Doing: Lab Experiments

Safety (Video & Handout)

http://chemconnections.org/general/chem108/Lab/Safety_focus_ques-18.pdf

Chem 108: Lab

Sign in: Roster @ front of lab

Open Lab Drawer

Select a partner to work with for today's lab experiment

Turn in:

completed safety handout before beginning experiment.

http://chemconnections.org/general/chem108/calendar-108-s19.html

CHEM 108

Monday

Week 2

Lab Notes:

 *Lab 2102-2116.2:*

Discussion, Experiments & Graded Assignments:

-  Must have DVC Lab Manual TODAY
-  Must have eye protection TODAY
- Lab.2 (Week 2) | Powerpoint Slides .html, .ppt, Print: .pdf (6 slides per page)
- *Safety Viewing Assignment*: Video [35 min.] *** *Safety Questions pdf* (DUE before Lab TODAY; Turn in hard copy.)
- *Reading Assignment*: Laboratory Techniques DUE before lab TODAY Refer to Measurement Units & Standards ANSWER *Guiding Questions* DUE before lab TODAY
- *Reading Assignment*: Laboratory Manual *Metric Measurement* pp. 9-11 (DUE before Lab TODAY)
- *Viewing Assignment*: Using a Centigram Weighing Balance #1 [2 min.]; Weighing by Difference #2 [6.5 min.] DUE before Lab TODAY

 Experimentation:

- *Doing:* Laboratory Manual *Metric Measurement* pp. 9-11; Select a lab partner.
- Following instructions in Laboratory Manual pp. 9-11; Complete measurements pp. 9-11 (Measurements MUST BE completed today *and* recorded separately on each lab partner's lab report form: pp.12-14)
- *Reading* **(HANDOUT pdf): Mathematics &**

Wednesday

 *Lab 2102-2116.2:*

Discussion, Experiments & Graded Assignments:

-  Must have DVC Lab Manual TODAY
-  Must have eye protection TODAY
- Lab.2 (Week 2) | Powerpoint Slides .html, .ppt, Print: .pdf (6 slides per page)
- *Safety Viewing Assignment*: Video [35 min.] *** *Safety Questions pdf* (DUE before Lab TODAY; Turn in hard copy.)
- *Reading Assignment*: Laboratory Techniques DUE before lab TODAY Refer to Measurement Units & Standards ANSWER *Guiding Questions* DUEbefore lab TODAY
- *Reading Assignment*: Laboratory Manual *Metric Measurement* pp. 9-11 (DUE before Lab TODAY)
- *Viewing Assignment*: Using a Centigram Weighing Balance #1 [2 min.]; Weighing by Difference #2 [6.5 min.] DUE before Lab TODAY

 Experimentation:

- *Doing:* Laboratory Manual *Metric Measurement* pp. 9-11; Select a lab partner.
- Following instructions in Laboratory Manual pp. 9-11; Complete measurements pp. 9-11 (Measurements MUST BE completed today *and* recorded separately on each lab partner's lab report form: pp.12-14)
- *Reading* (HANDOUT pdf): Mathematics & Measurement
- **WORKSHEET** (HANDOUT pdf): Units,

Question

The title of today's experiment is:

A. Measurement of the Properties of Gases
B. Metal Measurement
C. Measuring the Energy of Combustion
D. Metric Measurement
E. Measuring the Calories in a Can of Coca Cola

Answer D.

Experiment 1 – Metric Measurement

Metric Measurement

Background

If you haven't already done so, read the metric system or SI section in your text. All measurements in chemistry are made in SI units.

In this experiment you will measure length using a ruler which can be estimated to 0.1 cm, volume using one graduated cylinder which can be read to 0.1 mL and another which can be read to 0.01 mL, and mass on a balance which weighs to 0.01 g. Look carefully at each instrument to be sure you understand it before making any measurements. All measurements should be checked twice to be sure that the readings have been recorded correctly.

The ruler is calibrated in centimeters on one side and mm on the other. Since it can be estimated to 0.1 cm, a reading of exactly twenty–eight centimeters should be recorded as 28.0 cm.

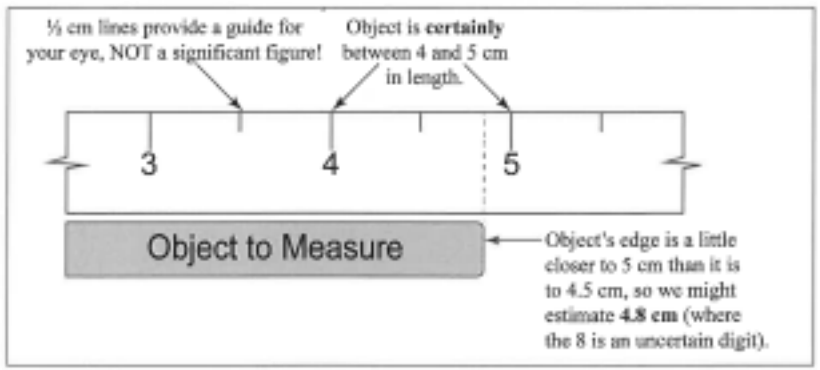


Figure 1. Using the centimeter ruler

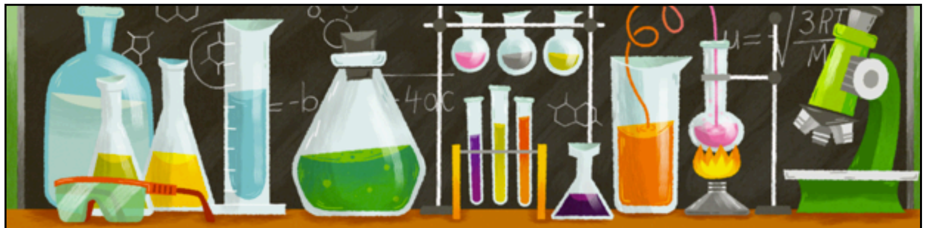
Getting accurate volume readings from a graduated cylinder can be tricky at first. Your 50 or 100 mL graduate is calibrated in 1 mL increments, i.e., each line represents 1 mL. However, by careful reading between the lines, volumes can be estimated to the nearest 0.1 mL. Similarly, your 10 mL graduate can give volumes to the nearest 0.01 mL.

When there is water in a graduated cylinder (or any other container for that matter) the surface of the water is curved downward. This curved surface is called the **meniscus**. Volume readings are taken at the bottom of the meniscus. The meniscus must be at eye level for an accurate reading. Be sure you have read the directions carefully before you make any measurements. It is important to record data with the precision requested. For example if you are directed to measure to the nearest 0.01 mL, reporting 9.9 mL would be incorrect.

Doing: Lab Experiments

Metric Measurement [Experiment #1]

Background & Preparation [Graded Guiding Questions]



Measurement: Units & Standards

Refer to the guiding questions below. Open:
http://chemconnections.org/general/chem106/measurement.html
View the links and complete the guiding questions.

* Required

Name: Last, First *

DVC id *

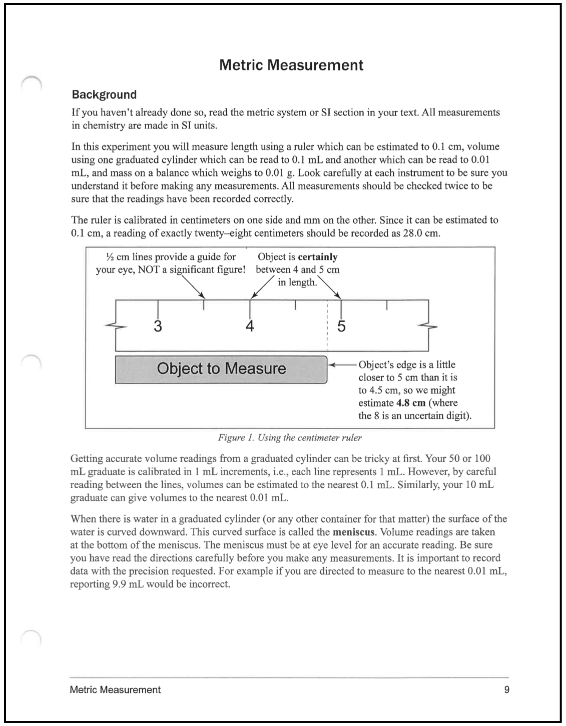
http://chemconnections.org/general/chem108/Measurements.Units-Guide.html

Doing: Lab Experiments

Metric Measurement [Experiment #1]

(Course/ Lab Manual pp. 9-11; pp. 12-15 [Report Form])

http://chemconnections.org/general/chem108/calendar-108-f18.html



Metric Measurement

Background

If you haven't already done so, read the metric system or SI section in your text. All measurements in chemistry are made in SI units.

In this experiment you will measure length using a ruler which can be estimated to 0.1 cm, volume using one graduated cylinder which can be read to 0.1 mL and another which can be read to 0.01 mL, and mass on a balance which weighs to 0.01 g. Look carefully at each instrument to be sure you understand it before making any measurements. All measurements should be checked twice to be sure that the readings have been recorded correctly.

The ruler is calibrated in centimeters on one side and mm on the other. Since it can be estimated to 0.1 cm, a reading of exactly twenty–eight centimeters should be recorded as 28.0 cm.

½ cm lines provide a guide for your eye, NOT a significant figure!

Object is **certainly** between 4 and 5 cm in length.

3

4

5

Object to Measure

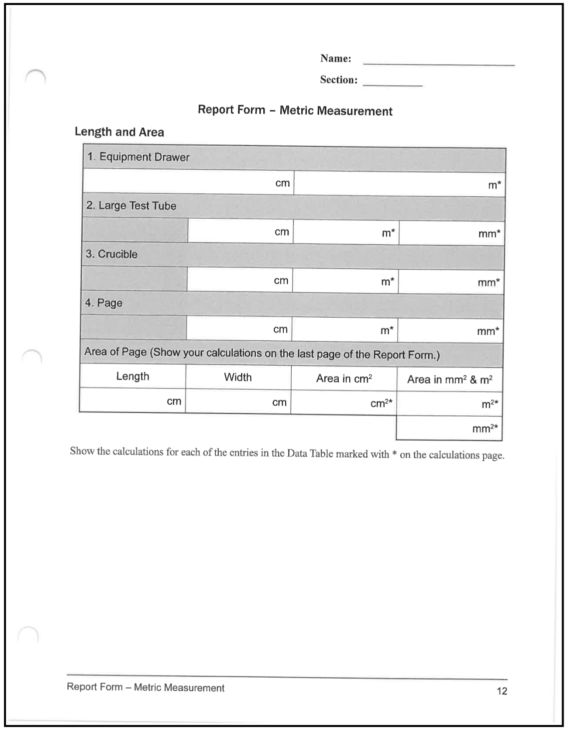
Object's edge is a little closer to 5 cm than it is to 4.5 cm, so we might estimate **4.8 cm** (where the 8 is an uncertain digit).

Figure 1. Using the centimeter ruler

Getting accurate volume readings from a graduated cylinder can be tricky at first. Your 50 or 100 mL graduate is calibrated in 1 mL increments, i.e., each line represents 1 mL. However, by careful reading between the lines, volumes can be estimated to the nearest 0.1 mL. Similarly, your 10 mL graduate can give volumes to the nearest 0.01 mL.

When there is water in a graduated cylinder (or any other container for that matter) the surface of the water is curved downward. This curved surface is called the **meniscus**. Volume readings are taken at the bottom of the meniscus. The meniscus must be at eye level for an accurate reading. Be sure you have read the directions carefully before you make any measurements. It is important to record data with the precision requested. For example if you are directed to measure to the nearest 0.01 mL, reporting 9.9 mL would be incorrect.

Metric Measurement 9



Name: ____________________

Section: __________

Report Form – Metric Measurement

Length and Area

1. Equipment Drawer			
cm		m*	
2. Large Test Tube			
	cm	m*	mm*
3. Crucible			
	cm	m*	mm*
4. Page			
	cm	m*	mm*
Area of Page (Show your calculations on the last page of the Report Form.)			
Length	Width	Area in cm^2	Area in mm^2 & m^2
cm	cm	cm^{2*}	m^{2*}
			mm^{2*}

Show the calculations for each of the entries in the Data Table marked with * on the calculations page.

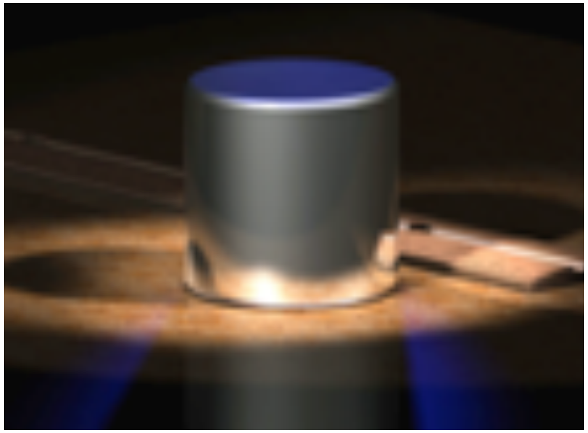
Report Form – Metric Measurement 12

Collaboration is encouraged, but individual record keeping and submissions are required. MUST use Lab Manual pages for record keeping. Black or blue ink preferred without erasures, but pencil OK for Chem 108.

Doing: Lab Experiments

Metric Measurement [Experiment #1]

(Course/ Lab Manual pp. 9-11; pp. 12-15 [Report Form])



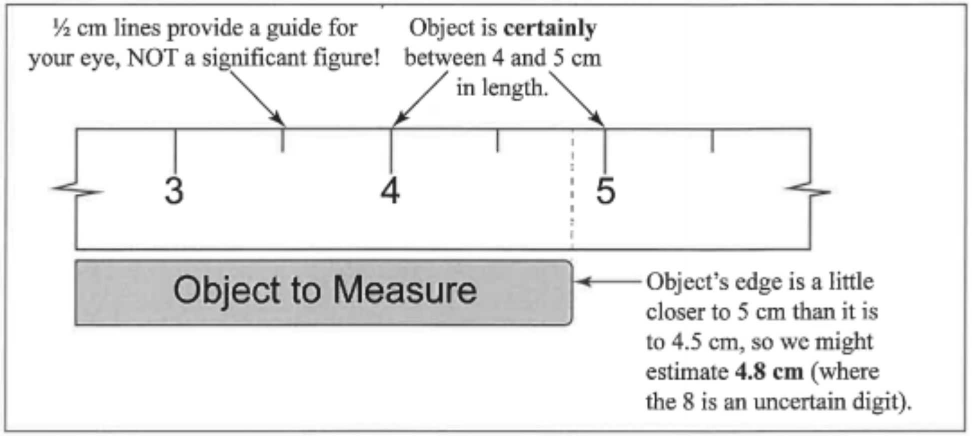


Figure 1. Using the centimeter ruler

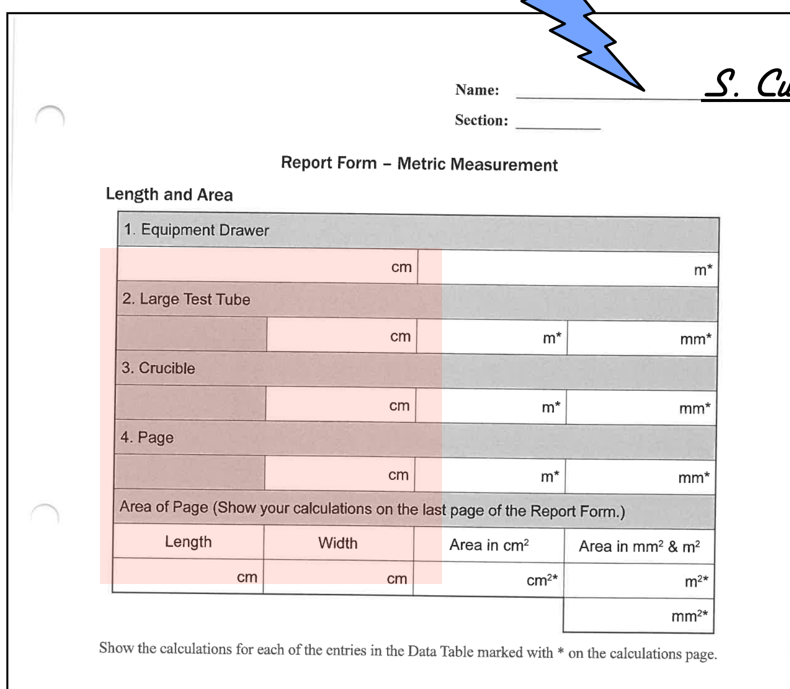
Exp. 1 – Metric Measurement

- Goal: Using instruments having different levels of precision, make accurate measurements of length, area, volume, and mass
- Convert measurements to different units using Dimensional Analysis

Exp. 1 – Metric Measurement

Work with a partner

- Keep separate records. On each partner's Lab **<u>REPORT FORM,</u>** write your name first & then your partner's in (_____)



Name:

Section:

Report Form – Metric Measurement

Length and Area

1. Equipment Drawer			
cm		m*	
2. Large Test Tube			
	cm	m*	mm*
3. Crucible			
	cm	m*	mm*
4. Page			
	cm	m*	mm*
Area of Page (Show your calculations on the last page of the Report Form.)			
Length	Width	Area in cm^2	Area in mm^2 & m^2
cm	cm	cm^{2}*	m^{2}*
			mm^{2}*

Show the calculations for each of the entries in the Data Table marked with * on the calculations page.

S. Curry (D. Green)

and on your partner's form

D. Green (S. Curry)

Exp. 1 – Metric Measurement

- Do each measurement separately and independently. Then, compare your value with your partner's. The values should be very close within the precision limits of the device used. If not, repeat the measurement together and correct the Report Form entries.

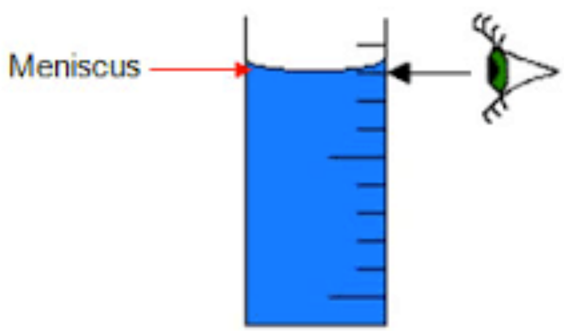
Exp. 1 – Metric Measurement

Mass Measurement with an Electronic Balance:

https://www.youtube.com/watch?v=QtnPiKSKKtI

Exp. 1 – Metric Measurement

Volume Measurement (Liquids)

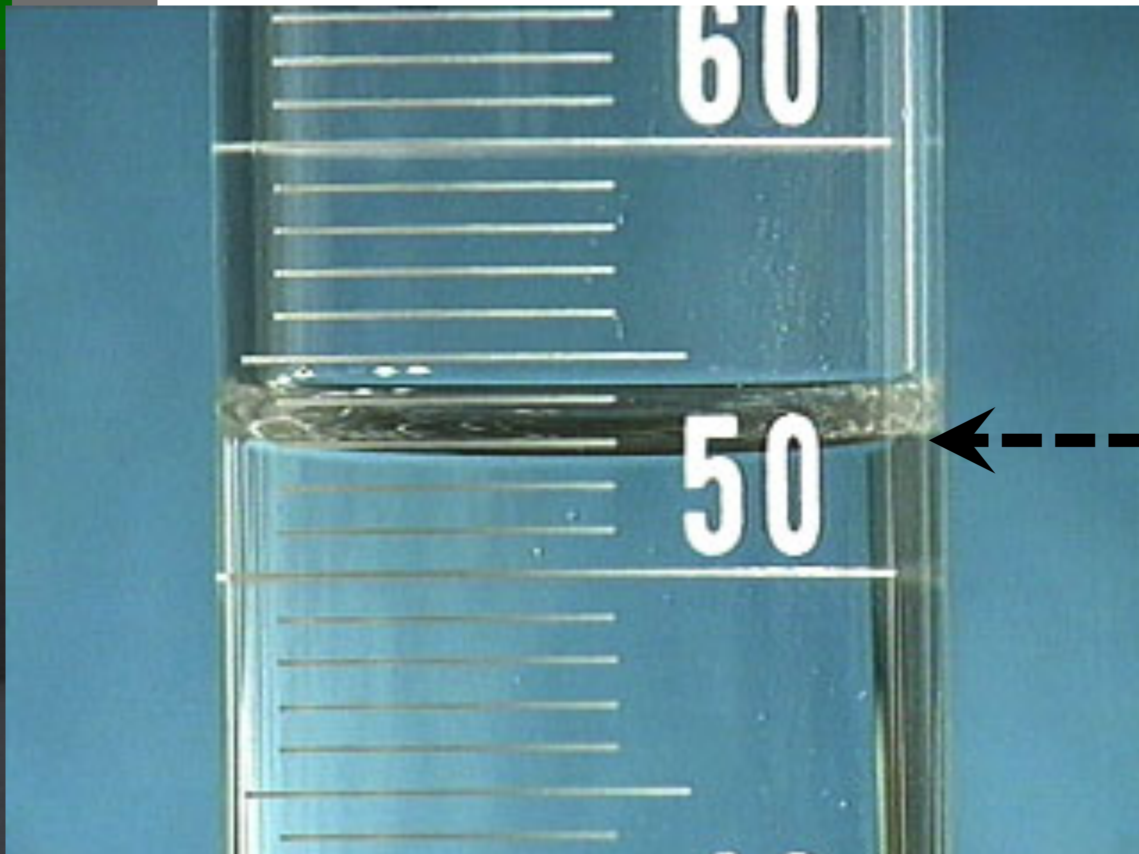


Measure at the ***bottom of the meniscus at eye level***

Measurements with a Graduated Cylinder:

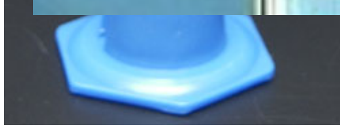
Exp. 1 – Metric Measurement

Measurement with a 100 mL Graduated Cylinder:



meniscus

bottom of the meniscus at eye level



Take out the cylinder; pour some water into it.

Report this measurement as?

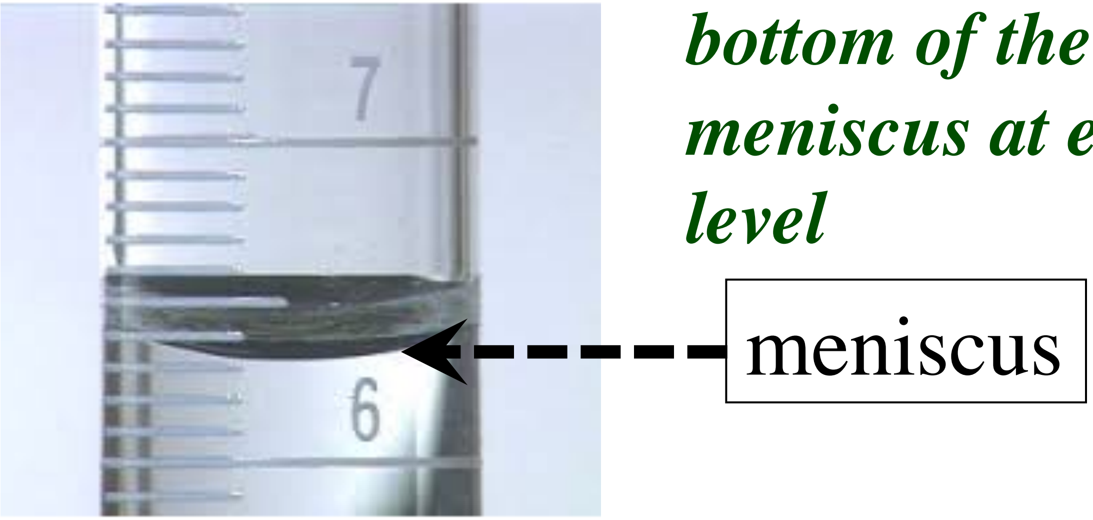
52.9 mL

What is the volume of water in your cylinder?

Exp. 1 – Metric Measurement

Measurement with a 10 mL Graduated Cylinder:

Measure at the ***bottom of the meniscus at eye level***



Report this measurement as?

<u>6.31 mL</u>

Exp. 1 – Metric Measurement

- Important to record ***measurements*** to the correct limits of the equipment used (i.e. uncertainty/significant figures). NOTE: For this experiment the uncertainty limits (+/–) of the equipment is to be included.
- Uncertainty limits are not normally included in calculations but are inferred from the correctly reported significant figure in the experimental value.

- Estimating to 6.3**0** mL is ok if the meniscus is viewed to be exactly on the mark.

Report: 6.3**0** **+/- 0.01** mL

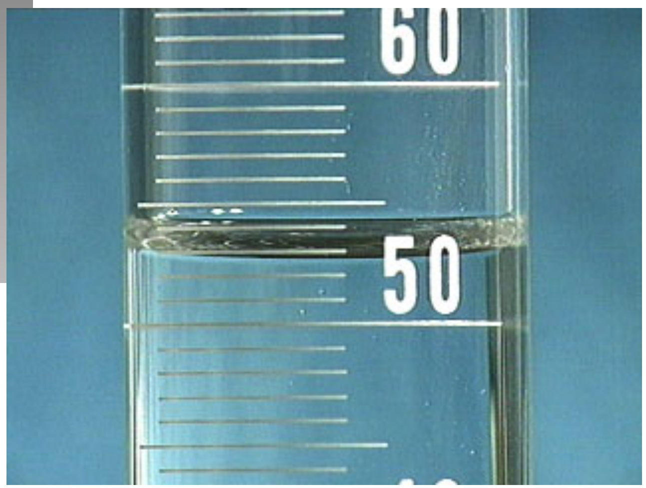
- Estimating to 6.3**1** mL is also ok if the meniscus is viewed to be off the mark.

Report: 6.3**1** **+/- 0.01** mL

Exp. 1 – Metric Measurement

Measurement with a Graduated Cylinder:

100 mL Graduated Cylinder



Measurement: 52.9 +/– 0.1mL

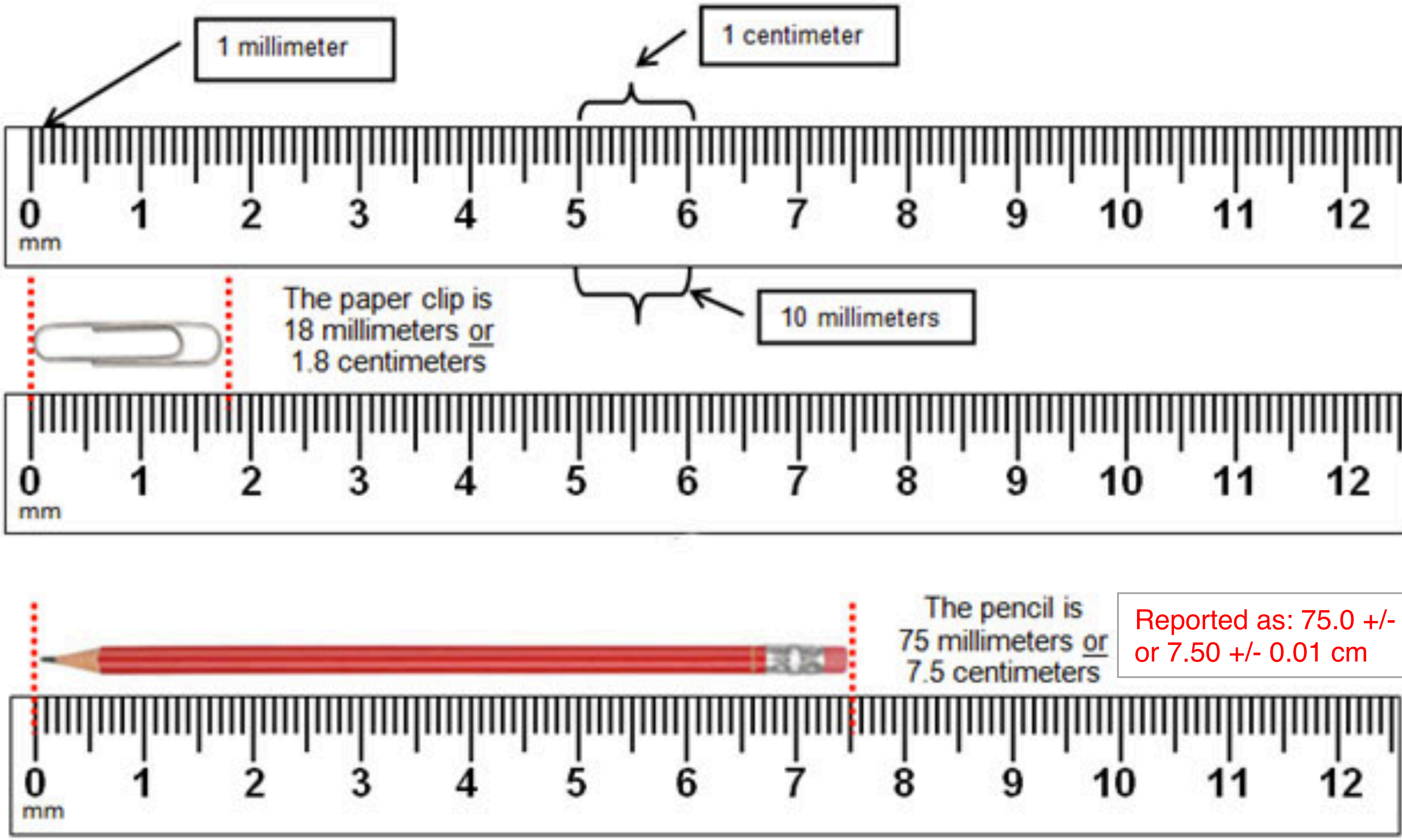
10 mL Graduated Cylinder

Measurement: 6.31 +/– 0.01mL

- Notice the difference in precision (uncertainty) with each instrument used and their maximum capacities

Exp. 1 – Metric Measurement

Measurement with a centimeter/millimeter ruler (Length)



Reported as: 75.0 +/- 0.1 mm
or 7.50 +/- 0.01 cm

Exp. 1 – Metric Measurement

- When measuring glassware with the ruler, use inner diameter of glassware, NOT outer diameter. Why?
- Experimental error will occur:

When pouring water out of test tube into graduated cylinder, some is always left in test tube; how does this systematic error affect accuracy of measured volume?

Is the beaker a perfect cylinder?

- Think about how equipment and handling; relate this to measurements and "systematic" errors.
- "Human Error" is **NOT** acceptable error.

Exp. 1 – Metric Measurement

"Human Error" is **NOT** acceptable in scientific measurements……. as in aeronautics.

SFO July 6, 2013

Experiment 1 – Metric Measurement

Complete and record all measurements today.

Name: ____________

Section: ________

Report Form – Metric Measurement

Length and Area

1. Equipment Drawer			
	cm	m*	
2. Large Test Tube			
	cm	m*	mm*
3. Crucible			
	cm	m*	mm*
4. Page			
	cm	m*	mm*
Area of Page (Show your calculations on the last page of the Report Form.)			
Length	Width	Area in cm^2	Area in mm^2 & m^2
cm	cm	cm^{2*}	m^{2*}
			mm^{2*}

Show the calculations for each of the entries in the Data Table marked with * on the calculations page.

Volume

1. Largest Test Tube		
mL	L*	
2. Crucible		
mL	L*	
3. Smallest Test Tube		
mL	L*	
4. 250 mL beaker–graduated cylinder readings		
mL	mL	mL
Total		
mL*	L*	
5. 250 mL beaker–measured as a cylinder		
Height	Diameter	Radius*
cm	cm	cm
	Volume	cm^{3*}

Show the calculations for each of the entries in the Data Table marked with * on the calculations page

Question: Why should the volumes be the same? Why aren't they the same?

Mass

1. Crucible	
g	mg*
2. Crucible Lid	
g	mg*
3. Crucible and Lid	
g	mg*
4. Sum of Crucible and Lid	
Crucible	g
Lid	g
Sum	g
5. Equipment Slip	
g	mg*

Show the calculations for each of the entries in the Data Table marked with * on the calculations page.

Conversions and calculations due next lab.

"Anything worth measuring is worth measuring well."

Source unknown

Mathematics & Measurements

To determine if a runner broke a world's record in a sprint or marathon, the time that passed between the start and finish must be carefully measured and compared to the world records. Since time can be measured and expressed as an amount, it is called a **quantity**. Ten seconds, two minutes, and five hours are examples of quantities of time. Other familiar quantities that are important in chemistry include mass (similar to the more familiar *weight*), length, volume, temperature, and density.

The International System of Units

In 1960, a group of scientists from many fields and many countries agreed upon a set of metric units that would serve as a standard for scientific communication. This standard set of units is known as the **International System of Units** and is abbreviated **SI** (the abbreviation is derived from the French spelling *le Systeme International d' Unites*). Seven quantities are the foundation for SI, and each has a **base unit** in which that quantity is expressed. Table 1 lists the base units for length, mass, volume, temperature, time and chemical amount, along with their abbreviations and their relationships to common United States units.

Table 1.

Quantity	*U.S.*	*SI Base Unit*	*Chemistry*
Mass (weight)	Pound (lb)	Kilogram (kg)	"Gram" (**g**, mg)
Volume	Gallon (gal)	Liter (L)	"Liter" (**mL**, L)
Temperature	Fahrenheit (^{o}F)	Kelvin (K)	**K** & Celsius (**^{o}C**)
Length	Mile (mi), Feet(ft), Inches (in)	Meter (m)	"Meter" (**cm**, mm, nm)
Time	Second (s)	Second (s)	Second (s)
			Mole (mol)

SI Base Units Equivalents

Quantity	*Base Unit*	*Abbreviation*	*U.S. Equivalent*
Mass	kilogram	kg	2.205 pounds
Volume	liter	L	0.946 quarts
Length	meter	m	39.37 inches

Reading (Handout)

http://chemconnections.org/general/chem108/Math%20%26%20Measurement-2018.pdf

Adapted from ***Workshop Chemistry***

> *"A grasshopper walks into a bar. The bartender says, 'We've got a drink named after you.' The grasshopper replies, 'You've got a drink named Steve?'"*

Unit Conversions—Dimensional Analysis

It is necessary to convert a measurement from one system of units to another, particularly for citizens and residents of the United States. In spite of the fact that all other countries of the world and all scientists use the metric system to express measured quantities, the U.S. still clings to an archaic British system of measurement, which even Great Britain no longer uses, having replaced it with the metric system.

For example, when your physician prescribes medication, he or she needs to convert your body weight to kilograms because dosages are usually expressed as milligrams of medication per kilogram of body weight. To convert a quantity from one system of units to another, medical personnel, scientists, and engineers frequently use a procedure called dimensional analysis.

Measured quantities are always represented by a number and its associated unit, such as 1.9 pounds or 3.5 inches. If you think of the number as a factor that multiplies the unit, you can apply standard algebraic conventions when you convert a measured quantity from one system of units to another. For example, to convert 3.45 kilograms to pounds, you multiply the given unit, kilograms, by a conversion factor that algebraically cancels the kilogram unit and yields pounds. Here's the conversion:

$$3.45\text{ kg} \times \frac{2.205\text{ lb}}{1\text{ kg}} = 7.61\text{ lb}$$

Dimensional analysis works because the given unit is always multiplied by a conversion factor that is equal to one. The conversion factor comes from an equation that relates the given unit to the wanted, or desired, unit. For example, the equation

$$1\text{ kg} = 2.205\text{ lb}$$

defines the relationship between kilograms and pounds. If we divide both sides of this equation by 1 kg, we get a fraction that is equivalent to one:

$$\frac{1\text{ kg}}{1\text{ kg}} = 1 = \frac{2.205\text{ lb}}{1\text{ kg}}$$

The expression 2.205 lb/1 kg is a **conversion factor** that changes kilograms to pounds or vice versa. The "1 kg" quantity in this conversion factor is *exactly* 1 kilogram. Therefore when you

Reading (Handout)

http://chemconnections.org/general/chem108/WKS%20Reading%20Unit%20Conversion%20-%20Dimensional%20A.pdf

Converting squared or cubic units

- When using linear factors conversion factors to "square" or "cube" be sure to square or cube the factor

10 mm = 1 cm

e.g.) Convert 6.81 mm^2 to cm^2

From: 6.81 mm^2

To: cm^2

$$\frac{6.81\ mm^2}{1}$$

$$= 6.81 \times 10^{-2}\ cm^2$$

Converting to squared or cubic units

- When using linear factors conversion factors to "square" or "cube" be sure to square or cube the factor

e.g.) Convert 6.81 mm^2 to cm^2

$\boxed{10 \text{ mm} = 1 \text{ cm}}$

From: 6.81 mm^2 To: cm^2

$$\frac{6.81\ mm^2}{1}\left(\frac{(1\ cm)^2}{(10\ mm)^2}\right) = \frac{6.81\ mm^2}{1}\left(\frac{1^2\ cm^2}{10^2\ mm^2}\right)$$

$$= \mathbf{6.81 \times 10^{-2}\ cm^2}$$

Experiment 1 – Metric Measurement

Complete and record all measurements today.

Name: ____________

Section: ________

Report Form – Metric Measurement

Length and Area

1. Equipment Drawer			
	cm		m*
2. Large Test Tube			
	cm	m*	mm*
3. Crucible			
	cm	m*	mm*
4. Page			
	cm	m*	mm*
Area of Page (Show your calculations on the last page of the Report Form.)			
Length	Width	Area in cm²	Area in mm² & m²
cm	cm	cm²*	m²*
			mm²*

Show the calculations for each of the entries in the Data Table marked with * on the calculations page.

Volume

1. Largest Test Tube		
mL		L*
2. Crucible		
mL		L*
3. Smallest Test Tube		
mL		L*
4. 250 mL beaker–graduated cylinder readings		
mL	mL	mL
Total		
mL*		L*
5. 250 mL beaker–measured as a cylinder		
Height	Diameter	Radius*
cm	cm	cm
	Volume	cm³*

Show the calculations for each of the entries in the Data Table marked with * on the calculations page

Question: Why should the volumes be the same? Why aren't they the same?

Mass

1. Crucible	
g	mg*
2. Crucible Lid	
g	mg*
3. Crucible and Lid	
g	mg*
4. Sum of Crucible and Lid	
Crucible	g
Lid	g
Sum	g
5. Equipment Slip	
g	mg*

Show the calculations for each of the entries in the Data Table marked with * on the calculations page.

Have Dr. R. sign **individual** forms before leaving lab today.

Only your measurement data is due to be signed today.
Conversions and calculations due next lab.

Exp. 1 – Metric Measurement

Example of an acceptable set of student data, conversions, and calculations.
DO NOT COPY.
Use as a guide.

Volume

1. Largest Test Tube		
61.0 mL +/- 0.1 mL mL	0.0610 L +/- 0.0001 L L*	
2. Crucible		
31.0 mL +/- 0.1 mL mL	0.0310 L +/- 0.0001 L L*	
3. Smallest Test Tube		
10.05 mL +/- 0.01 mL mL	0.01005 L +/- 0.00001 L L*	
4. 250 mL beaker–graduated cylinder readings		
97.3 mL +/- 0.1 mL mL	92.9 mL +/- 0.1 mL mL	76.1 +/- 0.1 mL mL
Total		
266.3 mL +/- 0.1 mL mL*	.2663 L +/- 0.0001 L L*	
5. 250 mL beaker–measured as a cylinder		
Height	Diameter	Radius*
9.6 cm +/- 0.1 cm cm	7.0 cm +/- 0.1 cm cm	3.5 cm +/- 0.1 cm cm
	Volume	330.8 cm^3 +/- 0.1 cm^3 cm^3*

Show the calculations for each of the entries in the Data Table marked with * on the calculations page

1. $61.0\ \cancel{mL} \times \frac{1\ L}{1000\ \cancel{mL}} = 0.0610\ L$

2. $31.0\ \cancel{mL} \times \frac{1\ L}{1000\ \cancel{mL}} = 0.0310\ L$

3. $10.05\ \cancel{mL} \times \frac{1\ L}{1000\ \cancel{mL}} \Rightarrow 0.01005\ L$

4. $97.3 + 92.9 + 76.1 = 266.3\ mL$ +/- .1 mL

$266.3\ \cancel{mL} \times \frac{1\ L}{1000\ \cancel{mL}} \Rightarrow .2663\ L$

Adapted from ***Workshop Chemistry***

Name(s): ___________________________________

Worksheet: Units, Measurements, & Conversions

https://www.youtube.com/watch?v=hQpQ0hxVNTg&list=PL8dPuuaLjXtPHzzYuWy6fYEaX9mQQ8oGr&index=2 (11:23 min/sec)

1. How many significant figures are there in the following numbers?

   a) 42,000. L ______ b) 0.4010 g ______

   c) 0.00130 s ______ d) 405,700,000 km ______

2. Complete the table. Provide ordinary decimal form or scientific notation and the type of unit. The first line has been completed as an example for **mass**.

Ordinary Decimal Form	Scientific Notation
0.683 kg (mass)	**6.83×10^{-1} kg**
1365 mL ( )	**mL**
( )	**1.034×10^{1} m**
0.00350 µs ( )	**µs**
( )	**1.75×10^{-3} cm^3**
1,605,000 nm ( )	**nm**

3. How many significant figures in the numeric value would be appropriate for each of the following values using the specified units?

   The speed of a car in miles per hour as read from a speedometer when traveling at the speed limit on Viking Drive (25 mph).

   Your weight using lbs.

4. Using your height in feet and inches convert to (a) centimeters (cm), and (b) meters

Worksheet (Handout): Due next lab. Collaboration is encouraged. Turn in one with the names of all contributors.

http://chemconnections.org/general/chem108/Math%20%26%20Measurements-WKS.f18.pdf

Name(s) ___________________________________

Workshop: Dimensional Analysis

In this workshop, we will use a group problem-solving method called a round robin. The round robin method helps people to work together and feel comfortable with group problem solving.

Round Robin Instructions

1. Each group member will be assigned a number, starting with #1 and ending with the number of people in the group.

2. Student #1 will read the question aloud and define the information needed to solve the problem, Sep #1 in the outline.

3. When the group agrees that the necessary information is complete, student number two will do the first mathematical step, Step #2 in the outline.. When the group agrees that the step is correct, student number three will do the next step. Continue this way until the group agrees that the given unit has been correctly converted to the wanted unit.

4. Student #2 will start the next question by reading it aloud as in #1. Follow this pattern for all of the questions in the workshop.

Questions

Use dimensional analysis and the group round robin to answer each question. Record your solutions and notes in the spaces provided on this worksheet. Turn-in the worksheet when

OPTIONAL: Chem 120, General Chemistry Level Workshop/ Worksheet (Handout)
http://chemconnections.org/general/chem108/WKS%20Unit%20Conversion%20-%20Dimensional%20A.pdf

Answers will not be provided; see Dr. R. with any questions after attempting the Worksheet's problems