Honors Physics Summer Assignment

Dear Honors Physics Student:

Welcome to Honors Physics class! Physics is the science of energy and motion. This is a laboratory science course covering the major laws that govern the physical universe. The material is taught from a mathematics viewpoint with strong emphasis on problem solving. Therefore, I am asking you to complete a mathematics review packet to strengthen the skills necessary for your success in Honors Physics.

This assignment has five parts:

➢ You will review the rules of significant figures and rounding, which are important throughout the entire course.

➢ You will review scientific notation, which is a key concept, as we often work with very large and very small numbers.

➢ You will review metric prefixes and conversions, which will help you solve problems and work with laboratory data.

➢ You will review graphical construction and interpretation.

➢ You will complete a comprehensive quiz that requires a little more critical thinking.

This assignment will be graded and must be completed independently. **It is due the first full day of school, whether you have Physics in the spring or fall semester.** Bring it to the Physics Lab. Ten points per day will be deducted for lateness. Please write your name at the top and sign the Honesty Agreement below. Feel free to contact me with any questions. Have a great summer – See you in Honors Physics class!

Mrs. Amy McDonald   amcdonald@nazarethacademyhs.org

I, _____, worked on this assignment myself. I take credit for all this work as my own, since that is a reflection of my personal character.

Significant Figures

Many experiments in science involve measuring different quantities. No matter how carefully scientists measure something, there is always a limit to how exact or how precise the results of the experiment are. For this reason, scientists use significant figures to keep track of the precision of their calculations.

For an example of why significant figures are needed, suppose you are measuring an empty swimming pool to find out what volume of water it holds. You have a measuring tape that can measure lengths to the nearest hundredth of a meter. Using this tape, you find that the pool is 10.54 m long, 3.30 m across, and 2.78 m deep. Thus, the volume is 96.69396 m^3, which has five decimal places and seven significant figures. In other words, your answer seems to be precise to the nearest hundred-thousandth of a cubic meter, but you could not get such a precise answer with your measuring tape, which measures only to the nearest hundredth of a meter. Significant figures help scientists determine how they should round off their answers by ensuring that their results don't appear to have more precision than their measuring devices. You must always round off your final answers to the lowest number of significant figures in the numbers that you put into your calculation. Therefore, the number 96.69396 m^3 should be rounded off to three significant figures, or 96.7 m^3. How do you know which numbers are significant?

Numbers That Are Significant Figures

1. All non-zero numbers

 Ex: 1.5 (2 sig figs)   7,456,991 (7 sig figs) 8.476×10^3 (4 sig figs; don't count

 any of the exponential notation part)

2. All zeroes between non-zero numbers

 Ex: 705 (3 sig figs)   1.020304 (7 sig figs)   1,000,186 (7 sig figs)

3. Zeroes after a decimal AND at the end of the number (must meet both criteria)

Ex:	654.90 (5 sig figs)	0.123 (3 sig figs)	.011 (2 sig figs)	0.08750 (4 sig figs)
	The zero is after the decimal AND also at the end of the number.	The zero is before the decimal.	The zero is after the decimal but not at the end of the number	Only the last zero is both after the decimal AND at the end of the number.

Rounding

When you have more significant figures than you need for an answer, you must round the answer. Follow these rules.

1. Starting at the left, count over to how many significant figures you need. Drop the remaining digits.

2. If you drop numbers that are all decimals, just round up or round off.

3. If you drop any whole numbers, round the last digit you keep, and replace any dropped whole numbers with zeroes to preserve place value.

4. Round up when the first digit you are dropping is 5 or greater. Round off when the first number you are dropping is 4 or less.

    Ex: Round each number to 3 significant figures.

A.   102,304 rounds to 102,000   B.   6.239 rounds to 6.24

C. 6.0547×10^4 rounds to 6.05×10^4 D.   0.00043286 rounds to 0.000432

Scientific Notation

Science often deals with large numbers. There are almost 70,000,000,000,000,000,000,000,000 hydrogen atoms in a liter of water, for example. The width of our galaxy is 9,315,000,000,000,000 km. On the other hand, the width of an atom is typically a miniscule .0000000005 m. To write out such huge or teeny numbers every time you used them would be a lot of trouble. If you were performing a series of calculations, working with long numbers could be time-consuming and confusing.

To deal with this problem, scientists often write numbers in scientific notation. In scientific notation, all numbers are expressed as two numbers multiplied together. The first is a number between one and ten, and the second is a power of ten. For example, 20 is written as 2×10^1 and for 0.000 000 026, we write 2.6×10^{-8}.

Rules for Writing in Scientific Notation

1. Move the decimal so that there is one non-zero number to the left of the decimal.

2. If you moved the decimal to the left, multiply the number by the number 10 raised to the power of how many decimal places you moved to the left.

3. If you moved to the decimal to the right, multiply the number by the number 10 raised to the negative power of how many decimal places you moved to the right.

Ex:

Standard Notation	Scientific Notation
12, 345.67	1.234567×10^4
.001234	1.234×10^{-3}
92.567	9.2567×10^1
0.105	1.05×10^{-1}

Metric Prefixes

Prefix	Symbol	Scientific Notation	Multiplying Factor	Value
kilo	k	10^3	1 000	Thousand
hecto	h	10^2	100	Hundred
deka	dk	10^1	10	Ten
deci	d	10^{-1}	0.1	Tenth
centi	c	10^{-2}	0.01	Hundredth
milli	m	10^{-3}	0.001	Thousandth

Metric prefixes also help us manage very large or small numbers. Instead of saying you have 1,000 grams of salt, you would say you have 1 kilogram of salt, since there are 1,000 meters in one kilometer. Rather than measuring a speed at .005 cm/s, you would say .5 m/s, since there are 100 centimeters in one meter.

How to Make a Good Graph

1. Organize your data into a table.

2. Identify and label the independent and dependent variables. If time is a variable, it is always the independent variable and goes on the x-axis.

3. Write your ordered pairs (data points) using the format (x,y).

4. Use graph paper.

5. Label the x-axis (independent variable) with

  *title

  *units

  *tick marks

6. Label the y-axis (dependent variable) with

  *title

  *units

  *tick marks

7. Be sure tick marks are evenly spaced and numbered. Use at least 75% of the graph paper; don't squeeze data into a small area. Count by numbers such as 5, 100, or 2,000. Don't simply label the axis with the random values of your data points, like 1.5, 17, 250.

8. Plot data points.

9. Draw a trend line (line of best fit).

10. Title your graph.

Types of Graphs

LINE GRAPHS

The below graph is an example of a line graph, which is used for continuous functions. For example, a car moving down the street is always there. It doesn't disappear between data points. We can estimate or interpolate the speed of the car at any. As an example, interpolating the speed at 2.5 seconds should be 12.5 meters per second. There is another technique called extrapolation, which is used to predict data beyond the data range. If you are asked to extrapolate the speed at 8 seconds, you might figure the speed remained at 0 m/s.

Speed vs Time
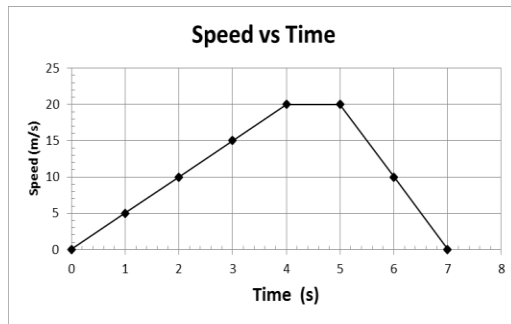
BAR GRAPHS

Bar graphs are used for data which is not continuous or is used to compare various properties of different objects or situations. For example, we could compare the melting points of some common elements:

Iron melts at 1,535°C, gold melts at 1,064°C, silver melts at 962°C, aluminum melts at 660°C, and lead melts at 328°C.

In this case we really don't have (x, y) coordinate pairs, but we can still make a data table and a graph.
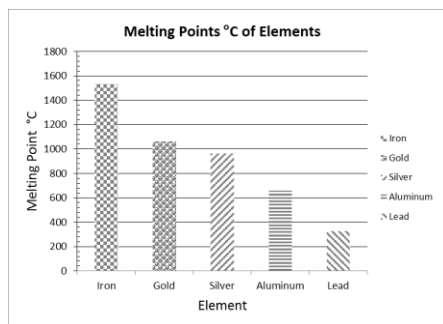
| Element	MP°C
Iron	1535
Gold	1064
Silver	962
Aluminum	660
Lead	328

PIE CHARTS

Pie charts are used to express data, which is a part of a complete item. It could be expressed as a percent, or a fraction, or a decimal. Take, for example, the chemical known as anthranilic acid. It has the chemical formula $C_7H_7NO_2$. The percentage of carbon (C) by weight is 60%; hydrogen (H), 5%; nitrogen (N), 10%, and oxygen (O), 25%.

Data Table

Make the pie graph.

Element	% by Weight
Carbon	60
Hydrogen	5
Nitrogen	10
Oxygen	25
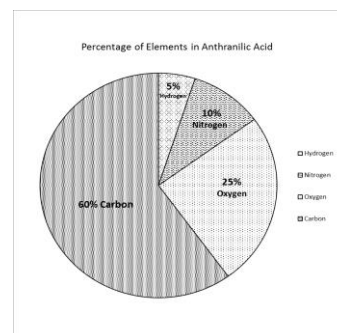
NAME: _____ Block: _____

Honors Physics Assessment: Summer Assignment

Directions: Write your answer clearly on the line. Follow rounding, significant figures, and correct units rules for each answer. This will count as a grade.

How many significant figures are in each number?

1. _____   103.560

2. _____   0.09072

3. _____ 1.98×10^3

4. _____ 6.02×10^{23}

5. _____   300

Round each number to 4 significant figures.

6. _____   16.985

7. _____   9,032, 276

8. _____ 2.1459×10^{-5}

9. _____   .084958

10. _____   1,000,999

Write each number in scientific notation.

11. _____   954

12. _____   .00312

13. _____   82,003

14. _____   .113

15. _____   .00005

Write each number is standard notation.

16. _____ 5.987×10^2

17. _____ 8.50×10^{-3}

18. _____ 9.9015×10^{-1}

19. _____ 8.5204×10^4

20. _____ 1.117×10^2

Convert to the new metric unit.

21. _____ meters   =   1,005 km

22. _____ liters   =   1,000 mL

23. _____ cm   =   .56 m

24. _____ km   =   0.000254 m

25. _____ g   =   50,000 mg

For Questions 26-27, consider the pie chart, which represents the percentage by weight of the elements hydrogen, sulfur and oxygen in sulfuric acid.

26. _____ Which element contributes the most

weight to sulfuric acid?

27. _____ True or False: Sulfur makes up more

than half of the weight of sulfuric acid.
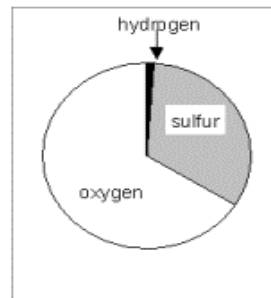
For Questions 28-29, consider the following bar chart, which represents the melting points of select metals.

28. _____ Which of these metals has

the highest melting point?

29. _____ True or False: Aluminum

has the lowest melting point of all of the metals depicted

in the chart.

8
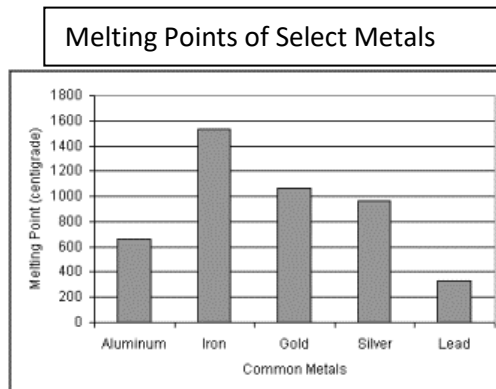
For Questions 30-35, consider the following line graph, which depicts the speed of a boat.

Speed vs Time
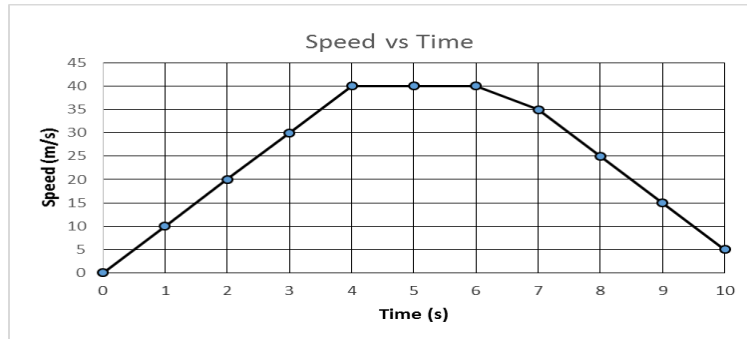
30. _____ What is the boat's speed at 3 seconds?

31. _____ How long did it take the boat to reach a speed of 40 m/s?

32. _____True or False: In this graph, Time is the dependent variable.

33. _____ What speed do you extrapolate the boat will have after 11 seconds?

34. _____ What speed do you interpolate the boat had at 2.5 seconds?

35. _____ For how long did the boat maintain a speed of 40 m/s?

DIRECTIONS: Complete each graph as directed. This will count for a grade.

Graph 1. As the light turns green a race car on a test track quickly speeds away. The distance that it has travelled from the green light is measured each second for six seconds. The following data were recorded:

0 m traveled after 0 s

5m traveled after 1 s

20m traveled after 2 s

45 m traveled after 3 s

80 m traveled after 4 s

125 m traveled after 5 s

180 m traveled after 6 s

Determine the dependent and independent variables. Set up the (x, y) ordered pairs. Construct a data table. Make and label a line graph of Distance vs. Time. Don't forget the x and y axes titles. Title the graph. You may use Excel to construct your graphs.
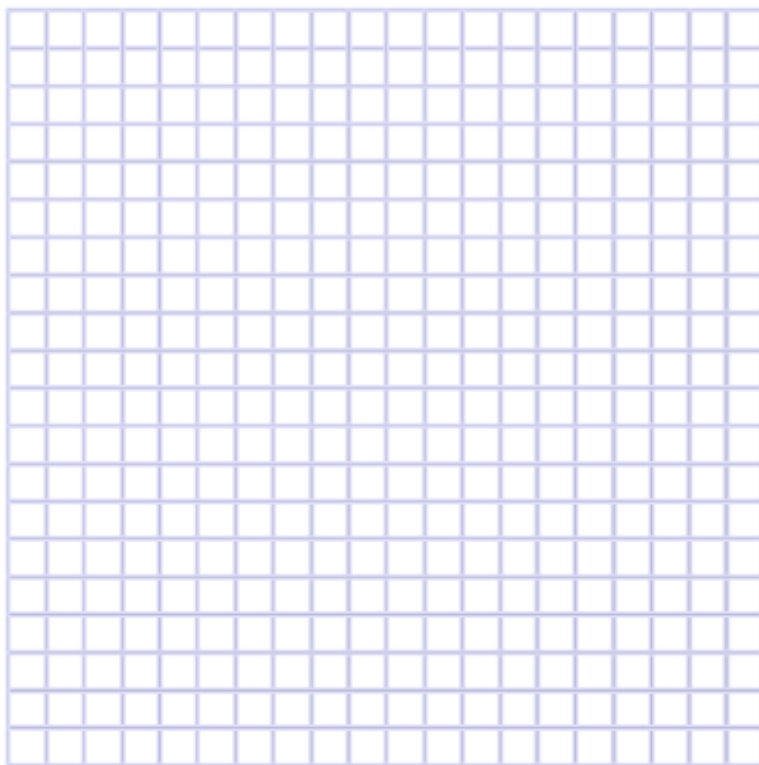
Independent variable: _____

Dependent variable: _____

Ordered pairs: _____

Data Table

Title/Units of Independent Variable: _____	Title/Units of Dependent Variable: _____

Graph 2. The boiling points of the compounds methane, CH_4; ammonia, NH_3; water, H_2O and hydrogen fluoride HF were measured and expressed in degrees Kelvin (K). The following data was recorded:

B.P. methane = 109 K   B.P. ammonia = 240 K

B.P. water = 373 K   B.P. hydrogen fluoride = 292 K

Construct a data table. Draw a bar graph to compare the various compounds. Title the graph and each axis.

Data Table

Title:	Title/Units:

Graph 3. Ammonium isocyanate has the formula: NH$_4$NCO. The percentages by weight of the four elements carbon (C), hydrogen (H), nitrogen (N), and oxygen (O) were determined as follows:
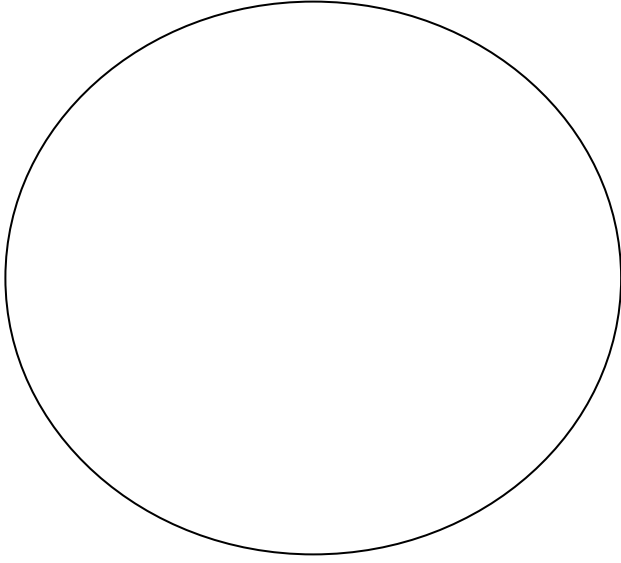
C = 20%	H = 6.7%	N = 46.7%	O = 26.6%

Construct a data table and draw and label a pie graph that expresses the percentages of the four elements in the compound ammonium isocyanate. Include a key.

Data Table

Key: