

Chapter 1 - Chemical Foundations

Section 1.1 - Scientific Method

1. Making observations
 - Qualitative Observations** - observations made by using your senses (does not involve a number)
 - Quantitative Observations** - observations made by measuring (involves a number and a unit)
2. Formulating hypotheses
 - hypothesis** - a possible explanation for an observation
3. Performing experiments
 - experiments** - performed to test the hypothesis. Experiments will either support or disprove your hypothesis.
4. Forming a **theory** - set of hypotheses that agree with observations over the test of time.

Know Table 1.1 and Table 1.2 (p.8)

Section 1.2 - Uncertainty in Measurement

- Every measurement always has some degree of uncertainty.
 - When measuring it is always important to record the **certain digits** (those that are marked on the measuring device) and the first uncertain digit (not marked on the device and the number is guessed at).
1. **Accuracy** - refers to the agreement of a particular value with the true value.
 2. **Precision** - refers to the degree of agreement among several measurements of the same quantity.
 3. **Random error** - means that a measurement has an equal probability of being high or low.
 4. **Systematic error** - this error occurs in the same direction each time; it is either always high or always low.

Section 1.3 - Rules for Counting Significant Figures

1. **Nonzero integers** - nonzero integers always count as significant figures.
2. **Zeros** - depending on the type of zero, it will determine whether the zero counts or does not.
 - A. **Leading zeros** - are zeros that precede all the nonzero digits. These do not count as significant figures, they are considered place holders.
 - B. **Captive zeros** - are zeros between nonzero digits. These always count as significant figures.
 - C. **Trailing zeros** - are zeros at the right end of the number. They are significant only if the number contains a decimal point.
3. **Exact numbers** - numbers that were not measured but determined by counting. These can be assumed to have an infinite number of significant figures.

Rules for Significant figures in Mathematical Operations

1. **For multiplication or division** - the number of significant figures in the result is the same as the number in the least precise measurement used in the calculation.
2. **For addition or subtraction** - the result has the same number of decimal places as the least precise measurement used in the calculation.

Rules for Rounding

1. In a series of calculations, carry the extra digits through to the final result, then round.
2. If the digit to be removed -
 - a. is less than 5, the preceding digit stays the same.
 - b. is equal to or greater than 5, the preceding digit is increased by 1.

Section 1.4 - Dimensional Analysis

- method used to change from one system of units to another.

Converting from one unit to another

To convert from one unit to another, use the equivalence that relates the two units.

Derive the appropriate unit factor (equivalence factor) by looking at the direction of the required change (to cancel the unwanted units)

Multiply the quantity to be converted by the unit factor to give the quantity with the desired units.

Density - the mass of substance per unit volume.

Section 1.5 - Classification of Matter

Matter - anything occupying space and having mass

Solid - rigid; it has a fixed volume and shape

Liquid - fluid; it has a definite volume but no specific shape; it takes the shape of its container

Gas - has no fixed volume or shape; it takes the shape and volume of its container.

Mixtures - combinations of more than one substance

Homogeneous - mixtures which have visibly indistinguishable parts.

Heterogeneous - mixtures which have visibly distinguishable parts.

Solution - a specific type of homogeneous mixture.

Pure Substance - substance with constant composition. One substance.

Physical Change - change in the form of the substance, but not in its chemical make up.

Separation processes

Distillation - a process that depends on differences in the volatility of compounds.

Filtration - used to separate mixtures of a solid and a liquid.

Chromatography - process used to separate liquids or gases by using a mobile phase and a stationary phase.

Compound - a substance with constant composition that can be broken down into elements by chemical process.

Chemical Change - one in which a given substance becomes a new substance or substances with different properties and different composition.

Elements - substances that cannot be decomposed into simpler substances by chemical or physical means. Composition of matter - see figure 1.13 p.30

**Notes have been derived from Zumdahl 4th ed. - All page and table references are made to this edition.