1.3 - Link to Algebra, Unit Analysis

Baby Formula, Anyone?

Demonstrate the conversion from mm3 or cm3 to m3.

Link to Algebra

Algebra skills are strongly used in AP Physics.

Depending on the situation, either use the PEMDAS (Remember that?), or the SADMEP (????!!!).

PEMDAS: the order of operations that MUST be followed when solving for a variable:

Parenthesis **E**xponents **M**ultiplication
Division **A**ddition **S**ubtraction
is what it stands for.

Using a calculator's parentheses keys is important: some calculators don't follow PEMDAS.

PEMDAS Example

Use PEMDAS to solve the following problem:

$$x = 14 + 2 \times 3 - 7$$

How many answers do you get solving it willy-nilly, not using PEMDAS?

PEMDAS Answer

Using PEMDAS:

$$x = 14 + 2 \times 3 - 7 \Rightarrow 14 + (2 \times 3) - 7 = 13$$

Willy-nilly:

$$x = (14 + 2) \times (3 - 7) = -64$$

$$x = ((14 + 2) \times 3) - 7 = 41$$

$$x = 14 + (2 \times (3 - 7)) = 6$$

Any more?

Isolating Variables: SADMEP

For an equation that has a variable deeply buried in it, use SADMEP: opposite PEMDAS.

Consider the equation: $A = 4\left(\frac{B}{C} + D\right)$

Ex 1: Isolate B.

Ex 2: Isolate C.

Ex 3: Isolate D.

SADMEP Example 2.

Isolate all variables in: $4A = \frac{(B \times C)^2}{D}$

A:

C:

B:

D:

Other Details:

1. Don't mix units

Ex: What is the area of a rectangle measuring 12 cm X 12 m?

It is not 144 cm·m.

It is 14,400 cm^2 or 1.44 m^2, depending on which unit you want.

2. Don't mix systems of units.
There are no such things as nano-feet!

3. Some quantities are dimensionless: like π.

Significant Figures

What do you remember?
How many significant figures in the following?

0.389 = 3 All non-zero digits are significant. Leading zeros are insignificant.
0.9023 = 4 Zeros between non-zeros are significant.
0.3890 = 4 A decimal makes all ending zeros significant.
480 = 2 If no decimal - ending zeros are insignificant.
480.0 = 4 A decimal makes all ending zeros significant.
5.20 E 4 = 3 Numbers in the exponent don't count.

Converting numbers into scientific notation eliminates ambiguity in significant figuring.

Operations and Rounding

What do you remember?
Perform the following, and round appropriately.

482.63 X 4.5 = 2,200
Multiplication and Division: Leave as many figures in the answer as there are in the quantity with fewest figures.

16.086 + 0.021643 = 16.108
Addition and Subtraction: Round answer to match the original value with the greatest ending place value. (If your numbers are in scientific notation, make sure they are raised to the same power!)

How many figures in these?

A century? = 100.00000. . . Years
A dozen? = 12.00000. . . Items
Infinity? = Infinite!

These are defined quantities, = infinite number of sig figs.

Calculation Practice

Try these, and abide by sig fig and rounding rules:
1. Multiply 15.286 cm by 0.0000005 cm

0.000008 cm^2
OR 8 E -6 cm^2

2. Add 0.000083 kg to 6.2873 kg

6.2874 kg

3. Divide 8.1 E 14 m by 2.96 s

2.7 E 14 m/s

4. Do:
14.0023
0.00003
- 0.000019

14.0023

Density

Density is a measurement of how much mass is contained within a volume of sample.

$$Density\,(\rho) = \frac{mass}{volume}$$

symbol ρ = Greek letter Rho (this is NOT a unit).

Density units depend on what makes sense: g/mL, g/cm^3, kg/L, kg/m^3, etc.

You might have to make conversions as needed.

Density Example

You are given a 5,390 g sample of a painted metal, and are give data for three different metals' densities (in the table). The sample is in a cube that measures 8.0 cm on a side. Without scratching the paint, determine what metal the cube is made of.

Metal	Brass	Lead	Silver
Density (kg/m^3)	8,700	11,400	10,500

Density Answer

Convert mass to kg, and figure out the volume in m^3

Mass: $5{,}390\,g \cdot \frac{1\,kg}{1000\,g} = 5.39\,kg$

Conversion: $8.00\,cm \cdot \frac{1\,m}{100\,cm} = 0.080\,m$

Cube Volume: $(0.080\,m)^3 = 5.12\,E-4\,m^3$

$$Density\,(\rho) = \frac{mass}{volume} = \frac{5.39\,kg}{5.12\,E-4\,m^3} = 10{,}500\,\frac{kg}{m^3}$$

Metal	Brass	Lead	Silver
Density (kg/m^3)	8,700	11,400	10,500

Homework

1.3 Problems in your Booklet

Number 3 is OPTIONAL. We will go over it but it doesn't count. (I'm getting rid of it next year).

Due: Next Class