**Lab 3 – Determination of the relationship between the surface area of a piece of paper and the diameter of a ball made with it**



**Objective**

To practice and revise how to collect data, calculate averages, understand precision, make graphs, interpret results, assess and evaluate the method.

**Materials**

* two sheets of paper of the same size (from your notebook)
* 50 cm ruler
* Vernier caliper
* millimeter paper

**Procedure**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sheet of paper | Length (unit) | Height (unit) | Surface area (unit) | Diameter with ruler (unit) | | | | Diameter with Vernier caliper (unit) | | | |
|  |  |  |  | Trial 1 | Trial 2 | Trial 3 | Average | Trial 1 | Trial 2 | Trial 3 | Average |
| 1 |  |  |  |  |  |  |  |  |  |  |  |
| 2 |  |  |  |  |  |  |  |  |  |  |  |
| 3 |  |  |  |  |  |  |  |  |  |  |  |

1. Make table in your lab notebook like the one below: Remember to give it a title and include the units.
2. Fold one of the sheets exactly in two and cut it on the line. Repeat this with one of the halves you have.
3. Record the the length and width of each piece of paper with a 50 cm ruler in a table. **Make sure to include all the significant figures.**
4. Calculate the surface area and record it in the same table. THINK OF THE UNITS!!!
5. Make a ball with each paper and measure its diameter with the ruler 3 times each. (Record all data in your table).
6. Calculate the average diameter for each ball.
7. Measure now the balls using a Vernier caliper.
8. Calculate the average diameter for each ball.
9. Plot two graphs of your results (diameter versus the surface area) on millimetre paper. Don’t forget to label the axes (name and unit), to write a title and to include the line of best fit. Make sure the scale of the graph is appropriate.

Graph 1: results obtained with the ruler.

Graph 2: results obtained with Vernier caliper.

**Calculations**

**Questions**

* Which of your measurements are based and which are derived quantities?
* Look at your ruler and the Vernier caliper and try to determine the error of both.
* Which instrument is more precise?

**Conclusion**

* Describe your graph and write a conclusion showing the possible correlation that might exist between surface area of the paper and diameter of the paper ball.
* Are your results precise? Are they reliable? Briefly outline.

**Evaluation** (Here we want you to think about the procedure or method).

* Go through each step of the procedure in this experiment and consider if there are any possible errors associated with it.
* List a minimum of 2 improvements that could be made in order to obtain better and more reliable data.

|  |  |
| --- | --- |
| Error sources | Improvements |
|  |  |