1.3 - Link to Algebra, Unit Analysis

Baby Formula, Anyone?

Demonstrate the conversion from mm$^3$ or cm$^3$ to m$^3$.

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 → Exponents → Multiplication → Division → Addition → Subtraction

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:

Willy-nilly:

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 cm² or 1.44 m², 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.
- 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 railed to the same power!)

- 6.2874 kg
- 0.000008 cm

OR 8 E -6 cm

2.7 E 14 m/s

Calculation Practice

Try these, and abide by sig fig and rounding rules:

1. Multiply 15.286 cm by 0.0000005 cm
   \[ 0.000008 \text{ cm}^2 \]
   OR 8 E -6 cm

2. Add 0.000083 kg to 6.2873 kg
   \[ 6.2874 \text{ kg} \]

3. Divide 8.1 E 14 m by 2.96 s
   \[ 2.7 \text{ E 14 m/s} \]

4. Do:
   - 14.0023
   - 0.00003
   - 0.000019
   \[ 14.0023 \]

Density

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

\[ \text{Density} (\rho) = \frac{\text{mass}}{\text{volume}} \]

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

Density units depend on what makes sense: g/mL, g/cm³, kg/L, kg/m³, 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 given 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.

<table>
<thead>
<tr>
<th>Metal</th>
<th>Brass</th>
<th>Lead</th>
<th>Silver</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density (kg/m³)</td>
<td>8,700</td>
<td>11,400</td>
<td>10,500</td>
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Density Answer

Convert mass to kg, and figure out the volume in m³.

Mass: \(5,390 \text{ g} \times \frac{1 \text{ kg}}{1000 \text{ g}} = 5.39 \text{ kg}\)

Conversion: \(8.00 \text{ cm} \times \frac{1 \text{ m}}{100 \text{ cm}} = 0.080 \text{ m}\)

Cube Volume: \((0.080 \text{ m})^3 = 5.12 \times 10^{-4} \text{ m}^3\)

\[ \text{Density} (\rho) = \frac{\text{mass}}{\text{volume}} = \frac{5.39 \text{ kg}}{5.12 \times 10^{-4} \text{ m}^3} = 10,500 \text{ kg/m}^3 \]

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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