**Worksheet - Rounding**

Now that "everyone" has a calculator that will give a result to six or eight (or more) figures, it is important that we know how to round the answer off correctly. Simply rounding "up" (increasing) the number that is followed by a 5 is probably the most common method of rounding in entry-level courses. Think about this, however. When all numbers, odd and even, are rounded up if they are followed by a 5, then whatever is being measured will certainly be reported to be a little greater than it really is. We can correct for this problem by rounding "off" (keeping the number the same) in fifty percent of the roundings—even numbers followed by a 5. Then, the roundings "off" will cancel out the roundings "up." (Numbers rounded off report measurements a little less than they really are.)

A little practice is all we need to root out the more commonly used method and replace it with the one that is more statistically significant. The following rules dictate the manner in which numbers are to be rounded to the number of figures indicated.

When rounding, examine the figure **following** (*i.e.*, to the right of) the figure that is to be last. This figure you are examining is the first figure to be dropped.
1) If it is **less than 5,** drop it and all the figures to the right of it.
2) If it is **more than 5, increase by 1** the number **to be rounded**, that is, the preceeding figure.
3) If it is 5, round the number so that it will be even.

**Examples**
1) Suppose you wish to round 62.5347 to *four* figures. Look at the *fifth* figure. It is a 4, a number less than 5. Therefore, you will simply drop every figure after the fourth, and the original number, when rounded, becomes 62.53.
2) Round 3.78721 to *three* figures. Look at the *fourth* figure. It is 7, a number greater than 5, so you round the original number up to 3.79.
3) Round 726.835 to *fiue* figures. Look at the *sixth* figure. It is a 5, so now you must look at the fifth figure also. That is a 3, which is an odd number, so you round the original number up to 726.84.
4) Round 24.8514 to *three* figures. Look at the *fourth* figure. It is a 5, so now you must also look at the third figure. It is 8, an even number, so you simply drop the 5 and the figures that follow it. The original number becomes 24.8

Round the following numbers as indicated.

| To four figures: | To the nearest 0.1: | to nearest 0.01 | To the nearest whole number: |
|---|---|---|---|
| 1) $2.16347 \times 10^5$ | 13) 3.64 | 25) 6.675 | 37) 56.912 |
| 2) $4.000574 \times 10^6$ | 14) 4.55 | 26) $4.203 \times 10^{-1}$ | 38) 3.4125 |
| 3) 3.682417 | 15) 7.250 | 27) 0.03062 | 39) 251.7817 |
| 4) 7.2518 | 16) 0.0865 | 28) 4.500 | 40) 112.511 |
| 5) 375.6523 | 17) 0.5182 | 29) 2.473 | 41) 63.541 |
| 6) 21.860051 | 18) 2.473 | 30) 7.555 | 42) 7.555 |
| **To two figures:** | **To one decimal place:** | **To the nearest 0.001:** | **Round off the farthest right digit** |
| 7) 3.512 | 19) 54.7421 | 31) 5.687524 | 43) 2.473 |
| 8) 25.631 | 20) 100.0925 | 32) 39.861214 | 44) 5.396 |
| 9) 40.523 | 21) 1.3511 | 33) 104.97055 | 45) 8.235 |
| 10) $2.751 \times 10^8$ | 22) 79.2588 | 34) 41.86632 | 46) 3.05 |
| 11) $3.9814 \times 10^5$ | 23) 0.9114 | 35) 0.03765 | 47) 8.25 |
| 12) 22.494 | 24) 0.2056 | 36) 0.0045 | 48) 8.65 |

**Worksheet - Density**

There are physical characteristics of a substance that help identify the substance. One of these characteristics is density. Density (whose symbol is the lowercase letter d) is defined as mass per unit volume. Density is calculated by dividing the mass of an object by its volume. This is shown in equation form, as follows:

$$\text{Density} = \text{mass} \div \text{volume}$$

We can calculate the density of a solid, liquid, or gas. The density of a gas will be dealt with elsewhere, because its density is very sensitive to temperature and pressure. Although the density of liquids and solids do change with temperature and pressure changes, the amount is fairly small. We will ignore these small amounts and act as if all our density problems are at the same temperature and pressure. Note carefully the difference in units in the formulas of the density of a solid and liquid. The unit for cubic centimeters is $cm^3$ and for milliliters is mL.

solid $d = \text{grams} \div \text{cubic centimeters}$

liquid $d = \text{grams} \div \text{milliliters}$

1) A sample of seawater weighs 158 g and has a volume of 156 mL. What is its density?
2) A block of aluminum occupies a volume of 15.0 mL and weighs 40.5 g. What is its density?
3) A cylindrical box with a volume of 200. $cm^3$ holds 432.0 g of sodium chloride. From these data, calculate the density of sodium chloride. (Ignore the space between the NaCl crystals.)
4) Sugar is used to fill the box in problem 3 and the weight of sugar used is equal to 316.0 g. What is sugar's density? (Ignore the space between sugar crystals.)
5) Mercury metal is poured into a graduated cylinder that holds exactly 22.5 mL. The mercury used to fill the cylinder weighs 306.0 g. From this information, calculate the density of Hg.
6) What is the weight of the ethyl alcohol that exactly fills a 200.0 mL container? The density of ethyl alcohol is 0.789 g/mL.
7) Calculate the density of helium (in g/L) if a balloon with a capacity of 5.00 L holds 0.890 g.
8) A flask built to hold exactly 2.5000 L is filled with nitrogen. The weight of the nitrogen in the flask at standard conditions is 0.1250 g. Calculate the density for nitrogen.
9) A flask that weighs 345.8 g is filled with 225 mL of carbon tetrachloride. The weight of the flask and carbon tetrachloride is found to be 703.55 g. From this information, calculate the density of carbon tetrachloride.
10) A rubber balloon weighing 144.85 g is filled with carbon dioxide gas and reweighed. The weight of the balloon plus gas is 153.77 g. The volume of the balloon filled with carbon dioxide is 4.55 L. What density do these data yield for carbon dioxide?
11) Calculate the density of sulfuric acid if 35.4 mL of the acid weighs 65.14 g.
12) Find the weight of 250.0 mL of benzene. The density of benzene is 0.90. g/mL.
13) A block of lead has dimensions of 4.5 cm by 5.2 cm by 6.0 cm. The block weighs 1587 g. From this information, calculate the density lead.
14) 28.5 g of iron shot is added to a graduated cylinder containing 45.5 mL of water. The water level rises to the 49.1 mL mark, From this information, calculate the density of iron.
15) A cylindrical glass tube of length 27.75 cm and the radius 2.00 cm is filled with argon gas. The empty tube weighs 188.25 g. and the tube filled with argon weighs 188.87 g. Use the data to calculate the density of argon gas. (Volume of a cylinder = $pr^2h$)
16) What volume of silver metal will weigh exactly 2500.0 g? The density of silver is 10.5 $g/cm^3$.
17) What is the weight of 215 L of hydrogen sulfide gas if the density of hydrogen sulfide is 1.54 g/L?
18) The helium gas stored inside a large weather balloon weighs 13.558 g. What is the volume of this balloon if the density of helium is 0.1786 g/L?
19) A rectangular block of copper metal weighs 1896 g. The dimensions of the block are 8.4 cm by 5.5 cm by 4.6 cm. From this data, what is the density of copper?