Chemistry 11
Worksheet for Unit Cancellation Problem Solving

Introduction:

Most calculations in chemistry involve measured quantities. In such calculations, the units in which quantities are measured must be treated mathematically just as the numerical parts of the quantities are. For example, in multiplying 1.2 cm by 2.0 cm, there are two separate calculations to be carried out. First, it is necessary to multiply the two numbers $1.2 \times 2.0 = 2.4$. Second, it is necessary to multiply the two units: $cm \times cm = cm^2$.

The complete answer then, is $1.2\ cm \times 2.0\ cm = 2.4\ cm^2$.

This concept can be applied in the solution of many problems. The application depends on the use of a **unit factor**. A unit factor is a fraction in which the numerator and denominator both represent the same measurement. For example, the fraction $\frac{100\ cm}{1\ m}$ is a unit factor since both numerator and denominator represent the same length (100 cm = 1 m). The following examples illustrate the use of unit factors in solving problems by unit cancellation.

example #1 Convert 13.2 minutes into seconds.

solution: The unit factor needed to solve this question is the simple conversion 60 seconds = 1 minute
Begin with the given information in the problem and set up a fraction in which the unit "minute" cancels, leaving the unit "second".

$$13.2\ \cancel{\text{minutes}} \times \frac{60\ \text{seconds}}{1\ \cancel{\text{minute}}} = 792\ \text{seconds}$$

example #2 Change a speed of 14.7 m/s to its equivilent speed in km/h.

solution: You will need two unit factors in order to solve this problem.

1000 m = 1 km and 3600 s = 1 h

It doesn't matter which of these unit factors you start with. Start with the given information in the problem and set up fractions to cancel unwanted units.

$$\frac{14.7\ \cancel{m}}{\cancel{s}} \times \frac{1\ km}{1000\ \cancel{m}} \times \frac{3600\ \cancel{s}}{1\ h} = \frac{52.92 km}{h}$$

example #3 If the density of mercury is 13.6 g/mL, then what will be the volume of 50.0 g of the metal?

solution: All of the information needed for this problem is already given in the question. The unit factor needed is actually the density value - think of it as 13.6 g = 1 mL. Since you are solving for the unit "volume" you will need the unit of mL (volume) in the numerator of your solution.

$$\frac{1\ mL}{13.6\ \cancel{g}} \times 50.0\ \cancel{g} = 3.68\ mL$$

Solve the following problems, showing the unit cancellation method for each problem.

1. Convert a speed of 88 m/s to its equivalent measurement in cm/s.

2. Convert a density of 9.45 g/L to its equivalent in g/mL.

3. The density of mercury metal is 13.6 g/mL. What is the mass of 3.55 mL of the metal?

4. The density of salt is 2.16 g/mL. What is the mass of 100 mL of this solid?

5. A particle moves through a gas at a speed of 15 km/s. How far will it move in 5.5 s?

6. A solution of barium nitrate contains 61.2 g/L of solution. How many grams of barium nitrate is contained in 2.75 L of this solution?

7. A sample of seawater contains 0.002 45 g of sodium chloride per mL of solution. How much sodium chloride is contained in 50.0 mL of this solution?

8. Convert 73.4 km/h to its equivalent value in m/s.

9. The density of iron is 7.86 g/mL. What volume will be occupied by 45.0 g?

10. The density of helium gas is 0.178 g/L. What would be the mass of 150 L of the gas?

11. A particle moving through a gas at a speed of 45.8 m/s will take how long to travel 25 cm?

12. A sample of seawater contains 6.277 g of sodium chloride per litre of solution. How many mg of sodium chloride would be contained in 25.0 mL of this solution?

Converting between Metric and Imperial systems can be very easy once you understand unit cancellation. The following problems may use any of the following conversion factors.

16 ounces (oz) = 1 pound (lb)	454 g = 1 pound (lb)
36 inches (in) = 1 yard	1 inch (in) = 2.54 cm
2 pints = 1 quart	1 L = 1.057 quart
1 km = 0.621 mile	1 cubic foot (ft^3) = 28.32 L

13. Convert 32.5 ounces to centigrams (cg).

14. Convert 3.55 yards to centimetres (cm).

15. Convert 35.8 miles per hour to m/s.

16. Convert 13.6 g/mL to pounds per cubic foot (lb/ft^3)

17. A sample of seawater contains 0.075 g of sodium chloride per mL of solution. How many moles of sodium chloride are there per L of this solution? A mole of sodium chloride is equivalent to 58.5 g of sodium chloride.