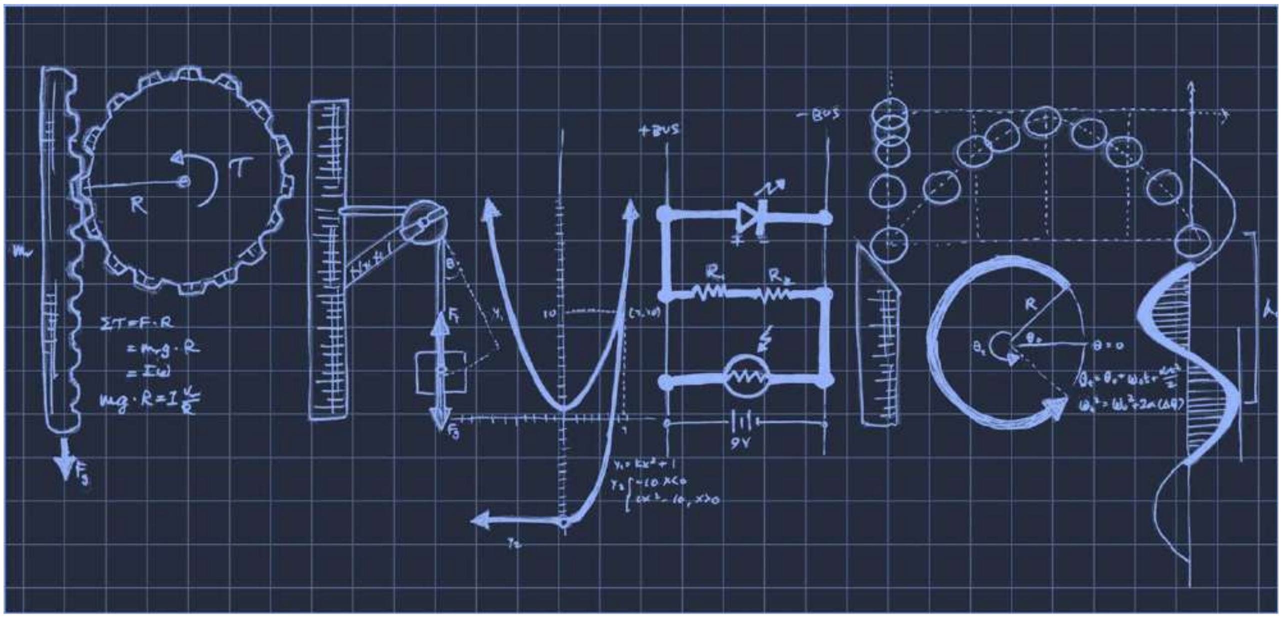


Physics Workbook

Introduction to Physics

____

STUDENT NAME

Section Check for Understanding

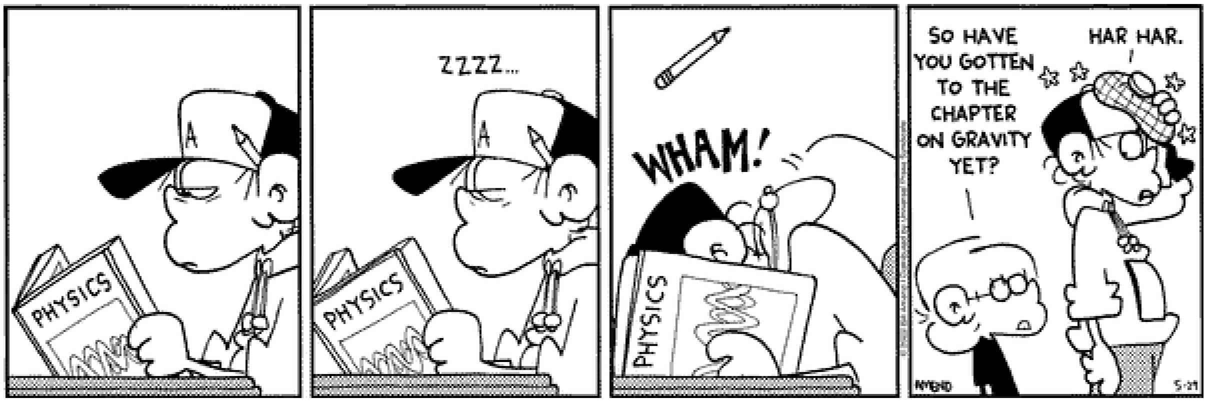
Teacher Demo

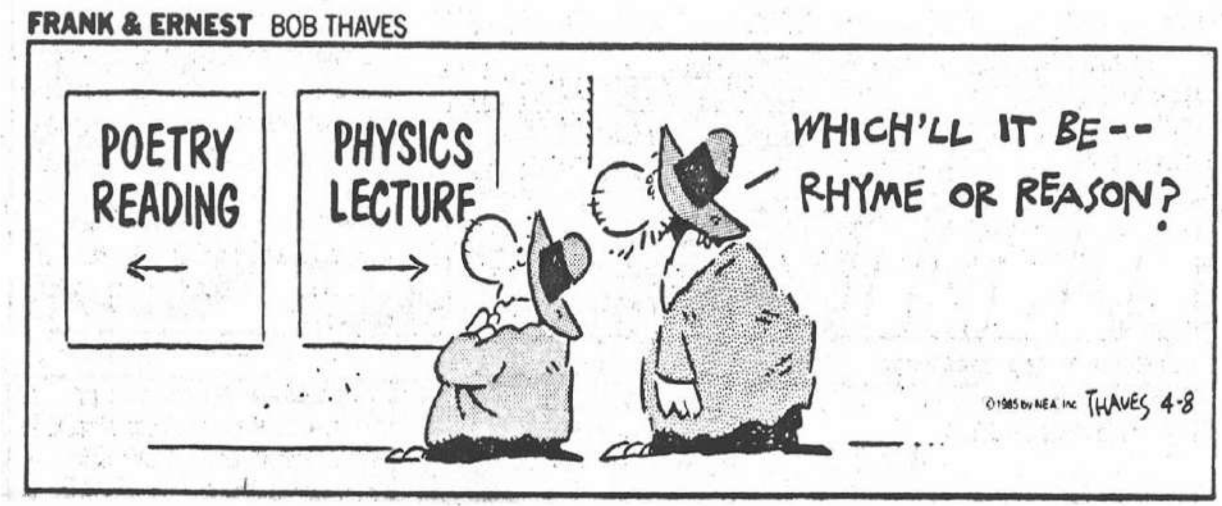
Final Check for Understanding

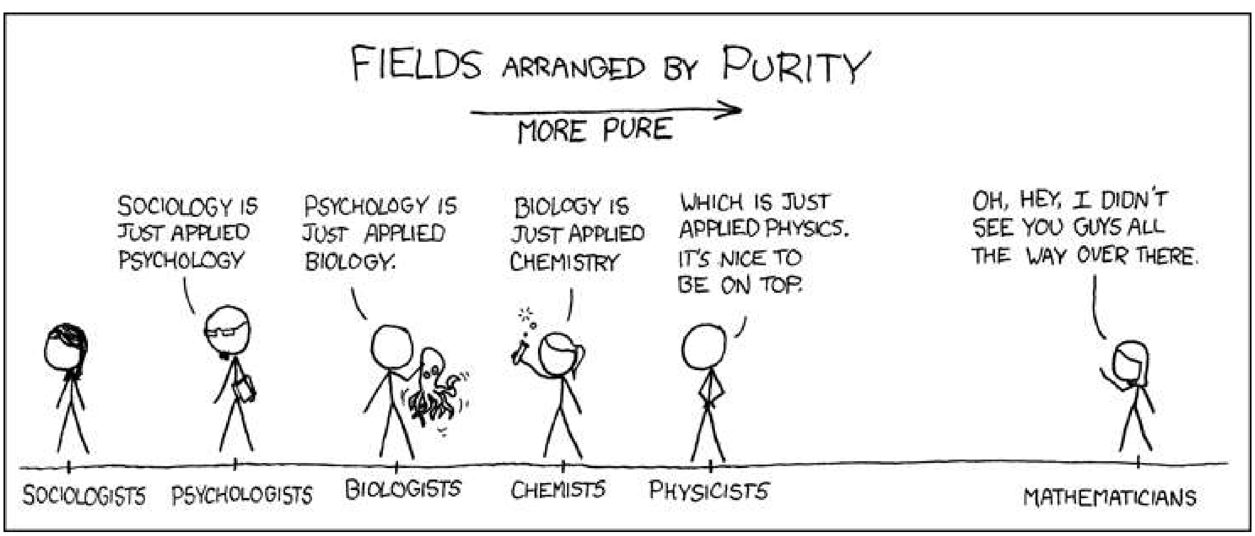
Note Area

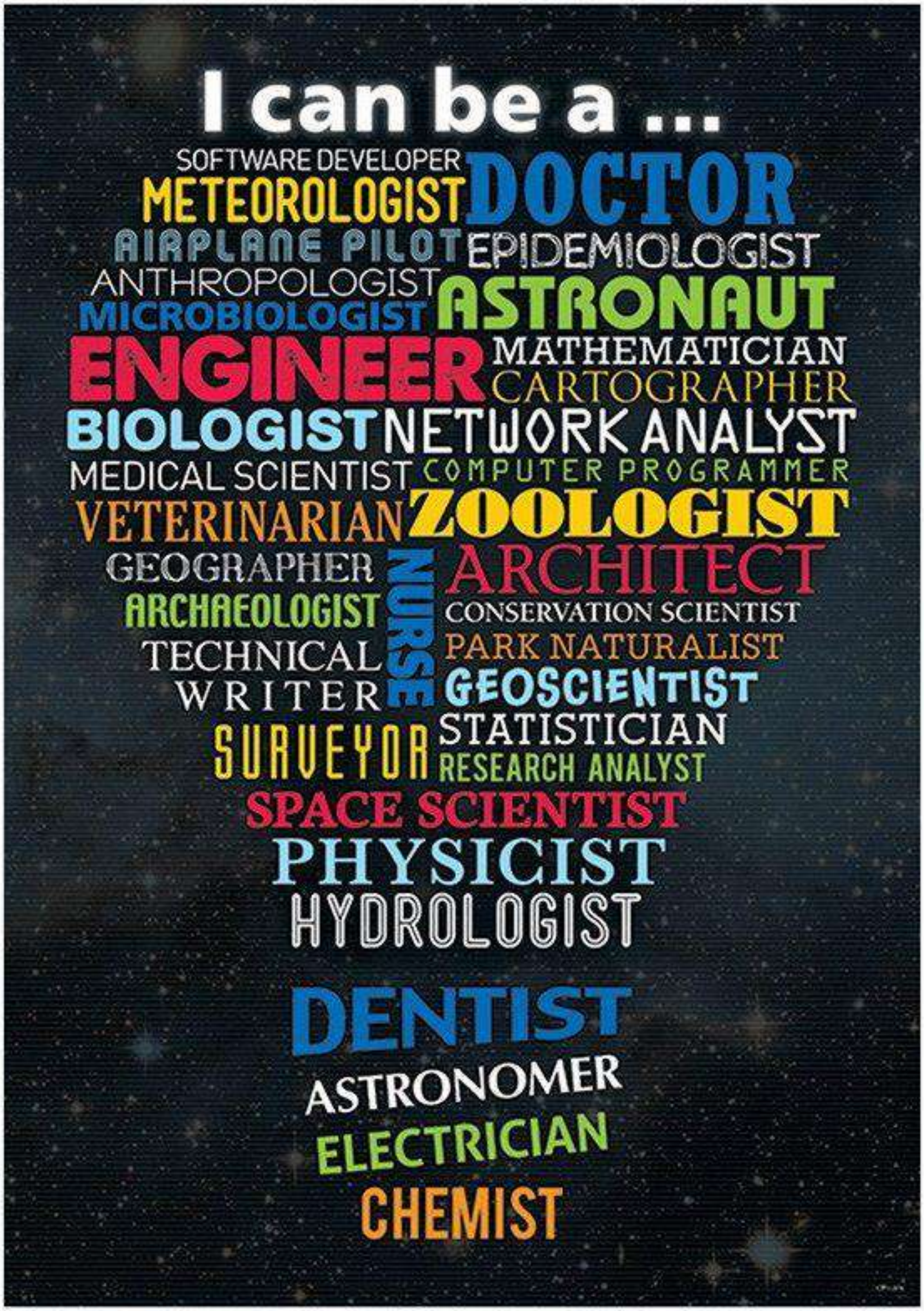
Video

Compiled by Miss Rebekah Taylor
2018


PHYSICS
ZZZZ...
WHAM!
SO HAVE YOU GOTTEN TO THE CHAPTER ON GRAVITY YET?
HAR HAR.


FRANK & ERNEST BOB THAVES
POETRY READING ←
PHYSICS LECTURE →
WHICH'LL IT BE-- RHYME OR REASON?
©1985 by NEA Inc THAVES 4-8


FIELDS ARRANGED BY PURITY
MORE PURE →
SOCIOLOGY IS JUST APPLIED PSYCHOLOGY
PSYCHOLOGY IS JUST APPLIED BIOLOGY.
BIOLOGY IS JUST APPLIED CHEMISTRY
WHICH IS JUST APPLIED PHYSICS. IT'S NICE TO BE ON TOP.
OH, HEY, I DIDN'T SEE YOU GUYS ALL THE WAY OVER THERE.
SOCIOLOGISTS
PSYCHOLOGISTS
BIOLOGISTS
CHEMISTS
PHYSICISTS
MATHEMATICIANS

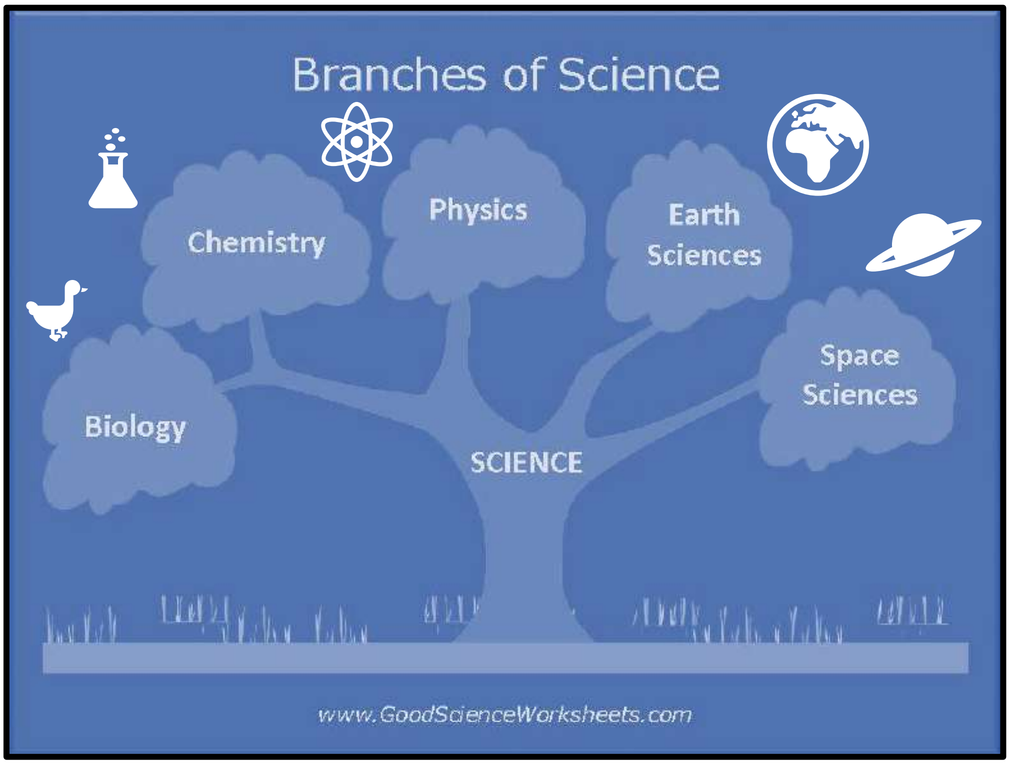


1: [What is Physics? – Inspiration Video]

2: Crash Course Physics Preview Video

Definition of Physics (noun):

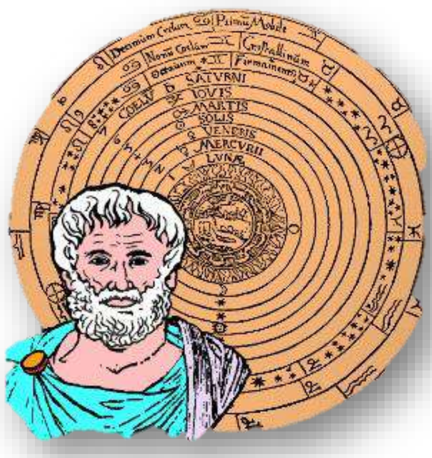
The branch of science concerned with the nature and properties of matter and energy.



MATCHING

Biology	**Study of matter, energy, space and time.**
Chemistry	**Study of Earth.**
Physics	**Study of the interactions between elements and compounds**
Earth Sciences	**Study of the universe.**
Space Sciences	**Study of living organisms**

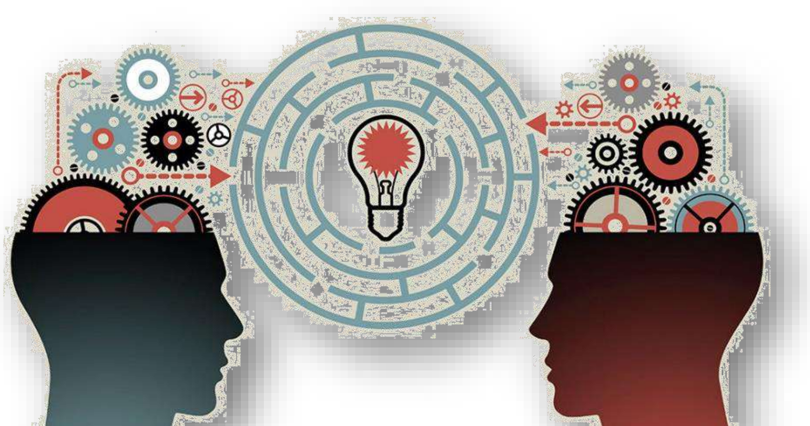
WHERE DID PHYSICS COME FROM?



Physics can trace its roots all the way back to ancient Greece. Some physicists trace it back to Aristotle (384-322 BC). Aristotle observed the world around him and used reasoning to explain how the world worked in terms of matter, energy, space and time. He did all this by using **critical thinking skills**.

WHY SHOULD WE CARE ABOUT PHYSICS?

Physics is where we develop **critical thinking skills.** Critical thinking skills help us to think clearly and rationally about what to do. These skills help us be independent thinkers and have a **growth mindset**.



Example of a critical thinking skill used in your everyday life:

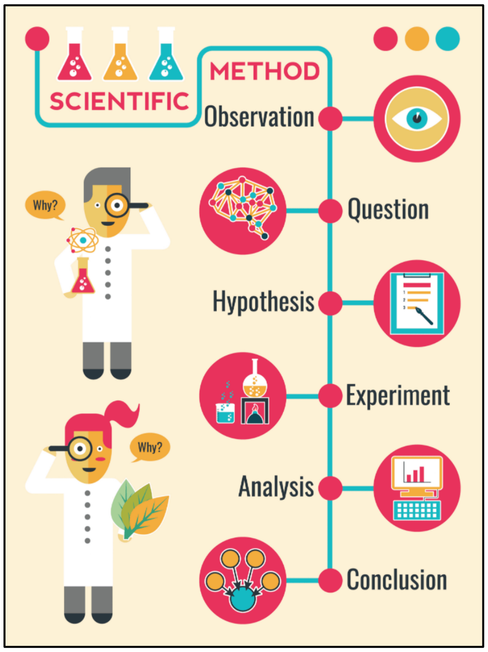
3: [Mindsets: Fixed Versus Growth Video]

CRITICAL THINKING SKILLS

Level	Key words	Question stems
1 Knowledge Identification and recall of information	define, fill in the blank, list, identify, label, locate, match, memorize, name, recall, spell, state, tell, underline	Who ______? What ______? Where ______? When ______? How ______? Describe ______. What is ______?
2 Comprehension Organization and selection of facts and ideas	convert, describe, explain, interpret, paraphrase, put in order, restate, retell in your own words, rewrite, summarize, trace, translate	Re-tell ______ in your own words. What is the main idea of ______? What differences exist between ______? Can you write a brief outline?
3 Application Use of facts, rules, and principles	apply, compute, conclude, construct, demonstrate, determine, draw, find out, give an example, illustrate, make, operate, show, solve, state a rule or principle, use	How is ______ an example of ______? How is ______ related to ______? Why is ______ significant? Do you know of another instance where ______? Could this have happened in ______?
4 Analysis Separating a whole into component parts	analyze, categorize, classify, compare, contrast, debate, deduct, determine the factors, diagram, differentiate, dissect, distinguish, examine, infer, specify	What are the parts or features of ______? Classify ______ according to ______. Outline/diagram/web/map ______. How does ______ compare/contrast with ______? What evidence can you present for ______?
5 Synthesis Combining ideas to form a new whole	change, combine, compose, construct, create, design, find an unusual way, formulate, generate, invent, originate, plan, predict, pretend, produce, rearrange, reconstruct, reorganize, revise, suggest, suppose, visualize, write	What would you predict/infer from ______? What ideas can you add to ______? How would you create/design a new ______? What solutions would you suggest for ______? What might happen if you combined ______ with ______?
6 Evaluation Developing opinions, judgements, or decisions	appraise, choose, compare, conclude, decide, defend, evaluate, give your opinion, judge, justify, prioritize, rank, rate, select, support, value	Do you agree that ______? Explain. What do you think about ______? What is most important? Prioritize ______ according to ______? How would you decide about ______? What criteria would you use to assess ______?

4: Galileo - Mini Biography Video

WHO IS CONSIDERED THE FIRST PHYSICIST?



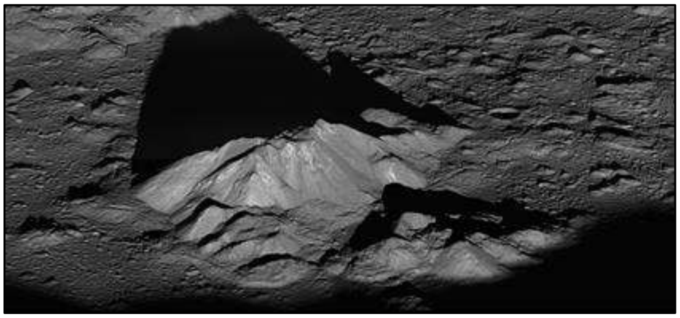
Galileo Galilei (1564-1642) was an Italian scientist that is considered the "Father of Modern Science". He all but disproved the Aristotelian physics and cosmology that had previously dominated the sciences in Europe. He set up many of the techniques we consider necessary in science, including experimentation and recording results. It wouldn't be until around 1650 that this became a standard amongst scientists. This standard is called the **Scientific Method**. It is not the only method that scientists use. Scientists approach problems with imagination, creativity, prior knowledge, and perseverance. What distinguishes science from other endeavors is scientists' focus on testing ideas against observations of real-world phenomenon.

WHAT ARE "REAL-WORLD PHENOMENON"?

A **real-world phenomenon** is a fact, occurrence, or circumstance that is observed or can be observed. *Example: Why do we see lightning before we hear the thunder?*

Teacher Demo 3
Spoon in water / Levitating Ping Pong Ball

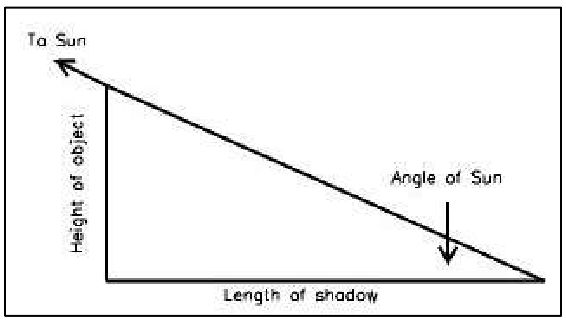
Studying Real-World Phenomenon

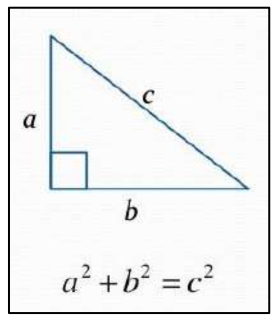


Galileo, with the aid of his telescope, estimated the heights of mountains on the Moon by estimating the lengths of the shadows. He may have used the Pythagorean theorem and/or right triangle trig.

Teacher Demo 4
Casting Shadows
Knowing Length and hypotenuse / Activity

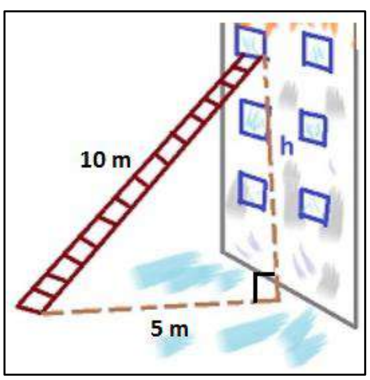
Pythagorean Theorem

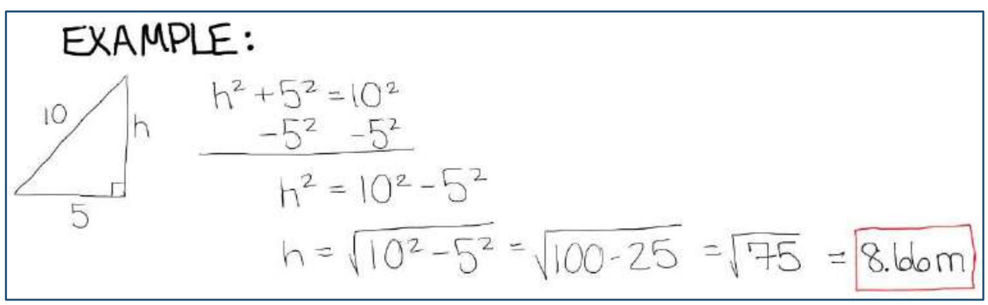


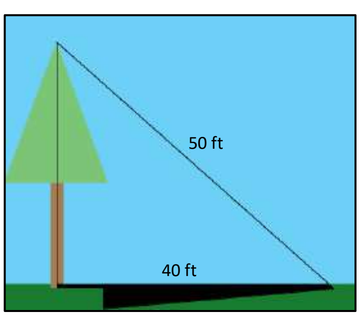


*This should bring back memories of Algebra class.

Applying the Pythagorean Theorem



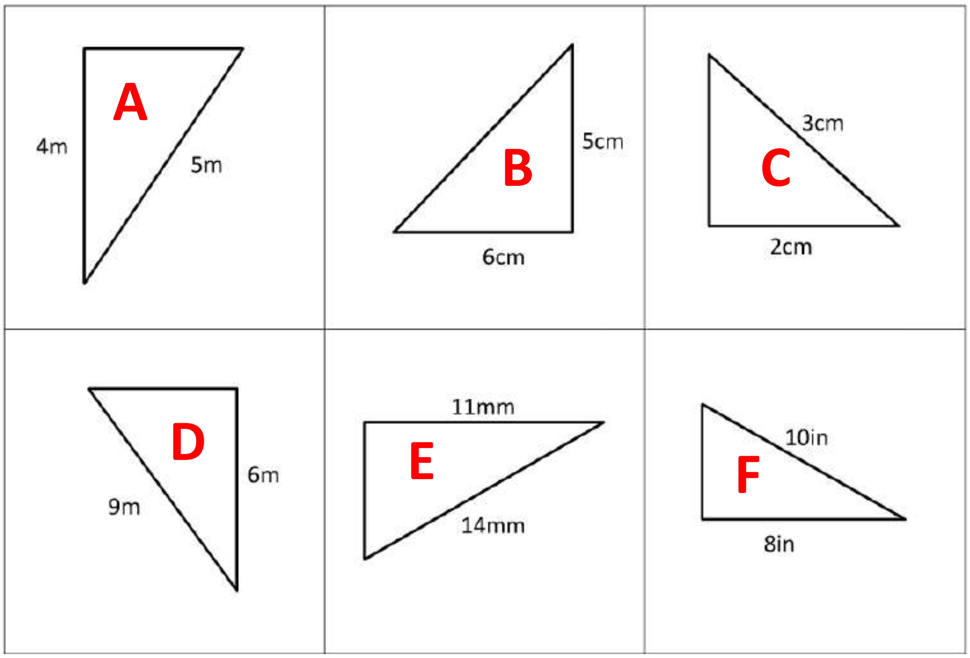




Using the picture on the left, find the height of the tree.

Pythagorean Theorem Practice

Solve for the missing side. Triangles not to scale.



A:	**B:**	**C:**
D:	**E:**	**F:**

Right Triangle Trig.

Teacher Demo 5
Casting Shadows
Konwing Length and Angle / Activity

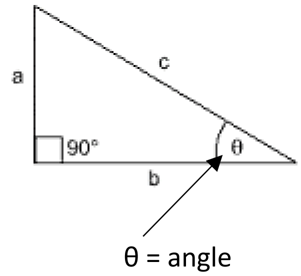
Right Triangle

$c^2 = a^2 + b^2$

$\sin\theta = \frac{a}{c}$

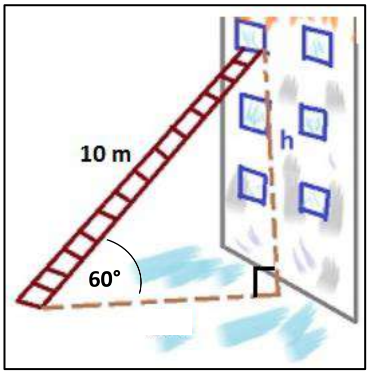
$\cos\theta = \frac{b}{c}$

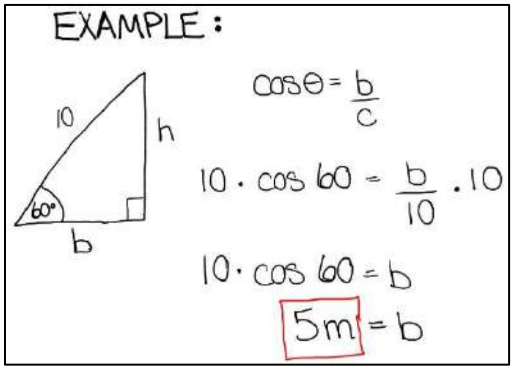
$\tan\theta = \frac{a}{b}$

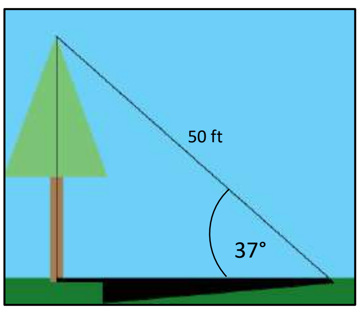


*This should bring back memories of Algebra class.

Applying Right Triangle Trig.



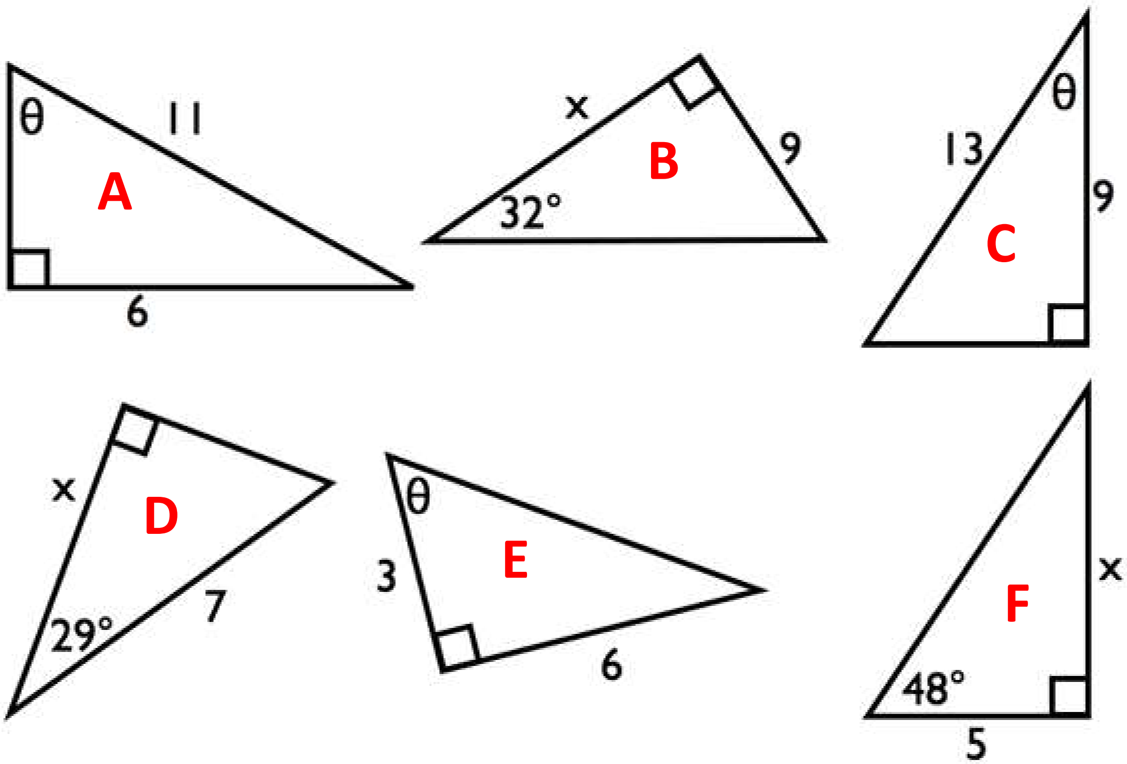




Using the picture on the left, find the height of the tree.

Right Triangle Trig. Practice

Solve for either "x" or "θ." Triangles are not to scale.



A:	**B:**	**C:**
D:	**E:**	**F:**

HOW DO PHYSICISTS COMMUNICATE?

Mathematics

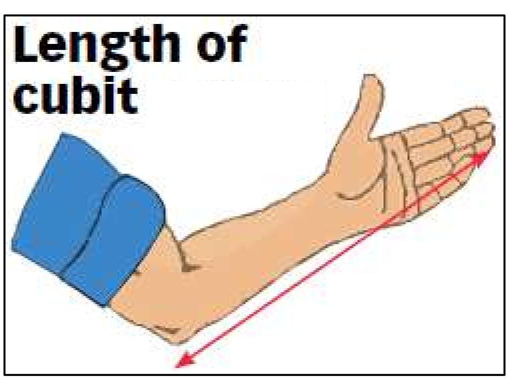
Physics uses mathematics to represent nature because nature can be described in logical and quantitative terms. In physics we use units to describe a quantity. If I'm giving you directions to party I might say, "Go six blocks and then…". Six is the quantity and blocks are the unit. I could replace blocks with feet. Now feet is the unit. A unit gives you a context for the quantity. In other words, it makes the quantity make sense. We will use a table to organize The International System of Units (SI). Why do scientists use the metric system, instead of using English units or some other system? In the metric system, with its base of ten, it is easy to convert from one scale of measurements to another. For instance, it's much easier to convert from centimeters to meters than from inches to yards.

5: Measurement Mystery: Crash Course Kids #9.2 Video

The International System of Units (SI) Examples

Quantity	Variable	Unit	Symbol
Distance	x or y	meter	m
Mass	m	kilogram	kg
Time	t	second	s
Velocity	v	meter / second	m/s
Acceleration	a	meter / second^2	$^{m}/_{s^2}$

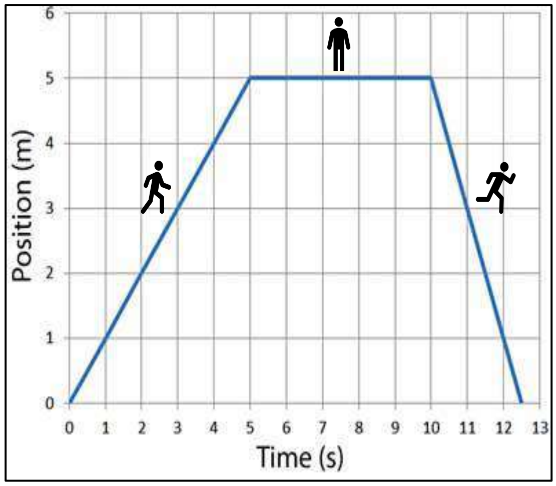
Ancient Standards Example



All civilizations have had to develop standards for measuring. For example, in Mesopotamia (3500-1800 B.C.), workers built the first cities using cubits, measuring roughly the length of one's forearms from elbow to wrist bone.

Teacher Demo 6
Measuring Forearms

Graph Example



Use the Position v. Time Graph to Create a Data Table:

Time (s)	Position (m)
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	

From your starting position to 5s what is the distance that you traveled? __________

When were you not moving? ____

What is the total distance that you traveled? ____________

Compare between your movement from 0 – 5s and 10 – 12.5s using evidence from the graph or table.

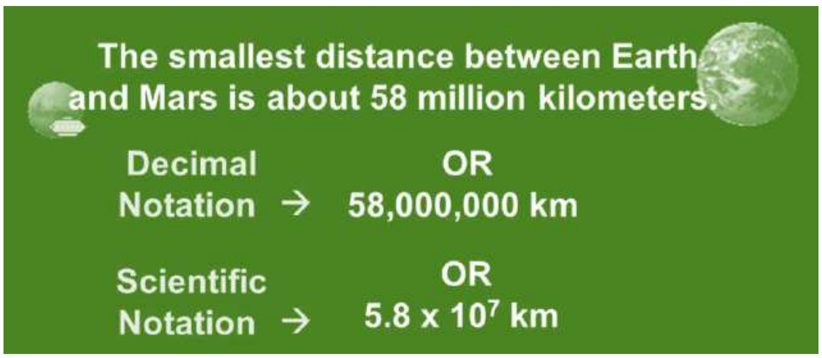
____

____

THE LANGUAGE OF PHYSICS

SCIENTIFIC NOTATION

Scientists are lazy and developed a method to express very large numbers. This method is called scientific notation. In common English *significant* means “important”, while in science it means “measured”.

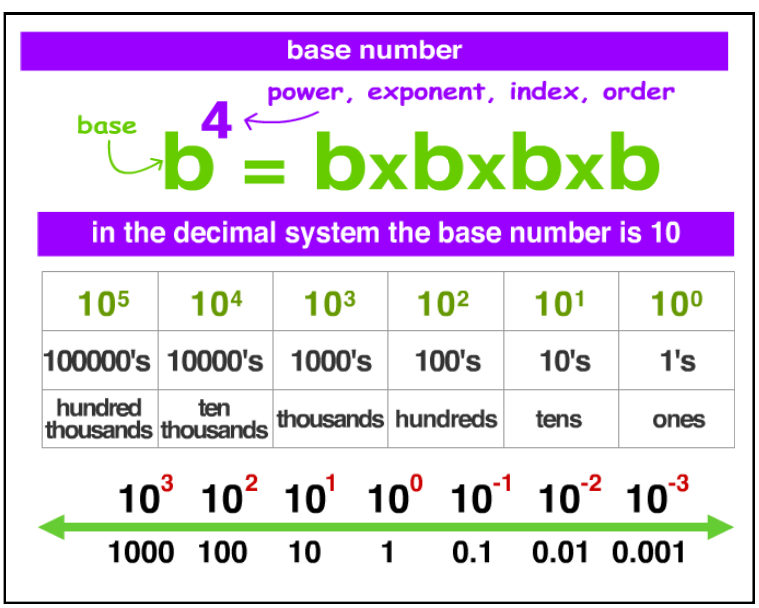


Teacher Demo 8
Lazy Scientists

The number 123,000,000,000 in scientific notation is written as:

$$1.23\ x\ 10^{11}$$

The first number 1.23 is called the ***coefficient***. It must be between 1 and 9. *The second number is called the* ***base***. It must always be 10 in scientific notation. *The number above the base is called the* ***power*** *(or exponent, index or order).*



Writing numbers in scientific notation.

1. Put a decimal point after the first digit.
2. To find what power of 10 to use, count the number of places from the decimal point to the end of the number.
3. Drop the zeros and write the number x 10 to the power.

3456000000000

$$= 3.456 \times 10^{12}$$

For very small numbers, count back to the original decimal point and write the power of 10 as a negative.

0.0000000725

$$= 7.25 \times 10^{-8}$$

examples

decimal notation	scientific notation
84 500	8.45×10^{4}
678 345.96	6.7834596×10^{5}
50 000 000 000	5×10^{10}
0.0246	2.46×10^{-2}
0.000 024 6	2.46×10^{-5}
0.000 000 000 1	1×10^{-10}

Teacher Demo 9 Accuracy and Precision

Accuracy refers to the closeness of a measured value to a standard or known value. For example, you obtain a mass of 3.2 kg for a given substance, but the actual or known mass is 10 kg, then your measurement is not accurate.

Precision refers to the closeness of two or more measurements to each other. Using the example above, if you measured the mass of a given substance five times, and get 3.2 kg each time, then your measurement is very precise. Precision is independent of accuracy.

Compile a list of real-world examples where it is important that measurements be done accurately and precisely.

Scientific Notation Practice

1. The speed of light in a vacuum (no air) is 300,000,000 m/s. How can we write this value of speed of light in scientific notation?

2. The mass of the Earth is 5,970,000,000,000,000,000,000,000 kg. Write this value in scientific notation.

3. The constant of universal gravitation is found to be 0.00000000006673 $\frac{N \bullet m^2}{kg^2}$. Write this value in scientific notation.

Scientific Notation Addition

Addition Example 1:

$(9\ x\ 10^5) + (1\ x\ 10^6)$

$9 \times 10^5 = 900{,}000$

$1 \times 10^6 = +1{,}000{,}000$

$1{,}900{,}000 = 1.9 \times 10^6$

6 5 4 3 2 1

Addition Example 2:

$(9\ x\ 10^{-5}) + (1\ x\ 10^{-4})$

$9 \times 10^{-5} = 0.00009$

$1 \times 10^{-4} = +0.00010$

$0.00019 = 1.9 \times 10^{-4}$

1 2 3 4

You may use your calculator.

Addition Practice:

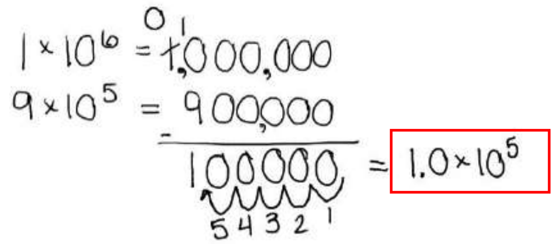
1. $(9.81\ x\ 10^3) + (10\ x\ 10^{-5})$

2. $(9.81\ x\ 10^3) + (10\ x\ 10^5)$

Scientific Notation Subtraction

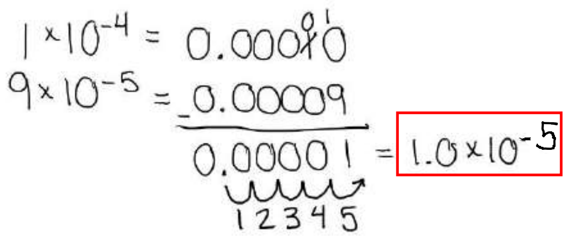
Subtraction Example 1:

$(1\ x\ 10^{6}) - (9\ x\ 10^{5})$



Subtraction Example 2:

$(1\ x\ 10^{-4}) - (9\ x\ 10^{-5})$



You may use your calculator.

Subtraction Practice:

1. $(9.81\ x\ 10^{-3}) - (10\ x\ 10^{-5})$

2. $(10\ x\ 10^{5}) - (9.81)$

Scientific Notation Multiplication

Multiplication Example 1:

$(1\ x\ 10^6) \bullet (9\ x\ 10^5)$

1st $1 \cdot 9 = 9$

2nd $(10^6) \cdot (10^5) =$ add powers $= 10^{6+5} = 10^{11}$

9×10^{11}

Multiplication Example 2:

$(2\ x\ 10^{-4}) \bullet (9\ x\ 10^{-5})$

1st $2 \cdot 9 = 18$

2nd $(10^{-4}) \cdot (10^{-5}) =$ add powers $= 10^{-4+-5} = 10^{-9}$

18×10^{-9}

has to be between 1 and 9

therefore $18 \times 10^{-9} = 1.8 \times 10^{-8}$

You may use your calculator.

Multiplication Practice:

1. $(9.81\ x\ 10^5) \bullet (10\ x\ 10^{-5})$

2. $(10\ x\ 10^5) \bullet (9.81\ x\ 10^{23})$

Scientific Notation Division

Division Example 1:

$$\frac{(9\ x\ 10^6)}{(3\ x\ 10^5)}$$

1st $\frac{9}{3} = 3$

2nd $\frac{10^6}{10^5} =$ subtract powers $= 10^{6-5} = 10^1$

$3 \times 10^1 = \boxed{30}$

Division Example 2:

$$\frac{(3\ x\ 10^{-4})}{(1\ x\ 10^{-5})}$$

1st $\frac{3}{1} = 3$

2nd $\frac{10^{-4}}{10^{-5}} =$ subtract powers $= 10^{-4--5} = 10^1$

$3 \times 10^1 = \boxed{30}$

You may use your calculator.

Division Practice:

1. $(9.81\ x\ 10^5)/(10\ x\ 10^{-6})$

2. $(10\ x\ 10^5)/(9.81\ x\ 10^{23})$

Putting It ALL Together

Combination Example:

$$\frac{(6\times10^{6})(2\times10^{3})(2\times10^{3})}{(4\times10^{4})}=$$

Top: $\overset{1st}{6}\cdot2\cdot2=24$

2nd

$10^{6}\cdot10^{3}\cdot10^{3}=10^{6+3+3}=10^{12}$

TOP: 24×10^{12}

Put together

$$\frac{24\times10^{12}}{4\times10^{4}}$$

1st: $\frac{24}{4}=6$

2nd: $\frac{10^{12}}{10^{4}}=10^{12-4}=10^{8}$

$\boxed{6\times10^{8}}$

You may use your calculator.

Practice:

1. $\frac{(4\times10^{6})(5\times10^{-3})}{(8\times10^{-4})(5\times10^{3})}=$

2. $\frac{(4\times10^{6})(2\times10^{3})}{(8\times10^{-4})(2\times10^{4})}=$

Scientific Notation and Prefixes

News Flash: Scientists are VERY lazy and developed another method to make their lives easier, when it comes to numbers. Scientists use prefixes in front of units to abbreviate numbers.

Teacher Demo 10
Even Lazier
Scientists

Prefix	Symbol	Multiplier
exa	E	10^{18}
peta	P	10^{15}
tera	T	10^{12}
giga	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}
atto	a	10^{-18}

Example 1: Converting from scientific notation to prefix

$\mathbf{1.8\ x\ 10^{6}\ meters}$ becomes

1.8 Mm (Megameter)

Explanation:

Mega stands for $1\ x\ 10^{6}$

$\frac{1.8\ x\ 10^{6}}{1\ x\ 10^{6}} \rightarrow 1.8\ x\ 10^{6-6}$ = 1.8 Mm

Note: $10^{0} = 1$

Example 2: Converting from prefix to scientific notation

65 kg becomes $65\ x\ 10^{3}$g or $6.5\ x\ 10^{4}$g or 65,000 g

Explanation:

Kilo stands for 1000

$65 \bullet 1000$ = 65,000 g

OR

$6.5\ x\ 10^{4}$g

Prefixes Practice

Write the following in scientific notation:

10 µg

Write the following using a prefix:

1,200 m

Mathematics Prefixes Practice

a. 10^{-2} m

b. 10^{9} yrs

c. 10^{3} g

d. 10^{-3} s

e. 10^{-9} m/s

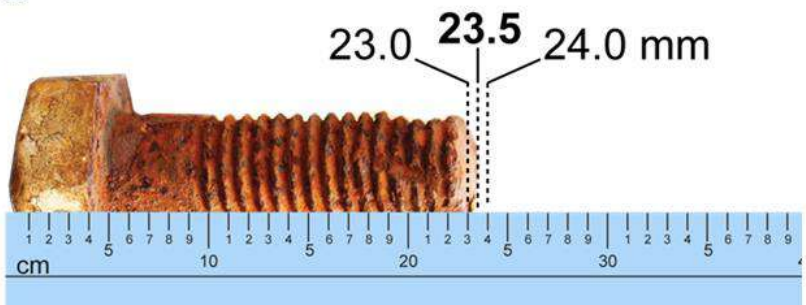
f. $10^{6}\ {}^{m}/_{s^2}$

THE LANGUAGE OF PHYSICS

SIGNIFICANT FIGURES

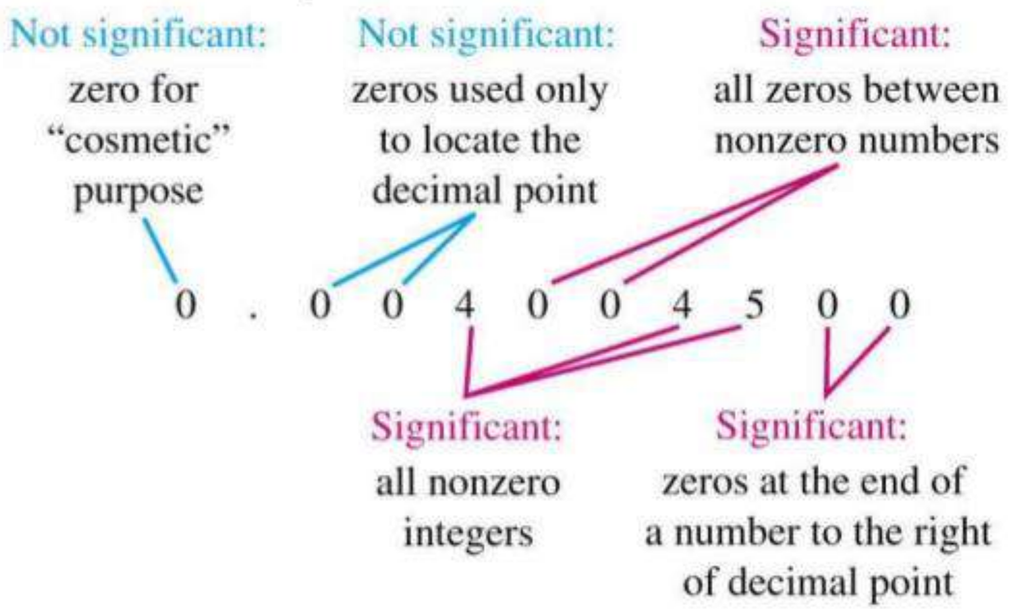
When making a measurement, you may estimate to one more subdivision than the smallest marking on the measuring instrument. The estimated digit is a significant figure.

This measurement of 23.5 mm has *three* significant figures.



Significant Figures Rules

Significant Figures can be done using a set of around 5 rules, With a lot of complications for how to deal with zeroes.



Determining Significant Figures

15 000

The Number is **Greater than 10**, so the **Exponent will be Positive**.

= 1 5 0 0 0 (4 places)

Move the Decimal point to the LEFT to create a number between 1 and 10.

= 1.5 ~~0~~ ~~0~~ ~~0~~

Remove Zeroes that are not needed.

= $\underline{1.5} \times 10^4$

Count how many digits are present.

15 000 has TWO Significant Figures ✓

Determining Significant Figures

0.0270

The Number is a decimal **less than 1**, so the **Exponent will be Negative**.

= 0 .0 2 7 0 (2 places)

Move the Decimal point to the RIGHT to create a number between 1 and 10.

= ~~0~~ ~~0~~ ~~0~~ 2.70

Remove Zeroes that are not needed, **but not ones from after a Decimal Pt.**

= $\underline{2.70} \times 10^{-2}$

Count how many digits are there.

0.0270 has THREE Significant Figures ✓

Significant Figures in Multiplication, and Division

5.02	×	89,665	×	0.10	= 45.0118 = 45
3 sig. figs.		5 sig. figs.		2 sig. figs.	2 sig. figs.

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

In a calculation involving multiplication and division the number of significant digits in an answer should equal the least number of significant digits in any one of the numbers being multiplied or divided.

Significant Figures in Addition and Subtraction

$$
\begin{array}{r}
89.453 \\
+\ 2.5 \\
\hline
91.953
\end{array}
$$

- 2.5 ← one significant figure after decimal point
- 91.953 ← round off to **92.0**

$$
\begin{array}{r}
3.72 \\
-\ 2.9173 \\
\hline
0.8027
\end{array}
$$

- 3.72 ← two significant figures after decimal point
- 0.8027 ← round off to **0.80**

When quantities are being added or subtracted, the number of *decimal places* (not significant digits) in the answer should be the same as the least number of decimal places in any of the numbers being added or subtracted.

Significant Figures Practice

1. Determine the number of significant figures in each of the following:

a) 3427

d) 172

b) 0.00456

e) 0.000984

c) $123,453$

f) 0.502

2. Calculate the following. Give the answer in correct scientific notation.

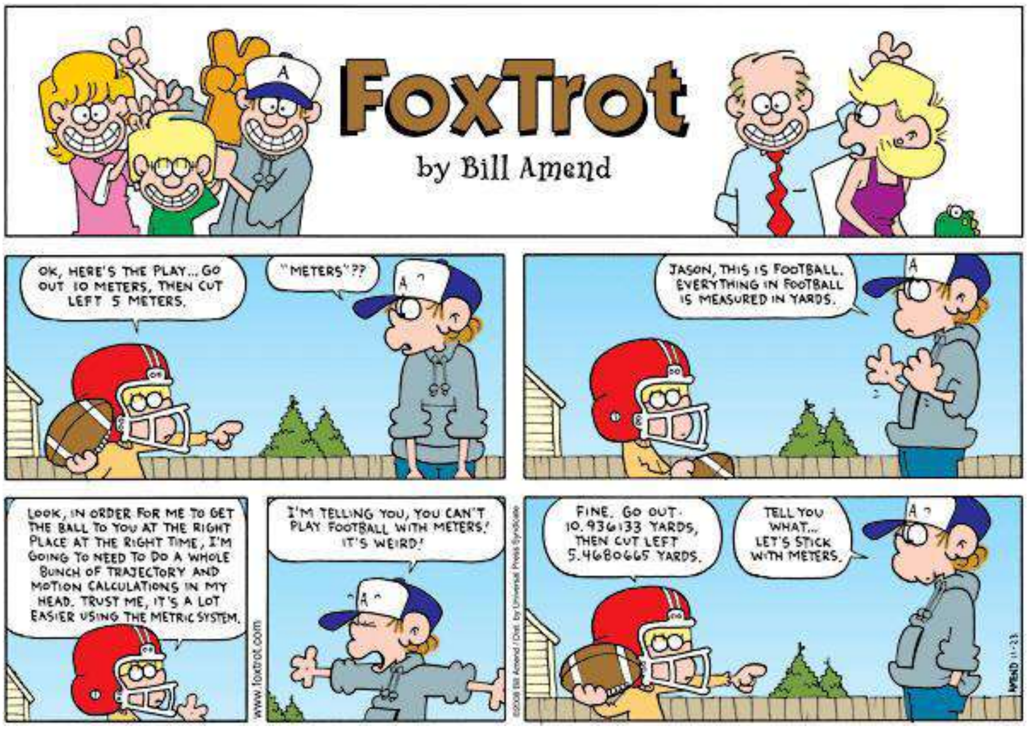
a) $\dfrac{3.95\times10^{2}}{1.5\times10^{6}}$

b) $\dfrac{1.05\times10^{-26}}{4.2\times10^{56}}$

c) $(3.5\times10^{2})(6.45\times10^{10})$

d) $(4.50\times10^{-12})(3.67\times10^{-12})$

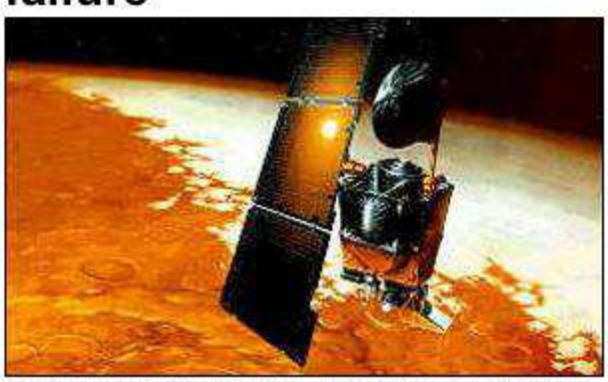
THE LANGUAGE OF PHYSICS
UNIT CONVERSION



Teacher Demo 12
Ruler

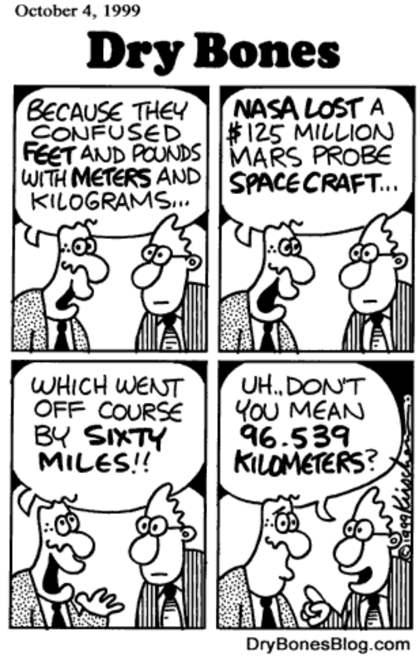
6: [When NASA Lost a Spacecraft Because It Didn't Use Metric Video]

Confusion leads to Mars failure



The Mars Climate Orbiter: Now in pieces on the planet's surface

The Mars Climate Orbiter Spacecraft was lost because one Nasa team used imperial units while another used metric units for a key spacecraft operation.



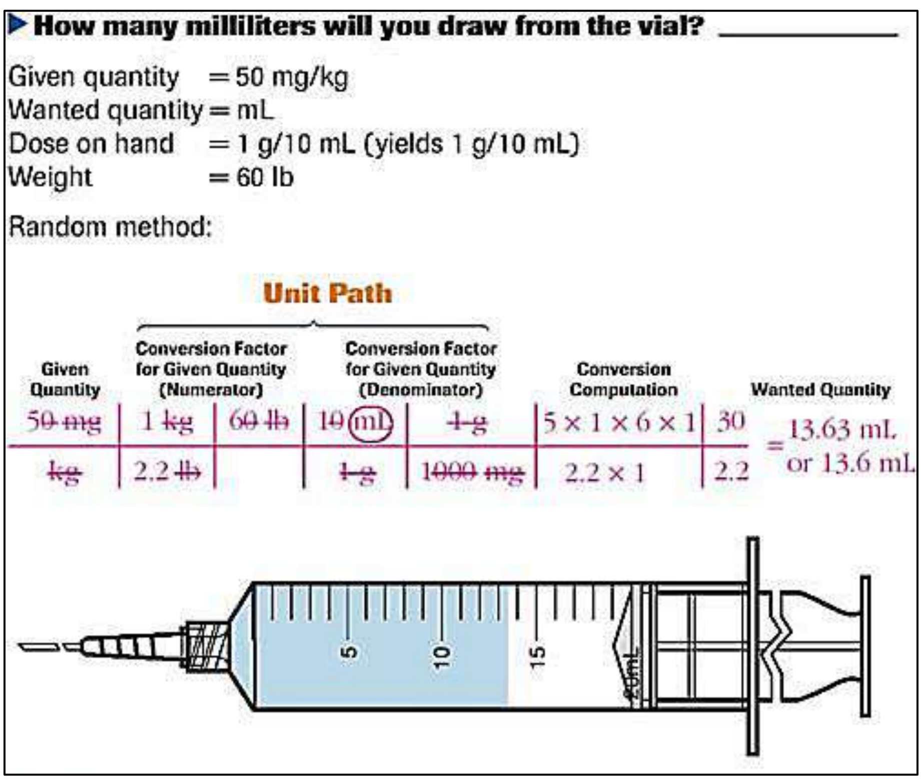
Metric Units

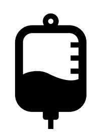
Unit	Symbol
meter	m
kilogram	kg
second	s
Kelvin	K
meter / second	m/s

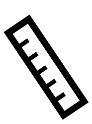
Imperial Units

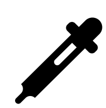
Unit	Symbol
feet	ft
pound	lb
minute	min.
Fahrenheit	°F
feet / hour	ft/hr

Different countries use different types of standard units. Internationally Physicist use metric units. The US uses imperial units. It is important to be able to convert from one to the other and to know which units we are using, or you might have an incident like NASA did with it's Mars Climate Orbiter (see previous page). It could also mean life or death for us here on Earth, especially when it comes to medicine. In medicine nurses, doctors and pharmacists must be able to convert from one form to another and lives depend on it.









Unit Conversion Example:

The International Space Station travels around the Earth at 7790 meters per second (7790 m/s). How fast is it traveling in miles per hour (miles/hr)? [Note: NASA uses miles/hr and the ESA (European Space Agency) uses m/s to describe speed.]

We want to go from $\frac{m}{s}$ to $\frac{miles}{hr}$. We can do this because we know that *1* $\frac{m}{s}$ *= 2.2* $\frac{miles}{hr}$.

$$7790 \frac{m}{s} \times 2.2 \frac{miles}{hr} = \boxed{17{,}138 \frac{miles}{hr}}$$

The units that we want to go away are placed on the bottom of the fraction so that they cancel out. See the next page for conversions used in these examples.

Convert 165 pounds into kilograms.

$$165\ \cancel{lbs} \times \left(\frac{0.45\,kg}{1\ \cancel{lbs}}\right) = \boxed{74.25\ kg}$$

Convert 5 grams into kilograms.

$$5\cancel{g} \times \left(\frac{1\,kg}{1000\cancel{g}}\right) = \boxed{0.005\,kg}$$

Convert 5 meters into centimeters.

$$5\cancel{m} \times \left(\frac{100\,cm}{1\cancel{m}}\right) = \boxed{500\,cm}$$

Unit Conversion Practice

Conversions

1 hour = 3600 seconds	1 mile = 5280 feet	1 yard = 3 feet
1 day = 24 hours	1 meter = 3.28 feet	1 km = 0.62 miles
1 meter = 100 centimeters	1 lbs = 453.6 grams	1 kg = 1000 grams
1 quart = 0.946 liters	1 m/s = 2.2 miles/hour	1 foot = 12 inches
1 inch = 2.54 cm = 25.4 mm	1 km = 1000 meters	1 mile = 1609.34 meters

1. 565,900 seconds is how many hours?

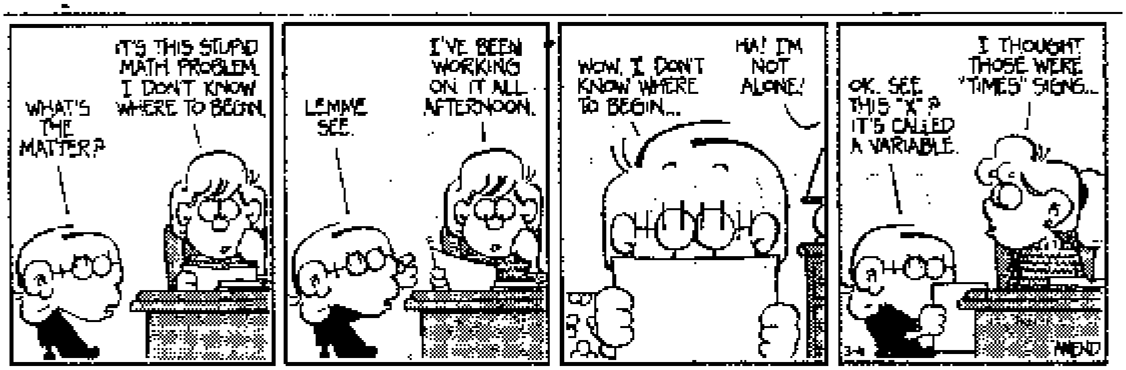
2. 17 years is how many minutes?

3. Convert 130 meters per second into miles per hour

4. Convert 721 lbs per week into kg per second

5. Convert 186,282 miles per second into meters per second

THE LANGUAGE OF PHYSICS
SOLVING VARIABLES



Example: Solve the following equation for the variable, Δx.

$$Example: v_{avg} = \frac{\Delta x}{\Delta t}$$

Teacher Demo 14
Variables

v_{avg} = average (avg) velocity (v)
Δx = Change in distance
Δt = Change in time

$$v_{avg} = \frac{\Delta x}{\Delta t}$$

To solve this equation for Δx we must get Δx by itself. To do this we must remember that the mathematical operation between Δx and Δt is division. The opposite of an operation is another operation that gets you back where you started. This is used primarily to get rid of numbers that are combined with a variable so you can solve for the variable in an equation.

To remove Δt from Δx we must do the opposite operation of division; multiplication. But, keep in mind that what we do to one side of an equation we must also do to the other, otherwise one side will get jealous of the other.

$$\Delta t \bullet v_{avg} = \frac{\Delta x}{\Delta t} \bullet \Delta t$$

By doing this Δt will cancel out on the right-hand side:

$$\Delta t \bullet v_{avg} = \frac{\Delta x}{\cancel{\Delta t}} \bullet \cancel{\Delta t}$$

We have then solved for the variable of Δx:

$$\boxed{\Delta t \bullet v_{avg} = \Delta x}$$

Practice Solving Variables:

Solve the following equation for Δv.

$$a_{avg} = \frac{\Delta v}{\Delta t}$$

Example: Solve the following equation for $\boldsymbol{\Delta t}$.

$$Example: v_{avg} = \frac{\Delta x}{\Delta t}$$

$$\boldsymbol{v_{avg} = \frac{\Delta x}{\Delta t}}$$

Steps:

$\Delta t \bullet v_{avg} = \frac{\Delta x}{\cancel{\Delta t}} \bullet \cancel{\Delta t}$ Multiplying by Δt to both sides because it is on the bottom of the fraction and we want it on top.

$\Delta t \bullet v_{avg} = \Delta x$ Canceling out Δt

$\frac{\Delta t \bullet \cancel{v_{avg}}}{\cancel{v_{avg}}} = \frac{\Delta x}{v_{avg}}$ Divide v_{avg} to both sides to get Δt by itself.

$$\boxed{\Delta t = \frac{\Delta x}{v_{avg}}}$$

Practice Solving Variables:

Solve the following equation for Δt.

$$a_{avg} = \frac{\Delta v}{\Delta t}$$

Example: Solve the following equation for the variable, v_i.

$$\Delta p = m \bullet v_f - m \bullet v_i$$

V_i = what we are solving for

$\Delta p = \boxed{m \cdot V_f} - m \cdot V_i$

we can bring this whole operation to the other side

$$\Delta p - m \cdot V_f = m \cdot V_f - m \cdot V_f - m \cdot V_i$$

minus $m \cdot V_f$ from both sides because we want to isolate $m \cdot V_i$

$$\Delta p - m \cdot V_f = - m \cdot V_i$$

divide by $-m$ to both sides to isolate V_i

$$\frac{\Delta p - m \cdot V_f}{-m} = \frac{-m \cdot V_i}{-m}$$

$$\boxed{\frac{\Delta p - m \cdot V_f}{-m} = V_i}$$

Practice Solving Variables:

Solve the following equation for t.

$v_f = v_i + a \bullet t$

Solving Variables Practice

Directions: Solve given equation for stated variable

1) Solve $d = rt \ \ for\, r$

2) Solve $ax + by = c \ \ for\, y$

3) Solve $S = R - rR \ \ for\, R$

4) Solve $B = \frac{703w}{h^2} \ \ for\, w$

5) Solve $K = \frac{1}{2}mv^2 \ \ for\, m$

6) Solve $F = \frac{Gm_1m_2}{r^2} \ \ for\, G$

Occupation Inquiry

You will be investigating an occupation of your choosing. Identify the occupation and give a description of it. State where someone would work in that occupation (be specific). How is physics used in that job?

Teacher Demo 15
Astronaut

Please Type this up. Include your name at the top.

Example:

Miss Taylor

Occupation: Astronaut

Canadian Astronaut Chris Hadfield

Description:

The term "astronaut" derives from the Greek words meaning "space sailor," and refers to all who have been launched as crew members aboard NASA spacecraft bound for orbit and beyond. Astronauts are not only selected by NASA but also private space agencies. The US uses the term astronaut while Russia uses the term cosmonaut.

Astronaut Responsibilities:
Astronauts are involved in all aspects of assembly and on-orbit operations of the ISS. This includes extravehicular activities (EVA), robotics operations using the remote manipulator system, experiment operations, and onboard maintenance tasks. Astronauts are required to have a detailed knowledge of the ISS systems, as well as detailed knowledge of the operational characteristics, mission requirements and objectives, and supporting systems and equipment for each experiment on their assigned missions.

Basic Qualification Requirements:
Applicants must meet the following minimum requirements before applying.

Bachelor’s degree from an accredited institution in engineering, biological science, physical science, computer science or mathematics.

Degree must be followed by at least 3 years of related, progressively responsible, professional experience or at least 1,000 pilot-in-command time in jet aircraft. An advanced degree is desirable and may be substituted for experience as follows: master’s degree = 1 year of experience, doctoral degree = 3 years of experience. Teaching experience, including experience at the K - 12 levels, is qualifying experience for the Astronaut Candidate position; provided degree is in a Science, Engineering, or Mathematics field.

Ability to pass the NASA long-duration Astronaut physical, which includes the following specific requirements:

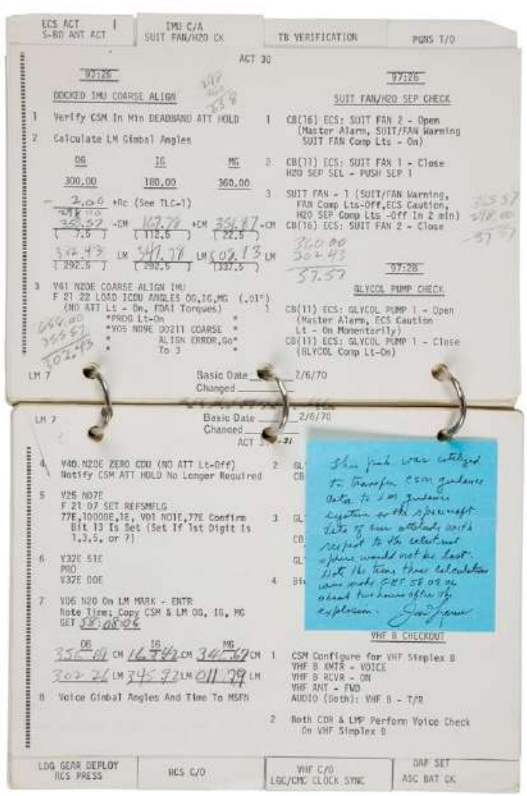
Distant and near visual acuity must be correctable to 20/20, each eye. The use of glasses is acceptable.

The refractive surgical procedures of the eye, PRK and LASIK, are allowed. Note that such surgeries are permitted, but not required for potential applicants.

Since all crewmembers will be expected to fly aboard a specific spacecraft vehicle and perform Extravehicular Activities (space walks), applicants must meet the anthropometric requirements for both the specific vehicle and the extravehicular activity mobility unit (space suit). Applicants brought in for an interview will be evaluated to ensure they meet the anthropometric requirements.

Physics Use:

Astronauts use physics in both their training and exploration, ranging from the complexity of dynamics of the ship to simple tasks such as exercising.



This picture is of some calculations done by the astronauts during the Apollo 13 mission to the moon. They were done by hand and verified by controllers / engineers back on Earth.

Name: ______________________

Introduction to Physics Check for Understanding

1. In your own words, what is the definition of physics and why is it important?

2. In your own words, what is a real-world phenomenon? Give an example.

3. What type of unit would you give to a measurement of distance?

4. Solve the following

   Answer boxed and in scientific notation.

   a. $\dfrac{(5\times10^{6})(2\times10^{3})(3\times10^{3})}{(5\times10^{4})} =$

   b. $\dfrac{(4\times10^{6})(2\times10^{3})}{(8\times10^{-4})(2\times10^{4})} =$

Conversions

1 hour = 3600 seconds	1 mile = 5280 feet	1 yard = 3 feet
1 meter = 3.28 feet	1 km = 0.62 miles	1 light second = 300,000,000 meters
1 kg = 2.2 lbs	1 lb = 0.45 kg	1 quart = 0.946 liters
1 m/s = 2.2 miles/hour	1 foot = 12 inches	1 inch = 2.54 cm = 25.4 mm

5. Write the following using prefixes. Box your answer.

a. $2\ x\ 10^3$ g

b. $2\ x\ 10^{-3}$ m

Prefix	Symbol	Multiplier
exa	E	10^{18}
peta	P	10^{15}
tera	T	10^{12}
giga	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}
atto	a	10^{-18}

6. Convert the following:

Answer boxed and in scientific notation.

a. 100 yards into meters

b. 22,647 inches into miles

c. 2678 cm into feet

d. 1100 feet per second into miles per hour

e. 53 yards per hour into inches per week

f. 721 lbs per week into kg per second

7. Determine the number of significant figures in each of the following:

   a. 3100.0×10^{2}

   b. 0.0114×10^{4}

   c. 107.2

   d. 0.0000455

   e. 2205.2

   f. 30.0×10^{-2}

8. Calculate the following. Give the answer in correct scientific notation.

   a. $\frac{4.44 \times 10^{7}}{2.25 \times 10^{5}}$

   b. $\frac{6.022 \times 10^{23}}{3.011 \times 10^{-56}}$

   c. $(2.5 \times 10^{9})(6.45 \times 10^{4})$

   c. $(6.88 \times 10^{2})(3.45 \times 10^{-10})$

9. Solve the following equation for the variable v_x

$$\Delta x = v_x \bullet \Delta t$$

10. Solve the following equation for the variable a

$$v_f^2 = v_i^2 + 2 \bullet a \bullet \Delta x$$