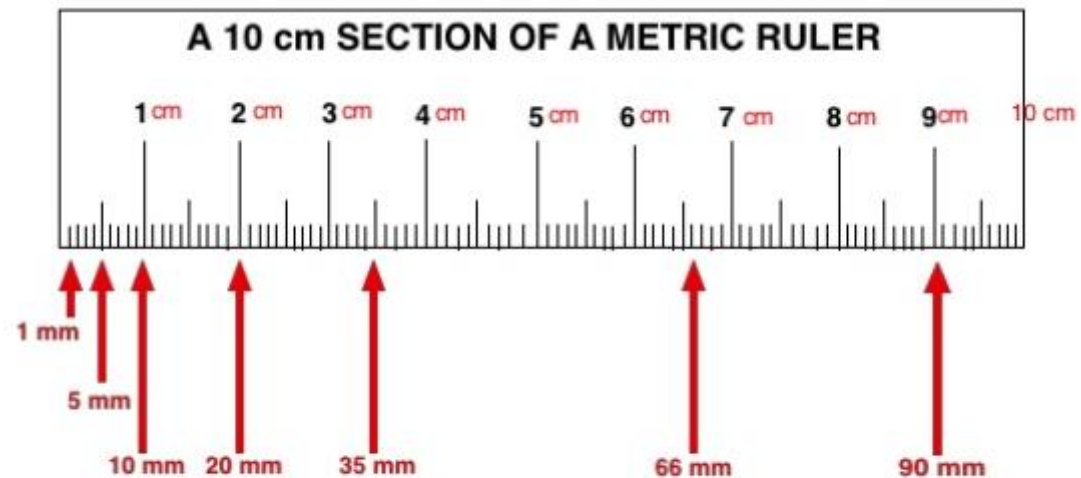


Measurement Stations

Length, Mass, Volume, Density, Temperature, and Time

Length

- Length measures the distance from end to end on an object; height and width are variations on length.
- Standard (S.I.) Unit: meter Abbreviation: m
- Common units for this course: centimeter Abbreviation: cm
- Tool: ruler, meter stick
- How to read a metric ruler:



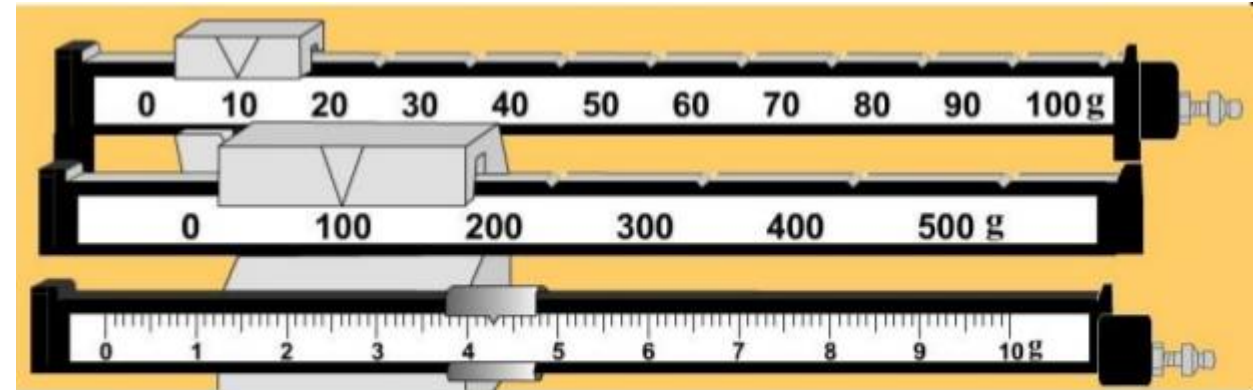
The arrows indicate specific mm locations.

- Practice:

Record the length of the paperclip and the table height.

Mass

- Mass measures the amount of matter (particles) in an object. It is similar to weight but does not change as gravity changes. For example, if you go to the moon, you will weigh less but your mass is that same (you didn't lose any body parts!).
- Standard (S.I.) Unit: kilogram Abbreviation: kg
- Common units for this course: gram Abbreviation: g
- Tool: triple beam balance, electronic balance
- How to read a triple beam balance:
PLAY THE VIDEO FIRST
- Practice:
Record the mass of the paperclip and pebble.



➤ **Mass = 100 + 10 + 4.3 = 114.3**

Mass—How to Use a Triple Beam Balance

See video (separate file)

Volume of a Liquid

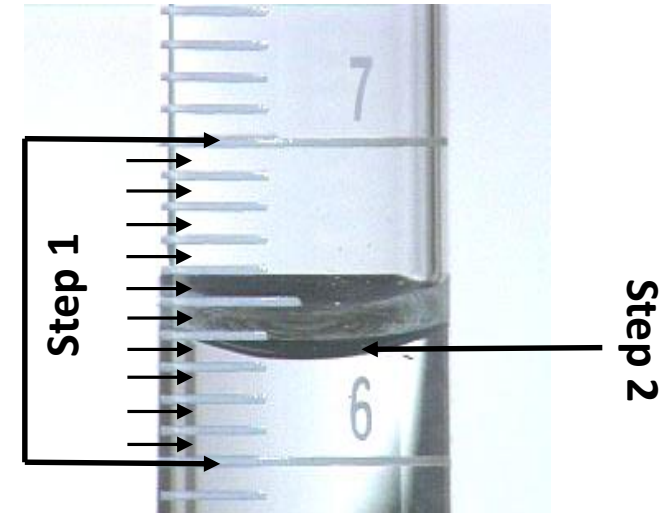
- Volume measures the amount of space an object occupies.
- Standard (S.I.) Unit: liter Abbreviation: L
- Common units for this course: milliliter Abbreviation: mL
- Tool: graduated cylinder
- How to read a graduated cylinder:

Step 1: Determine the scale of the cylinder

Subtract the values of any two labelled graduations and divide by the number of intervals between them. Here subtract 6 from 7 (answer = 1) and count that there 10 graduations between the 6 and 7 labelled graduations. One graduation therefore = $1/10$ mL, or simply 0.1 mL.

Step 2: Determine the volume of liquid in the cylinder

Get eye-level with the bottom of the meniscus (curve) of the liquid. Then use the scale to determine the volume, much like using a ruler. Here the meniscus is at 6.3 mL.



Practice:

Record the volume of the blue and green liquids.

Volume of a Regular Solid

- Volume measures the amount of space an object occupies.
- Standard (S.I.) Unit: cubic meter Abbreviation: m^3
- Common units for this course: cubic centimeter Abbreviation: cm^3
- Tool: ruler and calculator
- How to calculate the volume of a regular solid:

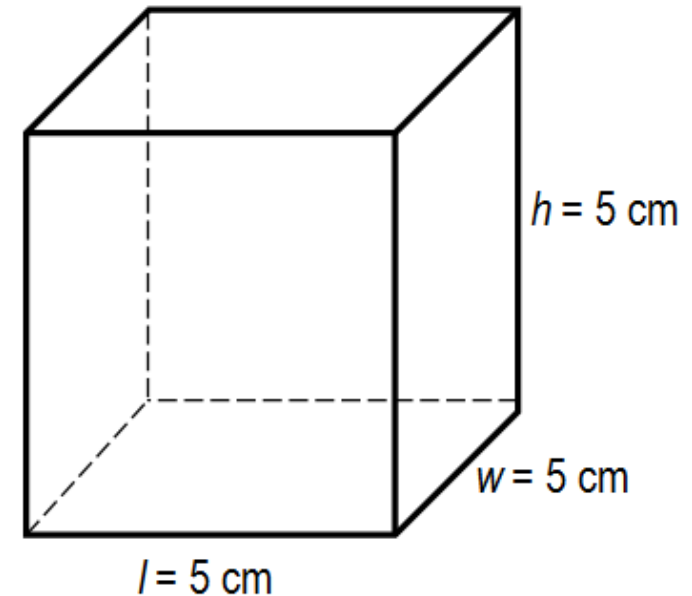
Step 1: Measure the length, width, and height of the regular solid using the same unit for all three (cm, m, etc.) .

Step 2: Use the following formula:
 $L \times W \times H = \text{Volume}$

Step 3: Check the units—it must be written as the cube of the same unit as the length, width, and height (cm^3 , m^3 , etc.).

- Practice:

Measure and record the volume of the block and book.
No work shown = No credit earned!



$$\text{Volume (V)} = 5\text{cm} \times 5\text{cm} \times 5\text{cm} = 125\text{cm}^3$$

Volume of an Irregular Solid

- Volume measures the amount of space an object occupies. Irregular solids do not have a rectangular shape, so a ruler cannot be used. The technique used instead is called Water Displacement.
- Standard (S.I.) Unit: cubic meter Abbreviation: m^3
- Common units for this course: cubic centimeter Abbreviation: cm^3
- Tool: graduated cylinder and calculator
- How to use Water Displacement: **PLAY THE VIDEO FIRST**

Add the object to a graduated cylinder of water. Calculate the rise in the water level. The units should be cm^3 since the object is a solid ($1 \text{ mL} = 1 \text{ cm}^3$).

Practice:

Measure the volume of the metal washers. Use the string attached to lower and retrieve the washers.

Volume of an Irregular Solid

See video (separate file)

Density

- Density measures the ratio of mass to volume for an object. Density must be calculated; it cannot be measured directly; density is the same for all parts of a single object.
- Liquid Standard (S.I.) Unit: grams per milliliter Abbreviation: g/mL
- Solid Standard (S.I.) Unit: grams per cubic centimeter Abbreviation: g/cm³
- Tool: calculator
- How to calculate density:
Density = mass ÷ volume or $D = \frac{m}{V}$
- Example: If a block has a mass of 5 g and a volume of 10 cm³, then the density is 5 g ÷ 10 cm³ or 0.5 g/cm³.
- Practice:
Complete the following density problems.
No work shown = No credit earned!

Density Problems

1. What is the density of a piece of wood that has a mass of 25.0 grams and a volume of 29.4 cm³?
2. Mercury metal is poured into a graduated cylinder that holds exactly 22.5 mL. The mercury used to fill the cylinder weighs 306.0 g. From this information, calculate the density of mercury.

Temperature

- Temperature measures the energy contained within a substance.
- Standard (S.I.) Unit: Kelvin Abbreviation: K
- Common units for this course: Degrees Celcius
- Abbreviation: °C
- Tool: thermometer
- How to read a thermometer:

Step 1: Determine the scale of the thermometer

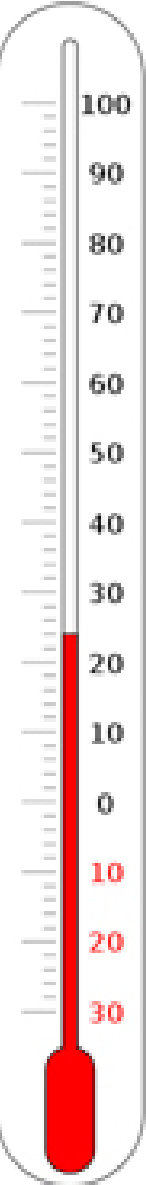
Subtract the values of any two labelled graduations and divide by the number of intervals between them.
 $60 - 50 = 10$ then divided by $5 = 2$. So each mark

Here
is worth 2°C.

Step 2: Determine the level of the thermometer fluid, much like reading a ruler. Here it is 24°C.

- Practice:

Record the temperatures of the air and water.



Time

- Standard (S.I.) Unit: second Abbreviation: s or sec
- Tool: clock, stop watch
- Practice:

Record time from the analog class clock. Yes, really. Need help?
Please ask. Only by using this clock correctly will you be able to ask for permission to use the restroom this semester.