Chemistry – A Physical Science Worksheets

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Printed: July 17, 2012

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CHAPTER 1 Chemistry – A Physical Science Worksheets

CHAPTER OUTLINE

- **The worksheet answer keys are available upon request. Please send an email to teachers-requests@ck12.org to request the worksheet answer keys.**

1.1 Lesson 2.1 Measurements in Chemistry

There are no worksheets for this lesson.

1.2 Lesson 2.2 Using Measurements

Significant Figures Worksheet

Name___________________________ **Date**_________

Working in the field of science almost always involves working with numbers. Some observations in science are qualitative and therefore, do not involve numbers, but in chemistry, most observations are quantitative and so, require numbers. You have been working with numbers for many years in your math classes thus numbers are not new to you. Unfortunately, there are some differences between the numbers you use in math and the numbers you use in science.

The numbers you use in math class are considered to be exact numbers. When you are given the number ***2*** in a math problem, it does not mean ***1.999*** rounded to ***2*** nor does it mean ***2.000001*** rounded to ***2***. In math class, the number ***2*** means exactly ***2.00000000...*** with an infinite number of zeros - ***a perfect 2!*** Such numbers are produced only by definition, not by measurement. That is, we can define 1 $foot$ to contain exactly 12 *inches*, and these two numbers are perfect numbers, but we cannot measure an object to be exactly 12 *inches* long. In the case of measurements, we can read our measuring instruments only to a limited number of subdivisions. We are limited by our ability to see smaller and smaller subdivisions, and we are limited by our ability to construct smaller and smaller subdivisions. Even using powerful microscopes to construct and read our measuring devices, we eventually reach a limit, and therefore, even though the actual measurement of an object may be a perfect number of inches, we cannot prove it to be so. ***Measurements do not produce perfect numbers*** and since science is greatly involved with measuring, science does not produce perfect numbers (except in defined numbers such as conversion factors).

It is very important to recognize and report the limitations of measurements along with the magnitude and unit of the measurement. Many times, the analysis of the measurements made in a science experiment is simply the search for regularity in the observations. If the numbers reported show the limits of the measurements, the regularity, or lack there of, becomes visible.

TABLE 1.1: **Two Sets of Observations**

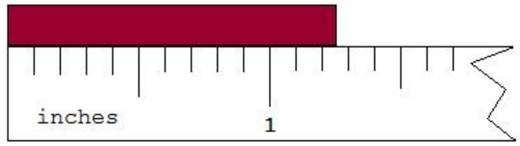
Observations List A	Observations List B
22.41359 m	22.4 m
22.37899 m	22.4 m
22.42333 m	22.4 m
22.39414 m	22.4 m

In the lists of observations above, it is difficult to perceive a regularity in List A, but when the numbers are reported showing the limits of the measurements as in List B, the regularity becomes apparent.

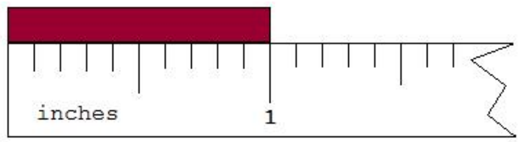
One of the methods used to keep track of the limit of a measurement is called ***Significant Figures***. In this system, when you record a measurement, the written number must indicate the limit of the measurement, and when you perform mathematical operations on measurements, the final answer must also indicate the limit of the original measurements.

To record a measurement, you must write down all the digits actually measured, including measurements of zero and you must NOT write down any digit not measured. The only real problem that occurs with this system is that zeros are sometimes used as measured numbers and are sometimes used simply to locate the decimal point and ARE

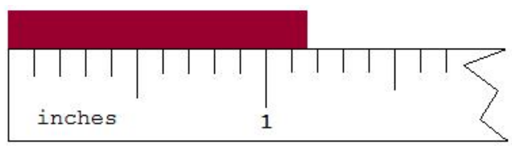
NOT measured numbers.



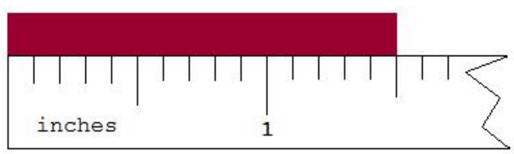
In the case shown above, the correct measurement is greater than 1.3 *inches* but less than 1.4 *inches*. ***It is proper to estimate one place beyond the calibrations*** of the measuring instrument. Therefore, this measurement should be reported as either $1.33, 1.34, 1.35, 1.36$, or 1.37 *inches*.



In this second case, it is apparent that the object is, as nearly as we can read, exactly at 1 *inch*. Since we know the tenths place is zero and can estimate the hundredths place to be zero, the measurement should be reported as 1.00 *inch*. It is vital that you include the zeros in your measurement report because these are measured places.



This is read as $1.13, 1.14, 1.15$, or 1.16 *inches*.



This is read 1.50 *inches*.

These readings indicate that the measuring instrument had subdivisions down to the tenths place and the hundredths place is estimated. There is some uncertainty about the last and only the last digit.

In our system of writing significant figures, we must distinguish between measured zeros and place-holding zeros. Here are the rules for determining the number of significant figures in a measurement.

RULES FOR DETERMINING THE NUMBER OF SIGNIFICANT FIGURES

a. All non-zero digits are significant.
b. All zeros between non-zero digits are significant.
c. All beginning zeros are NOT significant.
d. Ending zeros are significant if the decimal point is actually written in but not significant if the decimal point is an understood decimal.

Examples of the Rules

1. All non-zero digits are significant.

543 has 3 significant figures.

22.437 has 5 significant figures.

1.321754 has 7 significant figures.

2. All zeros between non-zero digits are significant.

$7,004$ has 4 significant figures.

10.3002 has 6 significant figures.

103.0406 has 7 significant figures.

3. All beginning zeros are NOT significant.

00013.25 has 4 significant figures.

0.0000075 has 2 significant figures.

0.000002 has 1 significant figure.

4. Ending zeros are significant if the decimal point is actually written in but not significant if the decimal point is an understood decimal.

37.300 has 5 significant figures.

33.00000 has 7 significant figures.

1.70 has 3 significant figures.

$1,000,000$ has 1 significant figure.

$302,000$ has 3 significant figures.

$1,050$ has 3 significant figures.

$1,000,000.$ has 7 significant figures.

$302,000.$ has 6 significant figures.

$1,050.$ has 4 significant figures.

Exercises

How many significant figures are given in each of the following measurements?

a. 454 g _____
b. 2.2 lbs _____
c. 2.205 lbs _____
d. 0.3937 L _____
e. 0.0353 L _____
f. 1.00800 g _____
g. 500 g _____
h. 480 ft _____
i. 0.0350 kg _____
j. 100. cm _____
k. $1,000$ m _____
l. 0.625 L _____
m. 63.4540 mm _____
n. $3,060$ m _____
o. 500. g _____
p. 14.0 mL _____

q. 1030 g ______
r. $9,700$ g _____
s. $125,000$ m _____
t. $12,030.7210$ g _____
u. 0.0000000030 cm _____
v. 0.002 m _____
w. 0.0300 cm _____
x. 1.00 L _____
y. 0.025 m/s _____
z. 0.100 kg _____
. 0.00300 km _____
. 303.0 g _____
. 250 g _____
. $1,000.$ m _____

Maintaining Significant Figures Through Mathematical Operations

In addition to using significant figures to report measurements, we also use them to report the results of computations made with measurements. The results of mathematical operations with measurements must include an indication of the number of significant figures in the original measurements. There are two rules for determining the number of significant figures after a mathematical operation. One rule is for addition and subtraction, and the other rule is for multiplication and division. (Most of the errors that occur in this area result from using the wrong rule, so always double check that you are using the correct rule for the mathematical operation involved.

Significant Figure Rule for Addition and Subtraction

The answer for an addition or subtraction problem must have digits no further to the right than the shortest addend.

Example:

$$\begin{array}{rl}
13.3843 & cm \\
1.012 & cm \\
+\ 3.22 & cm \\
\hline
17.6163 & cm = 17.62\ cm
\end{array}$$

Note that the vertical column farthest to the right has a **3** in the top number but that this column has blank spaces in the next two numbers in the column. In elementary math lasses, you were taught that these blank spaces can be filled in with zeros, and in such a case, the answer would be 17.6163 cm. In science, however, these blank spaces are NOT zeros but are unknown numbers. Since they are unknown numbers, you cannot substitute any numbers into the blank spaces and you cannot claim to know, forsure, the result of adding that column. You can know the sum of adding (or subtracting) any column of numbers that contains an unknown number. Therefore, when you add these three columns of numbers, the only columns for which you are sure of the sum are the columns that have a known number in each space in the column. When you have finished adding these three numbers in the normal mathematical process, you must round off all those columns that contain an unknown number (a blank space). Therefore, the correct answer for this addition is 17.62 cm and has four significant figures.

Example:

$$\begin{array}{rl}
12 & m \\
+\ 0.00045 & m \\
\hline
12.00045 & m = 12\ m
\end{array}$$

In this case, the **12** has no numbers beyond the decimal and therefore, all those columns must be rounded off and we have the seemingly odd result that after adding a number to **12**, the answer is still **12**. This is a common occurrence in science and is absolutely correct.

Example:

$$\begin{array}{l} \ 56.8885\ cm \\ \ \ 8.30\ \ \ cm \\ \underline{+\ 47.0\ \ \ \ cm} \\ \ 112.1885\ cm = 112.2\ cm \end{array}$$

This answer must be rounded back to the tenths place because that is the last place where all the added numbers have a recorded digit.

Significant Figure Rule for Multiplication and Division

The answer for a multiplication or division operation must have the same number of significant figures as the factor with the least number of significant figures.

Example: $(3.556\ cm)(2.4\ cm) = 8.5344\ cm^2 = 8.5\ cm^2$

In this case, the factor 2.4 has two significant figures and therefore, the answer must have two significant figures. The mathematical answer is rounded back to two significant figures.

Example: $(20.0\ cm)(5.0000\ cm) = 100\ cm^2 = 100.\ cm^2$

In this example, the factor 20.0 *cm* has three significant figures and therefore, the answer must have three significant figures. In order for this answer to have three significant figures, we place an actual decimal after the second zero to indicate three significant figures.

Example: $(5.444\ cm)(22\ cm) = 119.768\ cm^2 = 120\ cm^2$

In this example, the factor 22 *cm* has two significant figures and therefore, the answer must have two significant figures. The mathematical answer is rounded back to two significant figures. In order to keep the decimal in the correct position, a non-significant zero is used.

Exercises

Add, subtract, multiply, or divide as indicated and report your answer with the proper number of significant figures.

1.

$$\begin{array}{lr} & 703\ \ \ g \\ & 7\ \ \ g \\ \hline + & 0.66\ g \end{array}$$

2.

$$\begin{array}{lr} & 5.624\ ft \\ & 0.24\ ft \\ \hline + & 16.8\ \ ft \end{array}$$

3.

$$\begin{array}{lr} & 34\ \ kg \\ \hline - & 0.2\ kg \end{array}$$

4.

$$\begin{array}{r} 18.7 \quad m \\ \underline{+\ 0.009\ m} \end{array}$$

5. Add 65.23 cm, 2.666 cm, and 10 cm.

6. Multiply 2.21 cm and 0.3 cm.

7. Multiply: $(2.002\ cm)(84\ cm)$

8. Multiply: $(107.888\ cm)(0.060\ cm)$

9. Divide 72.4 cm by 0.0000082 cm.

10. Multiply 0.32 cm by 600 cm and then divide the product by 8.21 cm.

1.3 Exponential Notation Worksheet

Name____________________________ **Date**_________

Work in science frequently involves very large and very small numbers. The speed of light, for example, is $300,000,000\ meters/second$; the mass of the earth is 6,000,000,000,000,000,000,000,000 kg; and the mass of an electron is 0.0000000000000000000000000000009 kg. It is very inconvenient to write such numbers and even more inconvenient to attempt to carry out mathematical operations with them. Imagine trying to divide the mass of the earth by the mass of an electron! Scientists and mathematicians have designed an easier method for dealing with such numbers. This more convenient system is called **Exponential Notation** by mathematicians and **Scientific Notation** by scientists.

In scientific notation, very large and very small numbers are expressed as the product of a number between 1 and 10 and some power of 10. The number $9,000,000$, for example, can be written as the product of 9 times $1,000,000$ and $1,000,000$ can be written as 10^6. Therefore, $9,000,000$ can be written as 9×10^6. In a similar manner, 0.00000004 can be written as 4 times $\frac{1}{10^8}$ or 4×10^{-8}.

This is called the â[U+0080][U+009C]exponentâ[U+0080][U+009D]

This is called the â[U+0080][U+009C]coefficientâ[U+0080][U+009D]. $\longrightarrow 6.5 \times 10^4 \longleftarrow$

TABLE 1.2: Examples

Decimal Notation	*Scientific Notation*
$95,672$	9.5672×10^4
$8,340$	8.34×10^3
100	1×10^2
7.21	7.21×10^0
0.014	1.4×10^{-2}
0.0000000080	8.0×10^{-9}
0.00000000000975	9.75×10^{-12}

As you can see from the examples above, to convert a number from decimal to exponential form, you count the spaces that you need to move the decimal and that number becomes the exponent of 10. If you are moving the decimal to the left, the exponent is positive, and if you are moving the decimal to the right, the exponent is negative. One and only one non-zero digit exists to the left of the decimal and ALL significant figures are maintained. The value of using exponential notation occurs when there are many non-significant zeros.

Exercises

Express the following decimal numbers in exponential form. The exponential form should have exactly one non-zero digit to the left of the decimal and you must carry all significant figures.

a. 1000
b. 150,000
c. 243
d. 9.3
e. 435,000,000,000
f. 0.0035

g. 0.012567
h. 0.0000000000100
i. 0.000000000000467
j. 0.000200
k. 186,000
l. 9,000,000,000,000
m. 105
n. 77,000
o. 502,000

Carrying Out Mathematical Operations with Exponential Numbers

When numbers in exponential notation are added or subtracted, the exponents ***must*** be the same. If the exponents are the same, the coefficients are added and the exponent remains the same.

Consider the following example.

$$4.3 \times 10^4 + 1.5 \times 10^4 = (4.3 + 1.5) \times 10^4 = 5.8 \times 10^4 \ (43,000 + 15,000 = 58,000)$$
$$8.6 \times 10^7 - 5.310^7 = (8.6 - 5.3) \times 10^7 = 3.3 \times 10^7 \ (86,000,000 - 53,000,000 = 33,000,000)$$

If the exponents of the numbers to be added or subtracted are not the same, then one of the numbers must be changed so that the two numbers have the same exponent.

Examples

The two numbers given below, in their present form, cannot be added because they do not have the same exponent. We will change one of the numbers so that it has the same exponent as the other number. In this case, we choose to change 3.0×10^4 to 0.30×10^5. This change is made by moving the decimal one place to the left and increasing the exponent by 1. The two numbers can now be added.

$$8.6 \times 10^5 + 3.0 \times 10^4 = 8.6 \times 10^5 + 0.30 \times 10^5 = 8.9 \times 10^5$$

We also could have chosen to alter the other number. Instead of changing the second number to a higher exponent, we could have changed the first number to a lower exponent.

$$8.6 \times 10^5 \rightarrow 86 \times 10^4$$

Now, we can add the numbers, $86 \times 10^4 + 3.0 \times 10^4 = 89 \times 10^4$

The answer, in this case, is not in proper exponential form because it has two non-zero digits to the left of the decimal. When we convert the answer to proper exponential form, it is exactly the same answer as before, $89 \times 10^4 \rightarrow 8.9 \times 10^5$.

Exercises

Add or subtract the following exponential numbers as indicated.

a. $(8.34 \times 10^5) + (1.22 \times 10^5) =$
b. $(4.88 \times 10^3) - (1.22 \times 10^3) =$
c. $(5.6 \times 10^{-4}) + (1.2 \times 10^{-4}) =$
d. $(6.38 \times 10^5) + (1.2 \times 10^4) =$

e. $(8.34 \times 10^5) - (1.2 \times 10^4) =$
f. $(8.34 \times 10^{-5}) + (1.2 \times 10^{-6}) =$
g. $(4.93 \times 10^{-1}) - (1.2 \times 10^{-2}) =$
h. $(1.66 \times 10^{-5}) + (6.4 \times 10^{-6}) =$
i. $(6.34 \times 10^{15}) + (1.2 \times 10^{16}) =$
j. $(6.34 \times 10^{15}) - (1.2 \times 10^1) =$

Multiplying or Dividing with Numbers in Exponential Form

When multiplying or dividing numbers in scientific notation, the numbers do not have to have the same exponents. To multiply exponential numbers, ***multiply the coefficients*** and ***add the exponents***. To divide exponential numbers, ***divide the coefficients*** and ***subtract the exponents***.

Examples of Multiplying Exponential Numbers

Multiply: $(4.2 \times 10^4)(2.2 \times 10^2) = (4.2 \times 2.2)(10^{4+2}) = 9.2 \times 10^6$

The coefficient of the answer comes out to be 9.24 but since we can only carry two significant figures in the answer, it has been rounded to 9.2 .

Multiply: $(2 \times 10^9)(4 \times 10^{14}) = (2 \times 4)(10^{9+14}) = 8 \times 10^{23}$

Multiply: $(2 \times 10^{-9})(4 \times 10^4) = (2 \times 4)(10^{-9+4}) = 8 \times 10^{-5}$

Multiply: $(2 \times 10^{-5})(4 \times 10^{-4}) = (2 \times 4)(10^{-5-4}) = 8 \times 10^{-9}$

Multiply: $(8.2 \times 10^{-9})(8.2 \times 10^{-4}) = (8.2 \times 8.2)\left(10^{(-9)+(-4)}\right) = 32.8 \times 10^{-13}$

The product in the last example has too many significant figures and is not in proper exponential form, so we must round to two significant figures, 33×10^{-13}, and then move the decimal and correct the exponent, 3.3×10^{-12}.

Examples of Dividing Exponential Numbers

Divide: $\frac{8 \times 10^7}{2 \times 10^4} = \left(\frac{8}{2}\right)(10^{7-4}) = 4 \times 10^3$

Divide: $\frac{8 \times 10^{-7}}{2 \times 10^{-4}} = \left(\frac{8}{2}\right)\left(10^{(-7)-(-4)}\right) = 4 \times 10^{-3}$

Divide: $\frac{4.6 \times 10^3}{2.3 \times 10^{-4}} = \left(\frac{4.6}{2.3}\right)\left(10^{(3)-(-4)}\right) = 2.0 \times 10^7$

In the final example, since the original coefficients had two significant figures, the answer must have two significant figures and therefore, the zero in the tenths place is carried.

Exercises

a. Multiply: $(2.0 \times 10^7)(2.0 \times 10^7) =$
b. Multiply: $(5.0 \times 10^7)(4.0 \times 10^7) =$
c. Multiply: $(4.0 \times 10^{-3})(1.2 \times 10^{-2}) =$
d. Multiply: $(4 \times 10^{-11})(5 \times 10^2) =$
e. Multiply: $(1.53 \times 10^3)(4.200 \times 10^5) =$
f. Multiply: $(2 \times 10^{-13})(3.00 \times 10^{-22}) =$
g. Divide: $\frac{4.0 \times 10^5}{2.0 \times 10^5} =$
h. Divide: $\frac{6.2 \times 10^{15}}{2.0 \times 10^5} =$
i. Divide: $\frac{8.6 \times 10^{-5}}{3.1 \times 10^3} =$
j. Divide: $\frac{8.6 \times 10^{-5}}{3.1 \times 10^{-11}} =$

1.4 Lesson 2.3 Using Mathematics in Chemistry

Measurements Worksheet

Name___________________________ Date_________

Measurement makes it possible to obtain more exact observations about the properties of matter such as the size, shape, mass, temperature, or composition. It allows us to make more exact quantitative observations. For example, the balance makes it possible to determine the mass of an object more accurately than we could by lifting the object and a clock gives a better measure of time than we could determine by observing the sun's position in the sky.

Measurements were orginally made by comparing the object being measured to some familiar object. Length was compared to the length of one's foot. Other measures were handspans, elbow to fingertip, and so on. As people's needs increased for more consistent measurements, STANDARD systems of measurement were devised. In a standard system of measurement, some length is chosen to be the standard and copies of this object can then be used by everyone making measurements. With a standard system of measurement, two people measuring the same distance will get the same measurement.

For a time, the standard for length (one meter) was a platinum bar which was marked and stored at constant temperature in a vault. It was stored at constant temperature so that it did not expand or contract. Standard masses are also stored in airtight containers to insure no change due to oxidation. Presently, the standard ***meter*** is the distance light travels in a vacuum in $\frac{1}{299,792,458}$ second and the standard ***second*** is based on the vibrations of a cesium -133 atom.

For any system of measurements, all measurements must include a **unit** term; a word following the number that indicates the standard the measurement is based on. Systems of measurement have several standards such as length, mass, and time, and are based on physical objects such as platinum bars or vibrating atoms. Standards based on physical objects are called **undefined units**. All the other standards are expressed in terms of these object-based standards. For example, length and time are object-based standards and velocity (meters/second) and acceleration (m/s_2) are expressed in terms of length and time. Volume is expressed in terms of the length standard, volume = length $\times$ length $\times$ length, such as cm^3.

There are two major systems of standards used in the United States. The one commonly used by the public (pounds, feet) and the system used for all scientific and technical work (kilograms, meters). The system used for scientific work is called the **Metric System** in its short form and is called the **International System (SI)** in its complete form. The undefined units in the SI system are the meter, gram, and second. All the sub-divisions in the SI system are in decimal form.

Conversion Factors, English to Metric

$1.00\ inch = 2.54\ centimeters$

$1.00\ quart = 0.946\ liter$

$1.00\ pound = 4.54\ Newtons$ ($= 454\ grams$ on earth)

Units and Sub-Divisions for the SI System

Basic unit for length = meter

Basic unit for mass = gram

Basic unit for time = second

Unit for volume = liter (lee-ter)

$1000\ millimeters = 1\ meter$

$100\ centimeters = 1\ meter$

$1000\ meters = 1\ kilometer$

$10\ centimeters = 1\ millimeter$

$1000\ milligrams = 1\ gram$

$1000\ grams = 1\ kilogram$

$1000\ milliliters = 1\ liter$

$1\ milliliters = 1\ cubic\ centimeter = 1\ cm^3$

All the relationships between units are defined numbers and therefore, have an infinite number of significant figures. When converting units, the significant figures of the answer are based on the significant figures of the measurement, not on the conversion factors.

The unit terms for measurements are an integral part of the measurement expression and must be carried through every mathematical operation that the numbers go through. In performing mathematical operations on measurements, the unit terms as well as the numbers obey the algebraic laws of exponents and cancellation.

Examples:

TABLE 1.3: Unit Terms Follow the Rules of Algebra

Math Operations	Unit Term Operations
$6x+2x=8x$	$6\ mL+2\ mL=8\ mL$
$(5x)(3x)=15x^2$	$(5\ cm)(3\ cm)=15\ cm^2$
$\frac{9x^3}{3x}=3x^2$	$\frac{9\ cm^3}{3\ cm}=3\ cm^2$
$\frac{21x}{3a}=7(\frac{x}{a})$	$\frac{21\ grams}{3\ cm^3}=7\ \frac{grams}{cm^3}$

Converting Units

Frequently, it is necessary to convert units measuring the same quantity from one form to another. For example, it may be necessary to convert a length measurement in meters to millimeters. This process is quite simple if you follow a standard procedure called *unit analysis*. This procedure involves creating a **conversion factor** from equivalencies between various units.

For example, we know that there are 12 *inches* in 1 *foot*. Therefore, the conversion factor between inches and feet is 12 $inches = 1\ foot$. If we have a measurement in inches and we wish to convert the measurement to feet, we would generate a conversion factor $\left(\frac{1\ foot}{12\ inches}\right)$ and multiply the measurement by this conversion factor.

Example: Convert 500. *inches* to *feet*.

$$(500.\ inches)\left(\frac{1\ foot}{12\ inches}\right) = 41.7\ feet$$

We design the conversion factor specifically for this problem so that the unit term "inches" will cancel out and the final answer will have the unit "feet". This is how we know to put the unit term "inches" in the denominator and the unit term "foot" in the numerator.

Example: Convert 6.4 *nobs* to hics given the conversion factor, 5 $hics = 1\ nob$.

$$(6.4\ nobs)\left(\frac{5\ hics}{1\ nob}\right) = 32\ hics$$

Example: Convert 4.5 *whees* to dats given the conversion factor, 10 $whees = 1\ dat$.

$$(4.5\ whees)\left(\frac{1\ dat}{10\ whees}\right) = 0.45\ dats$$

Sometimes, it is necessary to insert a series of conversion factors.

Example: Convert 5.00 *wags* to pix given the conversion factors, 10 $wags = 1\ hat$, and 1 $hat = 2\ pix$.

$$(5.00\ wags)\left(\frac{1\ hat}{10\ wags}\right)\left(\frac{2\ pix}{1\ hat}\right) = 1.00\ pix$$

Solved Conversion Problems

1. Convert 1.22 *cm* to *mm*.

$$(1.22\ cm)\left(\frac{10\ mm}{1\ cm}\right) = 12.2\ mm$$

2. Convert 5.00 *inches* to *mm*.

$$(5.00\ inches)\left(\frac{2.54\ cm}{1\ inch}\right)\left(\frac{10\ mm}{1\ cm}\right) = 127\ mm$$

3. Convert 66 *lbs* to *kg*. As long as the object is at the surface of the earth, pounds (force) can be converted to grams (mass) with the conversion factor 454 $g = 1\ lb$.

$$(66\ lbs)\left(\frac{454\ g}{1\ lb}\right)\left(\frac{1\ kg}{1000\ g}\right) = 30.\ kg$$

The mathematical answer for this conversion comes out to be 29.964 but must be rounded off to two significant figures since the original measurement has only two significant figures. When 29.964 is rounded to two significant figures, it requires a written in decimal after the zero to make the zero significant. Therefore, the final answer is 30. kg.

4. Convert 340. mg/cm^3 to lbs/ft^3.

$$\left(\frac{340.\ mg}{1\ cm^3}\right)\left(\frac{1\ g}{1000\ mg}\right)\left(\frac{1\ lb}{454\ g}\right)\left(\frac{16.39\ cm^3}{1\ in^3}\right)\left(\frac{17.28\ in^3}{1\ ft^3}\right) = 21.2\ lbs/ft^3$$

You should examine the units yourself to make sure they cancel and leave the correct units for the answer.

Exercises

a. Convert 40. $cots$ to togs given the conversion factor, 10 $cots = 1\ tog$.
b. Convert 8.0 $curs$ to nibbles given the conversion factor, 1 $cur = 10\ nibbles$.
c. Convert 100. $gags$ to bobos given the conversion factor, 5 $gags = 1\ bobo$.
d. Convert 1.0 rat to utes given the conversion factors, 10 $rats = 1\ gob$ and 10 $gobs = 1\ ute$.
e. Express 3.69 m in cm.
f. Express 140 mm in cm.
g. Convert 15 $inches$ to mm.
h. Express 32.0 $grams$ in $pounds$. (Be aware that such a conversion between weight and mass is only reasonable on the surface of the earth.)
i. Express 690 mm in m.
j. Convert 32.0 lbs/qt to g/mL.
k. Convert 240. mm to cm.
l. Convert $14,000$ mm to m.

1.5 Lesson 2.4 Using Algebra in Chemistry

There are no worksheets for this lesson.