Investigating MEASUREMENT Tools & Techniques

Name:_____ **Block:** _____
Group Members:_____ **Date:** ____/____/____

Objective: To investigate…._____

Criteria	Student Self Evaluation	Teacher Assessment
Objective: Clearly states the aim of the experiment and briefly outlines the related theory	/2	/2
Data, Results & Calculations: *(hand written neatly)* Provides results/observations (and diagrams where appropriate) that are presented in correctly annotated tables and/or graphs	/12	/12
Follow-up Questions: *(hand written neatly)* Correctly identifies and explains the theory relating to the experiment and supports this with accurate observations	/7	/7
Conclusion: *(hand written neatly)* Identifies and defines important concepts and principles relevant to the experiment by relating back to the aim and hypothesis.	/3	/3
Presentation: Practical report is presented neatly, is written using appropriate scientific language and provides appropriate and accurate unit measures.	/2	/2
Safety: *(teacher assessed during practical lab work)* Demonstrates an organized and safe approach to experimental work	/2	/2
Punctuality: Student hands in a completed report on the due date.	/2	/2
Results Summary	/30	/30

Procedure: Individual instructions for each measurement station are included in the following pages.

*NOTE: all data, observations and **calculations** are to be completed in this booklet.*

Lab Station #1: Mystery Volume

Procedure: *At your table you should have a* ***small Plastic cup****, and a* ***test tube****, as well as several pieces of laboratory equipment that can be used to measure.*
Estimate, then find, and record their volumes, as accurately as possible, in the table provided in your student handout. Be sure to ***select the measuring tools carefully*** *and use only the equipment provided at your lab bench.*

Hint: note that you have a faucet and sink to help with this task.
REMINDER*: clean up any and ALL SPILLS!*
Leave the station exactly as you found it!

PART I:

Table 1: Mystery Volume *(be sure to include ± uncertainty when appropriate)*

Container	Equipment used	Estimated Volume (____)	Measured Volume (____)
Plastic Cup			
Test Tube			

PART II:

How many drops of water does it take to equal 1 mL?

To find out, fill a plastic pipette with tap water and figure out how many drops it takes to fill a small (10 mL) graduated cylinder **to the 1 mL mark**.

Hint: Don't forget to read the meniscus at eye level.

From this information, calculate how many mL each drop is, too!

Drops per 1 mL = _____ **Volume per drop = _____mL**

Lab Station #2: How to read a burette

Procedure: *At your table you will see two burettes filled to a specific volume. Be sure to change your point of view to "eyelevel" so you can precisely read at the bottom of the meniscus. Burettes are numbered from 0 starting at the top (highest point) of the burette. Reading the scale from top to bottom, record the initial volume of both the RED and the BLUE liquids in Table 2 below. Using the tap at the base of the burette,* ***dispense 20 drops of the red solution*** *and* ***10 drops of the blue solution*** *into the flask below. Record the new volume in Table 2 below. Calculate the total volume dispensed from each burette and record in Table 2. Based on your total volume dispensed, calculate the volume of 1 drop.*

Hint: turn the tap ***very*** *slowly in order to count drops*
REMINDER*: clean up any and ALL SPILLS!*

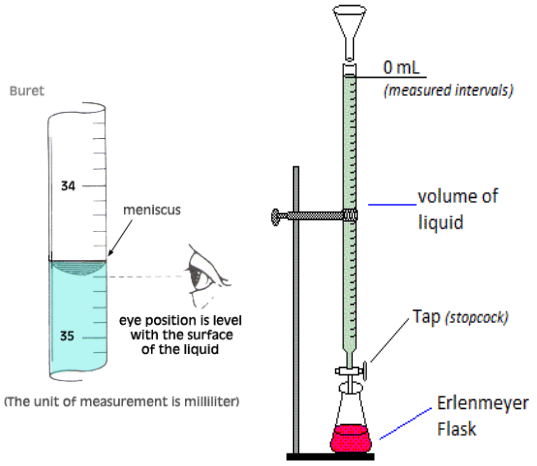

Fig 1. Burette Diagram

Table 2: How to read a burette *(be sure to include ± uncertainty)*

	RED burette (50mL)	**BLUE** burette (50mL)
Initial volume		
Final volume		
Volume dispensed		
Volume per drop		

Lab Station #3: Recording mass on a scale

Procedure: *At your table you will see various items: watch glass, rubber stopper, binder clip, cork, solution bottle, and square. Measure and record the mass of the objects, compare to the actual mass and calculate the percent error. Record all data in Table 3 below.*

$$\% \text{ Error} = \left| \frac{\text{measured - accepted}}{\text{accepted}} \right| \text{x100}$$

Hint: When you have finished your measurements, check with your teacher for the ***actual mass*** *values.*
Table 3: Comparing Masses

	Measured Mass (___)	**Actual Mass** (___) *(ask your teacher for these values)*	**Percent Error Calculation**
Watch glass			
Rubber stopper			
Cork			
Eraser			
Post It Note			
50 mL of H_2O			

Lab Station #4: Recording SI Length

Procedure: *At your table you will see various items. Measure and record the length of the objects, using SI metric units. Compare to the actual length and calculate the percent error. Record all data in Table 4 below. BE SURE TO INCLUDE UNITS!*

$$\% \text{ Error} = \left| \frac{\text{measured - accepted}}{\text{accepted}} \right| \text{x100}$$

*Hint: When you have finished your measurements, check with your teacher for the **actual length** values.*

Table 4: Comparing Length

	Measured Length	**Actual Length** *(ask your teacher for these values)*	**Percent Error Calculation**
Width of classroom door			
Side length of stamp			
Length of pen			
Width of lab bench			
Length of a paper clip			

Lab Station #5: Temperature

Procedure: *At your table you will see a thermometer. Record the following temperatures in your lab environment. In each case, allow the bulb end of the thermometer to remain in or on the sample for a minimum of 30 seconds before taking a reading.* ***Make sure you read the analog & digital thermometers at the SAME TIME to produce a fair test.*** *Otherwise your percent error calculations all ready will have an experimental error.*

REMINDER*: never set the thermometer down on your bench, it may roll off!*

Table 5: Things are heating up

Object	**Temperature (___)**		**Percent Error Calculation**
	Analog	**Digital** *(treat as "actual" measurement)*	
Room Temperature *(air)*			
Cold tap water			
Warm tap water			
External Temperature *(outside window)*			

Lab Station #6: Rainbow of Graduated Cylinders

Procedure: *At your table you will see five graduated cylinders set up containing various colours of liquid. Accurately read the measured values and record your results in Table 6 below. Be sure to also calculate and consider the* ***uncertainty*** *of each measure-careful, it's not the same for each scale!*

Hint: make your measurements precise by reproducing your reading- more than one group member should be reading & recording!
REMINDER*: don't forget about the meniscus!*

Table 6: Graduated Cylinder

Graduated Cylinder	10 mL	25 mL	50 mL	100 mL	500 mL
Volume (___)					
Value of smallest increment (____)					
10% Uncertainty (+/-)					

Follow-up questions:

1. If a student was asked to measure **54.3 mL of liquid**, what size(s) of graduated cylinder should they use?_____
2. If a student was asked to measure **436.8 mL of liquid**, what size(s) of graduated cylinder should they use?_____
3. Which size of graduated cylinder is ***most*** *precise? Why?*_____
   _____
4. Which size of graduated cylinder is ***least*** *precise? Why?*_____
   _____
5. Define the term **meniscus** and **explain** how this is related to reading a measurement on a graduated cylinder._____
   _____

Follow-up Questions:

6. Comment on your accuracy of measuring various masses in ***STATION #3.***

7. In **STATION #4** you measured several lengths in SI units, comment on your overall accuracy of measure. *(hint: consider equipment used)*

Conclusion: *(2-5 sentences. Your conclusion should briefly explain the experiment, reflect your experimental objective & discuss reasonable sources of error in the experiments)*

- ***Link to experimental objective***
- ***Identify and define key concepts related to the experiment***
- ***Present reasonable sources of experimental error***