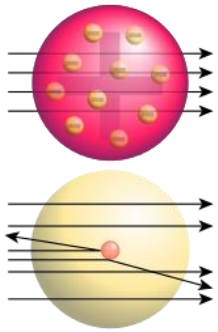
Name _____ **Date**_____

Rutherford Scattering Simulation

Ernest Rutherford, (30 August 1871 – 19 October 1937) was a New Zealand-born British physicist and chemist who became known as the father of nuclear physics. He was awarded the noble prize in chemistry in 1908 for his investigations into the disintegration of the elements, and radioactive substances. Rutherford performed his most famous work after he became a Nobel laureate. In 1911, although he could not prove that it was positive or negative, he theorized that atoms have their charge in a very small nucleus and pioneered the Rutherford model of the atom. Through his discovery and interpretation of Rutherford scattering in his gold foil experiment he is widely credited with discovery of the the proton. Rutherford remains the only science Nobel Prize winner to have performed his most famous work *after* receiving the prize.

The popular theory of atomic structure at the time of Rutherford's experiment was the "plum pudding model". This model was developed in 1904 by J. J. Thomson, the scientist who discovered the electron. This theory held that the negatively charged electrons in an atom were floating (sometimes moving) in a sea of positive charge. The gold foil experiment fires a series of positively charged alpha particles (helium nuclei) at a very thin sheet of gold foil. If Thomson's Plum Pudding model was to be accurate, the big alpha particles should have passed through the gold foil with only a few minor deflections. This is because the alpha particles are larger and heavier than electrons



GOLD FOIL EXPERIMENT

Expected results: alpha particles passing through the plum pudding model of the atom undisturbed.

Observed results: a small portion of the particles were deflected, indicating a small, concentrated charge.

Rutherford Scattering: Log on to: http://phet.colorado.edu/en/simulation/rutherford-scattering. Open up the Rutherford scattering experiment. Click: “RUN NOW” and answer the questions below.

Goal: At the end of the experiment you should be able to explain how Rutherford figures out the structure of the atom without being able to see it?

1. The atom in the middle is made of protons and neutrons. Set the scale to represent 79 protons and 118 neutrons. What is element is this and what is the atomic mass of this ? _____
2. If the center of the atom has many protons, the center of the atom has what kind of charge? _____(positive, negative, neutral).
3. If an alpha particle has two protons and two neutrons, what kind of charge does it have? _____
4. If one positively charged particles is brought near another positively charged particle, what should happen? _____.
5. Set the energy alpha particles to maximum, click traces and observe what happens. Describe the results: _____

6. At various points of the simulation click PAUSE. Count the total number of alpha particles on the screen. Count how many particles are deflecting backwards greater than a 90 degrees. What percent of the particles have greater than a 90 degree deflection. Perform this test 5 times. Place your answers in the data table.

Experimental Trial	Total alpha particles	Number of particle with 90^o deflection	% of particles with 90^o deflection
1			
2			
3			
4			
5			
Average			

7. Describe the actual results of the experiment, (what happened?)_____
_____.
8. Why do you think this happened? _____
_____

Additional Experiments:

9. What do you think will happen if the atom was smaller (less protons and less neutrons)?
   a. Hypothesis: What do think will happen to the alpha particles? _____
   b. Data: What happened? _____
   c. Conclusion: Why did this happen? _____

10. What do you think will happen if the atom was larger (more protons and more neutrons)?
   a. Hypothesis: What do think will happen to the alpha particles? _____
   b. Data: What happened? _____
   c. Conclusion: Why did this happen? _____

11. Using gold (79 Protons and 118 Neutrons) What will happen if the alpha particles had less energy?
   a. Hypothesis: What do think will happen to the alpha particles? _____
   b. Data: What happened? _____
   c. Conclusion: Why did this happen? _____

12. Why is it important to change only one variable at a time in the Rutherford scattering experiment?
_____
_____

13. A conclusion was made about the atoms of gold foil. Only a small percent of the alpha particles were deflected to a greater than 90^o from the gold foil. We can theorized that the center of the gold atom was a tiny sphere containing positive charges that deflect alpha charges which were also positive charges. Do agree or disagree with this conclusion? _____ Why?_____
_____
_____
_____
_____