. Problems will be allocated using the online homework system WileyPlus. Students must create an account on WileyPlus to access the homework, which will require students to purchase a registration number. Registration is included with purchase of the textbook, or can be purchased independently through WileyPlus. A flyer with details to sign up to the correct course section has been uploaded to Titanium.

One homework assignment will be assigned approximately each week. The homework sets are all equally weighted.

Exams

There will be 3 midterms and a Final exam. Each midterm will cover approximately the preceding 5 weeks of the course, and contain a mixture of conceptual and computational questions. The final will be comprehensive, but limited to conceptual questions only.

Course Weighting:

The various assessment pieces of the course will be weighted according to the following scale:

Homework:	35%
Midterms:	15% (each)
Final:	20%

Grading

Letter grades will be assigned according to the following scale (all grades will be rounded to the nearest integer):

A: 90% - 100%	(outstanding achievement)
B: 80% - 89%	(high quality achievement)
C: 70% - 79%	(satisfactory achievement)
D: 60% - 69%	(below satisfactory achievement)
F: 0% - 59%	(failing)

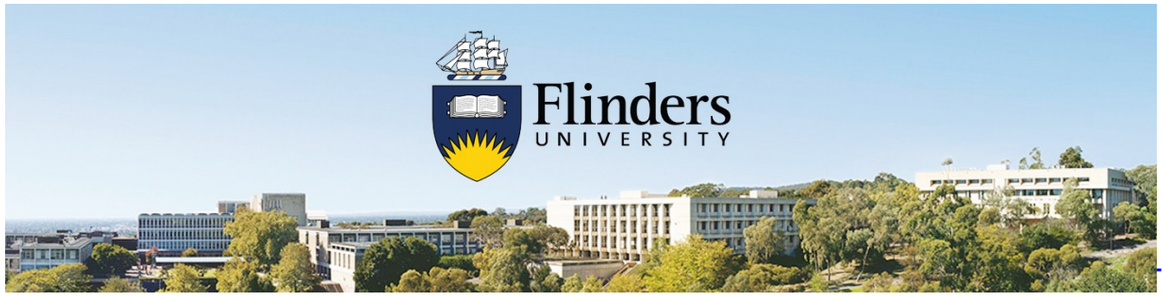
Plus/minus grading will be used in this course. Any student in the top or bottom 3 points of their grade bracket will receive a '+' or '-' grade, respectively. For example, a score of 87%, 88% or 89% would qualify for a B+, while 80%, 81% or 82% would receive B-.

There will be no grading curve employed in this class, your final grade will only depend on your own performance and not that of any other student.

2

Who am I?

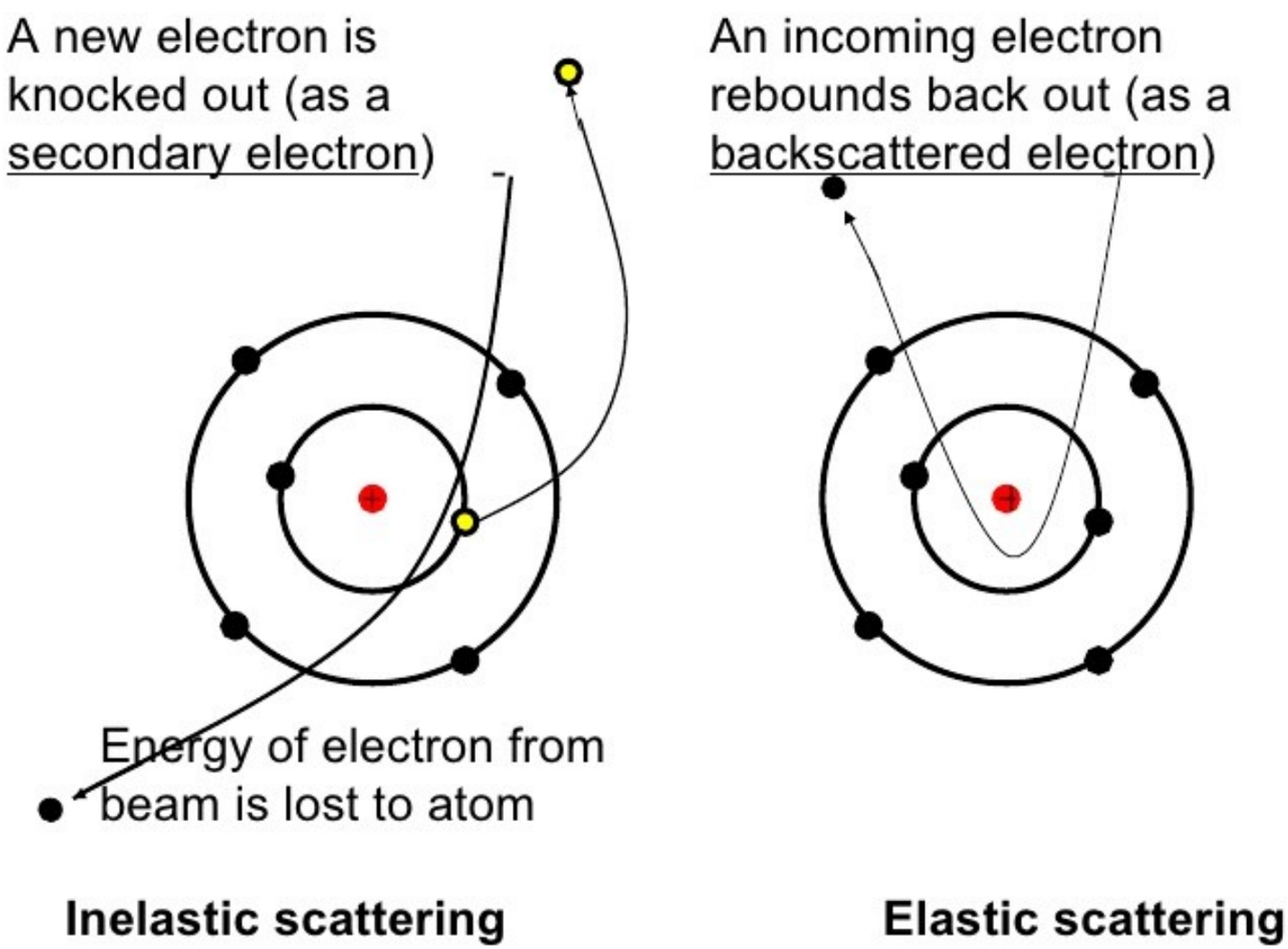
- Dr. Leigh Hargreaves
  Assoc. Prof. of Physics

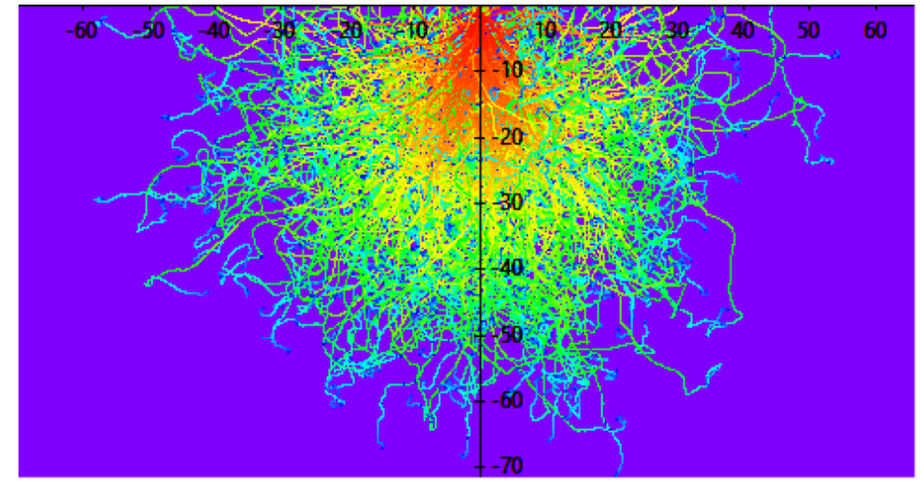


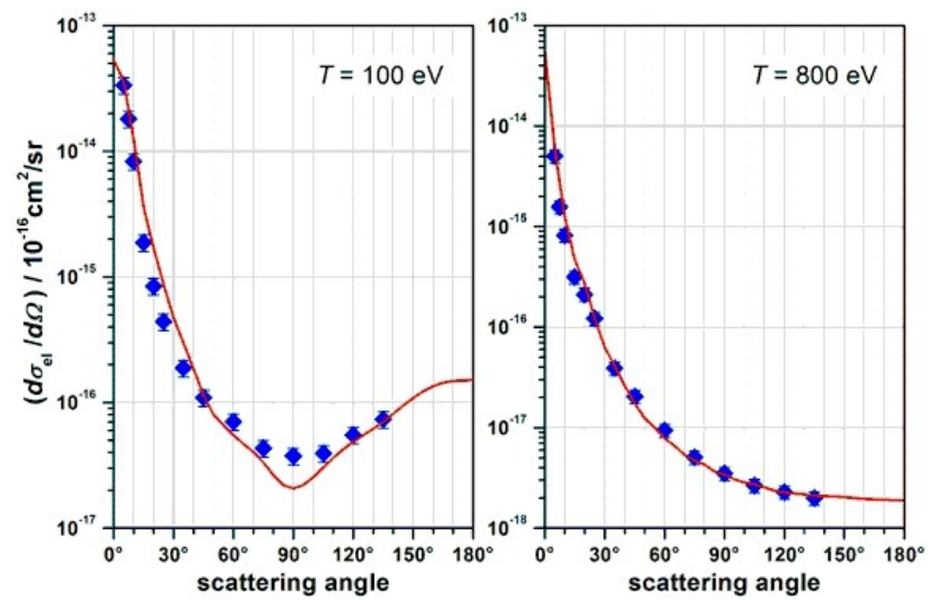
- Studies and Research at…
  - Flinders University
  - Adelaide University

- Joined CSUF in 2011
  - Teaching physics
  - Research in electron scattering

My research







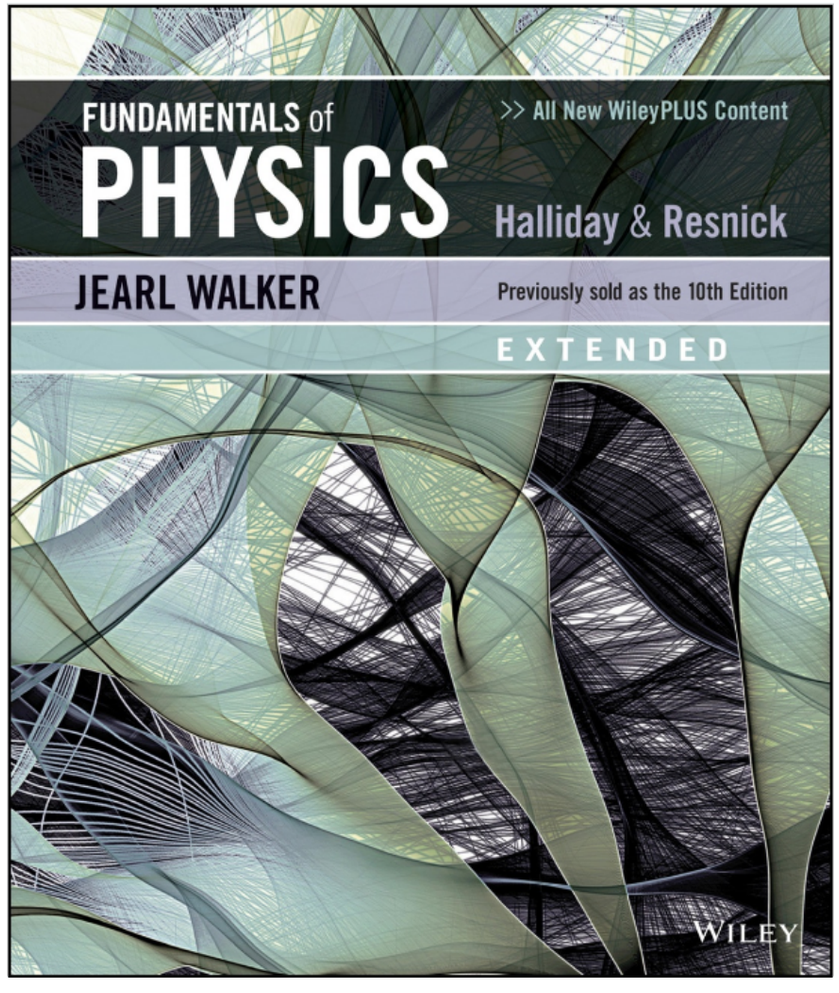
- Electron scattering from molecular targets (biomolecules)

Supplementary Instructor

- **Bianca Diaz**
  bianca.diaz@csu.fullerton.edu
  - Study sessions in McCarthy Hall room 600
  - MoWeFr, 10:00 – 10:50 AM
- **Purpose - peer led study session**
  - Work on practice problems
  - Help learn together
  - Statistically, students who attend SI score 1 letter grade higher than those that dont
  - Optional, but I strongly encourage you to go!

Materials

- *Fundamentals of Physics*, Halliday & Resnick & Walker 11th edition
  - Many worked examples
  - Good explanations
  - Practice problems
  - Great online resources (videos etc.)
- Ways to get the book
  - Campus bookstore
  - Online: amazon.com, wiley.com (print or ebook)



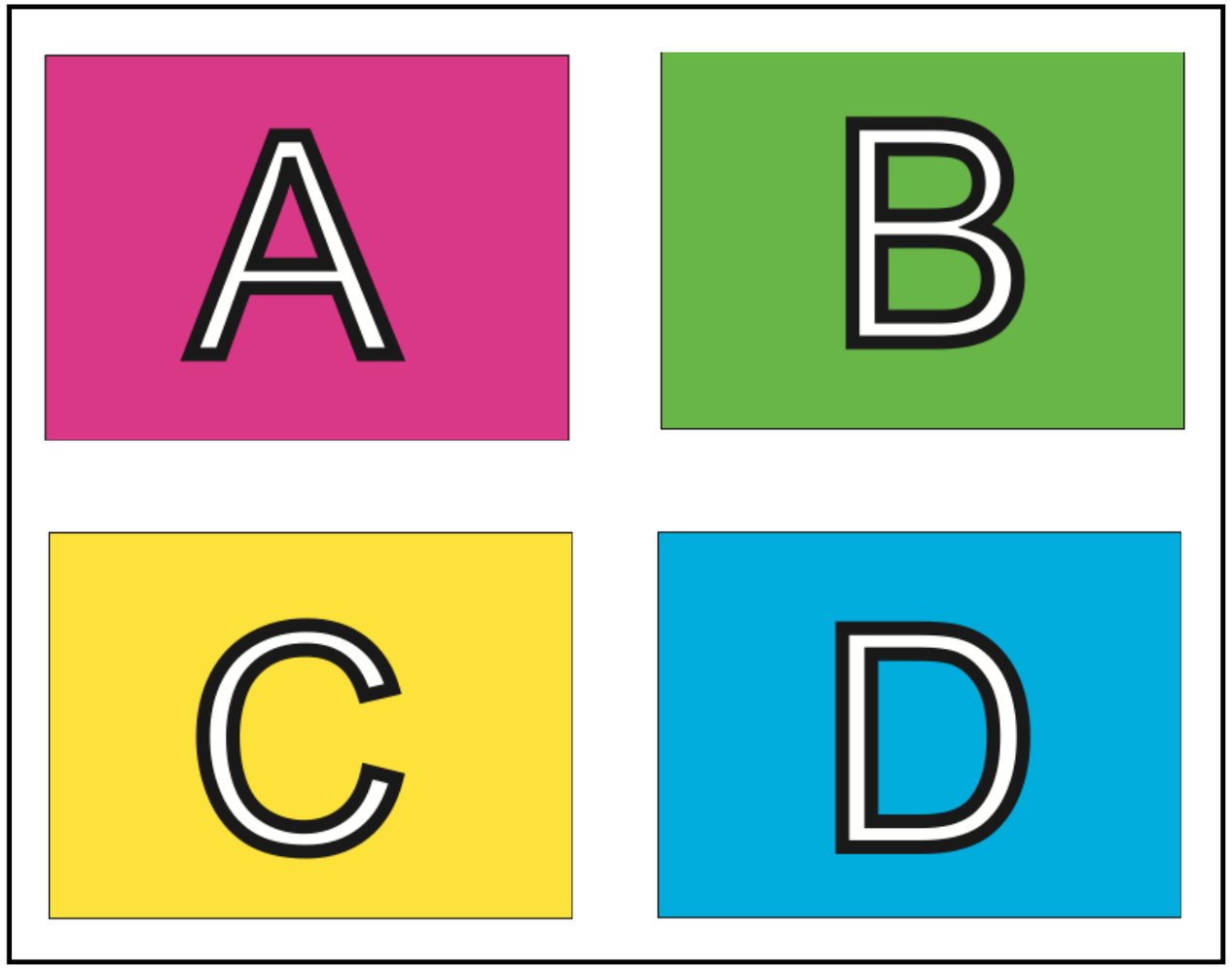
Course Website

- **Homework - WileyPLUS**
  - **Must** register at WileyPLUS website (ASAP)
  - Course ID: 657668

- **Course information and updates**
  - TITANium
  - Here I will post announcements and any other necessary information
  - Also announced in class

Materials

- **In-class activity cards**
  - Fold to select an answer
  - Hold it up in front of you



- **Purpose**
  - To make it easier to answer questions in class
  - A way for everyone to participate

Clicker question

- Where is my accent is from?

A

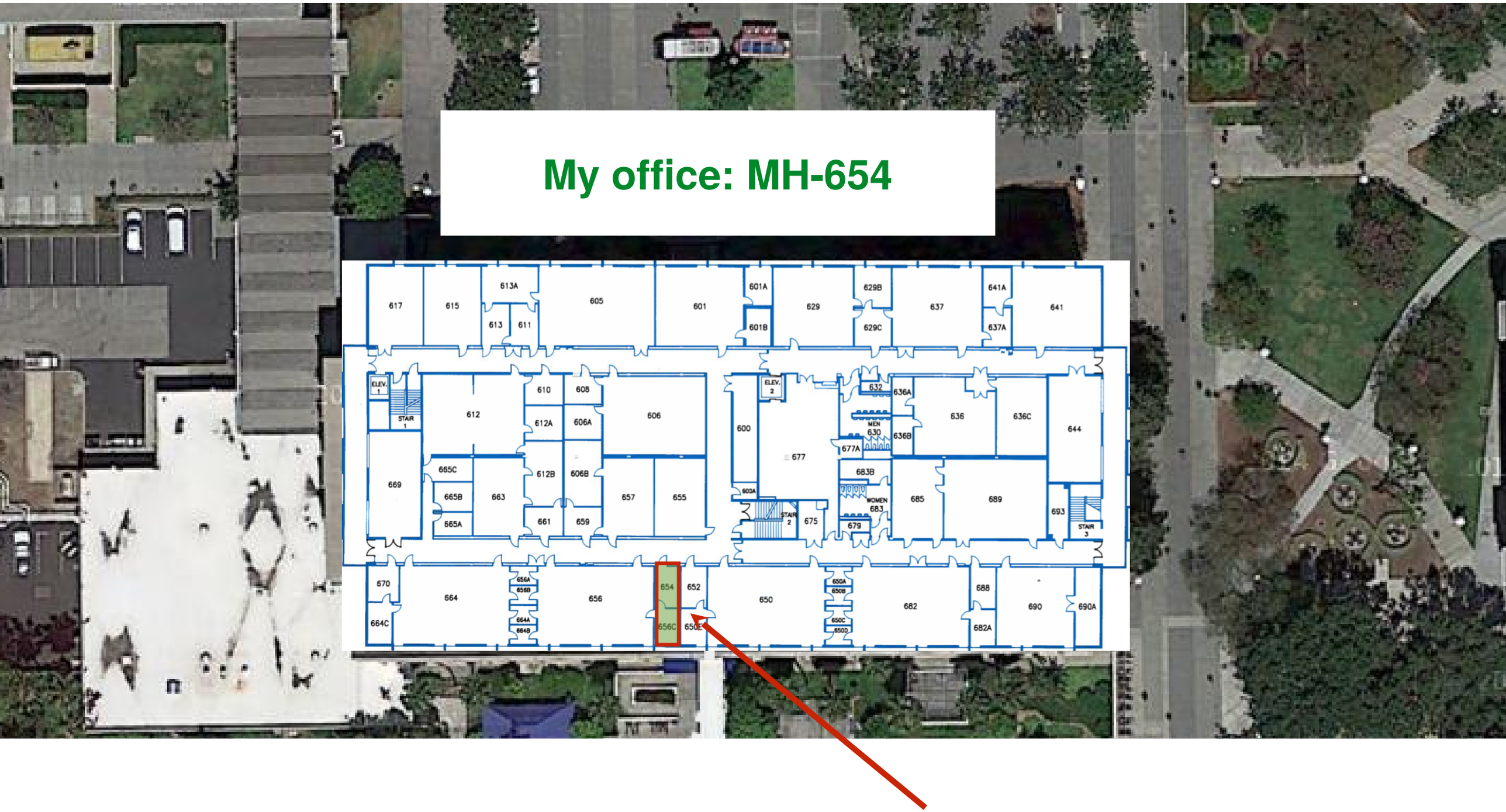
B

C

D

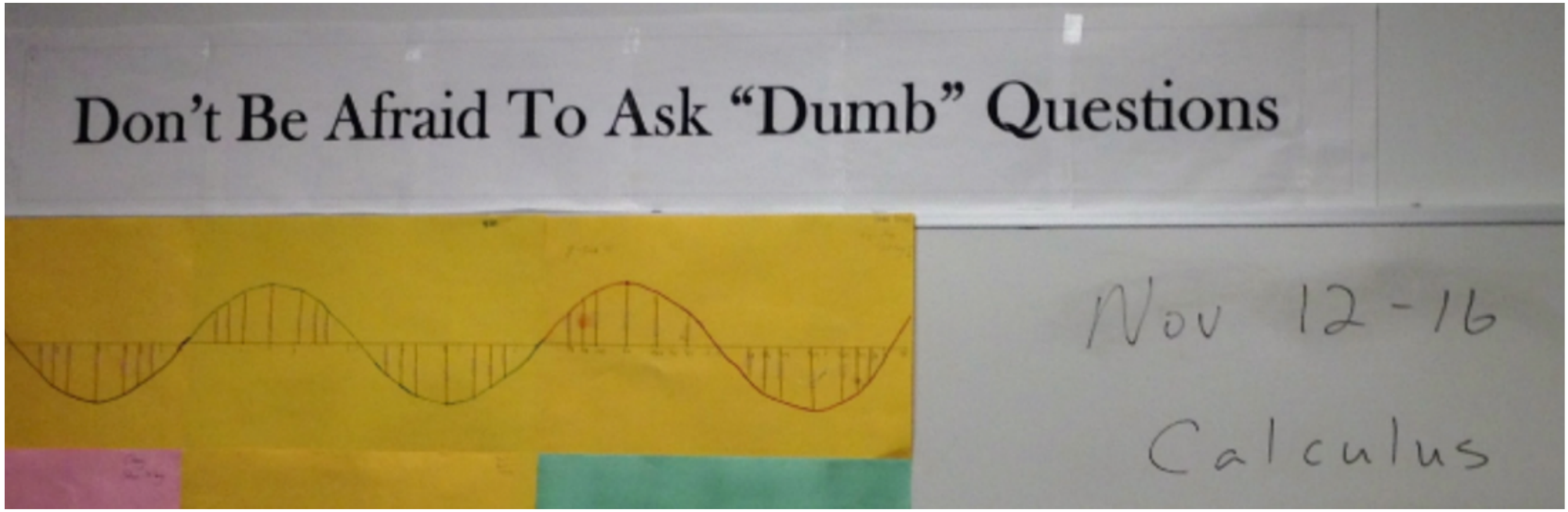
Office hours

- Tues, Thurs: 10:30-12:00PM in MH-654



Getting help

- You can succeed!
  - The material can be challenging, if you don't quite grasp something, you definitely aren't the only one
  - **No such thing as a dumb question**
  - Get help: office hours, SI, tutoring, study groups, online resources, WileyPLUS resources etc.



Exam schedule

- Midterm 1: Oct 5, 11:00 PM – 11:50 PM
- Midterm 2: Nov 9, 11:00 PM – 11:50 PM
- Midterm 3: Dec 10, 11:00 PM – 11:50 PM
- <u>Final: Dec 21, 12:00 PM – 1:50 PM</u>

*This schedule is TENTATIVE (except the final), but we will make an effort to stick to it. If for any reason exam dates are changed, an announcement will be made in class and on the course webpage.

Force Concept Inventory

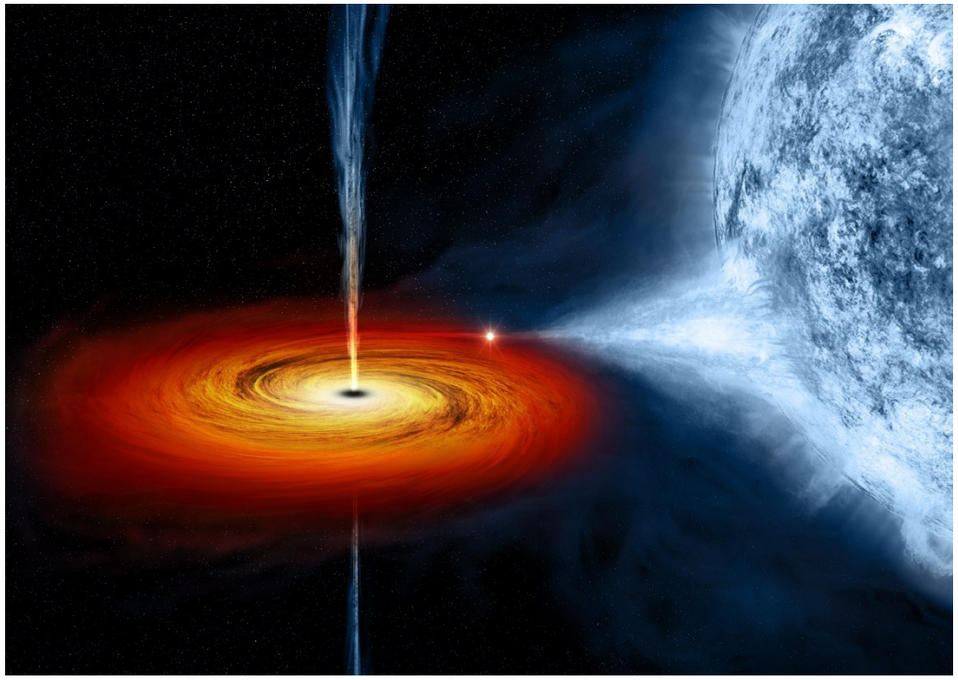
- Learning tool for mechanics
  - No math required

- Taken at the start of the course and again at the end of the course
  - Due by midnight Friday
- Answers will be revealed at the end of the course, then you can see how much your understanding of the world has improved!

- Completion of the FCI is required to prove course attendance

What is physics?

- Physics is a discipline that quantitatively describes how matter moves through time and space.
  - Forces and energy are related ideas
- Physics deals with both very large objects (black holes, neutron stars), through to very small objects (electrons, muons, quarks, neutrinos)



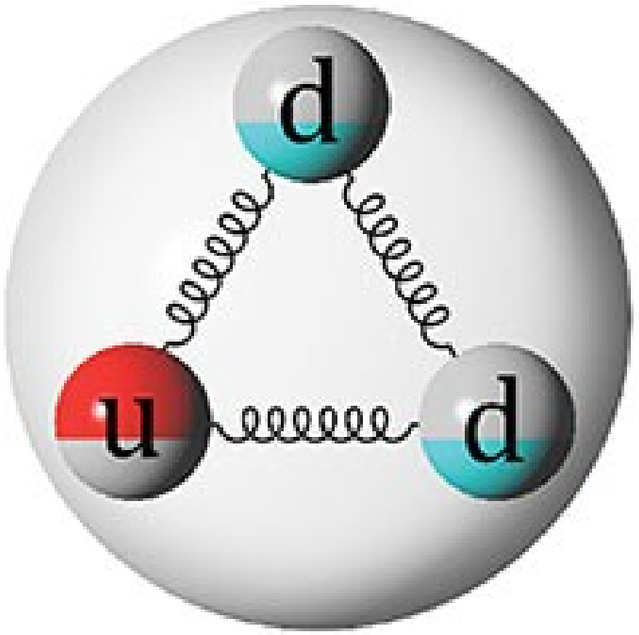


Figure 2. A schematic representation of the internal structure of a neutron.

What is physics?

- Physics uses measurements to study the world

"It doesn't matter how beautiful your theory is, it doesn't matter how smart you are. If it doesn't agree with experiment, it's wrong"

Richard Feynman

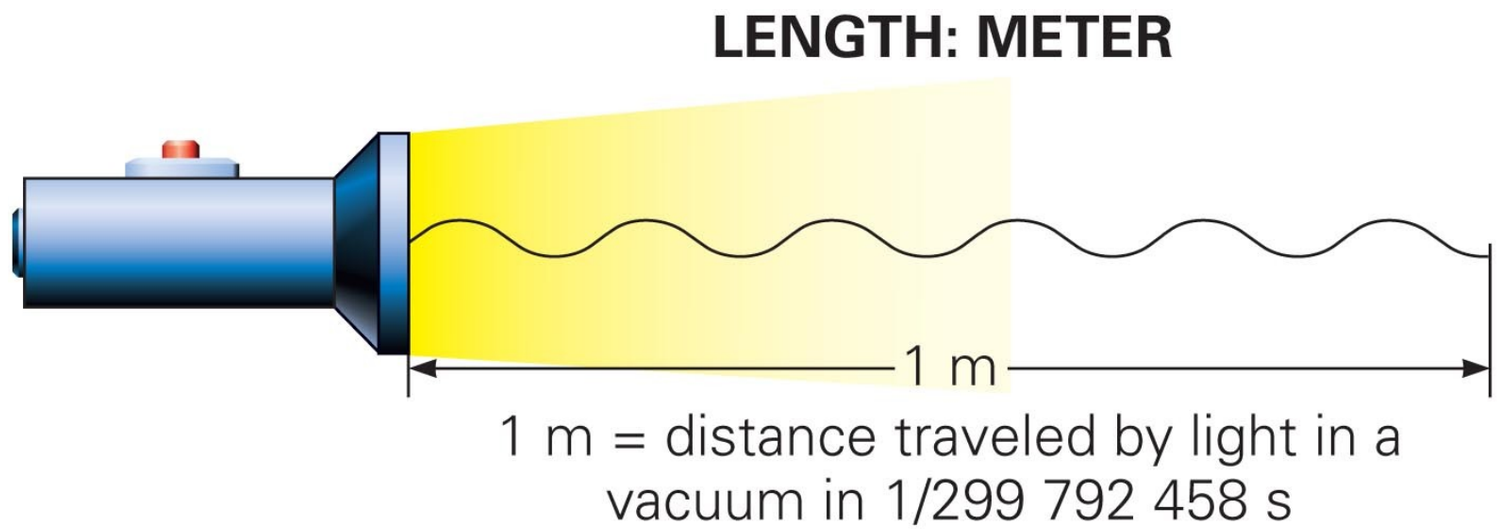
Orders of magnitude

- Order of magnitude
  = answer to nearest power of 10

$$10^{-3} = 0.001 \quad 10^{-1} = 0.1 \quad 10^{0} = 1 \quad 10^{1} = 10 \quad 10^{3} = 1000$$

$$10^{21} = 1000000000000000000000$$

- Example: length
  - Measure in meters



$$1\ m \approx 3.28\ feet \approx 39.4\ inches$$

$$1\ \mathrm{km} = 1000\ \mathrm{m} = 1. \times 10^{3}\ \mathrm{m} \approx 6. \times 10^{-1}\ \mathrm{mi} = 0.6\ \mathrm{mi}$$

is class we will usually stick to SI units for consistency. In real life though, it’s often better to chose un
he numbers in your calculations are about 1

Clicker question

- To the nearest power of 10, how far is it from this room to LAX airport in meters?
  Hint: $1\ \mathrm{km} = 10^3\ \mathrm{m} = 0.6\ \mathrm{mi}$

A 10^3 m

B 10^4 m

C 10^5 m

D 10^7 m

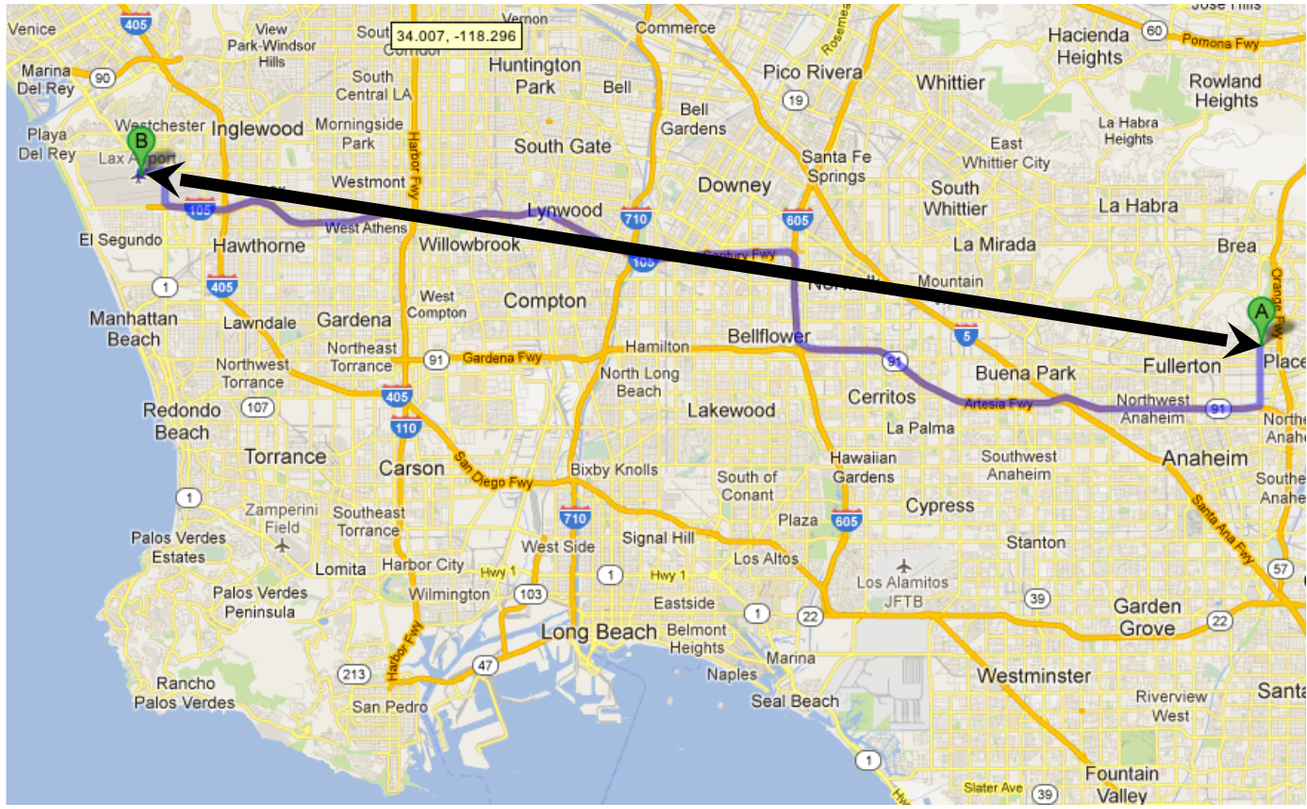


Image courtesy Google maps

Clicker question

- To the nearest power of 10, what is the diameter of the earth in meters?
  Hint: $1\ \mathrm{km} = 10^3\ \mathrm{m} = 0.6\ \mathrm{mi}$

A 10^6 m

B 10^7 m

C 10^8 m

D 10^9 m

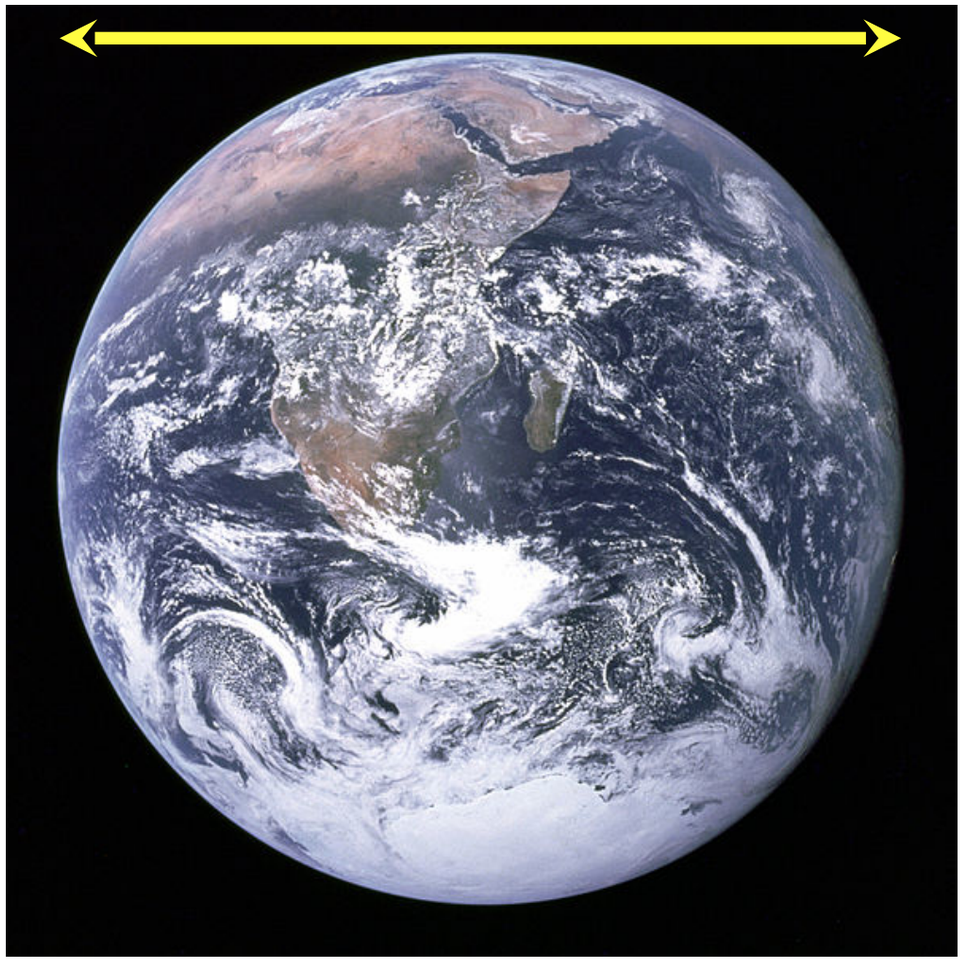


Image courtesy Wikipedia

Clicker question

- To the nearest power of 10, what is the size of a human white blood cell in meters?

A 10^{-9} m

B 10^{-7} m

C 10^{-5} m

D 10^{-3} m

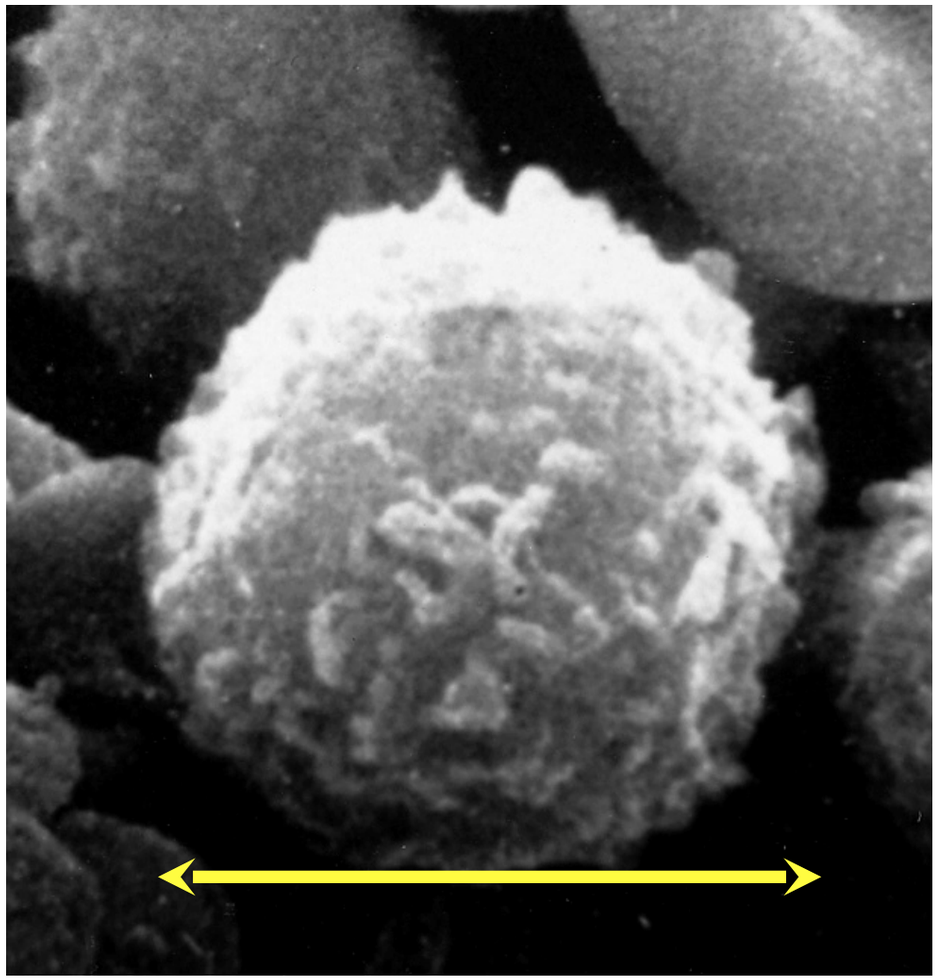


Image courtesy Wikipedia

Measurement

- What type of measurement have we been using in these last 3 clicker questions?

A length

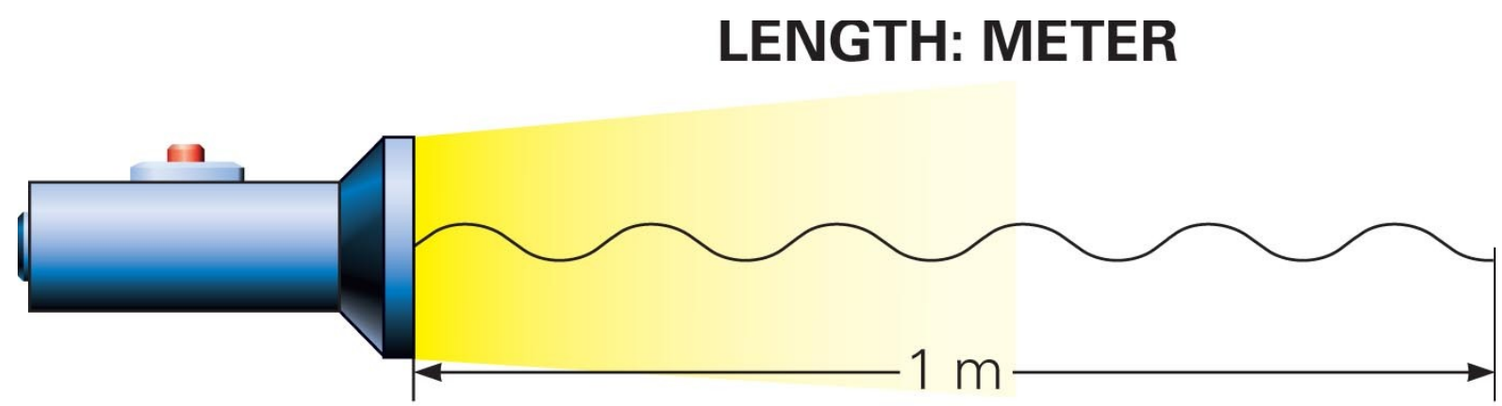
B mass

C time

D noodles

Length

- Distances or sizes in space
- SI Unit: Meter



1 m = distance traveled by light in a vacuum in 1/299 792 458 s

$$1 \text{ in} = 0.0254 \text{ m} = 2.54 \text{ cm}$$

https://en.wikipedia.org/wiki/Orders_of_magnitude_(length)

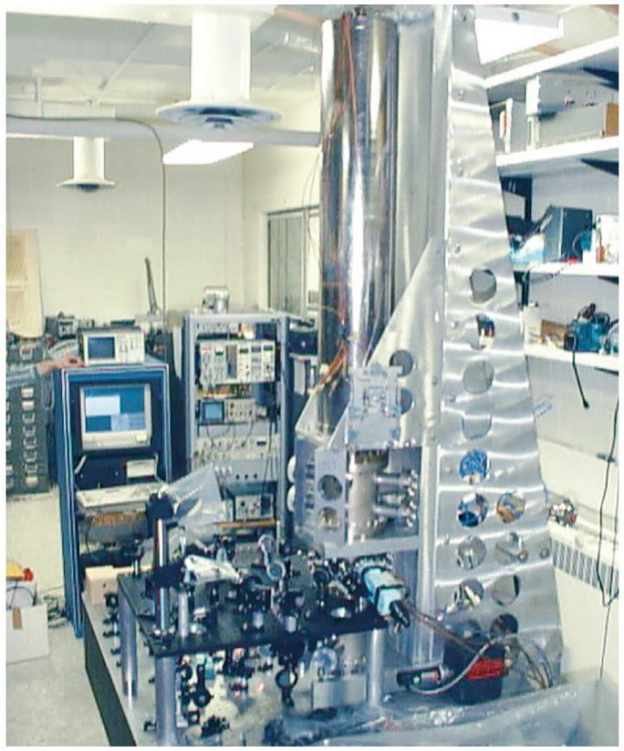
Length

Size = $10^{?}$ m

Approx. size of observable universe	27
Voids & filaments	24
Diameter of our galaxy	21
Average thickness of our galaxy	19
Distance to nearest star	17
Distance of Voyager 1 from sun	13
Diameter of sun	9
Diameter of earth	7
Mount Everest height	4
Average human height	0
Large mosquito	-2
Red blood cell diameter	-5
Cell membrane thickness	-8
Hydrogen atom radius	-11
H_2O molecule	-13

Time

- Hard to define
  - Continuous, forward flow of events
  - A "4th dimension"
- When? Duration?
- SI Unit: Second



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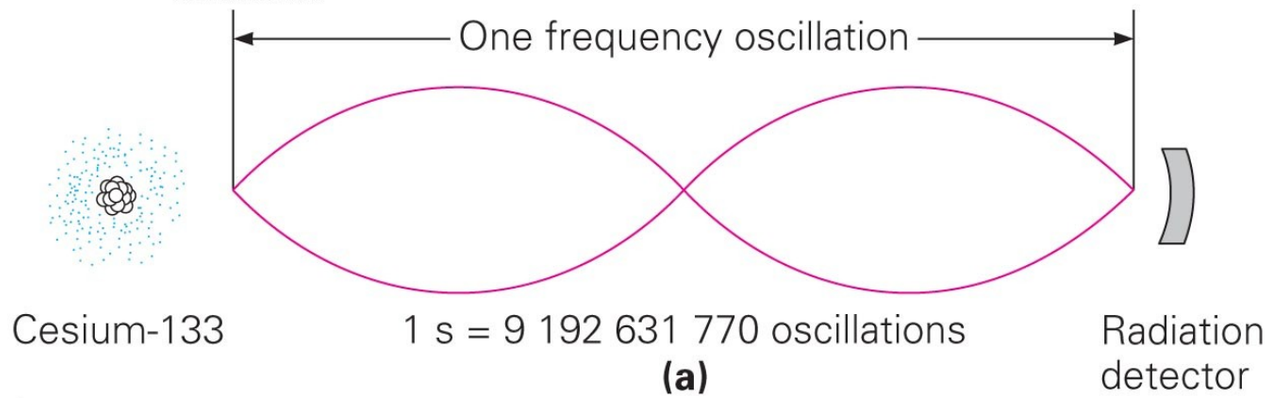

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- Time is a critical parameter to talk about "motion". Nothing moves in zero time.

Time

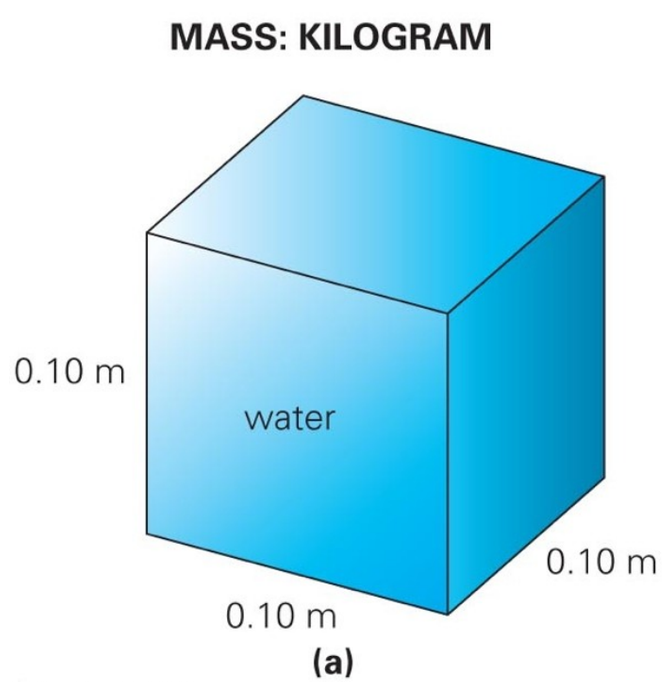
	Time = $10^{?}$ s
Age of universe	18
Age of Earth	17
Time since appearance of humans on Earth	13
Average human life expectancy	9
Winter break at CSUF	6
This lecture	4
“This word”	0
Blink of an eye	-1
Best human reaction time	-2
1 cycle of a 1960s computer	-6
Light travels 1 foot	-9
1 cycle of modern supercomputer	-11

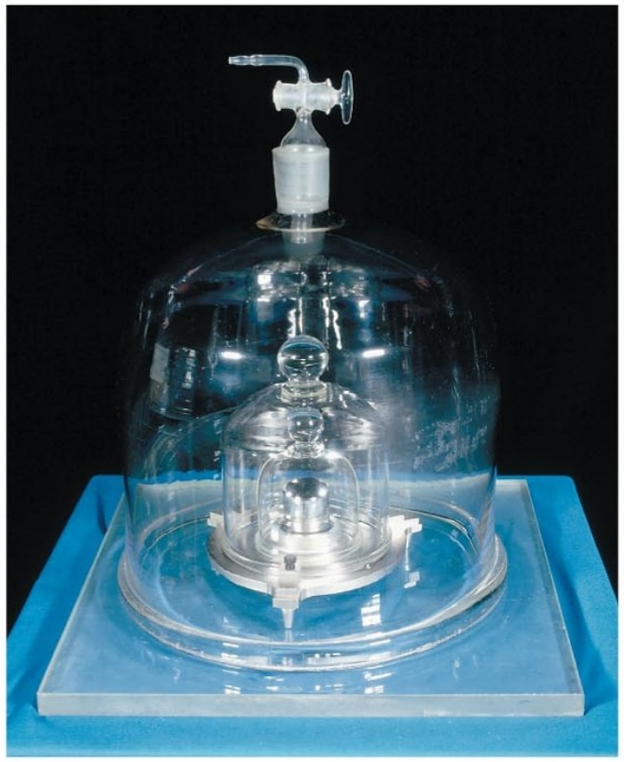
Mass

- Amount of matter
- SI unit: Kilogram
  - Defined as the mass of the *International Prototype Kilogram* ("Le Grand K") held in Saint-Cloud, France

$$1 \text{ kg} \approx 2.2 \text{ lb}$$

(near Earth's surface)





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Mass

Mass = $10^{?}$ kg

Mass of observable universe	53
Our galaxy	42
Black hole at center of our galaxy	37
Sun	30
Earth	25
Mass of all living humans	11
Largest living tree	6
Adult human	2
Bottle of soda	0
Fruit fly	-7
Average human cell	-12
HIV-1 virus	-18
Caffeine molecule	-25
Proton	-27
Electron	-31
Electron neutrino	-35

Multiple†	Prefix (and Abbreviation)	Pronunciation
10^{12}	tera- (T)	ter′a (as in *terr*ace)
10^{9}	giga- (G)	jig′a (*jig* as in *jig*gle, *a* as in *a*bout)
10^{6}	mega- (M)	meg′a (as in *mega*phone)
10^{3}	kilo- (k)	kil′o (as in *kilo*watt)
10^{2}	hecto- (h)	hek′to (*heck-toe*)
10	deka- (da)	dek′a (*deck* plus *a* as in *a*bout)
10^{-1}	deci- (d)	des′i (as in *deci*mal)
10^{-2}	centi- (c)	sen′ti (as in *senti*mental)
10^{-3}	milli- (m)	mil′li (as in *mili*tary)
10^{-6}	micro- (μ)	mi′kro (as in *micro*phone)
10^{-9}	nano- (n)	nan′o (*an* as in *ann*ual)
10^{-12}	pico- (p)	pe′ko (*peek-oh*)
10^{-15}	femto- (f)	fem′to (*fem* as in *fem*inine)
10^{-18}	atto- (a)	at′toe (as in *a*n*a*tomy)

*For example, 1 gram (g) multiplied by 1000, or 10^3, is 1 kilogram (kg); 1 gram multiplied by 1/1000, or 10^{-3}, is 1 milligram (mg).

†The most commonly used prefixes are printed in blue. Note that the abbreviations for the multiples 10^6 and greater are capitalized, whereas the abbreviations for the smaller multiples are

Unit conversion

- Multiply by "1", where "1" is written in a way using both units
  - Example: I'm 73 in tall

$$1 \text{ in} = 0.0254 \text{ m}$$

$$1 = \frac{0.0254 \text{ m}}{1 \text{ in}}$$

$$73 \text{ in} \times 1 = 73 \text{ in}$$

$$73 \cancel{\text{in}} \times \frac{0.0254 \text{ m}}{\cancel{\text{in}}} = 1.9 \text{ m}$$

- If a number has units, **always write the units.**
  - Otherwise mistakes are easy to make

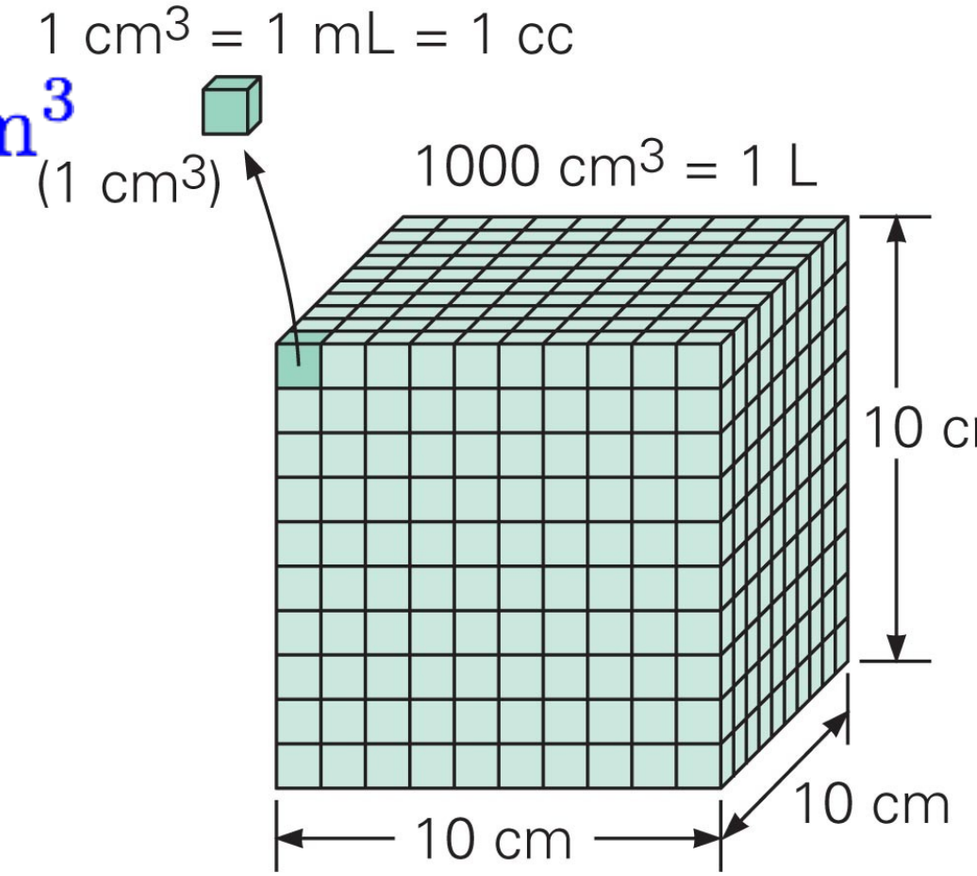
Unit conversion

- If a unit is raised to a power, so is the conversion factor
  - Examples

$$1\ \mathrm{dm}^3 = 1\ \mathrm{dm}^3 \left(\frac{10\ \mathrm{cm}}{\mathrm{dm}}\right)^3 = 1000\ \cancel{\mathrm{dm}}^3 \frac{\mathrm{cm}^3}{\cancel{\mathrm{dm}}^3} = 1000\ \mathrm{cm}^3$$

$$1\ \mathrm{m}^3 = 1\ \cancel{\mathrm{m}}^3 \left(\frac{10^2\ \mathrm{cm}}{\cancel{\mathrm{m}}}\right)^3 = 10^6\ \mathrm{cm}^3$$

$$1\ \mathrm{L} = 1\ \mathrm{dm}^3$$
$$1\ \mathrm{mL} = 1\ \mathrm{cm}^3$$



Mixed units

Quantity	Unit
mass	kg
time	s
length	m
area	m^2
volume	m^3
velocity (v)	m/s
acceleration	m/s^2