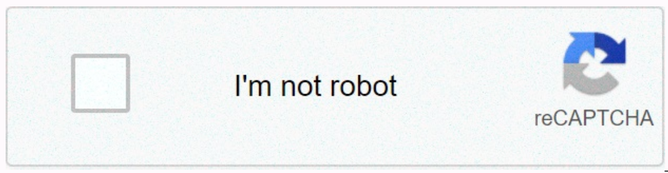

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Chemistry conversion chart

Learning goals The ability to convert a quantity into various units is important. Unit conversion and dimensional analysis are also scientific methods. There are many examples in Chemistry, and you will meet them later. In the field of science, the metric system is used to perform measurements. The metric system is actually easier to use than the English system, as you will see shortly. The metric system uses prefixes to indicate the magnitude of a measured quantity. The prefix itself provides the conversion factor. You should store some of the common prefixes, as you will use them regularly. The following are common prefixes: Table \(\Page Sa Index{1}\) Power Symbol Prefix Mega- M Power Symbol 106 cents- c 10-2 kilo- k 103 milli- m 10-3 hecto- h 102 micro - 10-6 deca- D 101 nano- n 10-9 deci- d 10-1 pico- p 10-12 Suppose you wanted to convert the mass of an aspirin tablet \(250\; mg\) into grams. Start with what you know and let the conversion factor units decide how to set up the problem. If a drive to be converted is in the numerator, that unit must be in the denominator of the conversion factor for it to be canceled. Note how units cancel to give grams. the conversion factor numerator appears as \(1 \for 10^{-3}\) because most calculators must enter it this way, not just as 10-3. If you don't know how to use scientific notation on the calculator, try to find out as soon as possible. Look in the calculator manual or ask someone who knows. Also, note that the unit, mg is assigned the value of 1, and the prefix milli-, is applied to the gram unit. In other words, \(1\, mg\) literally means \(1 \for 10^{-3}\, g\). So, let's try a more involved conversion. Let's say you wanted to convert 250 mg into kg. You may or may not know a direct conversion in one step. In fact, the best (foolproof) method to perform the conversion would be to go first to the base unit and then to the final drive you want. In other words, convert milligrams to grams and then switch to kilograms: Example \(\PageIndex{1}\) The world's ocean is estimated to contain \(\mathrm{1.4 \per 10^9\; km^3}\) of water. What is the volume in liters? What is the weight if the specific density is 1.1? How many water moles are present if all the weight is due to water? How many moles of atoms \(\ce{H}\) (not \(\ce{H2}\)) are in the ocean? How many atoms \(\ce{H}\) are in the ocean? Solution \(\mathrm{1.4e9 \left (\dfrac{1000\: m}{1\: km} \right)^3 \left (\dfrac{10\: dm}{1\:m } \right)^3\\ = 1.4e21\: dm^3 \left (\dfrac{1\: L}{1\: dm^3} \right)\\ = 1.5e21\: L \left (\dfrac{1.1\: kg}{1\: L})\\ = 1.5e21\: kg \left (\dfrac{1000\: g}{1\: kg} \right)\left (\dfrac{1\: mol}{18\: g} \right)\\ = 8.3e22\: mol\: H_2O \left (\dfrac{2\ : mol\: H\: atomi}{1\: mol\: H_2O} \right)\\ = 1.7e23\: mol\: H \left (\dfrac{6.02e23\: (\dfrac{6.02e23\: mol} \right)\\ = 5.0e46\: H\: atoms}\) In this example, a quantity was converted from one unit per volume to other units of volume, weight, quantity in moles, and number of atoms. Each factor used to convert the unit is a unit. The numerator and denominator represent the same quantity in different ways. Also in this simple example, different concepts such as the quantity in moles, the number of Avogadro and the specific density (or specific gravity) were applied in the conversion. If you haven't learned these concepts, you may have difficulty understanding some of the conversion processes. Identify what you don't know and find out in your text or from an asset. Example \(\PageIndex{2}\) A typical city speed for cars is 50 km/h. A few years ago, most people believed that 10 seconds to crash a 100-meter race was the lowest limit. What speed is faster, 50 km/h or 10 m/s? Solution By comparison, the two speeds must be expressed in the same unit. We convert 50 km/h to m/s. \[\mathrm{50 \;\dfrac{\cancel{km}}{\cancel{hr}} \left(\dfrac{1000\; m}{1\; \cancel{km}}\right) \left(\dfrac{1\; \cancel{hr}}{60\;\cancel{min}}\right) \left(\dfrac{1\;\cancel{min}}{ 60\; s}\right) =13.89\; m/s} \] Therefore, 50 km/h is faster. Note: You can select a different unit for comparison (for example, miles/hour) but the result will be the same (try it if interested). Exercise \(\Index{1}\) The speed of a typhoon is 100 m/s. What is the speed in km/h and in miles per hour? These conversions are performed in the same way as metric -metric conversions. The only difference is the conversion factor used. It would be a good idea to store some conversion factors that involve converting mass, volume, length and temperature. Here are some useful conversion factors. length: 2.54 cm = 1 inch (exact) mass: 454 g = 1 lb volume: 0.946 L = 1 qt temperature: oC = (oF - 32)/1.8 All above conversions are three-digit significant, except for length, which is an exact number. As before, let the units help you set up the conversion. Suppose you want to convert the cat mass \(23\, lb\) to kilograms. You can quickly see that this conversion is not achieved in a single step. Units of pounds will be converted into grams and then from grams to kilograms. Let the drives help you solve the problem: \[\dfrac{23 \, lb}{1} \times \dfrac{454\,g}{1 \, lb} \times \dfrac{1 \, kg}{ 1 \per 10^3 \, g} = 10 \, kg\] Let's try a conversion that sounds intimidating, but actually uses the same basic concepts that we've already looked at. Suppose you want to convert the pressure of 14 lb/in2 to g/cm2. When you set up the conversion, one unit at a time, such as converting pound units to gram units, first: Next, convert to 2 to cm2. Set the conversion without the exponent first, using the conversion factor, 1 in = 2.54 cm. Since we need in2 and and increase everything to the second power: notice how the units cancel out to the units you are looking for. Always check your drives because they indicate if the problem has been set correctly. Example \(\PageIndex{2}\): Convert quantity to SI units Mr. Smart is ready for a steak with bone T. Went to market A and found the price of $4.99 per kilogram. He drove out of town to a market along the way, which sells at 2.29 per pound. What price is better for Mr. Smart? Solution To help Mr. Smart, we need to know that 1.0 kg equals 2.206531 lb or 1 lb = 453.2 g. By the way, are they the same? \[\mathrm{4.99\; \dfrac{$}{\cancel{kg}} \left(\dfrac{1\; \cancel{kg}}{2.206532\; lb} \right) = 2.26468 \;\dfrac{$}{lb}\] Of course, with the monetary system in Canada, it makes no sense to mention the price as detailed as above. This leads to the problem of significant figures and quantization. The price is therefore $2.26/lb, better for Mr. Smart than the price of $2.29/lb. Exercises 1.2e-4 kg Skill - Conversion of a quantity into SI units. \((70-32)\times\dfrac{5}{9}\:\: {^\circ\textrm C}\) Skill - To convert the temperature from one scale to another. The price is Cdn $0.60/L Skill - Conversion of two quantities. Canada at Cdn $0.55 / L Skill - Determines costs per common volume unit. A marathon covers a distance of 26 miles and 385 yards. If 1.0 miles = 5280 feet, 1 ft = 12 inches and 1 in = 2.54 cm, express 26 miles in m. 6486 m Skill - Convert quantities to SI units. Contributors and Attributions Conversion between units is an important part of any science. Below is a table with common measurements in chemistry. The table provides useful qualities. Measure basic unit Abbreviation Conversion to Know Length meter m 1 inch = 2.54 centimeters Mass gram g 1 lb = 453.6 g Volume liter L 1,057 quart = 1 liter 1 cubic centimeter = 1 milliliter Temperature oCelsius o C oCelsio = (oFahrenheit - 32)/1.8 Kelvin = oCelseum + 273.15 Energy Joule J 1 caloric = 4,184 joules To convert between different measurement systems, conversion factors may be applied. A conversion factor is written based on equality between the two units. For example, a conversion factor per inches and centimeters can be written in two ways: which of these two conversion factors is used depends on the desired conversion. Example \(\PageIndex{1}\) Write two conversion factors for unit equality 12 inches = 1 foot. Workarooy Equality can be written as \(\dfrac {12 \ in} {1 \ ft} \) or \(\dfrac {1 \ ft} {12 \ in} \). Exercise \(\PageIndex{1}\) Write two conversion factors for the following unit equalities: a. 1 mile = 1.61 kilometers b. 4 cups = 1 fourth Response to. Equality can be written as \(\dfrac {1 \ mi} \ km} \) or \(\dfrac {1.61 \ km} {1 \ mi} \). B. Equality can be written as \(\dfrac {4 \ c} {1 \ qt} \) or \(\dfrac \dfrac \ qt} {4 \ c} \). Another set of conversion factors you'll need to know are metric prefixes. The metric system includes a set of factor-based prefixes of 10. These prefixes are extremely useful because they are applied to many different types of measurements (e.g. length measurements, mass measurements, etc.) The following table includes an abbreviated list of unit prefixes and qualities that introductory chemistry students should know about. Prefix abbreviation equality in general notation* Equality in scientific notation* nano- n- 1 m = 1,000,000,000 nm 1 m = 109 nm micro- µ- 1 m = 1,000.00 000 µm 1 m = 106 µm milli- m- 1 m = 1,000 mm 1 m = 103 mm centi- c- 1 m = 100 cm 1 m = 102 cm (basic units: g, m, L, Italy J, M, etc.) kilo- k- 1,000 m = 1 km 103 m = 1 km mega- M- 1,000,000 m = 1 Mm 106 m = 1 Mm giga- G- 1,000,000,000 m = 1 Gm 109 m = 1 Gm *These qualities use meters as an example. The same qualities can be written with one of the basic units. Example \(\PageIndex{2}\) Write two conversion factors that can be used to convert between meters and kilometers. Solution From the table above, 1000 m = 1 km. This can be written as \(\dfrac {1000 \ m} {1 \ km}\) or \(\dfrac {1 \ km} {1000 \ m} \). Exercise \(\PageIndex{2}\) Write two conversion factors that can be used to convert between the following units: microliters and liters milligrams and kilograms Response to. Add texts here. Do not delete this text first. The conversion can be written as \(\dfrac {10^6 \ µL} {1 \ L} \) or \(\dfrac {1 \ L} {10^6 \ µL} \). B. For this equality, we must use two relationships from the table: 1000 mg = 1 g and 1000 g = 1 kg. We can divide the latter by 1000 to get 1 g = 0.001 kg. This means that \[1000 \ mg = 1 \ g = 0.001 \ kg \] The conversion can be written as \(\dfrac {1000 \ mg} { 0.001 \ kg} \) or \(\dfrac {0.001 \ kg} {1000 \ mg} \). Often, conversion factors are not unit conversion factors for example, but are equivalences that can be derived from physical or chemical properties of substances or systems. For example, the density of a substance is often used to correlate its volume to its mass. Here are other common examples. Common Unit properties density g/mL, g/cm3, lb/ft3 speed m/s, mi/hr concentration mol/L, g/mL percentage composition g species/g substance Example \(\PageIndex{3}\) Write a conversion factor for gold density: 19.32 g/cm3. Solution The density can be written as \(\dfrac {19.32 \ g} {1 \ cm ^ {3}} \) or \(\dfrac {1 \ cm ^ {3}} {19.32 \ g} \). Exercise \(\PageIndex{3}\) Write a conversion factor for each of the following reports. 1 tablet contains 250 milligrams of acetaminophen. A water molecule has two hydrogen. Sodium chloride is 39.33% sodium. Reply Add texts here. Do not delete this text first. A. The relationship can be written as \(\dfrac {1 \ tablet} {250 \ mg} \) or \(\dfrac \dfrac \ mg} {1 \ tablet} \). B. The relationship can be written as \(\dfrac {1 \ H_2 O \ molecule} {2 \ H \ atoms} \) or \(\dfrac {2 \ H \ atoms} {1 \ H_2 O \ molecule} \). c. The report can be written as \(\dfrac {39.33 \ g \ Na} {100 \ g \ NaCl} \) or \(\dfrac {100 \ g \ NaCl} {39.33 \ g \ Na} \). To perform single-pitch conversions, a conversion factor is identified that connects the specified value to the desired value. The specified value is multiplied by the conversion factor so that the given units are divided by the quantity. \[given \ drive * \dfrac {desired \ drive} {given \ drive} = desired \ drive onumber \] When using this approach, it is important to include all drives in the calculations, treating them as algebraic quantities. Example \(\PageIndex{4}\) Perform the following conversion: 36 in. = ____ cm Solution We know that 1 in. = 2.54 cm. To convert 36 inches to centimeters, \[36 \ \cancel{in.} \ * \dfrac {2.54 \ cm} {1 \ \cancel{in.}} = 91.4 \ cm onumber \] Note that the inches units 'cancel'. The answer is in the remaining unit, centimeters. \(\PageIndex{4}\) Exercise Perform the following conversions. 50.0 cm = _____ in. 4.57 x 104 nm = _____ m Response to. \[50.0 \ \cancel{cm} * \dfrac {1 \ in.} {2.54 \ \cancel{cm}} = 19.7 \ cm onumber \] b. \[4.57*10^4 \ \cancel{nm} * \dfrac {1 \ m} {10^9 \ \cancel{nm} } = 4.57*10^{-5} \ m onumber \] Sometimes conversion factors are based on chemical or physical properties. Example \(\PageIndex{5}\) The iron density is 7.87 g/cm3. How much volume does 24.5 g of iron occupy? Solution \[24.5 \ \cancel{g} * \dfrac {1 \ cm^3 } {7.87 \ \cancel{g}} = 3.11 \ cm^3 onumber \] Iron will occupy 3.11 cm3. Exercise \(\PageIndex{5}\) Magnesium chloride is 25.5% magnesium. How many grams of magnesium are present in 5.24 x104 g of magnesium chloride (MgCl2)? Answer The sample contains 1.34 x 104 g of magnesium. \[5.24x10^4 \ \cancel {g \ MgCl_2} * \dfrac {25.5 \ g \ Mg} {100 \ \cancel {g \ MgCl_2}} = 1.34x10^4 \ g \ Mg onumber \] Temperature conversions between the Celsius scale and the Kelvin scale require only subtraction. because the size of one degree in the Celsius and Kelvin scales is identical. When converting to and from the Fahrenheit scale, both the grade size and the occurrence of 0° must be accounted for. Conversion equations are provided in the

first table. Example \(\PageIndex{6}\) What is 350°F on the Kelvin scale? Solution The first step is to convert the temperature to Celsius. \[^oC = \dfrac { 350 \ ^oF - 32 } {1.8} = 177 \ ^oC number _] Then the temperature in Celsius can be converted to the Kelvin scale. \[K = 177 \ ^oC + 273.15 = 450. \ K onumber \] Finally, to convert between units with powers, we must take into account the power in the conversion of the unit. To do this, conversion equality is grown to the desired power. For example, the conversion factor between (in.3) and cubic centimeters (cm3) can be determined by the inch-to-centimeter conversion factor. We know \(1 \ in. = 2.54 \ cm \). To find the relationship between in.3 and cm3, we can cube equality. \[{(1 \ in. = 2.54 \ cm)}^3 onumber \] \[1^3 \ in.^3 = 2.54^3 \ cm^3 onumber \] \[1 \ in.^3 = 16.39 \ cm^3 onumber \] Exercise \(\PageIndex{7}\) How many square meters does an 80. ft2 carpet occupy? (1 ft = 0.305 m) Answer First, we need to determine the relationship between ft2 and m2. \[{(1 \ ft = 0.305 \ m)}^2 number \] \[1 \ ft^2 = 0.305^2 \ m^2 = 0.0930 \ m^2 number _] You can then use this conversion factor to determine the carpet area. \[80. \ \cancel {ft^2} * \dfrac {0.0930 \ m^2} {1 \ \cancel {ft^2}} = 7.4 \ m^2 onumber \] The carpet occupies 7.4 square meters. 1. Perform the following drive conversions. a. 12 mg = _____ lb. h. 12 L = _____ cm3 b. 67.3 km = _____ mm i. 0.00245 m = _____ in.c. 39.3 inches = _____ cm j. 1.00 g = _____ oz. 60.0 cal = _____ J k. 170 g/cm2 = _____ lb/in2 e. 1.2 x 10-9 mg = _____ µg l. 2.5 x 107 km = _____ f. 5.2 m3 = _____ ft3 m. 45 °F = _____ °C g. 62 °C = _____ K no. -264 °F = _____ K 2. How many liters of air are there in a room that is 1200 m3? 3. What is the volume of a 59.5 g silver spoon? (densityAg = 10.5 g/cm3). 4. Burning a gallon of gasoline will produce about 8.39 kg of carbon dioxide (CO2). What volume will CO2 occupy? (CO2 density = 1.96 g/L). 5. The silver density is 10.5 g/cm3. Express this density in terms of lb/ft3. 6. The USDA recommends that a person's sodium intake be limited to 2,400 mg. Table salt is 39.33% sodium. How many grams of table salt can Jenny consume without exceeding this limit? (Suppose there are no other sources of sodium in his diet.) 7. If a cup of coffee contains 95 milligrams of caffeine, how many cups of coffee will contain 5.00 grams of caffeine? Caffeine?