Converting Units

**Textbook References:** Section 9.2 Converting Units on p.690

SI prefixes can be used to create conversion factors (ratios) to convert to larger or smaller values of a unit.

Conversions you should know:

 10 mm = 1 cm 100 cm = 1 m 1000 m = 1 km 1000 mg = 1 g

 1000 g = 1 kg 1000 ms = 1 s 60 s = 1 min 60 min = 1 h

*Examples*: **Convert 1256 m to km**

1256m x 1km = 1.256 km

 1000m

 **Convert 132 cm to mm**

132 cm x 10mm = 1320 mm

 1 cm

Multiplying by a conversion factor is like multiplying by one. It does not change the size of the quantity but just the unit in which it is expressed. Also, notice how the units “cancel” so that you arrive at the desired unit.

Sometimes several conversion factors can be used in one step.

*Examples:* **Convert 33m/s to km/h**

33 m x 1 km x 60s x 60 min = 118.8 km/h or **120 km/h with 2 SD’s**

 s 1000 m 1 min 1 h

 **Convert 95 km/h to m/s**

95 km x 1000 m x 1h x 1 min = 26.388 m/s or **26 m/s with 2SD’s**

 h 1 km 60 min 60 s

*Special Conversions*

To convert from km/h to m/s divide by 3.6.

To convert from m/s to km/h multiply by 3.6

**Convert each of the following:**

1. 114 mm to cm
2. 19 km to m
3. 12 347 mm to m
4. 1249 m/s to km/h
5. 13 km/h to m/s
6. 103 m/s to km/h

Qualitative and Quantitaive Descriptions

*Qualitative Descriptions:* Descriptions made using observations with the five senses. They may include smell or color of a chemical reaction or the behaviour of animals in the field. These observations can not be measured.

*Quantitative Descriptions:* Descriptions based on measurement. They are numerical and deal with quantities. Examples may include taking averages, length, volume, velocity and acceleration.

# Error and Discrepancy

*Error:* Refers to the uncertainty in a measurement. For example, a measurement using a meter stick has and uncertainty of + 0.05. A measurement of 1.56 m is considered to lie between 1.51 m and 1.61m.

There are three main types of error:

1. *Random Error:* An error in which an instrument will read differently each time a measurement is taken. **Random errors** are fluctuations (in either direction) in the measured data due to the precision limitations of the measurement device. Random errors usually result from the experimenter's inability to take the same measurement in exactly the same way to get exact the same number.

For example, a measuring tape can be stretched to different amounts or you measure the mass of a ring three times using the same balance and get slightly different values: 17.46 g, 17.42 g, 17.44 g. This type of error can be reduced by averaging results.

1. *Systematic Error:* An error that is inherently part of the measuring instrument. Systematic errors, by contrast to random errors, are inaccuracies that are consistently in the same direction. The error can be reduced by adding or subtracting the known error.

For example, scales not exactly on zero. The cloth tape measure that you use to measure the length of an object had been stretched out from years of use.

***Note: Mistakes made in the calculations or in reading the instrument are NOT considered to be random or systemic error.***

1. *Parallax:*  Refers to the change in the relative position of an object with a change in the viewing angle. For example, the speed of a speedometer in a car is different to the driver than the passenger. You can reduce parallax by taking measurements from the same angle. Other examples include photography, astronomy, and sights in rifles.

**Note**: Parallax and random error are related. If different people read a balance at a different angle, this is a source of random error. However, each individual reading was subject to parallax.

*Discrepancy*: This is the amount by which an experimental result differs from the accepted value.

 % Discrepancy = Experimental Value – Accepted Value

 Accepted Value x 100

Example: A group of students completed an experiment in which they were to determine the numerical value associated with gravity. Their experiment resulted in a value of 10.5m/s2. What was the percent discrepancy if the accepted value is 9.8 m/s2?

***Exercises:*** Calculate the percent discrepancy for each of the following:

1. A group of students estimate the speed of light at 3.20 x 108 m/s. The accepted value however is 3.00 x 108 m/s.

2. An electrician estimates the current through an electric baseboard heater to be 6.32 A. The expected value however is 6. 60 A.