

Doing: Lab Experiments

Safety Chem 108: Lab

(Video & Handout)

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

Names: _____ **Sign in: Roster @ front of lab**

I. Answer the following in a complete sentence based on common sense and the Safety Video: (If not sure simply write: Not sure.)

1. What is the safest way to pour liquids that are stored in bottles?

2. What should be done with any excess chemicals from your experiments?

3. What are 2 ways of heating a test tube?

4. What may you eat or drink in the lab?

5. When must safety glasses be worn in lab?

7. What should you do if you spill chemicals on the lab bench? on your skin?

8. What should you do if your clothes catch on fire? if it is your lab partner's?

a. broken glass

b. broken bottles

c. chemical waste

d. acids

10. Complete the following map of the lab. Mark your lab station with an X. Identify on the map the following items.

fire blanket, fume hoods, fire alarm,



Open Lab Drawer

Select a partner to work with

for today's lab experiment








Turn in:

completed safety handout before beginning experiment.

Monday

Wednesday

CHEM 108

Week 2	Lab Notes:	
	 <p>Lab 2102-2116.2:</p>	
	<p>Discussion, Experiments & Graded Assignments:</p>	
	 <ul style="list-style-type: none"> • Must have DVC Lab Manual TODAY 	
	 <ul style="list-style-type: none"> • Must have eye protection TODAY 	
	<ul style="list-style-type: none"> • 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 	<p>Discussion, Experiments & Graded Assignments:</p>  <ul style="list-style-type: none"> • Must have DVC Lab Manual TODAY  <ul style="list-style-type: none"> • Must have eye protection TODAY <ul style="list-style-type: none"> • 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
	 <p>Experimentation:</p> <ul style="list-style-type: none"> • <i>Doing</i>: Laboratory Manual <i>Metric Measurement pp. 9-11</i>; 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) • <i>Reading</i> (HANDOUT pdf): Mathematics & 	 <p>Experimentation:</p> <ul style="list-style-type: none"> • <i>Doing</i>: Laboratory Manual <i>Metric Measurement pp. 9-11</i>; 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) • <i>Reading</i> (HANDOUT pdf): Mathematics & Measurement • WORKSHEET (HANDOUT pdf): Units,

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.

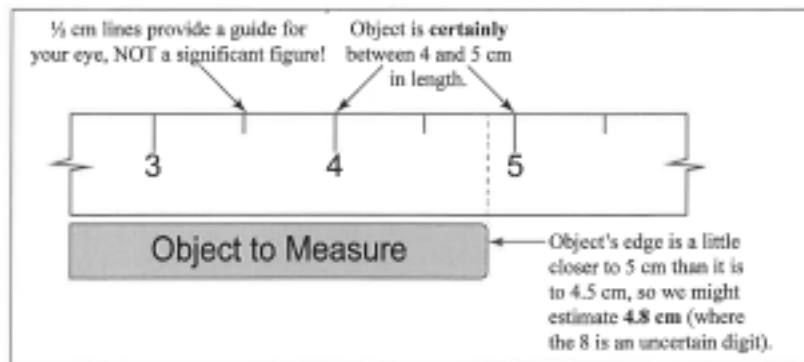


Figure 1. Using the centimeter ruler

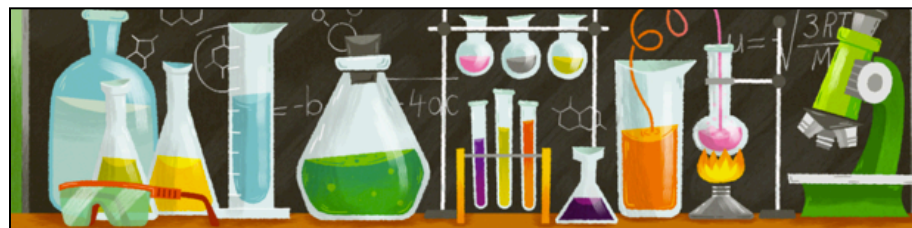
Getting accurate volume readings from a graduated cylinder can be tricky at first. Your 50 or 100 mL graduate is calibrated in 1 mL increments, i.e., each line represents 1 mL. However, by careful reading between the lines, volumes can be estimated to the nearest 0.1 mL. Similarly, your 10 mL graduate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

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

Must be submitted before noon Friday to receive any credit.

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-f19.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.

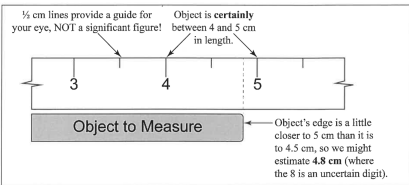


Figure 1. Using the centimeter ruler

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
2. Large Test Tube			
	cm	m ²	mm ²
3. Crucible			
	cm	m ²	mm ²
4. Page			
	cm	m ²	mm ²
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])

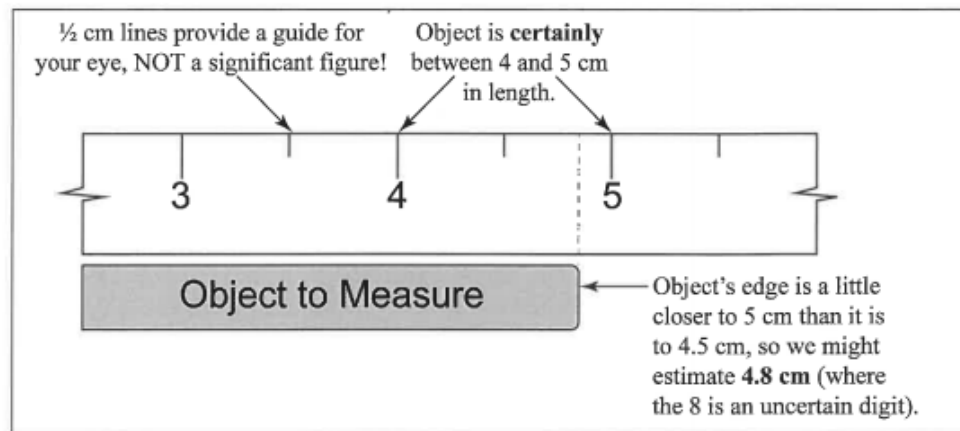
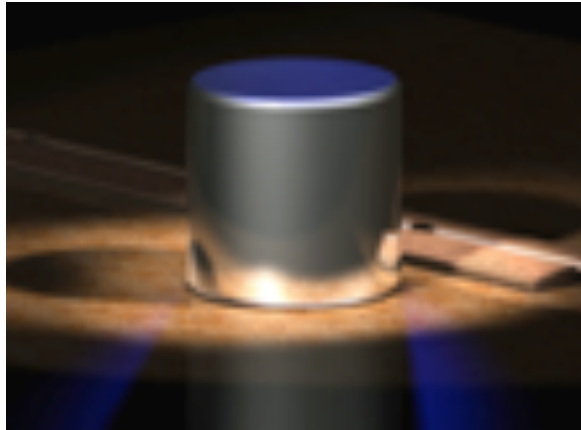


Figure 1. Using the centimeter ruler


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 **REPORT FORM**, write your name first & then your partner's in (_____)



Name: _____ S. Curry (D. Green)

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.

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

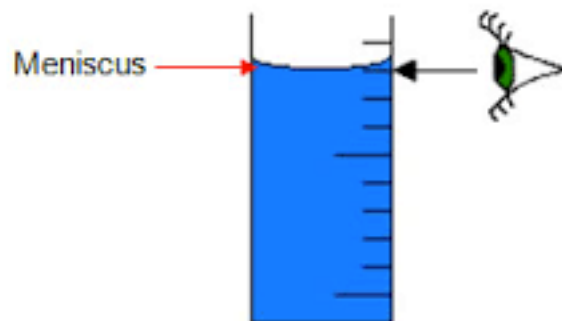
Mass Measurement with an Electronic Balance:



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

Exp. 1 – Metric Measurement

Volume Measurement (Liquids)

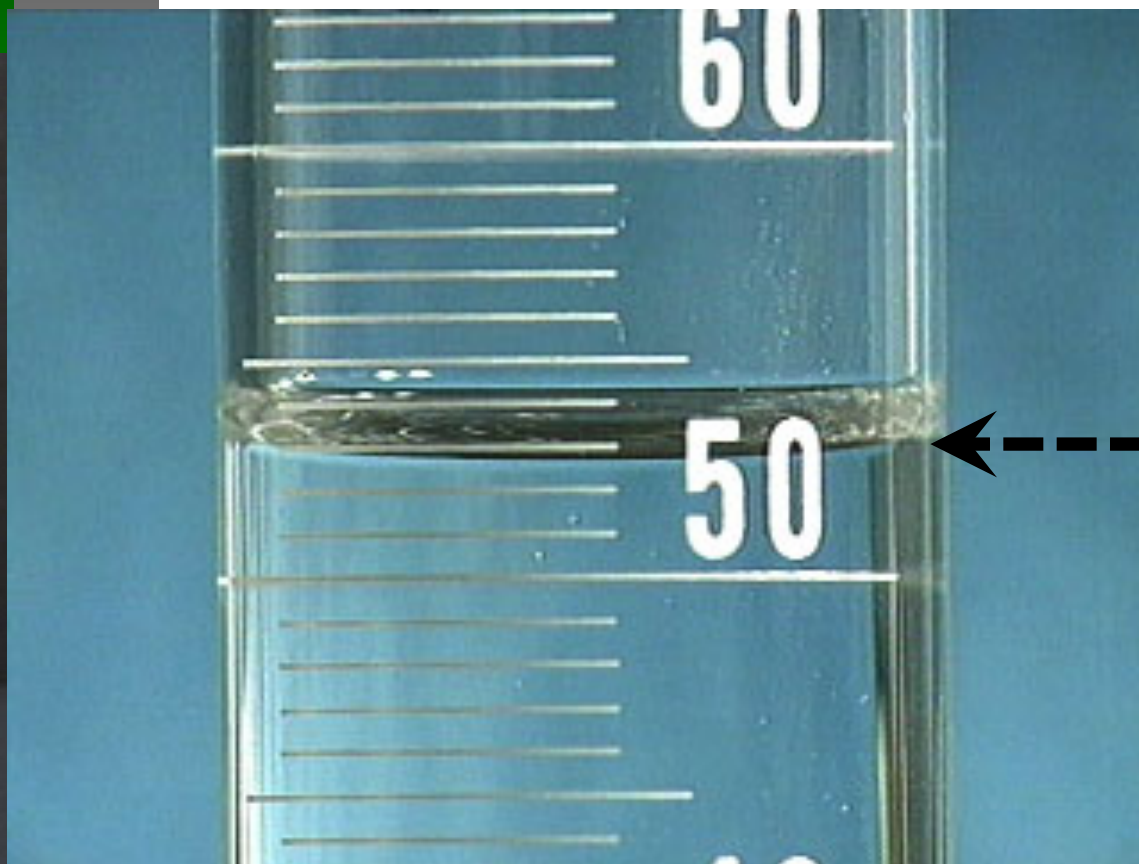


Measure at the
*bottom of the
meniscus at eye
level*

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.*

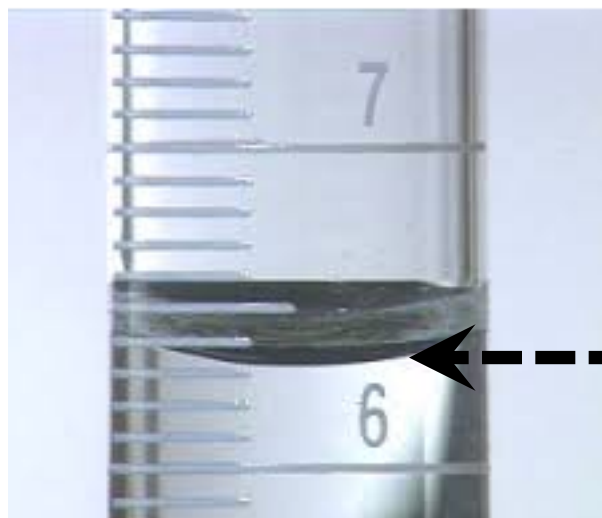
Report this measurement as?

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*

meniscus

Report this measurement as?

6.31 mL

*Take out the
cylinder; pour
some water into it.*

*What is the volume
of water in your
cylinder?*

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 **6.30** mL is ok if the meniscus is viewed to be exactly on the mark.



- Estimating to **6.31** mL is also ok if the meniscus is viewed to be off the mark.

Report: **6.30 +/- 0.01** mL

Report: **6.31 +/- 0.01** mL

5300. mL
5300 mL
0.01 kg
0.0100 kg

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 _____

5.300×10^3 mL
 5.3×10^3 mL
 1×10^{-2} kg
 1.00×10^{-2} kg

Worksheet (Handout): **Working with your partner, complete questions 1-4.** Collaboration is encouraged; you may “confer” with other partners.

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

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

Completed Worksheets due next week.

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 (m). Complete the dimensional set ups below.

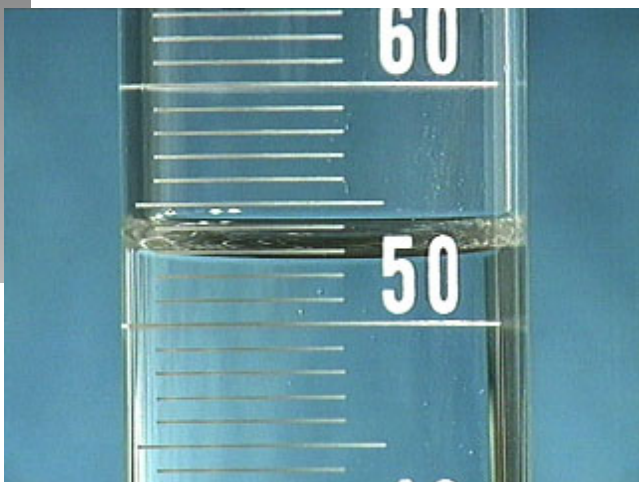
(a)
$$\frac{? \text{ ft}}{1 \text{ ft}} \times \frac{12 \text{ in}}{1 \text{ in}} + \frac{2.54 \text{ cm}}{1 \text{ in}} \times \frac{? \text{ in}}{1 \text{ in}} =$$

(b)
$$\frac{? \text{ cm}}{1 \text{ cm}} =$$

Exp. 1 – Metric Measurement

Measurement with a Graduated Cylinder:

100 mL Graduated Cylinder



10 mL Graduated Cylinder



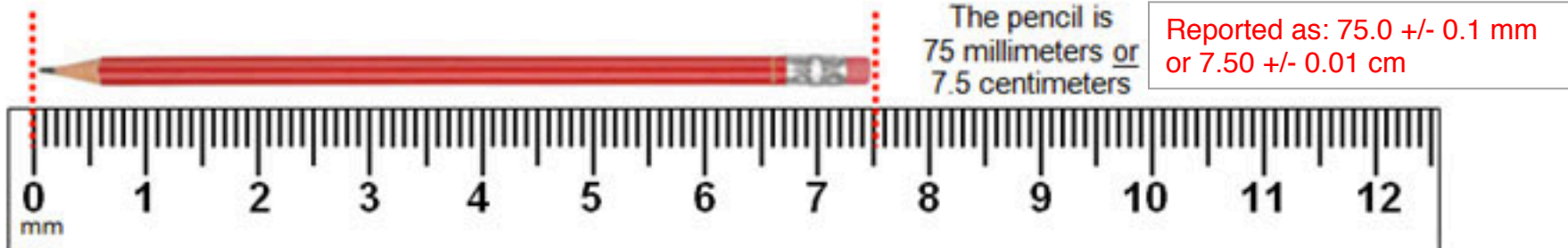
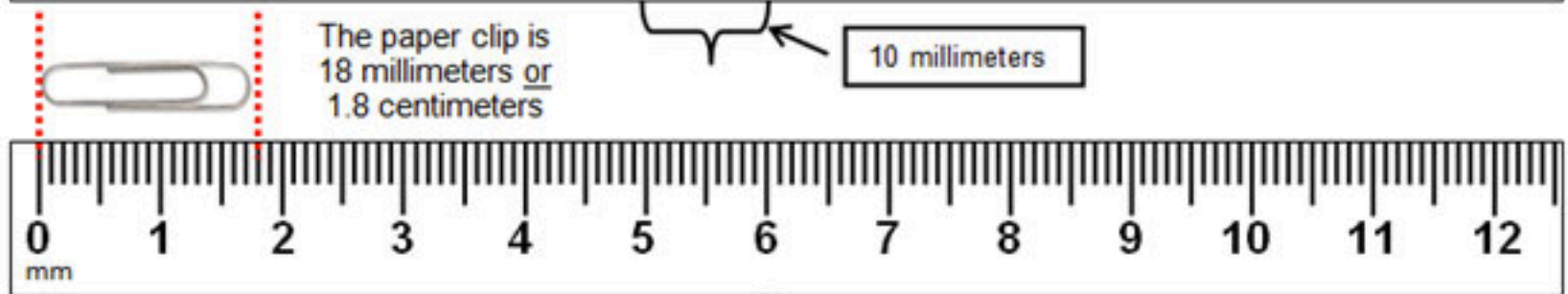
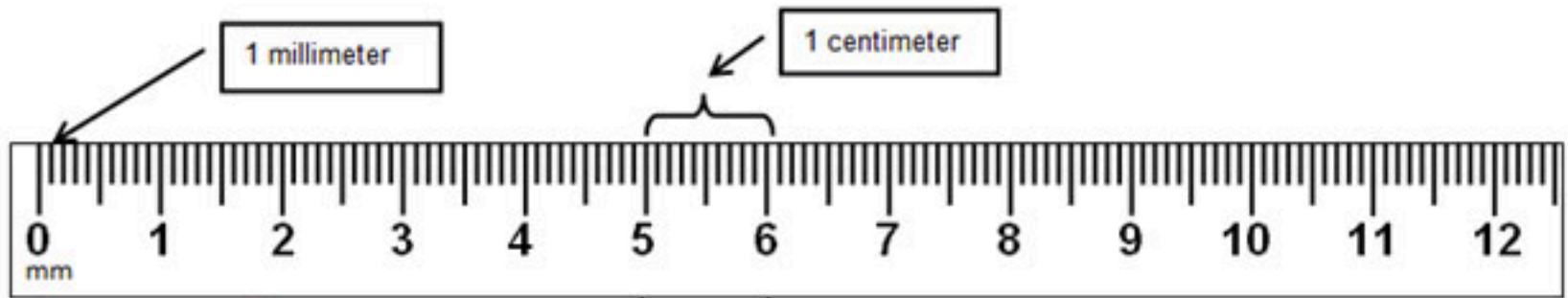
Measurement: $52.9 \pm 0.1\text{mL}$

Measurement: $6.31 \pm 0.01\text{mL}$

- 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)



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.

<i>Quantity</i>	<i>U.S.</i>	<i>SI Base Unit</i>	<i>Chemistry</i>
Mass (weight)	Pound (lb)	Kilogram (kg)	"Gram" (g, mg)
Volume	Gallon (gal)	Liter (L)	"Liter" (mL, L)
Temperature	Fahrenheit (°F)	Kelvin (K)	K & Celsius (°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

<i>Quantity</i>	<i>Base Unit</i>	<i>Abbreviation</i>	<i>U.S. Equivalent</i>
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>

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 μ s ()	μ s
()	1.75×10^{-3} cm ³
1,605,000 nm ()	nm

Worksheet (Handout): **Working with your partner, complete questions 1-4.** Collaboration is encouraged; you may “confer” with other partners.

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

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

Completed Worksheets due next week.

"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>

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?

Worksheet (Handout): **Working with your partner, complete questions 1-4.** Collaboration is encouraged; you may “confer” with other partners.

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

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

Completed Worksheets due next week.

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 (m). Complete the dimensional set ups below.

(a)
$$\begin{array}{c|c|c|c} ? \text{ ft} & 12 \text{ in} & 2.54 \text{ cm} & ? \text{ in} \\ \hline & 1 \text{ ft} & 1 \text{ in} & \end{array} + \frac{\quad}{\quad} =$$

(b)
$$\frac{? \text{ cm}}{\quad} =$$

Converting squared or cubic units

➤ When using linear factors conversion factors to “square” or “cube” be sure to square or cube the factor

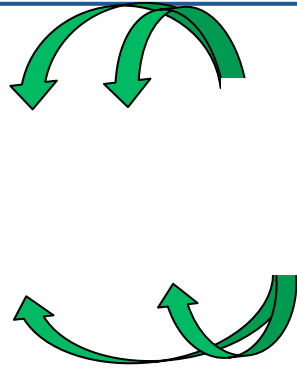
e.g.) Convert 6.81 mm^2 to cm^2

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

From: 6.81 mm^2

To: cm^2

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



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

Converting to squared or cubic units

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

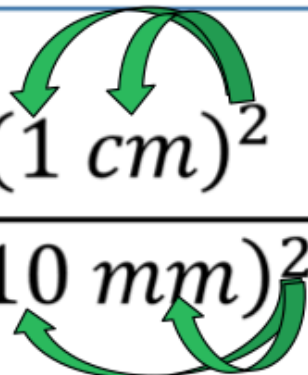
e.g.) Convert 6.81 mm^2 to cm^2

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

From: 6.81 mm^2

To: cm^2

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



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

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 cm ²	Area in mm ² & m ²
cm	cm	cm 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		g	mg*
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 \pm 0.1 mL mL	0.0610 L \pm 0.0001 L	L*
2. Crucible		
31.0 mL \pm 0.1 mL mL	0.0310 L \pm 0.0001 L	L*
3. Smallest Test Tube		
10.05 mL \pm 0.01 mL mL	0.01005 L \pm 0.00001 L	L*
4. 250 mL beaker—graduated cylinder readings		
97.8 mL \pm 0.1 mL mL	92.9 mL \pm 0.1 mL mL	76.1 \pm 0.1 mL mL
Total		
266.3 mL \pm 0.1 mL mL*	.2663 L \pm 0.0001 L	L*
5. 250 mL beaker—measured as a cylinder		
Height	Diameter	Radius*
4.6 cm \pm 0.1 cm cm	7.0 cm \pm 0.1 cm cm	3.5 cm \pm 0.1 cm cm
	Volume	330.8 cm ³ \pm 0.1 cm ³ *

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

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

$$2. \frac{31.0 \text{ mL}}{1000 \text{ mL}} = 0.0310 \text{ L}$$

$$3. \frac{10.05 \text{ mL}}{1000 \text{ mL}} \Rightarrow 0.01005 \text{ L}$$

$$4. 97.3 + 92.9 + 76.1 = 266.3 \text{ mL} \pm 0.1 \text{ mL}$$

$$\frac{266.3 \text{ mL}}{1000 \text{ mL}} \Rightarrow 0.2663 \text{ L}$$

Name(s): _____

Worksheet: Units, Measurements, & Conversions

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

- How many significant figures are there in the following numbers?
 - 42,000. L _____
 - 0.4010 g _____
 - 0.00130 s _____
 - 405,700,000 km _____
- 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 μ s ()	μ s
()	1.75×10^{-3} cm ³
1,605,000 nm ()	nm

Worksheet (Handout): **Working with your partner, complete questions 1-4.** Collaboration is encouraged; you may “confer” with other partners.

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

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

Completed Worksheets due next week.