

Test: Atomic Theory

Each question is worth 4 marks.

Part A: Multiple Guesses

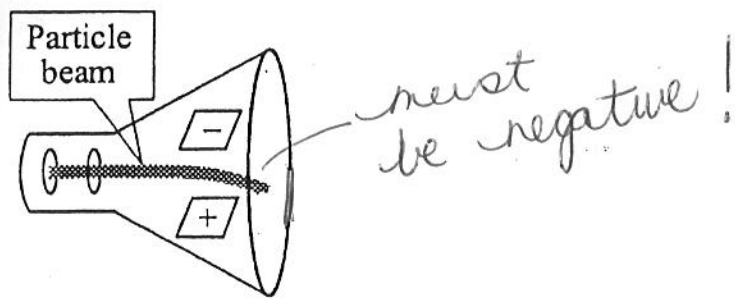
1. Among the following statements, which one is true?

- ~~A)~~ Aristotle thought that all matter was composed of small particles called atoms. However Democritus stated that the physical world resulted from combinations of four elements : earth, air, fire and water.
- ~~B)~~ Democritus believed that matter was continuous, whereas Aristotle believed it to be discontinuous.
- C) Democritus thought that all matter was composed of small particles called atoms. However Aristotle stated that the physical world resulted from combinations of four elements : earth, air, fire and water.
- ~~D)~~ Democritus and Aristotle thought that all matter was composed of small particles called atoms.

2. Which of the following statements is not associated with Dalton's Atomic Model?

- ~~A)~~ All matter is composed of very small, indestructible particles called atoms. = D = T
- ~~B)~~ Atoms of the same element are identical and have a characteristic mass. = D = T
- C) Atoms of different elements are identical and have the same mass. F
- ~~D)~~ Chemical reactions result from atoms of different elements combining to form compounds. D = T

3. The diagram below illustrates an experiment conducted using a cathode ray tube.



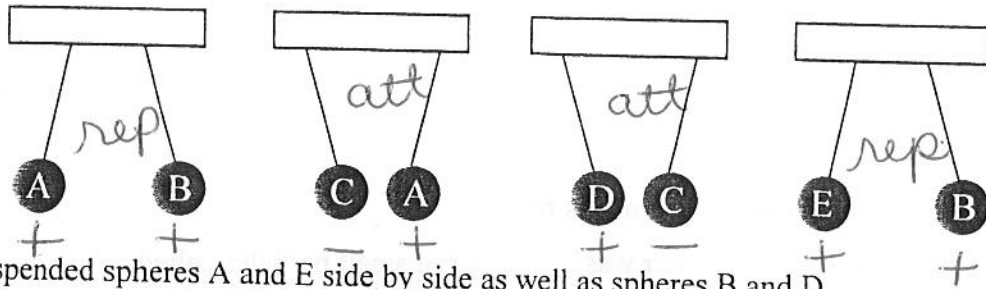
Which of the following conclusions is supported by this experiment?

- A) Cathode rays are negatively charged. ✓ T
- B) Cathode rays are composed of tiny moving particles. T
- C) Cathode rays travel in a straight line. T
- D) Cathode rays behave like light rays. T

*all are T
but only A)
is proven
by the above
expt.*

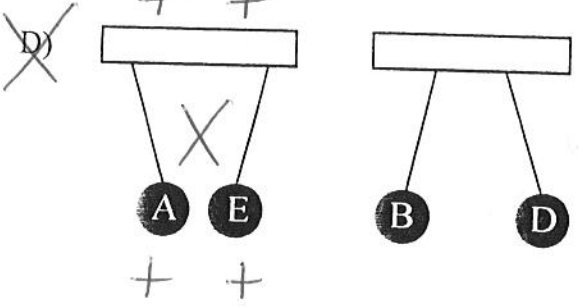
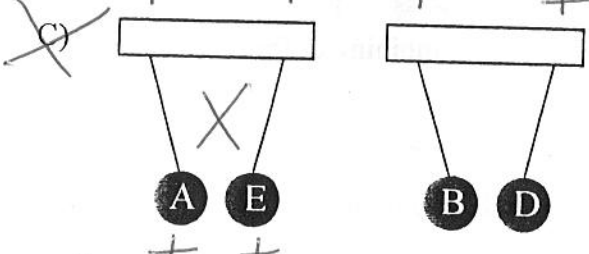
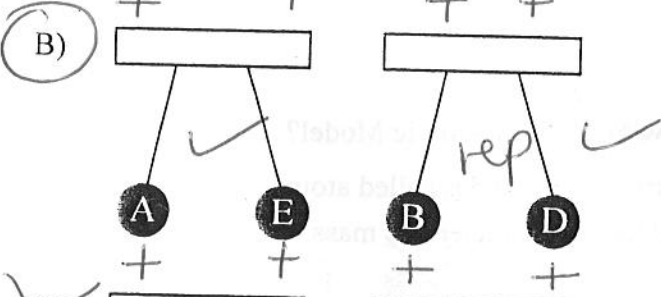
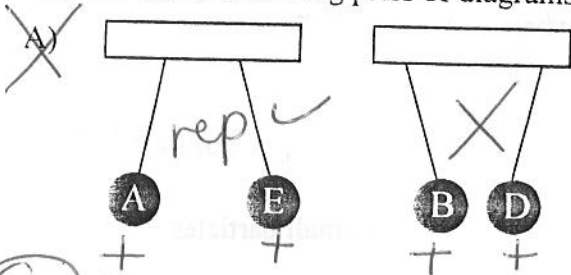
4. Five electrically charged spheres (A, B, C, D and E) are suspended from wires.

The following diagrams show what happens when these spheres are suspended in pairs close to one another.

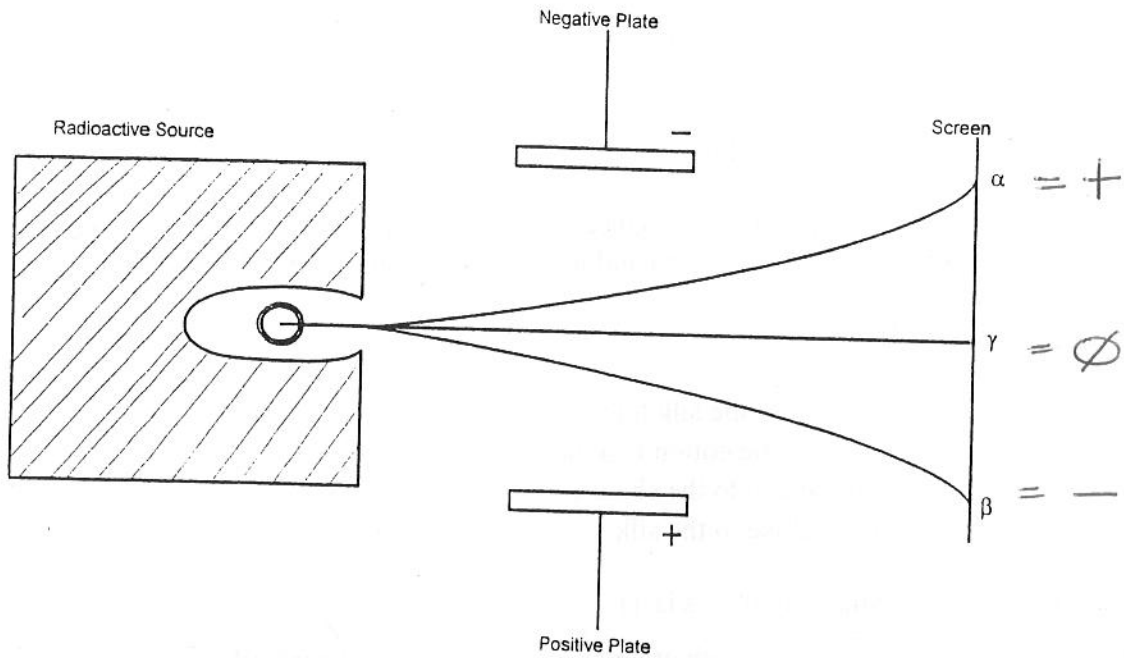


A student suspended spheres A and E side by side as well as spheres B and D.

Which one of the following pairs of diagrams correctly shows what will happen to these spheres?



8. The diagram below illustrates the results of an experiment on radioactivity:



Which of the following conclusions can be drawn from this diagram?

- A) The alpha and beta particles are electrically charged. ✓
- B) The atom contains a positive nucleus surrounded by negative electrons.
- C) The alpha and beta particles and the gamma rays can all penetrate matter.
- D) The alpha and beta particles and the gamma rays all have different masses.

9. Which of the following best explains why a small number of alpha particles were weakly deflected during Rutherford's alpha scattering experiment? *a few*

- A) These alpha particles ~~collided~~ with the positively charged nucleus. = *blue moon*
- B) These alpha particles were deflected because of electrical repulsion of the nucleus. ✓
- C) These alpha⁺ particles were deflected because they had a charge opposite to the nucleus. +
- D) These alpha particles were deflected because they ~~collided~~ with the ~~electrons~~ in the orbitals.

10. For a neutral atom the atomic number is equal to which of the following? *= redundant! atom = neutral = p⁺ = e⁻*

- A) The sum of the number of protons and ~~neutrons~~
- B) The number of ~~neutrons~~ or the number of ~~electrons~~
- C) The number of protons or the number of electrons
- D) The number of protons or the number of ~~neutrons~~

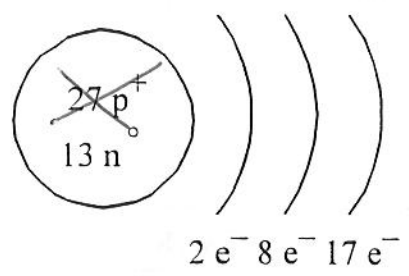
$\begin{matrix} 27 \\ 13 \end{matrix} \text{Al} \begin{matrix} 1 \\ 2 \\ 8 \\ 3 \end{matrix}$

$Z=13=13p^+=13e^-$
 mass number = 27
 per 3
 col 3

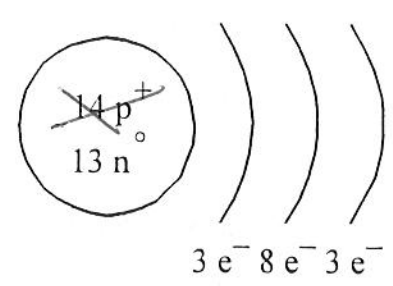
11. Which of the following best represents the aluminum (Al) atom according to the Rutherford-Bohr model?

$14n^0$

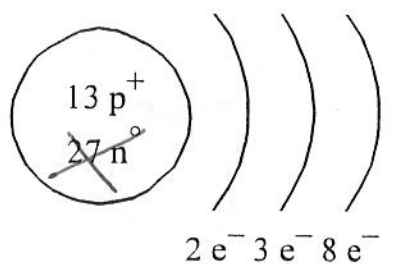
A)



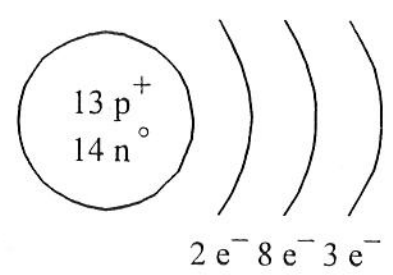
C)



B)



D)



12. Which of the following characteristics describe an atom in terms of the simplified (Bohr-Rutherford) model?

- 1. The number of electrons is equal to the number of protons. ✓
- 2. The number of protons is equal to the number of neutrons. ✗
- 3. The nucleus is made up of neutrons, protons and electrons. ✗
- 4. The nucleus is made up of neutrons and electrons. ✗
- 5. The nucleus is made up of protons and neutrons. ✓
- 6. Protons revolve around the nucleus. ✗
- 7. Electrons revolve around the nucleus. ✓

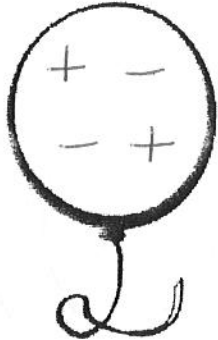
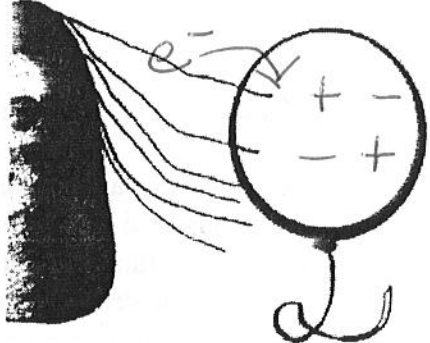
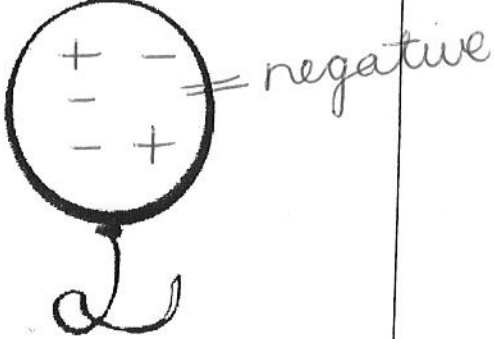
- A) 1, 2 and 3
- B) 1, 4 and 6
- C) 1, 5 and 7
- D) 2, 5 and 7

Part B: Extended Answers

13. A balloon rubbed against human hair becomes negatively charged with static electricity.

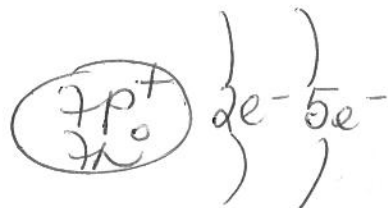
In the answer booklet:

- On the three diagrams, use (+) and (-) signs to show the electric charges and arrows to show any transfer of charges.
- Explain each of the three steps.

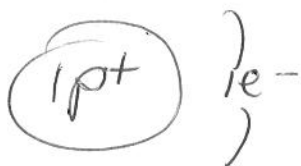
EXPLANATIONS	DIAGRAM
<p>Step 1 : Before the balloon is rubbed against hair</p> <p>neutral balloon neutral hair $\# p^+ = \# e^-$</p>	
<p>Step 2 : While the balloon is rubbed against hair</p> <p>balloon = rubber = high = gains e^- from hair which low on the electrostatic series & loses e^-</p>	
<p>Step 3 : After the balloon is rubbed against hair</p> <p>so... balloon now has more e^- than p^+ and is NEG. the hair has fewer e^- than p^+ & is POS.</p>	

14. Draw the Bohr-Rutherford model for the following elements.

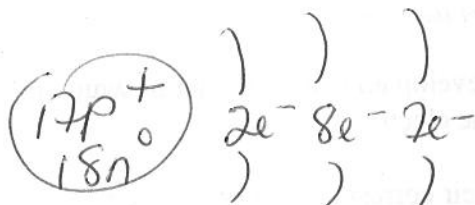
a) Nitrogen



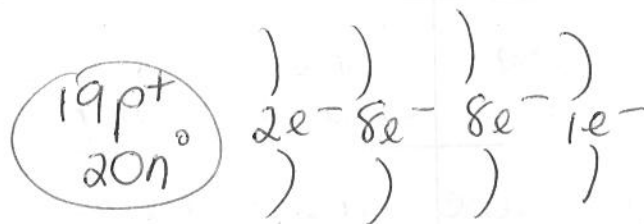
b) Hydrogen



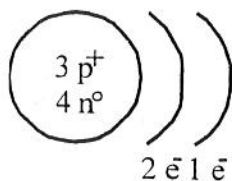
c) Chlorine



d) Potassium



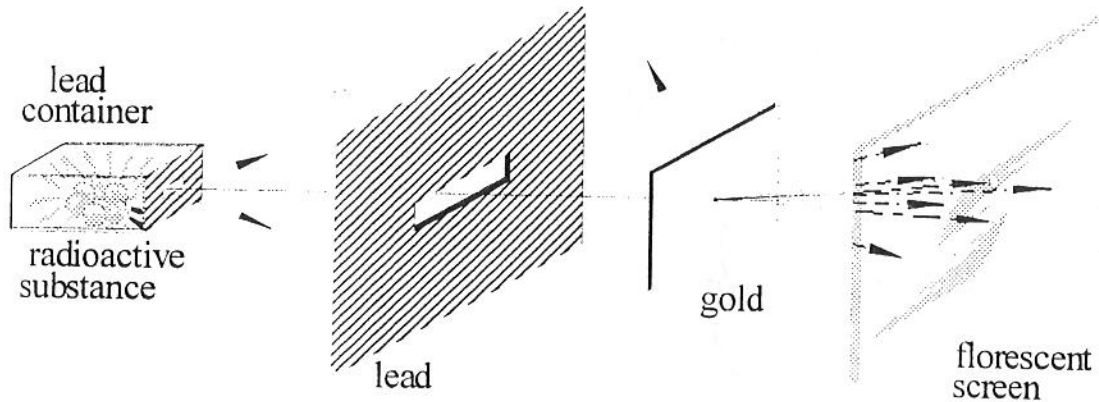
15. Below is the Bohr-Rutherford model of a certain element. What is this element?



Li

$3p^+$ = element 3 = Li
 $2EL$ = row = period 2
 $1\text{ val } e^-$ = col 1A

16. The diagram illustrates Rutherford's experiment at McGill University around 1907.



Taken from: Odyssee, Bandzuck C., Bélisle L., Valiquette P., ERPI, Montréal, 1991.

Rutherford's observations permitted him to develop an atomic model in which the atom is made up of a nucleus containing a concentration of the same electrical charge.

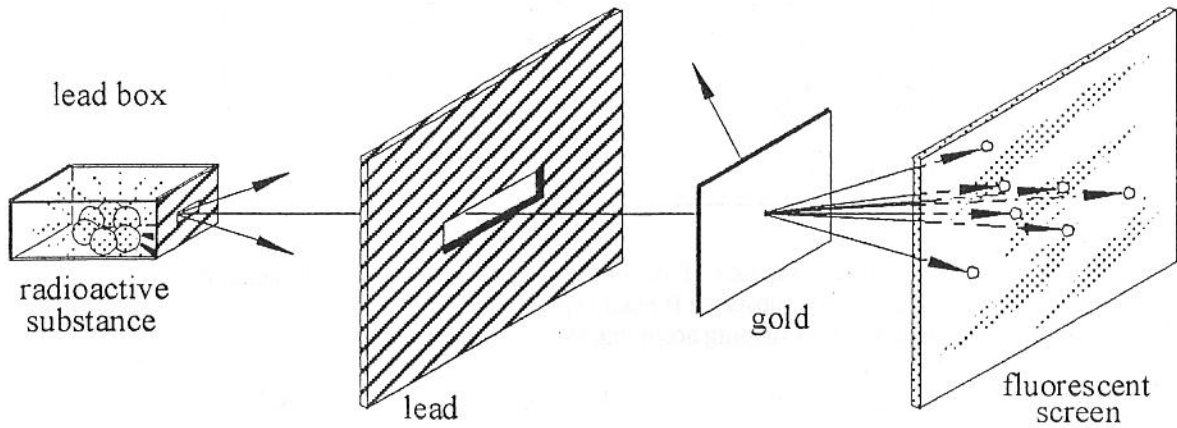
State two of Rutherford's observations and their corresponding conclusion.

Observation	Conclusion
1) most α particles went right thru	the atom is mainly empty space
2) some + α parts are slightly deflected	there is a pos. centre that the α particle came close to (I'm pulling a maryam!!!)

3) "once in a blue moon" an α part would be completely repelled backwards

so... the centre is not only + it is incredibly dense i.e. massive (all the mass of the atom is concentrated in the nucleus)

The famous experiment that Rutherford carried out is illustrated by the following diagram :



Taken from: *Odyssée*, Bandzuck C., Bélisle L., Valiquette P., ERPI, Montréal, 1991.

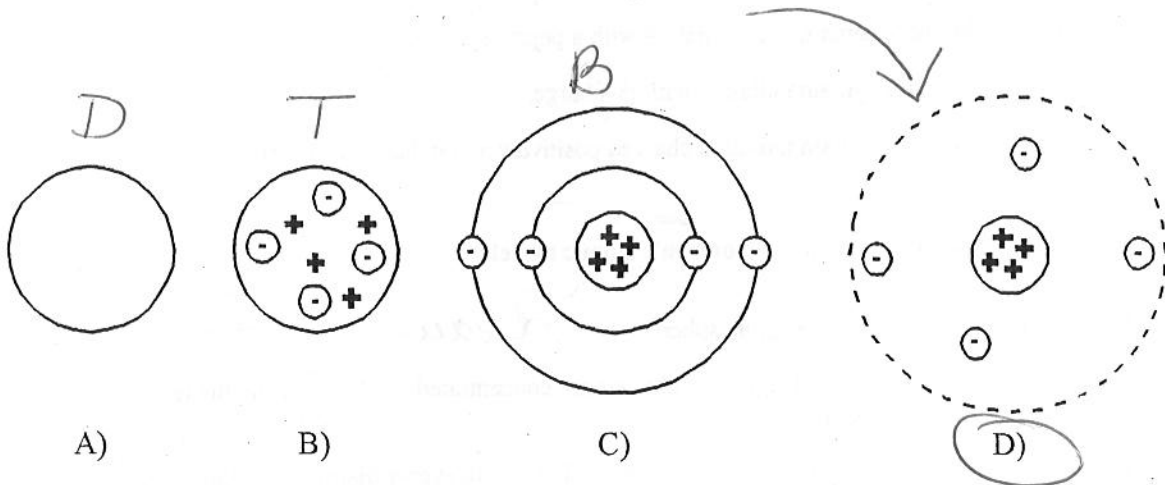
Which of the following statements is in agreement with Rutherford's results?

- A) ~~Most of the alpha particles are not deflected because the nucleus is composed of neutrons.~~
- B) Most of the alpha particles are not deflected because the atom is composed mostly of empty space.
- C) ~~Most of the alpha particles are deflected because they are attracted to the nucleus.~~
- D) ~~Most of the alpha particles are deflected because they are repelled by the protons.~~

2

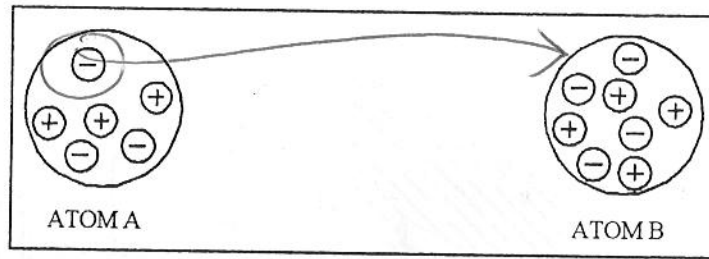
As a result of scientific research, the model of the atom has evolved over the years.

Among the following , which model resulted from Rutherford's experiment?



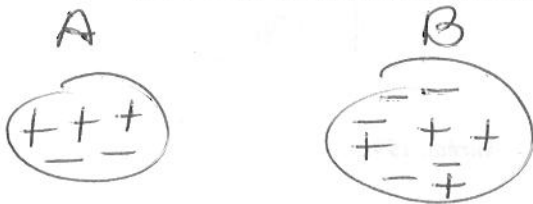
3

The diagram below shows two different atoms A and B according to Thomson's atomic model.



After rubbing a piece of a substance composed of A atoms against a piece of a substance composed of B atoms, the substance A has a positive charge and the substance B has a negative charge.

Draw diagrams of the charged atoms after rubbing according to Thomson's model.



A is lower down on the list so it loses e^- to B higher up on the list.
 A becomes POS bec $p^+ > e^-$.
 B becomes NEG bec $p^+ < e^-$.

4

Radioactive substances emit three types of radiation: alpha, beta and gamma radiation.

Scientists have observed that alpha radiation is attracted towards a negatively charged electrode and beta radiation is attracted towards a positive electrode

What do these observations permit us to conclude?

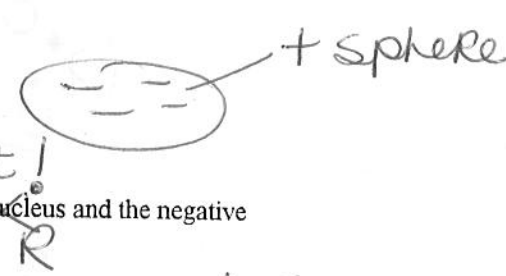
- A) Radioactive substances contain only radiation with a negative charge. ~~X~~
- B) Radioactive substances contain only radiation with a positive charge. ~~X~~
- C) Radioactive substances contain radiation with no charge. ~~X~~
- D) Radioactive substances contain radiation charged positively and radiation charged negatively.

5

Which of the following statements describes Thomson's atomic model?

- A) The atom is a small, dense, indivisible sphere. ~~X~~
- B) The atom is a sphere in which the positive charges are concentrated in a nucleus and the negative charges surround the nucleus. ~~X~~
- C) The atom is a positive sphere in which the negative charges are evenly distributed throughout.
- D) The atom is a sphere in which the positive charges are concentrated in a nucleus and the negative charges travel around the nucleus in orbits. ~~X~~

 B



Rutherford modified the atomic model after doing experiments where alpha particles were dispersed by a sheet of gold foil.

Consider the following statements :

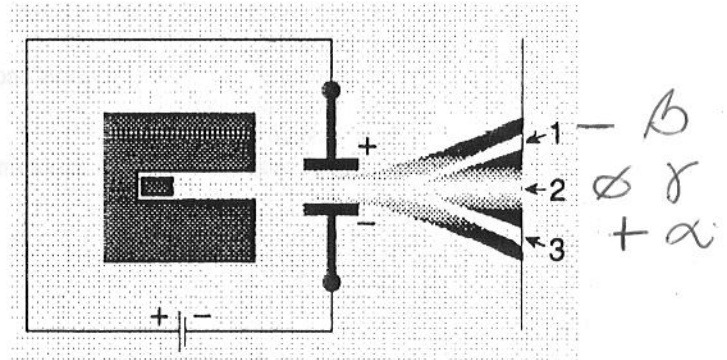
1. The number of protons equals the number of electrons. *? didn't prove this*
2. Protons are concentrated in a small positive space at the centre of the atom. ✓
3. Atoms consist mostly of empty space. ✓
4. Electrons are contained in a positive sphere made up of protons. ~~no one~~
5. Electrons move about in specific energy levels (shells). ~~B~~

Which of these statements are based on Rutherford's experiments?

- A) 1 and 2
- B) 1 and 4
- C) 2 and 3
- D) 3 and 5

7

The illustration at the right shows radiation from a radioactive point source passing through an electric field.



Which of the following correctly describes the rays formed after the radiation has passed through the electric field?

- A) Ray 1 : negatively charged gamma (γ) rays
Ray 2 : neutral alpha (α) particles
Ray 3 : positively charged beta (β) particles
- B) Ray 1 : negatively charged beta (β) particles ✓
Ray 2 : neutral gamma (γ) rays ✓
Ray 3 : positively charged alpha (α) particles ✓
- C) Ray 1 : positively charged beta (β) particles
Ray 2 : neutral gamma (γ) ray
Ray 3 : negatively charged alpha (α) particles
- D) Ray 1 : negatively charged alpha (α) particles
Ray 2 : neutral beta (β) particles
Ray 3 : positively charged gamma (γ) rays

8 Thomson's atomic model could account for only some of the facts about the behaviour of matter.

The following is a list of facts about the behaviour of matter.

- 1. Matter is electrically neutral. ✓
- 2. Matter emits radiation. ✓
- 3. Each element that makes up matter emits a unique spectrum of light. B
- 4. There are different isotopes of each element. X didn't know
- 5. An atom contains positive and negative charges. ✓
- 6. Static electricity is found in nature. ✓

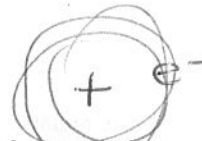
Which group of statements consists solely of facts that can be explained by Thomson's model of the atom?

- A) 1, 2 and 4
- B) 1, 5 and 6
- C) 2, 3 and 4
- D) 3, 5 and 6



9 Which of the following are characteristics of Rutherford's atomic model?

- 1. Electrons surround the nucleus. ✓
- 2. The nucleus of an atom consists of protons and neutrons. X didn't know
- 3. Atoms can lose or gain electrons. T
- 4. An atom is almost completely empty. B
- 5. An atom is a positively charged sphere containing negative particles. T
- 6. Electrons move within energy levels. B



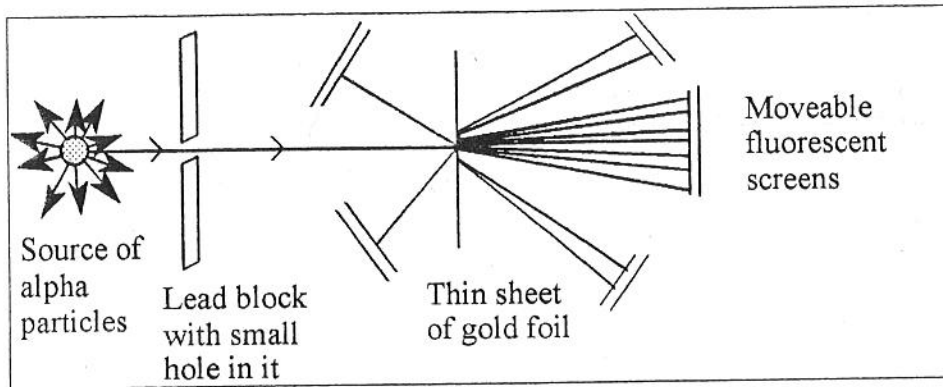
- A) 1 and 4
- B) 2 and 3
- C) 3 and 5
- D) 4 and 6

10 Which of the following IS NOT a characteristic of Rutherford's atomic model?

- A) An atom contains the same number of protons and electrons. R
- B) The nucleus contains protons and neutrons. ? didn't know
- C) The atom is mostly empty space. R
- D) The mass of an atom is concentrated in the nucleus. R

As a result of his famous experiment in which a thin sheet of gold foil was bombarded with alpha (α) particles, Rutherford significantly changed the atomic model proposed by Thomson.

The diagram below shows the trajectory of alpha particles passing through a thin sheet of gold foil or, in rare instances, being deflected on its surface.



Rutherford interpreted the results of his experiment by concluding that the atom is composed of a very small central nucleus in which certain particles were concentrated.

Which of the following is the correct composition of these particles?

- A) One or more particles of positive charges
- B) Particles of positive charges and negative charges
- C) One or more particles of neutrons
- D) One or more particles of negative charges