Summer Assignment Instructions for the Students of the AP Chemistry Class of 2018-2019

Your assignment consists of

1) **If you do not have the Summer Packet, please email me at jcampagnolo@epsd.org and on the same email, cc: me at joseph@ttsnj.com. YOU MUST PROVIDE ME AN EMAIL ADDRESS WHICH CAN TAKE A FEW MEGABYTES OF DOCUMENTS WITHOUT REJECTING THEM. GENERALLY OUR EPSD email ACCOUNTS ARE ADEQUATE. MOST PEOPLE PROVIDE A GMAIL OR HOTMAIL ACCOUNT. THE SUMMER WORK SHOULD ALSO BE AVAILABLE ON THE DISTRICT'S WEBSITE.**
2) **The Summer Packet is a number of documents which will be better emailed than printed. The summer assignment consists of a polyatomic ion, element, math review and practice, an exercise on the absorption and emission of quanta of energy, molecular shape exercise and general chemistry review assignment of the first 4 chapters. There are slideshow presentations which begin Chap0x… to give you instruction and guidance. Email me if you have any questions per the above. Also, visit such resources as the Khan Academy online to get clear explanations of the chemical principles or mathematical techniques involved.**
3) **The polyatomic ion assignment is to memorize each name and oxidation number of the polyatomic ions that have a border on the polyatomic ion sheet which will be emailed to you. You will be quizzed on this information in the first week. You will need to have this information.**
4) **The element assignment is to memorize the first 20 elements (in order) by name, atomic symbol, atomic number, atomic mass (to within 0.1 amu) and column number in the periodic table. You will be quizzed on this information in the first week. You will need to have this information at your finger-tips throughout.**
5) **Quantum theory and electron configuration. See the document with exercises.**
6) **Review the Math Review slide presentation. Don't be disturbed if some slides state "Connecting Math to Physics" since the info applies to Chemistry also. Do the small number of problems in this presentation both where a solution or no solution is given. After that perform the algebra in the packet titled "Practice_Algebra_Worksheet.pdf". Also, study and perform the calculations in the logarithm worksheet titled "APChem_Logarithm_Worksheet.doc"**
7) **Review the summary sheets for Chapters 1 to 4. Use your chemistry notes, the web or any other chemistry source if you need more information.**
8) **Solve the problems for each chapter on paper. I know the answers are often available in the document. You should try the questions and then compare your answers. Finally, transcribe the answer to a sheet of paper that you will hand in.**
9) **The VSEPR molecular shape/ model building exercise can be done without a kit. Read the information and answer the questions on paper.**

10) **Much of this material will be taken for granted as learned and mastered by you before the course begins. We start generally with reactions and stoichiometry so there is some overlap with your summer work.**
11) **Write out the solutions to exercises to turn in on the first day. It is not necessary to print and solve the exercises, but you must put a heading that exactly describes by file name which worksheet packet you are performing and staple each packet's work separately.**

AP Chemistry Summer Prep

Instructor: Dr. Joseph F Campagnolo

Recording Measurements

Reading Instruments

•Every physical measurement is made using an instrument. Inevitably every measurement has some uncertainty incorporated in it.

•When reading a metric ruler, recognize that using the number-marked ticks and the one in between, you can estimate to some value between the values represented by the ticks.

• When reading a meniscus in a graduated cylinder, make your estimate from the bottom of the parabola (the meniscus). Be sure to read at eye straight-on.

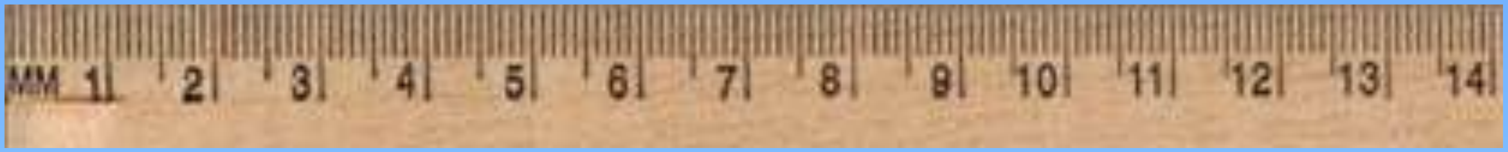
Significant Digits

Defined

- Basically every measurement is an estimate. There is some part which is not known with certainty. Example: 14.3 cm is composed of two you are confident of: 14 and the last which is estimated.

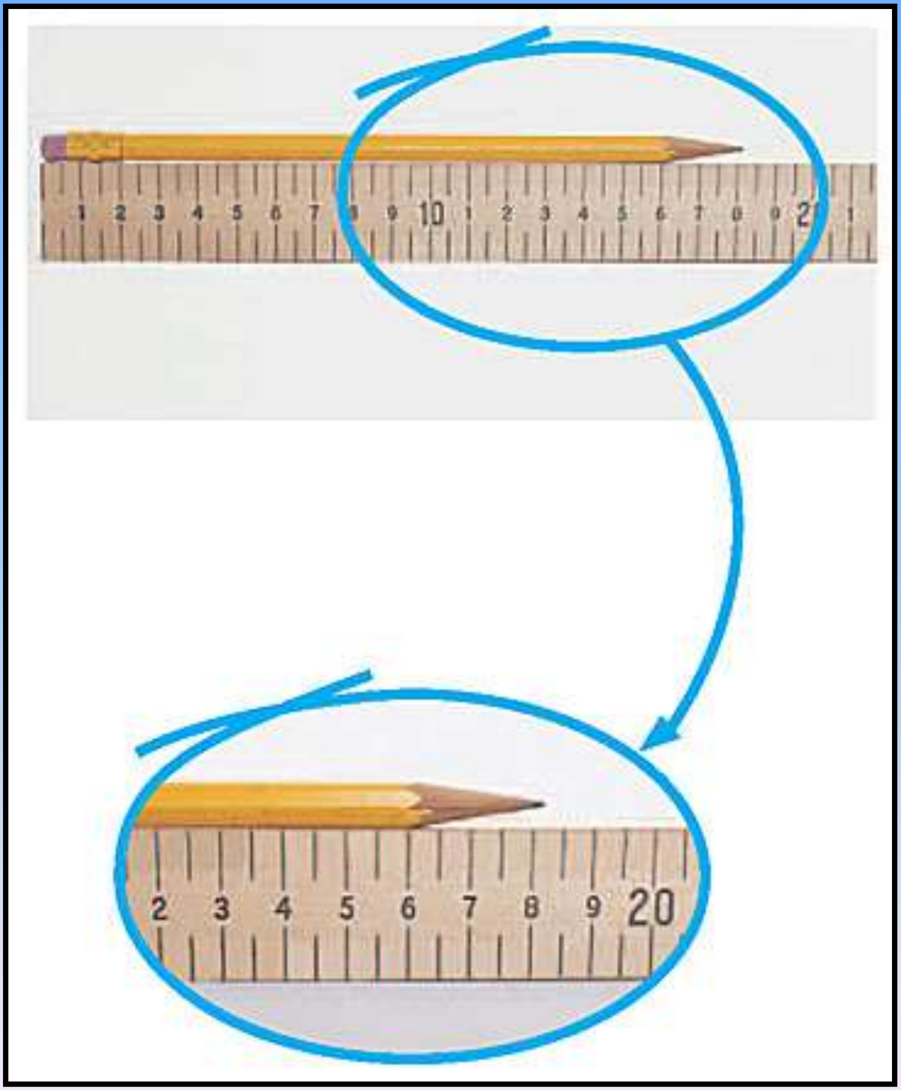
- The valid digits in a measurement are the **significant digits, also called significant figures.**

Recording Measurements: Instruments



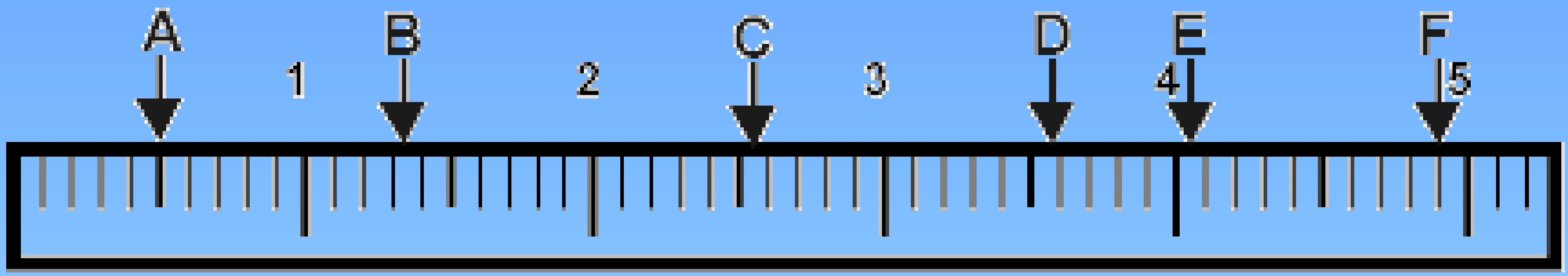
The instruments we use allow us to measure properties (e.g. length, volume) but we need to practice applying the rules of measurement.

Recording Measurements/ Significant Figures



Even though this ruler is marked in only centimeters and half-centimeters, if you estimate, you can use it to report measurements to a precision of a millimeter.

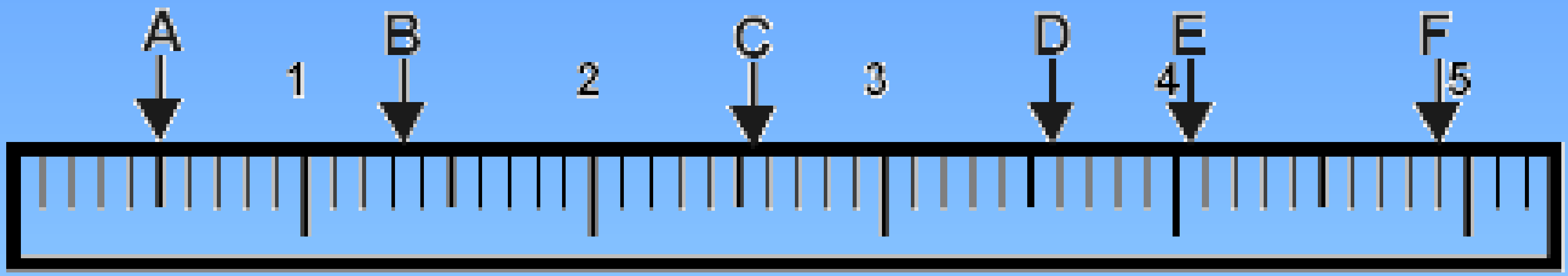
Recording Measurements/ Significant Figures



If each digit in the ruler represents 1 centimeter, and each tick mark represents 1/10 of a centimeters, what are the readings for A through F applying SIGNIFICANT DIGITS?

Remember you should estimate 1 digit past the unit of the tick mark.

Recording Measurements/ Significant Figures



Answers:

- A: 0.50 cm
- B: 1.32 cm
- C: 2.55 cm
- D: 3.58 cm
- E: 4.05 cm
- F: 4.90 cm

Significant Digits

Rules for Determining

- **Rule 1**: All non-zero digits are significant. The number 5692 has four significant figures. The number 27,477.2941 has 9 significant figures. There is one significant digit in 6.
- **Rule 2**: All zeros that lie between two non-zero digits are significant. The number 40, 028 has 5 significant figures.
- **Rule 3**: None of the zeros that lie to the left of the first non-zero digit are significant. 0.002911 has 4 significant figures.
- **Rule 4**: Zeros to the right of the last non-zero digit are significant if they lie to the right of a decimal point. Example: 341.0 has 4 significant figures; 202.40 has 5 significant digits; 330.4000 has 7 significant digits.
- **Rule 5**: Zeros to the right of the last non-zero digit in a number which has no decimal part may or may not be significant. Example 290 may be 2 or 3 sig digits : context
- **Rule 6**: Zeros to the right of the last non-zero digit with a decimal point present are significant: Example: 290. has 3 significant digits.

Rules for Sig Fig

Rule 1

All nonzero digits are **significant.**

Examples

a. 51.3 m has three significant figures

b. 3.2225 s has five significant figures

Rules for Sig Fig

Rule 2

Zeros between other nonzero digits are **significant.**

Examples

a. 50.3 m has three significant figures
b. 3.0025 s has five significant figures

Rules for Sig Fig

Rule 3

Zeros in front of nonzero digits are **not significant.**

Examples

a. 0.892 has three significant figures
b. 0.0008 s has one significant figure

Rules for Sig Fig

Rule 4

Zeros that are at the end of a number and also to the right of a decimal point are **significant.**

Examples

a. 57.00 g has four significant figures
b. 2.000 000 kg has seven significant figure

Rules for Sig Fig

Rule 5

Zeros that are at the end of a number but left of the decimal point are **not usually significant.**

Examples

a. 100 m has ONE significant figure
b. 20 m has ONE significant figure

Sometimes context with other numbers in the group may indicate significant digits in this case.

Rules for Sig. Fig.

Rule 6

Zeros that are at the end of a number but left of the decimal point that are measured to be **significant** are indeed **significant**.

Examples

a. A scale measures 1200. kg has four significant figures and is written in scientific notation:

1.200×10^3 kg   so Rule 6 applies

Arithmetic with Significant Digits

How to

- A physics calculation cannot result in a value which is more precise than the least-precise measurement.

- To add or subtract measurements, first perform the operation and then round off to correspond to the place represented by the least-precise addend.

- To multiply or divide measurements, perform the calculation and then round to the same number of significant digits in the least-precise measurement.

- Note: Calculators do NOT USUALLY give the result in significant digits but only perform the calculation. Rounding is left to the student. THEY CAN BE PROGRAMMED TO YIELD SIGNIFICANT DIGITS IN SOME CASES.

Rules for Calculating with Significant Figures

Type of calculation	Rule	Example
addition or subtraction	Given that addition and subtraction take place in columns, round the final answer to the *first column from the left containing an estimated digit.*	97.3 + 5.85 = 103.15 $\xrightarrow{\text{round off}}$ 103.2
multiplication or division	The final answer has the same number of significant figures as the measurement having the *smallest* number of *significant figures.*	123 × 5.35 = 658.05 $\xrightarrow{\text{round off}}$ 658

Rounding

How to

- Round up or down from the position which will make the result come out with the proper number of significant digits.
- When a number is halfway between two numbers (i.e. 5), then the following rules:
- When the leftmost digit to be dropped is 5 followed by a nonzero number, that digit and any digits that follow are dropped. The last digit in the rounded number is increased by 1.
- E.g. 8.7519 rounded to two significant figures: 8.8
- If the digit to the right of the last significant figure is equal to 5 and 5 is not followed by a nonzero digit, look at the last significant figure. If it is odd, increase it by 1; if even do not round up. E.g. 92.350 rounded to 3 sig figs: 92.4
- While 92.250 rounded to 3 sig figs is 92.2

Rules for Rounding in Calculations

What to do	When to do it	Examples
round down	• whenever the digit following the last significant figure is a 0, 1, 2, 3, or 4	30.24 becomes 30.2
	• if the last significant figure is an even number and the next digit is a 5, with no other nonzero digits	32.25 becomes 32.2 32.65000 becomes 32.6
round up	• whenever the digit following the last significant figure is a 6, 7, 8, or 9	22.49 becomes 22.5
	• if the digit following the last significant figure is a 5 followed by a nonzero digit	54.7511 becomes 54.8
	• if the last significant figure is an odd number and the next digit is a 5, with no other nonzero digits	54.75 becomes 54.8 79.3500 becomes 79.4

Addition with Significant Digits

Addition/Subtraction

- When adding /subtracting with significant digits, always work in columns.
- From the left column, search for the addend whose significant figures ends first.
- Your answer should be rounded to that column

- Examples:

	11	**15.23**
	+ 0.47	**- 3.1**
	______	**______**
	11.47	**12.13**
Ans:	**11**	**12.1**

Multiplication with Significant Digits

Multiplication/ Division

- When multiplying or dividing with significant digits, your answer should have the same number of significant digits as the factor with the fewest significant digits.

- Examples:

3.05 * 2.111 * 3.14159265 = 20.2

Why? Because 3.05 has just 3 significant digits and the other factors have more.

DO NOW

Write the result of the following applying significant figures:

5.55 * 2.000 / 1.1 = ?

Relative Error

Comparing Measurement to an Accepted Value

- Relative error compares a measurements relative nearness to an accepted value, and is expressed in percentage.

- Take the absolute value of the difference, divide by the accepted value and multiply by 100.

- % Relative Error = $$\frac{(100)\ |measurement - accepted\_value|}{accepted\_value}$$

Relative Error: Example

Comparing Measurement to an Accepted Value

- Your measurement was 19.5 centimeters. The accepted value was 20.0 cm. What is the relative error in percent?

- % Relative Error = $\dfrac{(100)\ |19.5 - 20.0|}{20.0} = 2.50\ \%$

Analyzing Graphs

Graphs are composed of two axes: **y-axis** or **vertical axis** and **x-axis** or **horizontal axis**.

Axes should have **descriptions**, **units**, and tick-marked **gradations of numerical magnitudes**.

Typically, the graph is also given a **title** stating what it is about.

Points (data) on a graph are often stated in **(x, y) pairs** while the graph is stated to be for **" y versus x" or "y vs. x"**

Graphs help us visualize trends in a way that tabulated data often does not. "A picture is worth a thousand words."

Linear Equations and Graphs

See "Connecting Math to Physics", p. 5

Linear Equations. An equation is linear when the exponent on each variable is 1.

For example,

$\mathbf{F^1 = m^1\, a}$ assuming a = constant

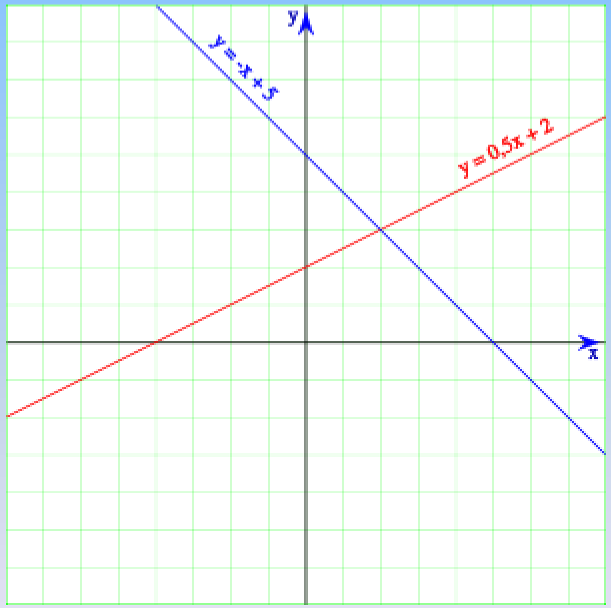
Or equivalently,

$\mathbf{F = m\, a}$ assuming a = constant;

(NOTE: Exponent of 1 is assumed when no exponent is shown.)

Linear Graphs: Slope

Linear Equations. Have constant slope.
Two points are sufficient to completely define a line.



$$\textbf{Slope} = \frac{\text{Change in vertical direction (Rise)}}{\text{Change in horizontal direction (Run)}}$$

= a constant for linear equations

- Horizontal Lines have zero slope.
- Vertical Lines have infinite slope.

Slope-Intercept Form of a Line

Slope-Intercept Form of a Line:

$$y = m\,x + b$$

Where: ***m*** **is the slope**
b **is the y-intercept.**

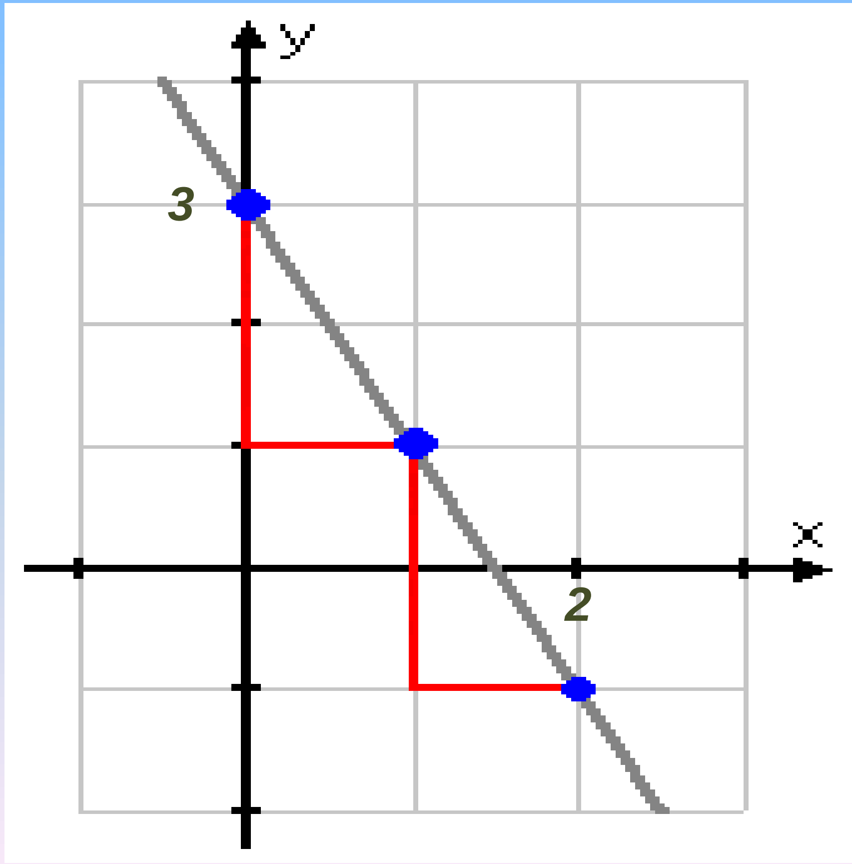
Example:

$$y = -2x + 3$$

Q: Will the line slant left or right?
Q: Where will it cut through the y-axis?

Slope-Intercept Form of a Line

Graph of y = -2x + 3



DO NOW

What is the slope and intercept of a line that goes through the points (5, 6) and (11,18)?

Answer

Slope: m = rise/ run = (18 – 6)/(11 – 5) = 2

$y = m x + b$

Intercept b: To get b, use slope and 1 pair

$y = 2 x + b$

$18 = 2 (11) + b$

$b = 18 - 22 = -4$

Ans: $y = 2 x - 4$

Scientific Notation

What it is and How to Represent

Scientific notation is a way of writing numbers that accommodates values too large or small to be conveniently written in standard decimal notation.

Scientific notation has a number of useful properties and is often favored by scientists, mathematicians and engineers, who work with such numbers.

scientific notation, numbers are written in the form:

$$a \times 10^{b}$$

("*a* times ten to the b")

Scientific notation helps us to represent significant digits clearly. Example: 167,000 (3, 4, 5, 6 sig figs?)
While 1.67×10^{5} has 3 significant digits.

Scientific Notation - 2

What it is and How to Represent

Scientific notation:

Move the decimal point until a absolute value of the number is greater than or equal 1.0 and less than 10 is formed: the *a* value.

$$1 \leq |a| < 10$$

Count the number of places the decimal point was moved: the *b* value. If moved to the left, *b* is positive. If to the right, *b* is negative.

If the absolute value of the original number is less than 1.0, the power *b* is negative. If greater, *b* is positive.

Scientific Notation - 3

What it is and How to Represent

Scientific notation:

See below: The sign of the exponent is not related at all to the sign of the number.

0.000651 = 6.51×10^{-4}
-0.000234 = -2.34×10^{-4}

In the above, we moved 4 places to the right: thus, the exponent is -4.

7282.56 = 7.28256×10^{3}
-9123.25 = -9.12325×10^{3}

In the above, we moved three places to the right: thus, exponent is 3.

Scientific Notation - 4

What it is and How to Represent

Multiplication and Division in Scientific Notation: Useful as powers are additive and the significands can be worked on separately.

$(4.1 \times 10^4) * (2.0 \times 10^3) = (2.0 * 4.1) \times 10^{(4 + 3)} = 8.2 \times 10^7$

$(6.0 \times 10^5) / (3.0 \times 10^3) = (6.0 / 3.0) \times 10^{(5 - 3)} = 2.0 \times 10^2$

Do Now

Scientific Notation

Answer the following multiplication and division in scientific notation?

$(5.0 \times 10^{6}) * (1.5 \times 10^{-3}) =$ ________________

$(6.0 \times 10^{5}) / (2.0 \times 10^{-4}) =$ ________________

Do Now

Scientific Notation

Answer the following multiplication and division in scientific notation?

$(5.0 \times 10^{6}) * (1.5 \times 10^{-3}) = (5.0 * 1.5) \times 10^{(6 - 3)} = 7.5 \times 10^{3}$

$(6.0 \times 10^{5}) / (2.0 \times 10^{-4}) = (6.0 / 2.0) \times 10^{[5 - (-4)]} = 3.0 \times 10^{9}$

Properties of Real Numbers & Algebraic Terms

Properties

- **Commutative: a + b = b + a**
- **Associative: (a + b) + c = a + (b + c)**
- **Distributive: a (b + c) = ab + ac**
- **Example: What property is applied in the following expressions?**

2 (x + 7) = 2x + 14

3a + (v + b) = b + (3a + v)   [two properties!]

Algebraic Substitution

Substitution

- **Substituting a constant (or a variable expression) for a variable in another equation is a common algebraic method in physics. This a vital part of solving problems!**

- **Example:**

What is an expression for Power (P) in terms of Voltage (V) and Resistance ® in an electric circuit, given:

$V = IR \rightarrow I = V/R$

$P = IV$

$P = V^2 / R$

Algebraic Substitution

"Connecting Math to Physics", p. 16, #10

Change $F = ma$

To $\tau = \alpha \mathrm{I}$

Using: $a = \alpha \mathrm{r}$

$\tau = F \mathrm{r}$ $I = mr^2$

Exponential Notation

- **In exponential notation, the exponent is the number of times the mantissa is multiplied by itself. For instance:**

$$8 \times 8 \times 8 \times 8 \times 8 \times 8 = 8^6$$

- **Negative exponent rule:**

$$1/\ b^{x} = b^{-x}$$

$$1/\ 7^{2} = 7^{-2}$$

- **Exponents raised to a power:**

$$(8^6)^2 = 8^{6*2} = 8^{12}$$

- **Terms with same mantissa multiplied together:**

$$(8^6) * (8^2) = 8^{6+2} = 8^8$$

SI Units

Units Everyone Understands

• SI is a non-national system of units used by the world-wide scientific community.

•Institutes maintain the standards of measurement (p 6)

• There are 7 base quantities. These come originally from direct measurements. Fundamental Units.

•Other units called Derived Units are created by combining the base units. For example , if kg (mass), m (length) and seconds (time) are base units, then the Joule (J) being
 $1\ J = 1\ kg\ m/\ s2$ is a derived unit.

The Seven Base SI Units

SI Base Units

- Page 5: See table 1 -1

• Length	meter	m
• Mass	kilogram	kg
• Time	second	s
• Temperature	kelvin	K
• Amount of subs	mole	mol
• Electric Current	ampere	A
• Luminous Intens	candela	cd

Prefixes of SI Units

Ease of Representing Quantities

- Page 6: Table 1-2

	Prefix	“10 to the …
• E.g.	nano	-9
	micro	-6
	milli	-3
	centi	-2
	kilo	3
	mega	6
	giga	9
	tera	12

Some prefixes were not in common use until some development in technology made them handy. Now everyone know gigaBytes for computer storage, etc.

Dimensional Analysis

Checking that Units Make Sense

- Dimensional Analysis. In converting between units, this helps us to determine if our conversion makes sense.

- DA is the method of treating units as algebraic quantities

- A way of checking our work.

- Example: Try converting 5 m/s to x km/ hr

- Can we convert a quantity like 5 m/s to x kg/ hr. Why not?

Algebraic Substitution

"Connecting Math to Physics", p. 16, #10

Change $F = ma$

To $\tau = \alpha \, \mathrm{I}$

Using: $a = \alpha \, \mathrm{r}$

$\tau = F \, \mathrm{r}$

$I = mr^2$

Order of Operations

Proper Order of Operations

- Where no grouping is explicitly done with parentheses, it is imperative to follow the traditional order of operations to get the correct result.

- Order of Operations
  1. Perform all operations within grouping symbols such as parentheses.
  2. Evaluate all exponential expressions.
  3. Evaluate all trigonometric functions.
  4. Perform all multiplications and divisions in the order they occur from left to right.
  5. Perform all additions and subtractions in the order they occur from left to right.

Order of Operations - 2

"Connecting Math to Physics", p 30, #8

$$48 \div (4.0 \times 6.0) - 10.0$$

Order of operations for this problem:

- perform the computation in parentheses: 4.0 X 6.0 = 24
- perform the division 48 / 24 = 2.0 ; where 24 is from above result
- perform the subtraction 2.0 – 10.0 ; where 2.0 is from above result
- final answer: -8.0

** ORDER OF OPERATIONS IS REMEMBERRED BY THE PHRASE: "*Please excuse my dear Aunt Sally*!" THAT IS parentheses, exponents, multiplication, division, addition, subtraction. At the same level, proceed left to right.

Scientific Method

How Science is Done

- The Scientific Method: An orderly way (framework) for answering questions about the world we live in.

- Outline of the Scientific Method

    1. Observation – Wondering about
    2. Question – Asking WHY?
    3. Hypothesis – A tentative answer; preconception
    4. Experiment – Test the Hypothesis
    5. Conclusion – What was learned; interpret result
    6. May lead to new questions and so … back to 2.

    a. Natural Law: Empirical; consistent with observation
    Describes how nature behaves but does not explain why

    b. Theory: Explains why nature behaves the way it does; a predictive model which is checked by new experiments and revised.

Scientific Method - 2

Be Aware of and Beware of

- The hypothesis must be capable of being tested. Otherwise, it cannot be part of science. The Scientific Method "Chain" is broken otherwise.

- The experiment must be repeatable by others; well explained and without hidden tricks or secret procedures

- It is not always obvious how to design the experiment to get the result; results are not always obviously interpretable.

- Scientific Method does not always lead to success. Laws and Theories are not always successfully found.

- Scientists do not always follow the Scientific Method in "cook-book" style.

Synthetic Multiplication

Just sort of neat

- Synthetic multiplication is a fast way of evaluating polynomials in your head. Usually simple polynomials with integers inputs are easy!
- Example: Evaluate $f(t) = 5t^3 - 6t^2 - 4t + 16$ when $t = 3$ sec
- Method

write the 3, separator and the coefficients of the polynomial on a line

3) 5 -6 -4 16

multiply the input by the first coefficient and add to the second coeff

3 * 5 = 15; 15 + (-6) = 9

multiply the input by the result and add to the third coefficient

3 * 9 = 27; 27 + (-4) = 23

proceed similarly through to the constant. Your last result is f(3)

3 * 23 = 69; 69 + 16 = 85

SO

f(3) = 85

Remember that if a term in the series of exponential terms is not present its coefficient is zero!