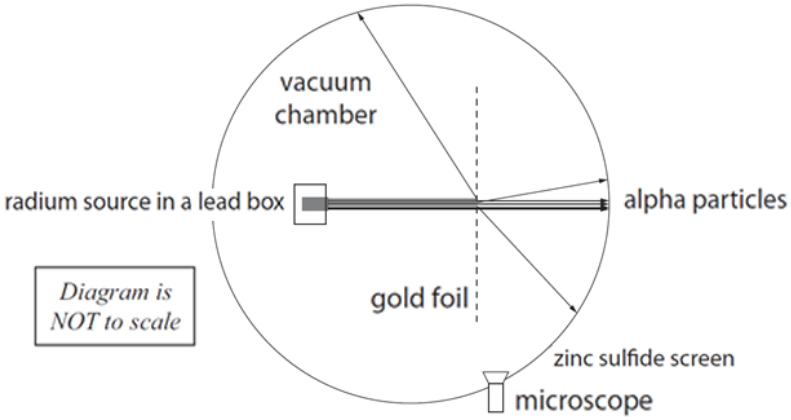
ATOMS: ATOMIC STRUCTURE QUESTIONS

QUESTION ONE: MODELS OF THE ATOM (2011;1)

At different times scientists have proposed various descriptions or models of the atom to match experimental evidence available.

(a) The model that Thomson proposed was called the plum-pudding model. Describe this model.

Geiger and Marsden performed a series of experiments under the direction of Ernest Rutherford which led to a new model of the atom. A model of the gold foil experiment is shown below.



(b) For each of the conclusions given below, state which observation from the experiment provides evidence that:

(i) Most of the mass of the atom is concentrated in a tiny region which Rutherford called the nucleus.

(ii) The nucleus is positively charged.

(c) Rutherford included several features in the experiment due to the characteristics of the alpha particles. Discuss the reason for each of the features below:

(i) The source of the alpha particles is at the end of a narrow lead tube

(ii) Vacuum chamber

(iii) Zinc sulfide screen

RUTHERFORD'S EXPERIMENTS (2010;2)

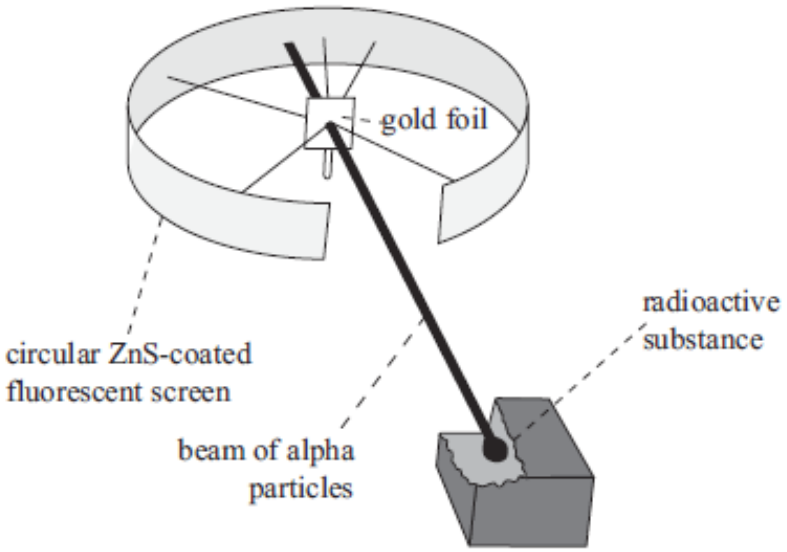
In 1905, Ernest Rutherford carried out an experiment to determine the nature of atoms. He fired alpha particles at a thin gold foil. After carrying out the experiment, he concluded that the atoms were mainly empty space, and that most of the matter was contained in a small, very dense, positively charged object that was more massive than the alpha particle. The object later became called the nucleus.

(a) If there was air between the alpha source and the gold foil, the air would become ionised. Explain what is meant by the term "ionised".

(b) Describe the results of the experiment and explain clearly how he linked his results to his conclusion.

MODELS OF THE ATOM (2009;1)

(a) Around 1800, James Dalton proposed a modern atomic model, based on experimentation rather than pure reason. Describe one aspect of Dalton's model of the atom.
(b) Thomson's model is commonly referred to as the "Plum Pudding Model". Describe Thomson's model of the atom.
(c) A diagram of Rutherford's gold foil experiment, which he performed with Geiger and Marsden, is shown below. The whole apparatus was in an evacuated chamber that is in a vacuum.

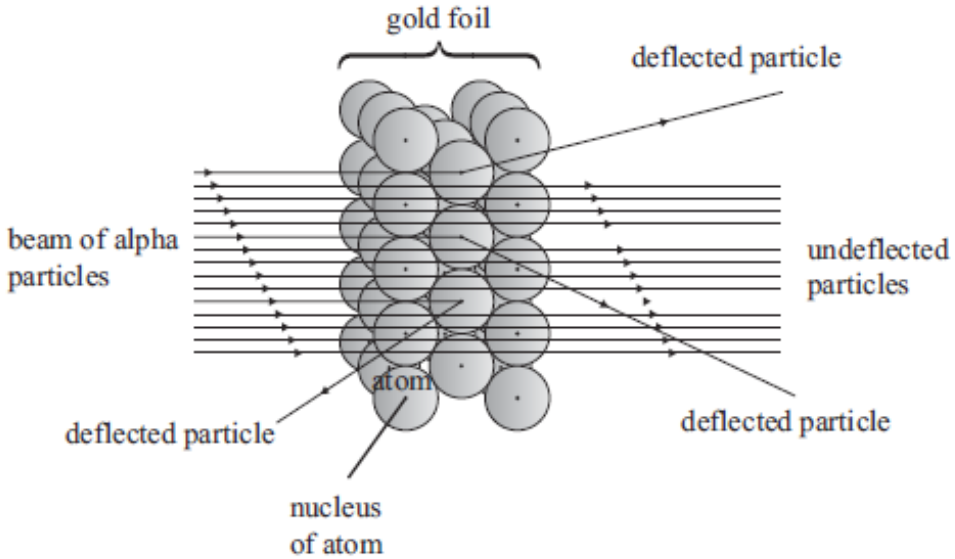


Give the purposes of the following in the experimental setup:

(i) zinc sulfide (ZnS) fluorescent coating on the circular screen
(ii) circular shape of screen
(iii) evacuated chamber

RUTHERFORD AND RADIOACTIVITY (2009;2)

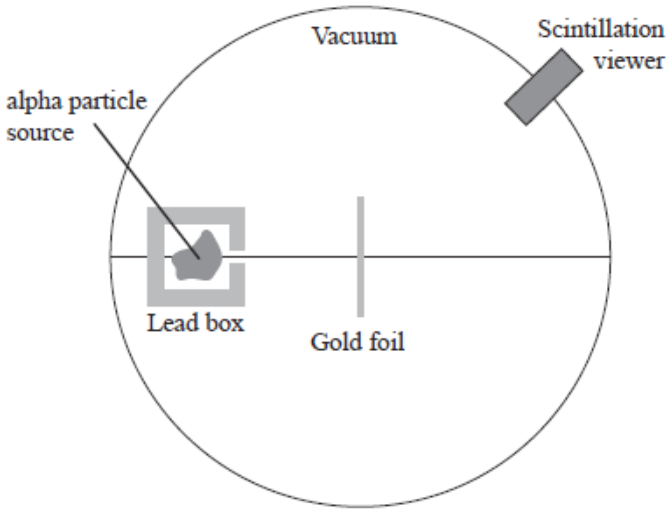
The observations that Rutherford made are shown in the diagram below:



(a) Based on his observations, Rutherford came to certain conclusions about the structure of the atom. Explain Rutherford's THREE main conclusions about the structure of the atom.

RUTHERFORD'S EXPERIMENT (2008;3)

In 1910 Ernest Rutherford directed an experiment that involved firing alpha particles at a thin gold foil. From the results he developed a new model of the atom.

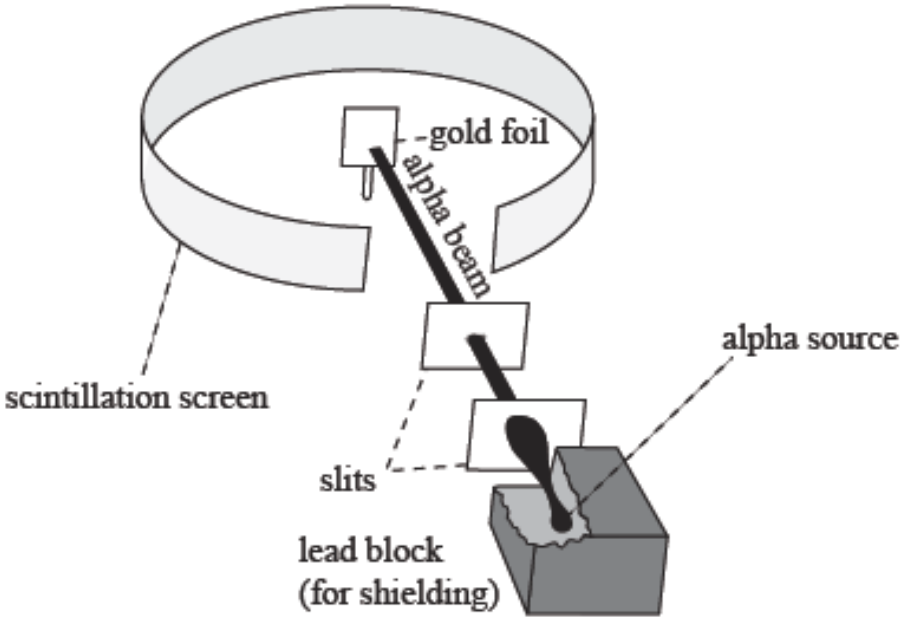


(a) What part of the results did he find surprising?
(b) Briefly describe the model Rutherford developed.

ATOMIC MODELS (2007;1)

(a) Give a concise explanation that shows clear understanding of the development of the model of the atom from Dalton to Thomson to Rutherford.

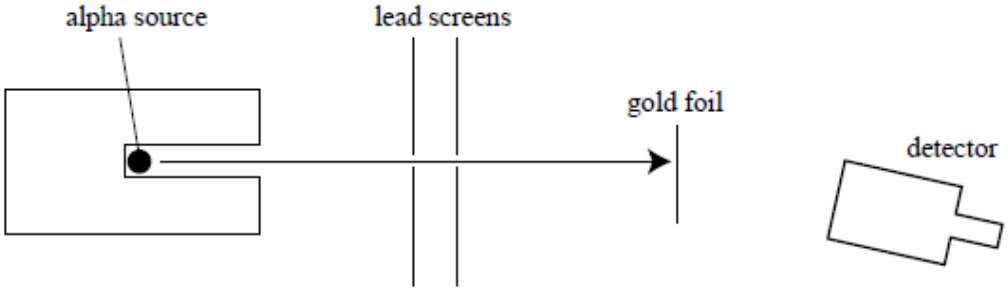
The following diagram shows Rutherford's gold foil experiment.



(b) What would Rutherford have expected to see in his experiment if Thomson's model was correct?
(c) Write three observations that Rutherford made in his gold foil experiment.
(d) Rutherford's experiment was carried out in a vacuum. If the chamber contained air, describe the effect this would have had on the alpha particles and on the air.
(e) Describe what would have been observed if Rutherford had used a beta emitter instead of an alpha emitter.

RUTHERFORD'S EXPERIMENT (2006;1)

Ernest Rutherford carried out an experiment to investigate the structure of the atom. He fired alpha particles at a thin gold foil, and observed the path of the alpha particles. The whole apparatus was in a vacuum chamber.



(a) State what an alpha particle is.
(b) State why the apparatus was placed in a vacuum.
(c) State the purpose of the lead screens.

Rutherford made the following observations:

Observation 1: Most of the alpha particles went straight through the gold atoms undeflected.
Observation 2: A few of the alpha particles rebounded (bounced back) from the gold atoms.

(d) State what Rutherford concluded about the structure of the gold atom from Observation 1.
(e) State and explain TWO of Rutherford's conclusions from Observation 2.

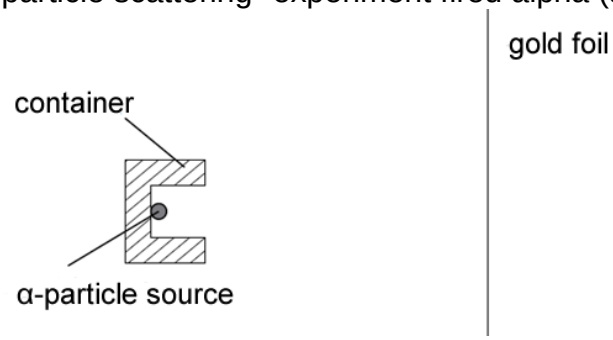
QUESTION ONE (2005;1)

For thousands of years, atoms were thought to be tiny solid spheres. Following his discovery of the electron in 1897, J J Thomson proposed a new model of the atom. A few years later, as a result of his "alpha particle scattering" experiment, Rutherford proposed an improved model.

(a) Describe the one way in which Thomson's and Rutherford's models of the atom were similar.
(b) Describe the key difference between Thomson's and Rutherford's models of the atom.

QUESTION TWO (2005;2)

Rutherford's famous "alpha particle scattering" experiment fired alpha (a) particles at gold foil.



As predicted, most of the alpha particles were observed to go straight through the gold foil or were deflected only very slightly as they passed through. A very small percentage of the alpha particles bounced back towards the source or were deflected at very large angles.

Explain why only a very small percentage of the alpha particles bounced back or were deflected at very large angles.

QUESTION SIX(2005;6)

Technetium-99 is used as a radioactive tracer in medical diagnoses because it has a half-life of 6 hours, and therefore does not stay in the body for too long. It emits only gamma rays, which means that it has very little ionising ability and thus causes very little **ionisation**.

State clearly the **meaning** of the term ionisation.

ATOMIC MODELS (2004;2)

To find out more about the structure of the atom, Rutherford decided to fire alpha particles at a thin gold foil. The whole apparatus was in a vacuum.

(a) Explain why the apparatus had to be in a vacuum.
(b) What type of charge does an alpha particle have?
(c) When the experiment was carried out, it was found that most of the alpha particles passed straight through the gold atoms, but a few were deflected through very large angles. Describe TWO conclusions possible from these observations. Give an explanation for your answers.