Atomic Structure

Pre-Lab Assignment -20pts

Directions:

- Read entire lab before you begin Pre-Lab assignment
- **Create data table for the teacher approval checkpoints. Include the # of the check-off along with a one or two word description. Example #6 (Area of paper)**

The second page begins the Pre-lab: Follow the steps below and label each Heading of the pre-lab

Title of lab **and unit (Atomic Structure)**

- Definitions: "Define" the following terms: atom, nucleus, electron cloud,
- Read through entire the lab and list the "key points" as related to data collecting
- Purpose: In a sentence, write the purpose of the lab.
- Procedure: In a numbered list write what you will be doing.
- Preliminary Questions: Write and answer the preliminary question.
- Create as data table (in your your lab notebook) based on the data you are collecting .
- Have your teacher initial your pre-lab before you begin the lab.

Preliminary question

1. You are given a piece of paper with many circles drawn on it. Each circle has the same radius. You know the dimensions of the paper. Without using any measuring devices, explain a process with which you could determine the radius of one of the circles?

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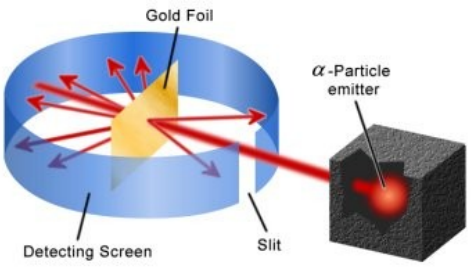

In 1911, British physicist Ernest Rutherford and his colleagues, Hans Geiger and Ernest Marsden, bombarded a thin sheet of gold foil with tiny alpha particles. Most of the alpha particles passed through the foil and hit a screen behind it. But to their surprise, some of the particles bounced back. They must have hit areas of the foil that were more dense! From these results, Rutherford hypothesized that an atom must be made up mostly of empty space allowing most of the alpha particles to pass through the foil. In the center of the atom, he suggested, there was a tiny core called a nucleus, where most of the atom's mass could be found. In the gold foil experiment, the alpha particles that hit the nucleus of an atom of gold bounced back.

Rutherford and his colleagues set up a ratio of alpha particles that bounced back to total alpha particles. This allowed them to estimate the amount of space taken up by the nucleus in a gold atom,. In this investigation, you will use a similar technique to measure the radius of a circle.

Procedure:

1. Pick-up your Mission Folder from the designated drop point.
2. Place the circle-sheet (exactly 8.5 in by 11 in) face up inside your carbon paper. It should replace the tissue paper.
3. Lay the carbon paper on your table and tape it down in order to hold it in place.
4. Choose one person to act as the first "dropper." The other group members will serve as the "catchers." You will switch roles after 25 drops.
5. The "dropper" should hold the marble about 20 cm (the width of a piece of paper) above the carbon paper. You will drop the marble onto the paper. Be sure to catch the marble before it bounces. This ensures that each drop of the marble will make only one mark on the paper. The impact of the marble will cause the carbon paper to make a mark on the circle sheet. Your goal is to evenly distribute the impact marks on the paper. Later you will use the impact marks to assist in solving for the radius.
6. Drop the marble 25 times. Try to spread the drops around the paper. If the marble misses the paper, repeat the drop. Switch roles, and repeat the procedure. Continue this process until 100 successful drops have been completed.
7. **You may now ask Agent SAM for a marble.**

Mission 1 Analysis - Complete in your training notebook

1. Remove your circle-sheet from the carbon paper. Discard the carbon paper.
2. Count the total number of impact marks on the paper. Do not include those that bleed off the edge of the paper. **Record your data** on your data sheet. Yes you should make one in your notebook.
3. Count the number of marks that are completely within a circle. Do not include those that touch the edge of the circle. **Record your data** on your data sheet.
4. Convert (show unit cancellation) the length and width of the paper from inches to centimeters. 1 inch = 2.54 cm
5. Calculate (**K-U-E-S)** the area of the paper in square centimeters. **Record this result** on your data sheet.
6. **Check with SAM before continuing.**

The circles are of uniform size and the placement of the marks was random. Therefore, we can set up

a proportion:

$$\frac{\text{number of marks in circles}}{\text{number of marks or paper}} = \frac{\text{total area of all circles}}{\text{total area of paper}}$$

7. Solve (**K-U-E-S**) this equation for the total area of all circles. **Record this result** on your data sheet.
8. **Check with SAM before continuing.**
9. Divide the total area of all circles by the number of circles on your paper. This will tell you the area of one circle by ***indirect measurement.*** **Record this result** on your data sheet.
10. Now, calculate (**K-U-E-S**) the radius of one circle. Use the following equation: $A_c = \pi r^2$, where A_c is the area of a circle and r is the radius of the circle. **Record this result** on your data sheet.
11. At this point you will need to determine how well you did in your training: **Ask Agent SAM for the accepted radius of your paper sample.**
12. Determine (**K-U-E-S**) the percent error of your indirect radius results by comparing them to the agency radius. **Record this result** on your data sheet.

$$\text{percent error} = \left| \frac{\text{indirect radius} - \text{agency radius}}{\text{agency radius}} \right| \times 100$$

13. **Check with SAM before continuing.**

14. Do you think your percent error would have decreased if the marble were dropped 200 times? Or 1000 times? Explain your answers.
15. Name two potential sources of error in your experiment. How could you change the procedure to minimize these errors? Simply stating, "Human error" is not an option, pick specific things that were done in the lab. Sources of error come from procedures not analysis. If you believe there is an error in your analysis you can redo the steps in question, and therefore should no longer be in "error".
16. Calculate (**K-U-E-S**) the number of marks that should fall inside the circles on your paper if you dropped the marble 500 times.

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Individual Report (25 pts) to be done on your own time & on a separate sheet of paper!

Cover Sheet

Title, name, group, group members, date, class period

Your Individual Report should include the following & be written in this order:

Purpose: In a sentence, state the purpose of the lab

Background Information: Use your printed class notes to answer the following questions in complete sentences:

1. **Write a paragraph to explain how this activity is like the gold foil experiment. Be sure to comment on each piece of equipment used. For example, what does the marble represent?**
2. **Could Rutherford and his colleagues calculate percent error in the same manner that you did? Why or why not?**
3. **Would your percent error decrease if the marble were dropped 200 times? Or 1000 times**
4. **Name two potential sources of error in your experiment. How could you change the procedure to minimize these errors?**
5. **What particle in the atom determines its uniqueness or identity?**
6. **What particle in the atom determines its chemical properties?**
7. **What does the "Z" number refer to?**

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Group Points (25 pts)

Cover Sheet (3 pts)

Title, group members, date, class period

Group Work

- **Mission 1 (7pt)**
  - Circle-sheet

Group Participation (15pts)

Group participation (ability to work as a group member Including working & staying on task in group, using lab time wisely, keeping work station clean & proper use & care of equipment

Lab Notebook Scoring (50 pts)

pre-lab (-5 pts/day late) --	20pts
M1 Analysis approval #6 --	6 pts
M1 Analysis approval #8 --	3 pts
M1 Analysis approval #11 --	5 pts
M1 Analysis approval #13 --	3 pts
M2 Analysis #14 --	3 pts
M2 Analysis #15 --	4 pts
M2 Analysis #16 --	6 pts