Name _____

Honors Chemistry Summer Assignment 2017

Welcome to Honors Chemistry. Included are several sections that assess your math and science skills. Each section contains an informational portion that explains a topic. Examples are provided and then there are exercises that test your understanding. The sections are:

- Scientific Numbers
- Significant Figures
- Graphing

All summer work is due in the high school main office no later than 2PM on **Friday August 18, 2017.** Late assignments will be **penalized 20 percent each day** that the assignment is late, beginning with the Monday following the due date. **This grade counts for 10% of the first term's overall grade.**

If you have questions during the summer simply e-mail me at lcusumano@tivertonschools.org

See you in late August,

Ms. Cusumano

Part 1 - Scientfic Numbers

A. Qualitative vs. Quantitative

The following observations are qualitative.

- The building is really tall.
- It takes a long time for me to ride my bike to the store.
- I live really far away.

The following observations are quantitative.

- The river is 31.5 m deep.
- The cheese costs $4.25 per pound.
- It is 75°F outside today.

Critical Thinking Questions

1. What is the difference between qualitative and quantitative observations? (Your answers should reveal an understanding of the definitions for qualitative and quantitative.)

2. Write an example of a quantitative observation that you may make at home or school.

3. Why are instruments such as rulers, scales (balances), thermometers, etc. necessary?

Information: Units

The following tables contain common metric (SI) units and their prefixes.

Table 1: Metric Base Units

Quantity	Unit	Unit Symbol
Length	meter	m
Mass	kilogram	kg
Time	second	s
Temperature	Kelvin	K
Volume	Liter	L
Amount of substance	mole	mol

Table 2: Prefixes for Metric Base Units

Prefix	Symbol	Meaning
Mega	M	Million
Kilo	k	Thousand
Deci	d	Tenth
Centi	c	Hundredth
Milli	m	Thousandth
Micro	μ	Millionth
Nano	n	Billionth
Pico	p	Trillionth

Note the following examples:

- "milli' means thousandths so a milliliter (mL) is one thousandth of a Liter and it takes one thousand mL to make one L.
- "Mega" means million so "Megagram" (Mg) means one million grams NOT one millionth of a gram. One millionth of a gram would be represented by the microgram (μg). It takes one million micrograms to equal one gram and it takes one million grams to equal one Megagram.
- One cm is equal to 0.01 m because one cm is "one hundredth of a meter" and 0.01 is the expression for "one hundredth of a meter"

Critical Thinking Questions

4. How many milligrams are there in one kilogram?

5. How many meters are in 21.5 km?

6. Is it possible to answer this question: How many mg are in one km? Explain.

7. What is the difference between a Mm and a mm? Which is larger one Mm or mm?

Information: Scientific Notation

Scientific Notation is used to make very large or very small numbers easier to handle. For example, the number 45,000,000,000,000,000 can be written as 4.5×10^{16}. The 16 tells you that there are sixteen decimal places between the right side of the four and the end of the number. Very small numbers are written with negative exponents. For example, $0.00000000000000378 \times 10^{-15}$. The -15 tells you that there are 15 decimal places between the right side of the 3 and the end of the number. In both very large and very small numbers, the exponent tells you how many decimal points are between the right side of the first diit and the end of the number. If the exponent is positive, the decimal places are to the right of the number. If the exponent is negative, the decimal places are to the left of the number.

Critical Thinking Questions

8. Two of the following six numbers are written incorrectly. Circle the two that are incorrect.

a) 3.57×10^{-8} b) 4.23×10^{-2} c) 75.3×10^{2} d) 2.92×10^{9} e) 0.000354×10^{4} f) 9.1×10^{4}

What do you think is wrong about the two numbers you circled?

9. Write the following numbers in scientific notation:

a) 25,310,000,000,000,000 = _____ b) 0.000000003018 = _____

10. Write the following scientific numbers in regular notation:

a) 8.41×10^{-7} = _____ b) 3.215×10^{8} = _____

Info: Multiplying & Dividing Using Scientific Notation

When you multiply two numbers in scientific notation, you must add their exponents. Here are two examples. Make sure you understand each step:

$(4.5 \times 10^{12}) \times (3.2 \times 10^{36}) = (4.5)(3.2) \times 10^{12+36} = 14.4 \times 10^{48} \rightarrow 1.44 \times 10^{49}$

$(5.9 \times 10^{9}) \times (6.3 \times 10^{-5}) = (5.9)(6.3) \times 10^{9+(-5)} = 37.17 \times 10^{4} \rightarrow 3.717 \times 10^{5}$

When you divide two numbers, you must subtract denominator's exponent from the numerator's exponent. Here are 2 examples. Make sure you understand each step:

$$\frac{2.8 \times 10^{14}}{3.2 \times 10^{7}} = \frac{2.8}{3.2} \times 10^{14-7} = 0.875 \times 10^{7} = 8.75 \times 10^{6}$$

$$\frac{5.7 \times 10^{19}}{3.1 \times 10^{-9}} = \frac{5.7}{3.1} \times 10^{19-(-9)} = 1.84 \times 10^{19+9} = 1.84 \times 10^{28}$$

Critical Thinking Questions

11. Solve the following problems:

a) $(4.6 \times 10^{34})(7.9 \times 10^{-21}) =$

b) $(1.24 \times 10^{12})(3.31 \times 10^{20}) =$

12. Solve the following problems.

a) $\frac{8.4 \times 10^{-5}}{4.1 \times 10^{17}} =$

b) $\frac{5.4 \times 10^{32}}{7.3 \times 10^{14}} =$

Info: Adding and Subtracting Using Scientific Notation

Whenever you add or subtract two numbers in scientific notation, you must make sure that they have the same exponents. Your answer will then have the same exponent as the number you add or subtract. Here are some examples. Make sure you understand each step:

$4.2 \times 10^{6} + 3.1 \times 10^{5} \rightarrow$ make exponents the same, either a 5 or 6 $\rightarrow 42 \times 10^{5} + 3.1 \times 10^{5} = 45.1 \times 10^{5} = 4.51 \times 10^{6}$

$7.3 \times 10^{-7} - 2.0 \times 10^{-8} \rightarrow$ make exponents the same, either -7 or -8 $\rightarrow 73 \times 10^{-8} - 2.0 \times 10^{-8} = 71 \times 10^{-8} = 7.1 \times 10^{-7}$

Critical Thinking Questions

13. Solve the following problems.

a) $4.25 \times 10^{13} + 2.10 \times 10^{14} =$

b) $6.4 \times 10^{-18} - 3 \times 10^{-19} =$

c) $3.1 \times 10^{-34} + 2.2 \times 10^{-33}$

Part 2 – Significant Figures

Information- Significant Figures

In the previous section, we discussed scientific notation and how it is a nice way of getting rid of unneccessary zeros in a number. In this section, we will address what zeros are "important" or significant. Let's start with 3 general rules:

1. Zeros at the beginning of a number are never significant or important.
   Example: 0.0000582 has just three signficiant figures 5, 8, and 2.
2. Zeros at the end of a number are not significant unless a decimal ends the value.
   Example: 21500 has just three significant figures 2,1, and 5
   Example: **21500.** has five significant figures 2,1,5,0, and 0
3. Zeros that are between two nonzero numbers are always significant.
   Example: 10,005 has 5 significant figures 1,0,0,0, and 5

Critical Thinking Questions

1. Verify that each of the following numbers contain four significant figures. Circle the digits that are significant.

   a) 0.00004182 b) 494,100,000 c) 32,010,000,000 d) 0.00003002

2. How many significant figures are in each of the following numebrs?

   _____ a) 0.000015045 **_____ b) 4,600,000** **_____ c) 2406**

   _____ d) 0.000005 **_____ e) 0.0300001** **_____ f) 12,000.**

One More Rule

Rule #4 – A decimal point anywhere in the number makes zeros at the end of a number significant.
Example: 1200.0 has five significant figures 1,2,0,0, and 0
Example: 0.0000007290 has four significant figures 7,2,9, and 0

Critical Thinking Questions

3. Verify that each of the following numbers contain five significant figures. Circle the digits that are significant.

a) 0.00030200 b) 200.00 c) 2300.0 d) 0.000032000

4. How many significant figures are there in each of the following numbers?

_____ a) 0.000201000 _____ b) 23,001,000 _____ c) 0.0300

_____ d) 24,000,410 _____ e) 2400.100 _____ f) 0.000021

Information: Rounding Numbers

In numerical problems, it is often necessary to round numbers to the appropriate significant figures. Consider the following examples in which each number is rounded so that each of them contains 4 significant figures. Study each example and make sure you understand why they were rounded as they were:

42,008,00 → 42, 010,000
12,562,425,217 → 12,560,000,000
0.00017837901 → 0.0001784
120 → 120.0

Information: Rounding Numbers

5. Round the following numbers so that they contain 3 significantg figures.

a) 173,792 b) 0.0025021 c) 0.0003198 d) 30

_____ _____ _____ _____

6. Round the following numbers so that they contain 4 significant figures.

a) 249,441 b) 0.00250122 c) 12,049,002 d) 0.00200210

_____ _____ _____ _____

Information: Multiplying and Dividing

When you divide 456 by 13 you get 35.0769230769… How should we round such a number? The concept of significant figures has the answer. When multiplying and dividing numbers, you need to round your answers to the correct number of significant figures. To round correctly, follow these simple steps:

1) Count the number of significant figures in each number.
2) Round your answer to the least number of significant figures.

Here's an example:

(3 sig fig) 4560 = 325.714285714 = 330 (final rounded answer has 2 significant figures)
(2 sig fig) 14

Here's another example:

13.1 x 1.2039 = 15.77109 = 15.8 (final rounded answer should have 3)
(3 sig fig) (5 sig fig)

Critical Thinking Questions

7. Solve the following problems. Make sure your answers are in the correct number of significant figures.

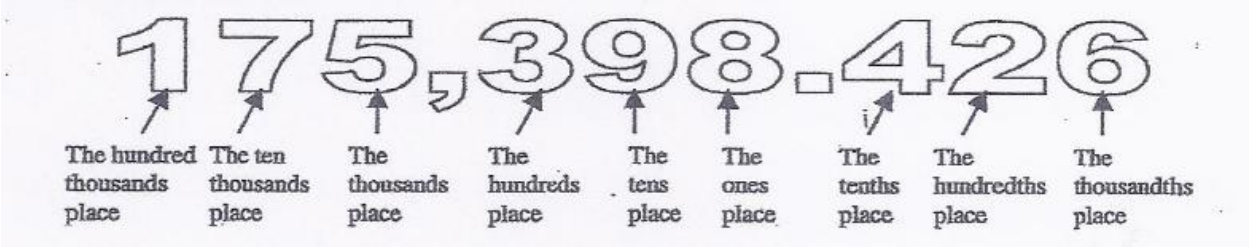
(a) (12,470) (270) = _____ (b) 36,000/1245 = _____

(c) (310.0) (12) = _____ (d) 129.6/3 = _____

(e) (125) (1.4452) = _____ (f) 6000/2.53 = _____

Information: Rounding to a Decimal Place

As you will soon discover, sometimes it is necessary to round to a decimal place. Recall the names of the decimal places:



If we rounded the above number to the hundreds place, that means that there can be no significant figures to the right of the hundreds place. Thus, "175,400" is the above number rounded to the hundreds place. If we rounded to the tenths place we would get 175,398.4. If we rounded to the thousands place we would get 175,000.

Critical Thinking Questions

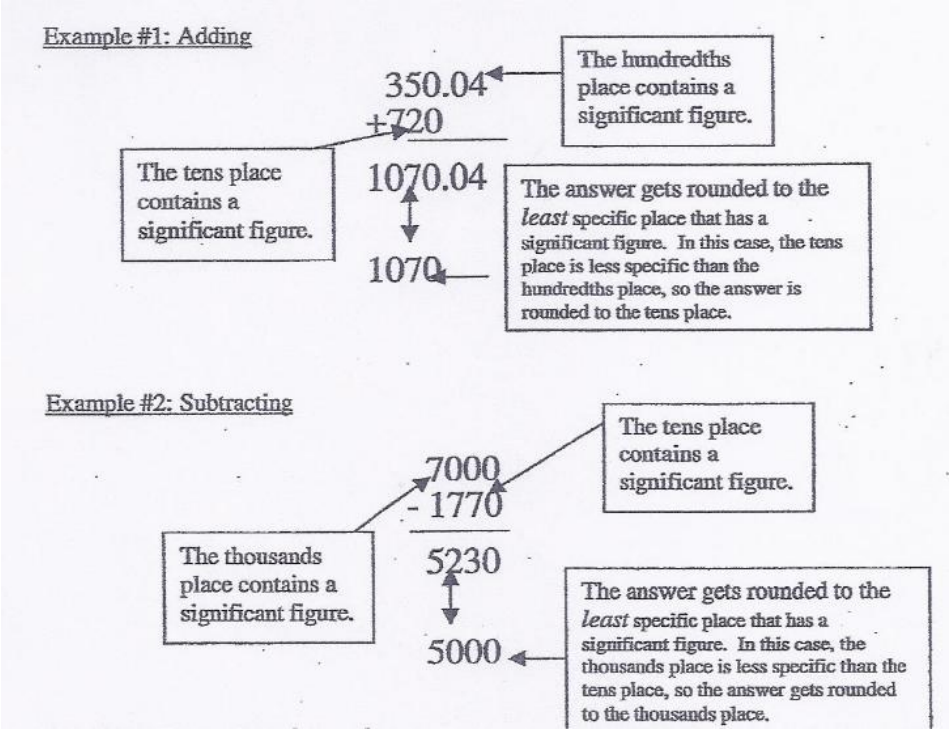
8. Round the following numbers to the tens place.

a) 134, 123, 018 _____ b) 23,190.109 _____

c) 439.1931 _____ d) 2948.25 _____

Information: Adding and Subtracting

Rounding numbers when adding and subtracting is different from multiplying and dividing. In adding and subtracting you round to the least specific decimal place of any number in the problem.



Critical Thinking Questions

9. a) 24.28 + 12.5 = _____ b) 120,000 + 420 = _____

c) 140,100 – 1422 = _____ d) 2.24 – 0.4101 =_____

e) 12,470 + 2200.44 = _____ f) 450 -12.8 = _____

10. The following are problems involving multiplication, dividing, adding, and subtracting. Be careful of the different rules you need to follow!

a) 245.4/120 = _____ b) 12,310 + 23.5 = _____

c) (31,900) (4) = _____ d) (320.0) (145,712) = _____

e) 1420-34 = _____ f) 4129 + 200 = _____

Part 3 – Graphing

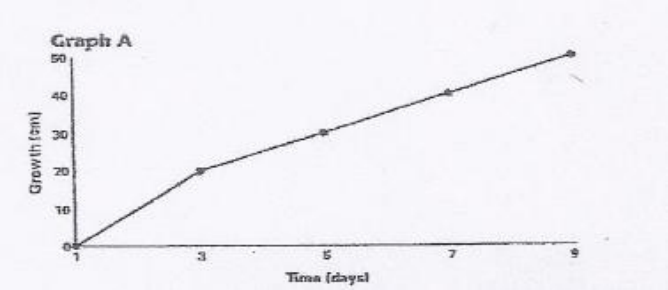
Graphs are a useful tool for displaying scientific data because they show relationships among variables in a compact, visual form. You may have used x-y graphs, or Cartesian graphs, in your math classes. There are 4 basic steps to constructing a graph from data in the chemistry lab. These basic steps are (1) determining the independent variable, (2) scaling the axes, (3) plotting the data, and (4) writing a title on a graph.

Determining The Independent Variable

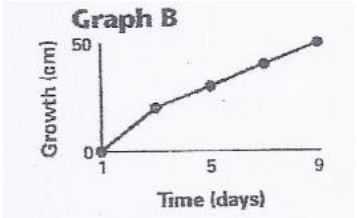
In the experiment, the independent variable (x-axis) is the property that is under control and can be varied. The dependent variable (y-axis) is the property that is measured, observed, counted, or found. The dependent variable changes when the independent variable changes.

Scaling The Axes

When preparing a graph, the scale of the axes should be chosen to include all data points and to allow as much room as possible on both axes. Each axis should be evenly divided with plenty of space between divisions, making the graph easy to read and understand. The divisions should be labeled in multiples units. Each axis should also be labeled with a description of what it represents and the units of measurement.

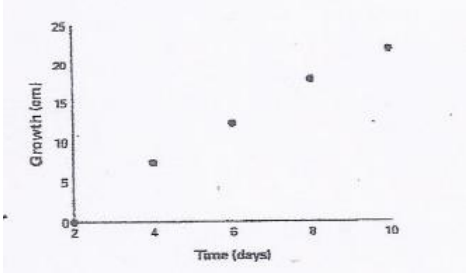


Graph A has well-spaced dimenions on the 2 axes that are easy to read. Graph B, below, shows the same data, but there are too few divisions on the y-axis to allow for easy interpreation.

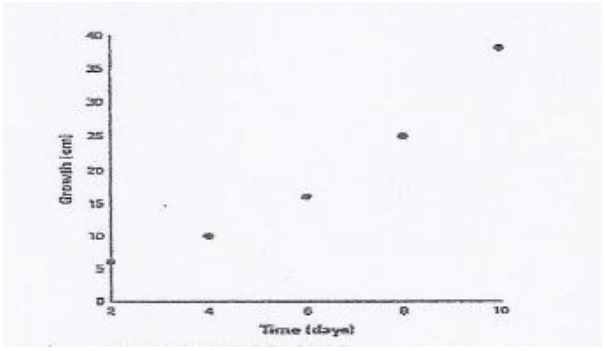


Plotting the Data

If the plotted data points roughly form a straight line, use a transparent ruler to draw a line that best represents the data points. This is known as a best-fit line.



If the points do not form a stright line but appear to form a curve, lightly sketch the curve with a pencil, connecting all the data points. After you have sketched a suitable curve, draw over it darkly with a pen or colored pencil.



Writing the Title on a Graph

It is important to add a title to the top of your graph, so that anyone looking at the graph can easily identify its purpose. Choose a title that is brief and descriptive of the data. Suppose your school is putting on a play. To raise money for the event, tickets for the play are being sold for $3 each. The chart below shows how much money will be made from selling certain numbers of tickets. Construct a graph.

Number of Tickets Sold	Amount of Money Collected
5	$15
15	$45
25	$75
40	$120
45	$135

Step 1 :Determine the Independent Variable - In this example, the amount of money collected depends on the number of tickets sold. Independent variable (x) is number of tickets sold. Dependent variable (y) is the amount collected.

Step 2 :Scale the Axes - When choosing the scales for the axes, consider what you want the graph to show and how it will be used. For this example, you want to be able to easily determine the amount of money made from selling different numbers of tickets, not just those given as data points. Therefore, you should choose a scale that is large enough that you can easily find the values between your data points.

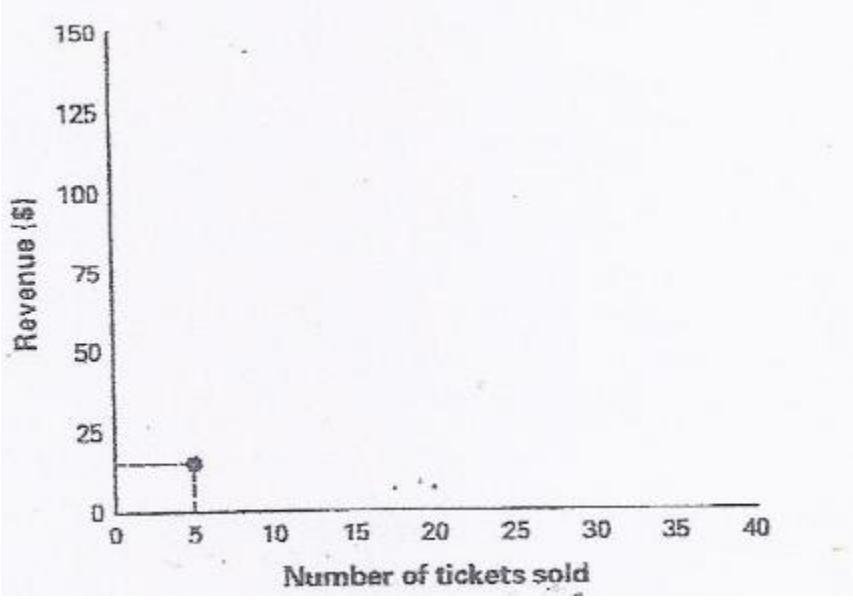
a) **Decide how many divisions are needed on the x-axis.** Since you want to be able to easily determine the amount of money made for any number of tickets sold, you should choose a large number of divisions, such as 10. Divide the largest value from the data table for the independent variable by the number of division chosen**.** For example, 45 is the largest value for the independent variable, and 10 is the number of divisions chosen.

$$\frac{45}{10} = 4.5$$

b) **<u>Find the closest whole number value</u> .** Five is the closest whole value to 4.5, so this divisions on the x-axis should be labeld in intervals of 5.

c) **<u>Now determine the scale for the dependent variable</u>.** Decide how many divisions are needed on the y-axis.Divide the largest value from the data table for the dependent variable by the number of divisions you have chosen.Find the closest whole-number value..

<u>Step 3: Plotting the Data-</u> Plot the data on the graph by carefully locating the x and y coordinates and marking the corresponding point on the graph. To plot the first set of coordinates (5,15), start from zero and move 5 units to the right along the x-axis. From that point, move up the y-axis 15 units. Mark that location with a dot.

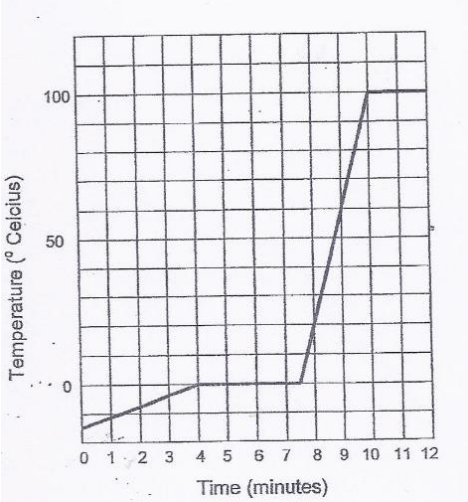


To plot the next point (15,45) again start from zero and move 15 units to the right along the x-axis. From that point, move 45 units up the y-axis. **<u>Mark that point on the graph.</u>** **<u>When you have plotted all the points, draw the line, or curve, that best fits the data.</u>**

<u>Step 4: Title the Graph</u>- The title should be the dependent vs independent variable which is **Amount of Money Collected vs. Number of Tickets Sold.**

Reading the Graph

Being able to read a graph is a very important skill. Many fields of endeavor, including science, politics, and economics often use graphs to quickly and effectively relate a large amount of information.
Look as the graph below and answer the following questions.



1. (a) What is the label on the x-axis?

   (b) What is the label on the y-axis?

2. What units are used to describe these labels?

(a) x-axis _____ (b) y-axis _____

3. Describe in detail what you think the experimenter did to get the data for this graph.

4. Over what time interval (s) does the temperature remain constant? Include units.

5. Over what time interval (s) is the temperature rising? Include units.

6. What is the temperature of the water after 4 minutes? Include units.

7. At what time is the temperature 10°C? Include units.

Creating Graphs

All good graphs have several items in common. All good graphs…

1. have a title at the top.
2. have axes that are labeled, with proper units.
3. are neat, and easy to read.
4. use most of the available space.

Time (by hour)	Total Distance Bicylced (km)
8 AM	0
9 AM	12
10 AM	23
11 AM	33
Noon	42
1 PM	50
2 PM	57
3 PM	63
4 PM	68

Use the table above to prepare a graph that illustrates this data about a bicycle trip.

1. How would you expect the graph to look if data were available for 5 and 6 PM? Then, identify one factor that might cause the graph NOT to look like this.

2. Use your graph to estimate the total distance traveled by 10:30 AM. Can you be absolutely certain of this value? Why or why not?

3. Compare the distance traveled during the first hour of the trip with the distance traveled during the last hour of the trip. Suggest a possible explanantion for the difference. How is this difference illustrated on the graph?