PHYS 1403 Stars and Galaxies

Introduction

A look at the Syllabus – Our Contract

PDF version available on class webpage. Print, Read and keep a copy for reference.

https://faculty.tarleton.edu/goderya/documents/Teaching/Phy1403/index.html

Goals of the course

Help you develop:

- a basic understanding of the central ideas of astronomy
- an appreciation for the role astronomy has played in shaping the consciousness of the world in the past, at present and what the future holds.
- a real world perspective for how astronomy is connected to your daily lives
- the skills and motivation to pursue life long learning and become a valuable member of the workforce and our society

Misconception

- I just have to sit and listen in this class.
  Not True
  "Be prepared to answer questions and engage in classroom activity"
- I can skip classes and just show up for exams
  Not True
  "Class participation is monitored and is counted towards the grade"

I hear and I forget

Yes if you just sit in class and do nothing else

I read and I remember

Is reading text sufficient! Not in this class

I do and I understand

"Confucius"

How?

- *Participate in class*
- *Do the assigned class activities*
- *Do the Labs*

Plickers Card

Class participation/Quiz is monitored via Plicker

1. Each student is assigned a Plicker Card. Note and remember your card number.
2. At the beginning of the class hour pick up your Plicker card
3. Every class you must use your own individual Plicker card to answer questions.
4. You must return the card at the end of the class hour.
5. Get ready when you see the next slide

Lets give it a try

Questions for Today's Class?

1. What tools do I need to learn astronomy?
2. What is Science?
3. What is Astronomy?

What Math tools do I Need for this Class?

1. High School Level of Algebra, Trigonometry and Geometry
   a. Astronomy is a quantitative science however, the amount of math used in this class is very small and is not intensive beyond what is expected at a high school level.
   b. Please review and refresh if you have not used it in a while.
2. Measurements
3. SI units
4. Conversions
5. Scientific Notation
6. Uncertainty

Appendix C, D and E of Text

Measurements

A tool to use the laws of mathematics to solve problems and to be able to distinguish between logical and illogical arguments.

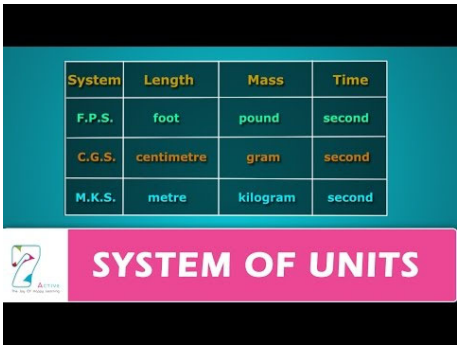
The most fundamental measurements are that of;

Length ➡ L

Mass ➡ M

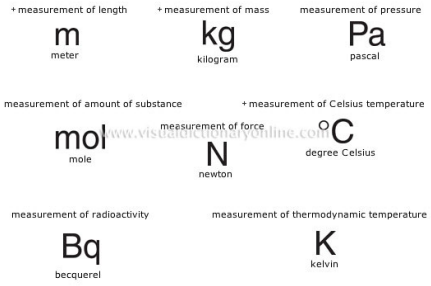
Time ➡ T

System of Units



System International (SI)

A modern form of metric system



Conversion from MKS to FPS

Conversion Table

Length	1 yd	=	0.9144 m
	12 in.	=	1 ft
	5280 ft	=	1 mile
	1 m	=	3.281 ft
	1 in.	=	0.0254 m
Time	60 sec	=	1 min
	3600 sec	=	1 hr
Mass	1 lbm	=	0.4535 kg
	2.205 lbm	=	1 kg
	1 kg	=	1000 g
Area	1 ft^2	=	144 $in.^2$
	10.764 ft^2	=	1 m^2
	1 yd^2	=	9 ft^2
	1 $mile^2$ =		3.098 X 10^6 yd^2
Volume	7.48 gal	=	1 ft^3
	1 gal	=	3.785 l (liter)
	1 l	=	1000 cm^3

http://www.tpub.com/doephysics/classicalphysics6.htm

Scientific Notation

Astronomical numbers are
very large
or
very small
so Astronomers use Scientific Notation

Scientific Notation

- Useful in expressing very large or very small numbers
- To convert a large number to scientific notation, move the decimal leftward to the first digit and count the number of places.

For example, Earth is about 149,598,000,000 meters from the Sun.

149,598,000,000. m

11 9 6 3

In scientific notation, this distance is 1.49598×10^{11} m.

- To convert a small number to scientific notation, move the decimal rightward to the first digit and count the number of places.

For example, the wavelength of green light is about 0.000 000 510 meters.

0.000 000 510 m

-3 -6 -7

In scientific notation, the wavelength is 5.10×10^{-7} m.

Astronomy Education at the University of Nebraska-Lincoln Web Site (http://astro.unl.edu)

Metric Prefixes

- Various prefixes represent different powers of 10.
- The prefix goes before the unit label.

For example,

149,598,000,000 m = 1.49598×10^{11} m

= 149.598×10^9 m = 149.598 Gm

or could be expressed with

= 149598×10^6 m = 149598 Mm

- Traditionally, though, the metric prefix used corresponds to the smallest decimal number possible.

Prefix	Abb.	Number
pico	p	10^{-12}
nano	n	10^{-9}
micro	μ	10^{-6}
milli	m	10^{-3}
centi	c	10^{-2}
deci	d	10^{-1}
---	---	10^{0}
deka	da	10^{1}
hecto	h	10^{2}
kilo	k	10^{3}
mega	M	10^{6}
giga	G	10^{9}
tera	T	10^{12}

Astronomy Education at the University of Nebraska-Lincoln Web Site (http://astro.unl.edu)

Math in Scientific Notation

- **Multiplication**
  - Multiply the coefficients and powers of ten separately, then combine.
  - Add exponents in multiplication.

For example,

$(2 \times 10^7) \cdot (4 \times 10^5) =$
$(2 \cdot 4) \cdot (10^7 \cdot 10^5) =$
$(8) \cdot (10^{7+5}) = 8 \times 10^{12}$

- **Division**
  - Divide the coefficients and powers of ten separately, then combine.
  - Subtract exponents in division.

For example,

$(2 \times 10^7) / (4 \times 10^5) =$
$(2 / 4) \cdot (10^7 / 10^5) =$
$(0.5) \cdot (10^{7-5}) = 0.5 \times 10^2 = 50$

Astronomy Education at the University of Nebraska-Lincoln Web Site (http://astro.unl.edu)

Significant Numbers

Not significant: zero for "cosmetic" purpose

Not significant: zeros used only to locate the decimal point

Significant: all zeros between nonzero numbers

0 . 0 0 4 0 0 4 5 0 0

Significant: all nonzero integers

Significant: zeros at the end of a number to the right of decimal point

Getstartedinsicence.weebly.com

Significant Numbers

Significant figures
The **number** of **meaningful digits** in a measurement including the **uncertain digit**.
"sig figs"

0.520	3	do not count **zeros** at the **beginning**
0.0025	2	
500	1	do not count **end** zeros if no **decimal**
0.02300	4	count **all other zeros**
120035	6	
500.	3	
2.0×10^5	2	do not expand

slideplayer.com

Significant Numbers

Practice:

1) 5.02 × 89.665 × 0.10 = 45.0118 = 45
3 sig. figs. 5 sig. figs. 2 sig. figs.

2) 5.892 ÷ 6.10 = 0.96590 = 0.966
4 sig. figs. 3 sig. figs.

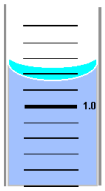
3) 1.01 × 0.12 × 53.51 ÷ 96 = 0.06775 = 0.068
3 sig. figs. 2 sig. figs. 4 sig. figs. 2 sig. figs.

4) 56.55 × 0.920 ÷ 34.2585 = 1.51863 = 1.52
4 sig. figs. 3 sig. figs. 6 sig. figs.

Tro's "Introductory Chemistry", Chapter 2 11

Uncertainty

Uncertainty in Measurements



1.14 mL? 1.15 mL? 1.16 mL?

1.15 ± 0.01 mL

uncertain digit
(1/10 the smallest scale division)

What is Science?

Topics
1. Definition
2. Science and Technology
3. Science and Pseudoscience
4. Scientific Method
5. What is Astronomy?

To Seek Knowledge

- Latin word meaning "to know"
  - First Step in Scientific Method
    Form a Hypothesis
    - A single assertion or conjecture that must be tested
  - Collect Observations/Facts
    - Measurements

Example: All things fall towards Earth's center unless something prevents it from doing so.

Science is not…

- A list of previously known facts about nature
- A list of equations handed down from Ancient times
- A set of laws that were discovered by Dead Guys a long time ago and are kept from the general public

Science Is…

- a continuing process that
  - seeks to understand the rules and laws of nature
  - uses systematic observations
  - uses mathematical models
  - experimentally tests ideas
- subject to independent verification
  - These are the components of the scientific method (observe, theorize, predict, test and modify) used to comprehend the universe.

Scientific Activity

- Theory:
  - A description of natural phenomenon and cannot be right or wrong
- Models
  - A method to describe the theory
- Law of Nature
  - A theory that everyone accepts it to be true

Example: Law of Gravity

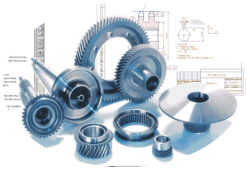
What is an Argument?

Argument = Premises/fact(s) + Conclusions

One can say that a Scientific hypothesis is an argument

Science and Technology

- Science
  - Discover laws of Nature
  - Independent of social, political and economic conditions
- Technology uses these laws to meet human needs.
  - Technology is driven by these conditions.



- Engineering and Medicine are technologies

Science Versus Pseudoscience

- Science
  - Deals with facts that can be proven
  - Does not concern itself with human life
- Pseudoscience
  - Uses science to predict human fate or provide healing. Methods and techniques are non investigable
- Astrology and Chiropractic is a pseudoscience

Images from Wikipedia Encyclopedia

What is Astronomy?

- Astronomy is part of science
- Astronomy is the study of the Universe, using knowledge from other science areas as well as using technology
- Astrophysics, Cosmology, Astrobiology, Planetary Astronomy are different areas of Astronomy

Acknowledgment

- The slides in this lecture is for Tarleton: PHYS1411/PHYS1403 class use only
- Images and text material have been borrowed from various sources with appropriate citations in the slides, including PowerPoint slides from adopted text book.