Bodine High School
Physics Summer Assignment

Contents:

- SI Base Units
- Dimensional Analysis
- Scientific Notation
- Significant Figures
- Algebra
- Geometry
- Graphing Techniques

Instructions:

- Read the lesson material
- Review the examples
- Solve the practice problems as best you can
    - You may print the practice worksheets or complete them on lined paper

DUE FRIDAY SEPTEMBER, 8, 2023

Questions? Email Ms. Williams (lwilliams8@philasd.org)

SI Base Units for Physics

Quantity	Unit Name	Unit Symbol
Length	meter	m
Mass	kilogram	kg
Time	second	s
Temperature	Kelvin	K
Electric Charge	Coulomb	C

All other units that we will use in physics are **derived units**… combinations of base units.

Some examples are:

Measurement	Equation	Derived Unit	Derived Unit Symbol
Velocity	$v = \frac{d}{t}$	$\frac{meters}{seconds}$	$\frac{m}{s}$
Acceleration	$a = \frac{v}{t}$	$\frac{meters/second}{seconds}$	$m/s/s$
Momentum	$p = mv$	$kilogram \cdot \frac{meters}{second}$	$kg \cdot m/s$

Many times a derived unit will be complicated due to the increasing complexity of the equation. In this case, a derived unit will get a special name and symbol.

Measurement	Equation	Derived Unit	Special Unit & Symbol
Force	$F = ma$	$kg \cdot m/s/s$	Newton (N)

Dimensional Analysis

In physics, it is often necessary to convert from one unit of measure to another using dimensional analysis. Dimensional analysis was used in chemistry in stoichiometry to convert from grams/liters to moles or vice versa. This method depends on the use of conversion factors.

Metric Conversion Factors

Prefix	Abbreviation	Exponential Multiplier	Meaning	Example using Length
giga	G	10^9	1000000000	1 gigameter (Gm) = 1000000000m
mega	M	10^6	1000000	1 megameter (Mm) = 1000000m
kilo	k	10^3	1000	1 kilometer (km) = 1000m
hecto	h	10^2	100	1 hectometer (hm) = 100m
deka	da	10^1	10	1 dekameter (dam) = 10m
			1	1 meter (m)
deci	d	10^{-1}	1/10	1 decimeter (dm) = -0.1m
centi	c	10^{-2}	1/100	1 centimeter (cm) = 0.01m
milli	m	10^{-3}	1/1000	1 millimeter (mm) = 0.001m
micro	μ	10^{-6}	1/1000000	1 micrometer (μm) = 0.000001m
nano	n	10^{-9}	1/1000000000	1 nanometer (nm) = 0.000000001m
pico	p	10^{-12}	1/1000000000000	1 picometer (pm) = 0.000000000001m

Other Useful Conversion Factors:

- Time
  1 minute = 60 seconds
  1 hour = 60 minutes

- Distance
  1 inch = 2.54 cm
  1 mile = 5280 feet
  1 mile = 1.61 km

There are three steps in the process of converting from one unit to another:

- Start with the original number and unit.
- Determine a conversion factor.
- Multiply or divide the given with the conversion factor so that the common unit cancels out.
- Perform the numerical calculations.

Examples:

1. Convert 350 centimeters to meters.
   - Start with 350 cm.
   - The conversion factor is 1 m = 100 cm.

$$350\ \cancel{cm}\ x\ \frac{1\ m}{100\ \cancel{cm}} = 3.5\ m$$

2. Convert 65 km/h to m/s.
   - There are two conversions (distance & time) so this requires two steps.
   - First, complete the distance conversion.

$$\frac{65\ \cancel{km}}{1\ h}\ x\ \frac{1000\ m}{1\ \cancel{km}} = \frac{65000\ m}{1\ h}$$

   - Use the solution of the distance conversion as the given for the time conversion.

$$\frac{65000\ m}{1\ \cancel{h}}\ x\ \frac{1\ \cancel{h}}{3600\ s} = 18\ m/s$$

Practice:

Convert the following quantities using dimensional analysis.

1. 2.32 m to mm

2. 329 min to h

3. 16.3 inches to cm

4. 204000 cm to km

5. 15 mi to m

6. 82.4 km/h to mi/h

7. 55 mi/h to m/s

Scientific Notation

To write numbers using scientific notation:

1. Move the decimal point until only one non-zero digit remains to the left of the decimal.
2. Count the number of places the decimal was moved and use that number as the exponent of 10.

- If the decimal moved to the LEFT, the exponent is POSITIVE (+).
- If the decimal moved to the RIGHT, the exponent is NEGATIVE (-).

To enter numbers in scientific notation into your calculator:

1. Enter the numerical part of the quantity.
2. Use the EE or EXP button.
3. Enter the exponent.

For example,

6.5 x 10^{8} would be entered **<u>6.5</u> <u>EE</u> <u>8</u>**
The display should read: **6.5E8**

Practice:

Convert the following into scientific notation.

1. 9,480,000 _____
2. 0.00025 _____
3. 0.00000007054 _____
4. 4500 _____

Convert the following into standard notation.

1. 3.0 x 10^{8} _____
2. 1.450 x 10^{-4} _____
3. 9.0 x 10^{9} _____
4. 6.67 x 10^{-11} _____

Significant Figures

Easy rule for determining sig figs for a measurement:

- If the decimal is ABSENT, begin counting with the first non-zero digit from the RIGHT.
- If the decimal is PRESENT, begin counting with the first non-zero digit from the LEFT.

Practice.

Determine the number of significant figures in the following measurements.

1. 2.34 g _____
2. 50.040 g _____
3. 0.00035 kg _____
4. 4600 m _____
5. 40,000. mm _____
6. 5.690 cm _____
7. 8.6×10^{3} g _____
8. 3.09×10^{-2} m _____

Calculations with Significant Figures

Adding and Subtracting

- The number of significant figures in the answer must match the number with the least number of decimal places in the problem.

Example:

$$\begin{array}{r} 467.3754 \text{ m} \\ 30.02 \text{ m} \\ +\ 0.809 \text{ m} \\ \hline 498.2044 \text{ m} \end{array}$$

Answer : 498.20 m

- The number of significant figures in the answer must match the number with the least amount of significant figures in the problem.

Example: 14.475 m x 23 m x 11.000 m = 3662.175 m

Answer: 3700 m because 23 only has 2 sig figs

Practice:

1. 3.08 x 5.2 = _____
2. 2.36 + 3.38 + 0.355 + 1.06 = _____
3. 23.27 / 12.058 = _____

Algebra Skills

- Solving for an unknown.
- Equation of a line: $y = mx + b$
- Pythagorean Theorem: $a^2 + b^2 = c^2$
- Quadratic Formula: $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Solve the following for the unknown variable:

1. $400 = 25x$
2. $\frac{1}{3}d = 78$
3. $4x + 27 = 3x$
4. $\frac{2}{3}(24t - 9) = 8t + 24$
5. $\frac{5}{x} = 40$
6. $(-4 + y)10 = 2y$
7. $0 = -16t^2 + 40t + 1.5$ (2 answers)

Rearrange each of the following equations to solve for x.

1. $w = fx$
2. $g = \frac{f}{x}$
3. $n = \frac{x}{y} - m$
4. $d = ax^2$

Geometry

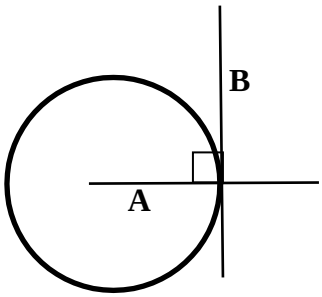
Solve the following geometric problems showing all work.

1. Line **B** touches the circle at a single point. Line **A** extends through the center of the circle.
   a. What is line **B** in reference to the circle?

   _____

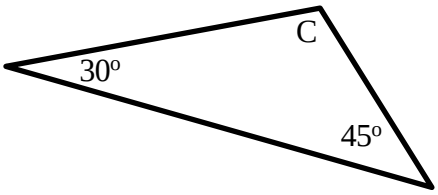
   b. How large is the angle between lines **A** and **B**?

   _____



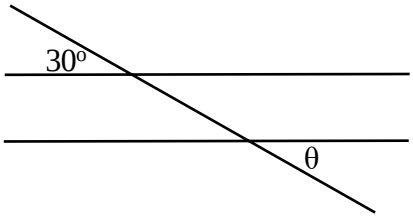
2. What is angle C?

   _____



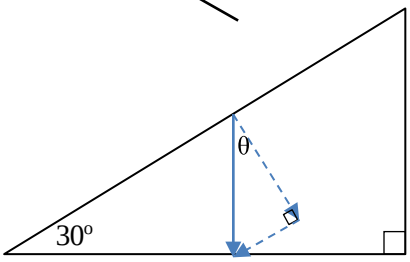
3. What is angle θ?

   _____



4. How large is θ?

   _____



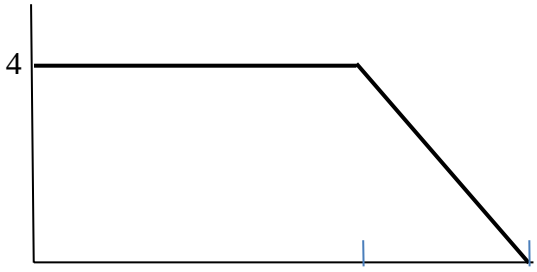
5. The radius of a circle is 5.5 cm.
   a. What is the circumference in centimeters?

   _____

   b. What is the circumference in meters?

   _____

6. What is the area under the curve at right?



Graphing Techniques

Independent Variable – Variable that the scientist controls

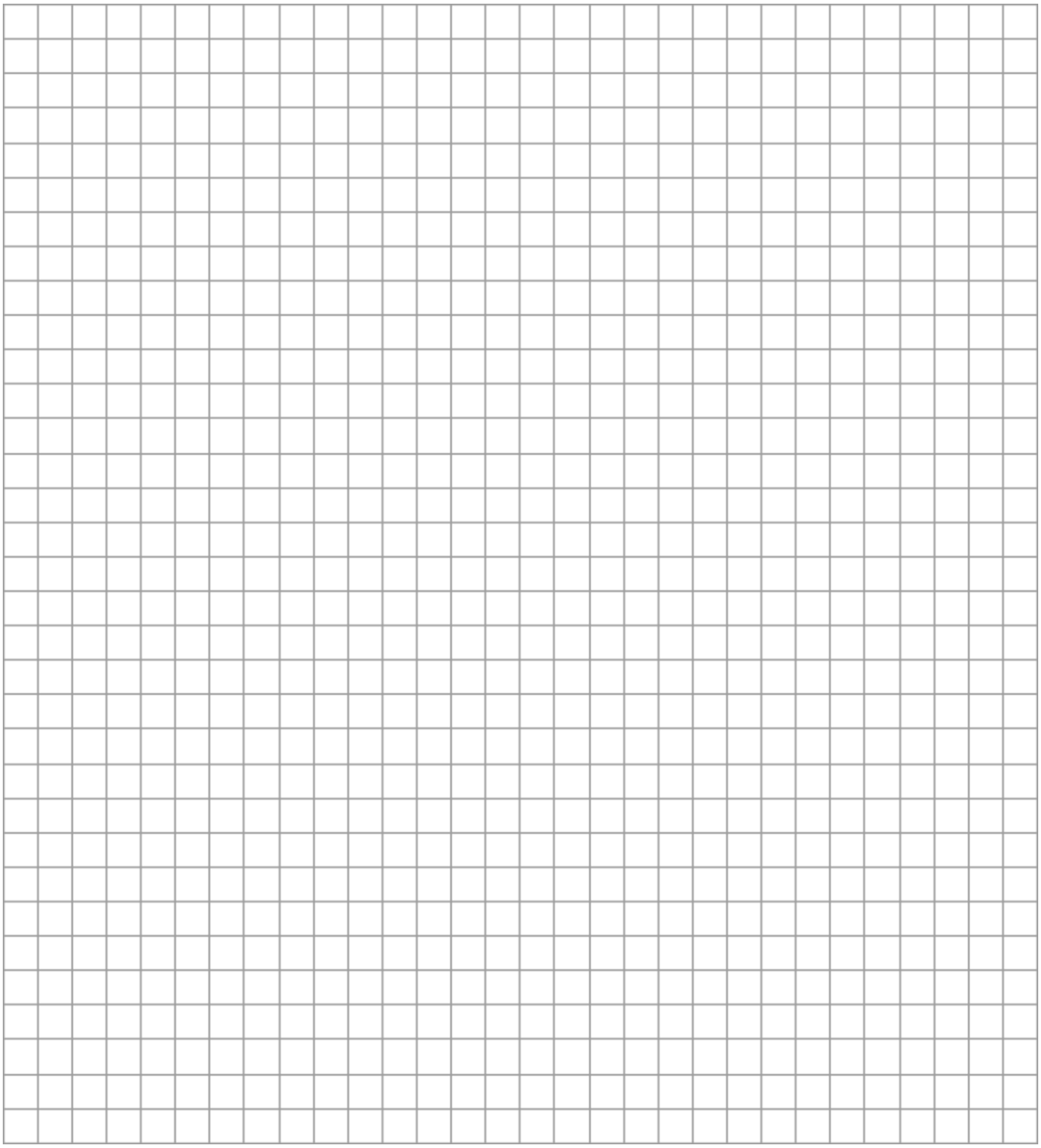
Dependent Variable – Variable that changes as a result of the independent variable

1. Identify the independent and dependent variables
2. Choose a scale carefully so that the graph is as large as possible.
3. Remember, all graphs do not go through the origin.
4. Label the x-axis with the name and unit of the independent variable and the y-axis with the name and unit of the dependent variable.*
5. Plot each data point. Plot the independent variable on the x-axis and the dependent variable on the y-axis.*
6. Draw the line or curve.
    - If the data points appear to lie roughly in a straight line, draw a **line of best fit** with a ruler. Have the line go through as many points as possible with approximately the same number of points above the line as below the line.
    - If the data points do not form a straight line, draw a **curve of best fit**.
    - NEVER, EVER PLAY CONNECT THE DOTS WITH DATA POINTS.
7. Title your graph. The title should clearly state the purpose of the graph and include the independent and dependent variables.

Practice:

Plot a graph of the following data assuming time is the independent variable.

Time (s)	Distance (cm)
0	0.0
1	1.5
2	3.0
3	4.5
4	6.0
5	7.5



Answer the following based on your graph.

1. What is the shape of the graph? _____
2. What is the relationship between time and distance? _____
3. As time increases, the distance _____ by a
   (increases, decreases)
   _____ amount.
   (constant, changing)
4. What is the equation associated with this graph? _____