**Comparing Units**

**Shape \_\_\_beaker**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Volume (mL),  x | Height  (cm) | Calculated Volume (cm3),  y |
| 1 | 100 | 2.4 | 96.25 |
| 2 | 150 | 3.9 | 146.3 |
| 3 | 200 | 4.5 | 196.35  This is the maximum value of y or y-maximum |
| 4 | 250 | 5.1 | 240.62 |
| 5 | 300 | 6.2 | 289.135 |

**y = 0.9602x + 1.695**

**b = 1.65**

The slope and y intercept comes from the graph on the TI Nspire calculator. You don’t need write the line equation on the graph.

**The y-intercept \_ \_\_\_\_\_\_\_less than 5% of the maximum value of y.**

**(In this example: The y intercept is less than 5% of the maximum value of y.)**

**y = 0.9602x + 0 *or* y = 0.9602x**

**(**

**Explanation: If b ( the y intercept) < 5% of the maximum y value your y-intercept (b) *can be changed to zero* because a value for the y intercept that is less than 5% of the y-maximum value is negligible. Rewrite your linear equation so that b = 0 as shown above. )**

***More Explanation about the 5% rule and the y-intercept (see the graph & data table on page 1)***

**1. Write the linear equation of the trend line from the TI Nspire calculator:**

**below the data table:**

**example: y = 0.9602x + 1.695**

**2. Sketch the graph of the TI-Nspire and include the the origin (0,0) and label the y intercept on the graph (see example above).**

**3. Do the 5% rule test: multiply the largest y value (see Monday’s Bell work) by 0.05. Is your y-intercept (b) from the linear equation from your graph greater or less than 5% of your largest y value?**

* + **example from data above: 5% x 289 = 0.05 x 289 = 14.45**
  + **b = 1.695, 1.695 < 14.45**

**If the y intercept is less than 5% of the maximum value of y, then we can say the value of the y intercept in negligible *and we can assign a zero value to the y intercept*.**

**4. Write the following and fill in the blank with either is or is not:**

**The y-intercept \_\_\_\_\_\_\_\_less than 5% of the maximum value of y.**

* **In our example above, 5% of 289 = 14.45. Our y-intercept of 1.65 is less than 14.45 so we will write:** 
  + **The y intercept is less than 5% of the maximum value of y.**

**5. If b (the y intercept) < 5% of the max y value rewrite your equation y = mx (fill in value of m) below your statement about the 5% from above.**

**Example: y = 0.9602x + 0 *or* y = 0.9602x**

Conclusion

1. Address the question or purpose of your experiment.

***The purpose of this investigation is to relate the volume of a container (in cm3) to the volume of liquid it contains (in mL).***

1. **Explain how you obtained the volumes in your data table.**

***We measured liquid volumes in mL with a graduated cylinder. We measured the height and multiplied by the area. The formula for the volume of a \_\_\_\_\_\_\_\_\_\_ is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.***

1. State the results (how the independent variable affected the dependent variable).

***According to our data 1 mL = \_\_\_\_\_\_\_ cm3. If this value is rounded off to two significant figures, 1mL = \_\_\_ cm3.***

Fill in the first blank with the value of the slope from the line on your graph. Any value between 0.95 – 1.04 rounded to 2 sig fig equals 1.0; if you have slopes less than 0.95 or greater than 1.04, you need to explain what went wrong with your measurements.

1. Support your group’s results with some of the evidence listed below. Explain how your results are consistent with:
   1. The data – trends in the data; Range of independent variables (was it large enough and was it a sufficient range for this experiment) and consistency of the independent values (could you reproduce the data and does this give you confidence in your ability to make conclusions).

***The range of IV was large enough (from \_\_\_ - \_\_\_\_) but we only did one trial so we do not know if we could reproduce the data. The class histograms showed to us give us confidence that your data showed that 1mL = 1cm3, because the slope on our graph is 0.95 -1.04 and you y intercept is > 5% of the greatest value of y.***

***(Otherwise you must say you do not have confidence that you could conclude 1mL = 1 cm3.)***

b. State important observations (especially if you made mistakes).

1. What did you learn?

***The true value of 1 mL = 1cm3. We also learned how determine when data is negligible (the 5% rule) and how significant figures can change the outcome of the results.***

1. Why is that important?

***In order to make conclusions we need methods to look at the results and interpret data tables and graphs***

1. State and explain the errors that were due to the way you did the experiment and due to the precision of the measuring instruments (ruler & graduated cylinder).

***State the errors (paper rulers curling up, hard to read in water, hard to measure the water in plastic shapes because of the way you had to line up the zero mark on the ruler on the correct spot on the plastic shapes). Explain about any other errors you made that affected your results. State the uncertainty of your measuring instruments. The uncertainty can cause a measurement error of plus or minus (±) the value of the uncertainty. Most of you measured with the ruler using 1 decimal place so the uncertainty or error was ± 0.5 cm. This means any measurement you took with the ruler could be 0.5 cm greater than what you reported or 0.5 cm less than you reported.***

***If you measure a line that is 5 cm long and your uncertainty is 0.5 cm, your error due to the precision of the ruler (precision is uncertainty) is 0.5/5 x100 = 10%!!! If you measure a line that is 5000 cm long (approximately 50 yards)your uncertainty due to the precision of the ruler is 0.5/5000 x 100 = 0.01%***

***The uncertainty is for the cylinder was ±* ½ of minor mark:**

**100 ml graduated cylinder, 1 ml minor marks, uncertainty of ± 0.5 ml**

**250 ml graduated cylinder, 2 ml minor marks, uncertainty of ± 1 ml at**

**500 ml graduated cylinder, 5 ml minor marks, uncertainty of ± 2.5 ml at**

**1000 ml graduated cylinder, 10 ml minor marks, uncertainty of ± 5 ml at**

1. What would you do differently next time? Why? (If you mention errors be specific about what caused the errors). Explain how you would do the experiment differently so these errors did not occur.

***Explain how you would do the experiment differently so these errors did not occur.***

***Example: we would put spacers under the plastic shapes so that the shape would high enough of the table so that the rule could be resting on the table and the zero line on the ruler would line up with the bottom of the water in the shape. We would find a more precise measuring instrument than a ruler to measure the height of the water.***

***Example: We would not use a beaker for a small cylinder because the beaker is curved at the bottom and the base (the bottom of the cylinder is not flat). Also, we would find another way to measure the height of the water that did not involve placing the ruler in the water. The paper ruler becomes saturated with water and curls up making the measurements inaccurate. Also, placing the ruler in the water causes refraction and makes the measurement very difficult to read.***

***BE SURE TO DISCUSS ANY ERRORS YOUR LAB GROUP MADE!!!!!***

**RUBRIC, 100 points**

**Results, 35**

1. **Data table is complete. 10 points**
2. **Write the linear equation of the trend line from the TI Nspire calculator. 5 points**
3. **Sketch the graph of the TI-Nspire and include the origin (0, 0) and label the y intercept on the graph. 15 points**
4. **Statement of the 5% test & linear equation rewritten if b< 5%. 5 points**

**Conclusion**

1. **Address the question or purpose of your experiment. 5 points**
2. **Explain how you obtained the volumes in your data table.** 
   1. **measured liquid volumes in mL with a graduated cylinder. 2 points**
   2. **measured the height and multiplied by the area. 2 points**
   3. **The formula for the volume of a \_\_\_\_\_\_\_\_\_\_ is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. 6 points**
3. **State the results (how the independent variable affected the dependent variable). 5 pt.s**
   1. **Use the slope to show how many cm3 = 1 mL**
   2. **Round off the slope to two significant figures.**
4. **Support your group’s results statement with the evidence (range of IV values, data reproducible?, analysis of the graph. What is the significance of the slope & y-intercept)? Does the 5% test show your y-intercept is negligible? Is your slope within 5% of 1? 10 points**
5. **What did you learn & why is this important. 5 points**
6. **State and explain the experimental errors. 10 points**
7. **State the precision of your measuring instruments using plus or minus (±) the uncertainty. 10 points**
8. **How would you improve the experiment? 10 points**