Metric Measurement Lab

This laboratory exercise is designed as a review of the metric system and will provide practice in manipulating units.

The metric system is based on standard units of length, mass and volume.
Standard units:
> **Length – meter**
> **Mass – gram**
> **Volume (liquid) – liter**
> **Volume (solid) – cm^3**
> **1 mL = 1 cm^3**

These standard metric units can be modified by the addition of various prefixes.
Metric prefixes:
> **Kilo- 1,000 (10^3)**
> **Deci- 0.1 (10^{-1})**
> **Centi- 0.01 (10^{-2})**
> **Milli- 0.001 (10^{-3})**
> **Micro- 0.000001 (10^{-6})**
> **Nano- 0.000000001 (10^{-9})**

Various instruments are used to make metric measurements.
Metric instruments:
> **Length – metric ruler**
> **Mass – metric scale (triple beam balance)**
> **Volume – graduated cylinder, pipettes**

You will use all these instruments to complete the following metric measurement exercise.

Metric Table

	Quantity	Numerical Value	English Equivalent	Convert English to Metric
Length	kilometer (km) *meter (m)* decimeter (dm) centimeter (cm) millimeter (mm) micrometer (μm) nanometer (nm)	1,000 m 0.1 m 0.01 m 0.001 m 0.000001 m 0.000000001 m	1 km= 0.62 mile 1 m= 1.09 yards= 3.28 ft 1 cm= 0.394 inch 1 mm= 0.039 inch	1 mile= 1.609 km 1 yard= 0.914 m 1 foot= 0.305 m 1 foot= 30.5 cm 1 inch= 2.54 cm
Mass	kilogram (kg) *gram (g)* milligram (mg) microgram (μg)	1,000 g 0.001 g 0.000001 g	1 kg= 2.205 pounds (lb) 1 g= 0.0353 ounce (oz)	1 pound= 0.45 kg 1 ounce= 28.35 g
Volume (liquid)	kiloliter (kL) liter (L) milliliter (mL) microliter (μL)	1,000 L 0.001 L 0.000001 L	1 kL= 264.17 gallons 1 L= 1.06 quarts (qt) 1 mL= 0.034 oz	1 gallon = 3.785 L 1 quart =0.94 L 1 pint =0.47 L 1 oz =29.57 mL
Time	second (sec) millisecond microsecond	0.001 second 0.000001 second		

Standard units

$\underline{1\ meter}$ = 100 cm = 1000 mm = 1x10^6 μm (1000000 μm)
$\underline{1\ gram}$ = 100 cg = 1000 mg = 1x10^6 μg (1000000 μg)
$\underline{1\ liter}$ = 100 cL = 1000 mL = 1x10^6 μL (1000000 μL)
$\underline{1\ second}$ = 1000 milliseconds

Temperature Conversion:

$$°C = \frac{5}{9}\ (°F – 32)$$

$$°F = \frac{9}{5}\ °C\ + 32$$

Metric Measurements Lab
Name/Lab session: _____

Record all measurements and <u>do the calculations</u> on this sheet of paper to be handed in to instructor. Record all measurements in this lab to the nearest tenth of a unit. Calculations are significant only to the same number of decimal places as measurements, so round off calculations to the nearest tenth unit.   <u>All answers must have proper units!</u>

A. 1. Measure and record the length (L), height (H) and width (W) of a block in cm.
  Length: Height: Width:

  2. Calculate its volume (LxWxH).

  3. Convert the length, height and width of this block to mm.
    Length: Height: Width:

  4. What is the volume in cubic mm?

  5. Determine the mass of the block to the nearest tenth gram using the weigh balance.

B. 1. Measure and record the length (L) and inside diameter (D) of a test tube in cm.
  Length: Diameter:

  2. Calculate its volume (V) in cubic cm (cc).
$$V = \frac{3.14 \times L \times D^2}{4}$$

    Calculated Volume:

3. Fill the test tube to the lip with water. Carefully pour the water into a 50 ml graduated cylinder. Place the cylinder on the table and view at eye level to read the volume at the bottom of the meniscus (curved surface of the water). Record this measured volume.

        Measured Volume:

4. How does your measured volume compare with your calculated volume? If there is a discrepancy, give an explanation.

C.   1. Weigh an empty small beaker and record its weight to the nearest tenth gram.

          Weight of beaker:

      2. Measure 20 mL of water with a serological pipette into the previously weighed beaker and then weigh again.

          Weight of beaker plus water:

      3. Calculate the weight of the water from these 2 measurements.

          Weight of water:

      4. How much would 1 mL of water weigh?

          Weight of 1 mL of water:

D.   1. Fill a 250 mL graduated cylinder to 200 mL with water. Record the volume. Carefully place a solid rubber stopper into the water. Record the volume.

          Volume of water:

          Volume of water + rubber stopper:

      2. Calculate the volume of the rubber stopper.

E.   1. Temperature measurement. Record the temperature (°C) of the water in the instructor's beaker.

      Temperature:

      2. Convert to °F.

Metric Worksheet   **Name /Lab session:** _____

1. What do the following prefixes mean in relation to the standard unit?

     a. kilo-   c. deci-

     b. centi-   d. milli-

2. What do the following abbreviations mean?

     a. lb =   e. µg =   i. sec =

     b. g =   f. oz =   j. gal =

     c. cc =   g. km =   k. cm =

     d. mL =   h. L =   l. qt =

3. Which is greater (larger)?

a. 1 m or 1 yd?   g. 1 µg or 1 cg?

b. 1 L or 1 qt?   h. 1 L or 1 dL?

c. 1 lb or 1 kg?   i. 1 mm or 1 km?

d. 1 oz or 1 g?   j. 1 cL or 1 mL?

e. 1 m or 1 km?   k. 1 kg or 1 g?

f. 1 cm or 1 in?   l. 1 dm or 1 cm?

4. Complete: (use decimals)

a. _____ g = 1 dg   f. _____ cm = 5 m

b. _____ km = 1 m   g. _____ L = 3 mL

c. _____ cL = 1 L   h. _____ dg = 7 g

d. _____ mg = 1 cg   i. _____ mm = 6 m

e. _____ dL = 1 mL   j. _____ cL = 4 mL

5. Problems:

a. Add 5.0 m + 6.25 m + 3.1 m = _____ m

(hint: use proper significant figures)

b. Add 1.2 g + 3 dg + 2.6 g + 90 cg = _____ (hint: convert all numbers to the same unit)

c. A box measures 1 cm x 6 cm x 5 cm. What is its volume?