

Scientific Measurement

Two types of MEASUREMENT

QUANTITATIVE - Results are given in a definite form, usually with **numbers**.

QUALITATIVE - Results are given in a descriptive **nonnumeric** form.

We try to have both:

ACCURACY - How close a measurement comes to the actual value of whatever is being measured.

PRECISION - Reproducibility of the measurement

PRACTICE PROBLEMS (by DA)

1. How many words can a typist type in 10.86 minutes if she types at the rate of 70 words per minute?
2. Calculate the number of lab reports that I will have to grade during the year if the students do 15 experiments. The teacher has 4 classes with 24 students in each.
3. If you were to count at a rate of 2 numbers every second, how many days would it take you to count to 1 million?
4. How many days will it take to earn \$160 if your pay is \$4.00 per hour? (Assume 8-hour workday)
5. How fast is 55 miles/hour, expressed in meters/sec? (1 mile = 5280 ft, 2.54 cm = 1 in)
6. A cheetah has been clocked at 112 km/hr over a 100-m distance. What is this speed in m/s?

Volume - measured in L usually by a graduated cylinder

$$L * W * H = \text{Volume}$$

$$\text{cm} * \text{cm} * \text{cm} = \text{cm}^3 \text{ (cc)}$$

$$1 \text{ cm}^3 = 1 \text{ mL} = 1 \text{ g} = 1 \text{ cc}$$

Mass vs. Weight

1. Weight - pull between the earth and an object usually measured with a spring scale.

↑ stretch- ↑ force - ↑ weight

- Force - push or pull on an object depends on
 - a. the height of an object
 - b. the amount of matter in an object

2. Mass - the amount of matter in an object measured with a triple-beam balance.

- Inertia - resistance to any change of motion in direction

Mass does not change

Weight does change depending on your location

Density - ratio of the mass of an object to its volume

g/mol

kg/L

g/cm³

$$D = M/V \text{ (Mass/Volume)}$$

SPECIFIC GRAVITY - comparison ratio of the density of a substance to the density of a reference substance (H₂O) at the same temperature - (NO UNITS)

Water has a specific gravity of 1 g/cm³ at 4°C. This is the reference substance for liquids and solids.

HYDROMETER - used to measure specific gravity

TEMPERATURE - degree of hotness or coldness of an object

CELSIUS - temperature scale based on the freezing point of water at 0°C and boiling point at 100°C. It is a metric unit of temperature.

ABSOLUTE ZERO - -273°C All motion ceases. 0 K

KELVIN - Another temperature scale - non negative

ZERO POINT - 0 K on Kelvin scale

$$K = ^\circ\text{C} + 273$$

The melting pt of Au is 1064°C . Express this temperature in K

HEAT - energy that is transferred from one body to another because of a temperature difference

ENERGY

Measure heat by:

1. calorie - (cal) quantity of heat that rises the temperature of 1 gram of pure water at 1°C .
2. joule - (J) $4.18 \text{ J} = 1 \text{ cal}$

A piece of coal was burned and emitted 245 KJ of heat energy. How many calories is this?

200.50 kJ of heat was added to spaghetti sauce. How much is this in calories? (1 cal = 4.18 J).

SPECIFIC HEAT CAPACITY (HEAT CAPACITY) - quantity of heat required to change an object's temperature by exactly 1°C .

The greater the mass of an object, the more heat capacity it has.

Heat lost or heat gained = mass X change in temperature * specific heat

Heat lost or gained = MTS

Heat lost = heat gained