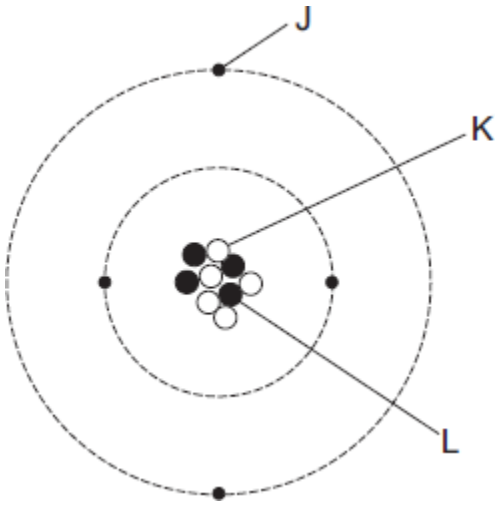
1 The diagram represents an atom of beryllium.



(a) Complete the following statements by writing one of the letters, **J**, **K** or **L**, in each box.

Each letter should be used only **once**.

The particle with a positive charge is ☐

The particle with the smallest mass is ☐

The particle with no charge is ☐

(2)

(b) Give the reason why all atoms have a total charge of zero.

_____

_____

(1)

(c) Complete the following sentence.

There are several isotopes of beryllium. Atoms of different beryllium isotopes will have different numbers of _____

(1)

(d) What happens to the structure of an atom to change it into an ion?

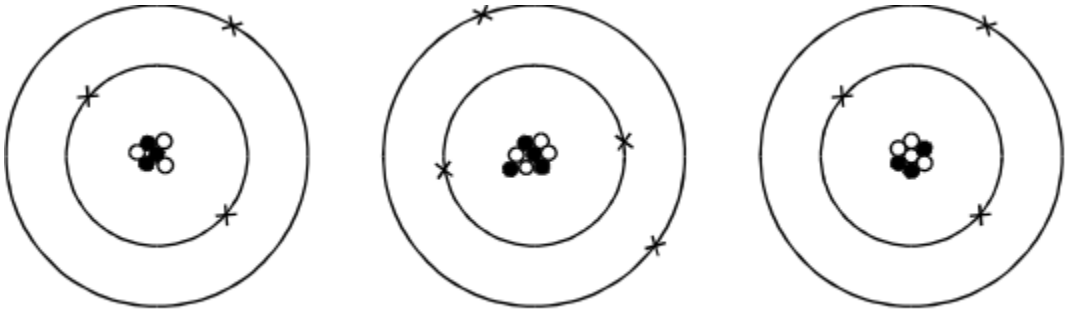
_____

_____

(1)

(Total 5 marks)

2 The diagrams below represent three atoms, **A**, **B** and **C**.



(a) Two of these atoms are from the **same** element.

(i) Which of **A**, **B** and **C** is an atom of a different element? _____

(ii) Give **one** reason for your answer.

_____

_____

_____

(2)

(b) Two of these atoms are isotopes of the same element.

(i) Which **two** are isotopes of the same element? _____ and _____

(ii) Explain your answer.

_____

_____

_____

(3)

(c) Which of the particles ○, ● and **X**, shown in the diagrams:

(i) has a positive charge; _____

(ii) has no charge; _____

(iii) has the smallest mass? _____

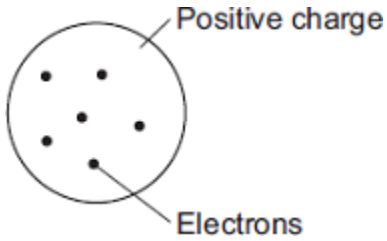
(3)

(d) Using the same symbols as those in the atom diagrams, draw an alpha particle.

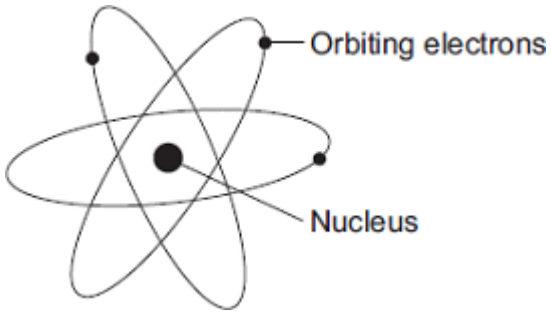
(1)

(Total 9 marks)

3 In the early part of the 20th century, scientists used the 'plum pudding' model to explain the structure of the atom.



Following work by Rutherford and Marsden, a new model of the atom, called the 'nuclear' model, was suggested.



Describe the differences between the two models of the atom.

_____

_____

_____

_____

_____

_____

_____

_____

(Total 4 marks)

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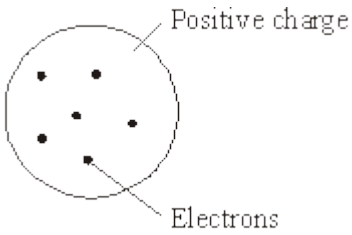

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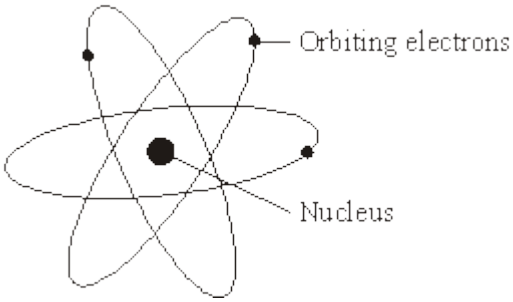


(a) Describe the differences between the two models of the atom.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(b) In their investigation, Rutherford and Marsden fired positively charged alpha particles at a very thin sheet of gold. Over a period of several months, the scientists made over 100 000 measurements. These measurements showed that:

- a very small number of alpha particles were deflected backwards from the gold foil.

Use the nuclear model to explain this experimental result.

_____

_____

_____

_____

(2)

(c) Why did the work of Rutherford and Marsden convince many scientists that the 'plum pudding' model of the atom was incorrect?

_____

_____

_____

_____

(2)

(Total 8 marks)

5 Scientists sometimes replace one scientific model with a different model.

For example, in the early 20th Century the plum pudding model of the atom was replaced by the nuclear model of the atom.

Explain what led to the plum pudding model of the atom being replaced by the nuclear model of the atom.

_____

_____

_____

_____

_____

_____

_____

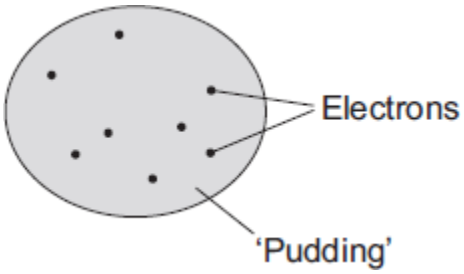
_____

_____

_____

(Total 6 marks)

6 The 'plum pudding' model of the atom was used by scientists in the early part of the 20th century to explain atomic structure.



(a) Those scientists knew that atoms contained electrons and that the electrons had a negative charge. They also knew that an atom was electrically neutral overall.

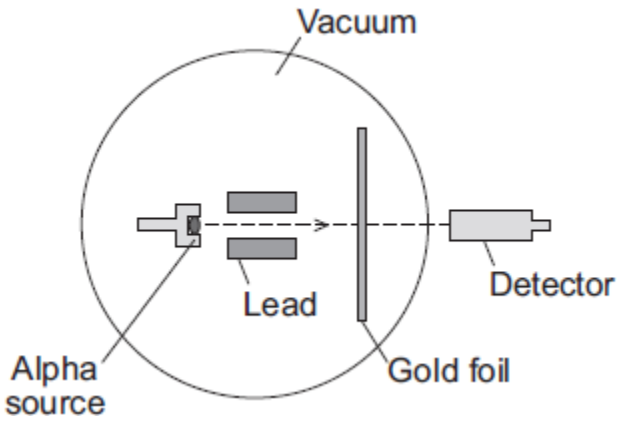
What did this allow the scientists to deduce about the 'pudding' part of the atom?

_____

_____

(1)

(b) An experiment, designed to investigate the 'plum pudding' model, involved firing alpha particles at a thin gold foil.



If the 'plum pudding' model was correct, then most of the alpha particles would go straight through the gold foil. A few would be deflected, but by less than 4°.

The results of the experiment were unexpected. Although most of the alpha particles did go straight through the gold foil, about 1 in every 8 000 was deflected by more than 90°.

Why did this experiment lead to a new model of the atom, called the nuclear model, replacing the 'plum pudding' model?

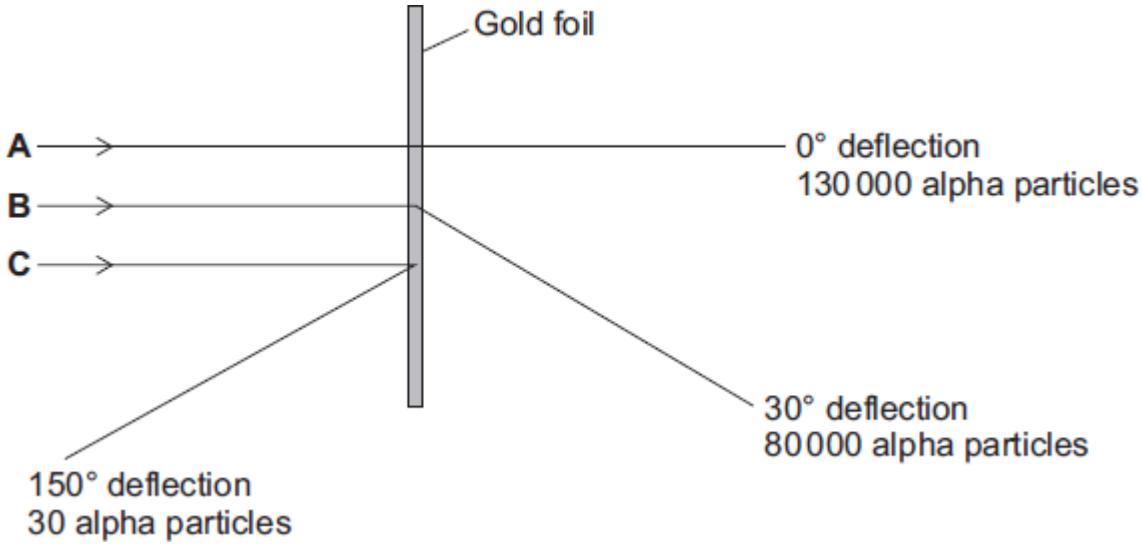
_____

_____

_____

(1)

(c) The diagram shows the paths, **A**, **B** and **C**, of three alpha particles. The total number of alpha particles deflected through each angle is also given.



(i) Using the nuclear model of the atom, explain the three paths, **A**, **B** and **C**.

A _____

_____

B _____

_____

C _____

_____

(3)

(ii) Using the nuclear model, the scientist E. Rutherford devised an equation to predict the proportion of alpha particles that would be deflected through various angles.

The results of the experiment were the same as the predictions made by Rutherford.

What was the importance of the experimental results and the predictions being the same?

_____

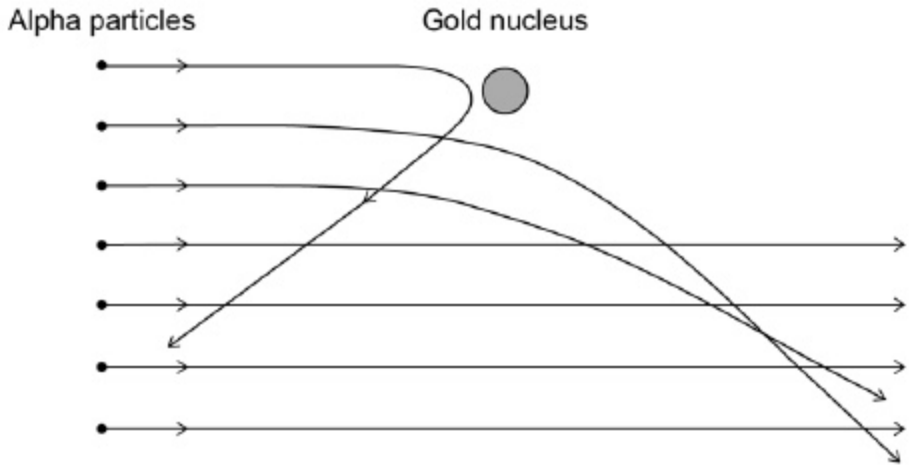
_____

(1)

(Total 6 marks)

7 In the early 20th century, scientists developed an alpha particle scattering experiment using gold foil.

The diagram shows the paths of some of the alpha particles in the alpha particle scattering experiment.



(a) Explain how the paths of the alpha particles were used to develop the nuclear model of the atom.

(4)

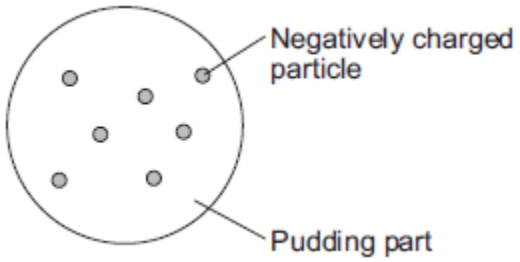
(b) Niels Bohr adapted the nuclear model by suggesting electrons orbited the nucleus at specific distances.

Explain how the distance at which an electron orbits the nucleus may be changed.

(3)

(Total 7 marks)

8 (a) Over 100 years ago, scientists thought the atom was like a 'plum pudding'.
The diagram below shows the plum pudding model of the atom.



The scientists knew that an atom has negatively charged particles. They also knew that an atom has no overall charge.

What did the scientists conclude about the **charge** on the 'pudding part' of the atom?

_____

_____

(1)

(b) Two scientists named Rutherford and Marsden devised an experiment to investigate the plum pudding model of the atom. The experiment involved firing alpha particles at a thin sheet of gold. The scientists measured how many of the alpha particles were scattered.

Using the plum pudding model, the scientists predicted that only a few of the alpha particles would be scattered by more than 4°.

Over several months, more than 100 000 measurements were made.

(i) The results from this experiment caused the plum pudding model to be replaced by a new model of the atom.

Explain why.

_____

_____

_____

_____

_____

_____

(2)

(ii) Suggest **one** reason why other scientists thought this experiment provided valid evidence for a new model of the atom.

_____

_____

_____

(1)

(c) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Describe the model now used for the structure of an atom.

In your answer you should:

- give details of the individual particles that make up an atom
- include the relative masses and relative charges of these particles.

Do **not** include a diagram in your answer.

(6)

(Total 10 marks)

9 (a) Complete the table about atomic particles.

ATOMIC PARTICLE	RELATIVE MASS	RELATIVE CHARGE
proton		+1
neutron	1	0
electron	negligible	

(2)

(b) Use the Data Sheet to help you to answer some parts of this question.

Read the following passage about potassium.

Potassium is a metallic element in Group 1 of the Periodic Table.
It has a proton (atomic) number of 19.

Its most common isotope is potassium-39, ($^{40}_{19}K$).

Another isotope, potassium-40, ($^{40}_{19}K$), is a radioisotope.

(i) State the number of protons, neutrons and electrons in potassium-39.

Number of protons _____

Number of neutrons _____

Number of electrons _____

(2)

(ii) Explain why potassium-40 has a different mass number from potassium-39.

_____

(1)

(iii) What is meant by a *radioisotope*?

_____

_____

(1)

(iv) Atoms of potassium-40 change into atoms of a different element. This element has a proton (atomic) number of 20 and a mass number of 40.

Name, or give the symbol of, this new element.

_____

(1)

(v) Explain in terms of atomic structure, why potassium-39 and potassium-40 have the same chemical reactions.

_____

(1)

(c) (i) Name a suitable detector that could be used to show that potassium-40 gives out radiation.

_____

(1)

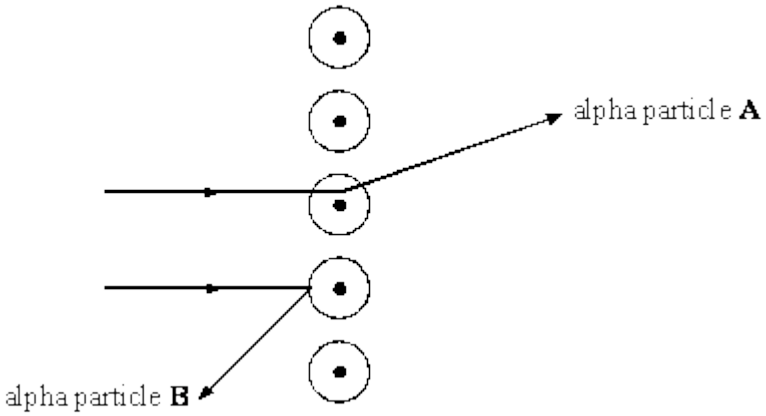
(ii) Name a disease which can be caused by too much exposure to a radioactive substance such as potassium-40.

_____

(1)

(Total 10 marks)

10 The diagram below shows the paths of two alpha particles A and B into and out of a thin piece of metal foil.



(a) The paths of the alpha particles depend on the forces on them in the metal.
Describe the model of the atom which is used to explain the paths of alpha particles aimed at thin sheets of metal foil.

_____

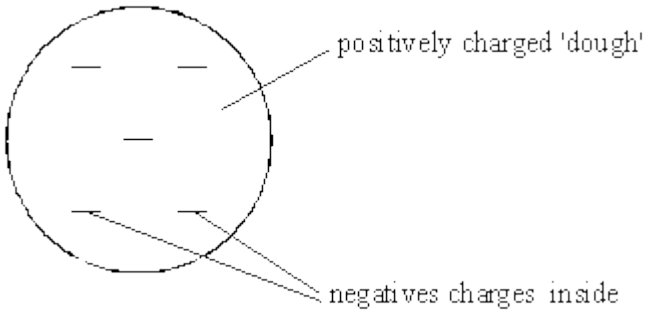
_____

_____

_____

(3)

(b) Scientists used to believe that atoms were made up of negative charges embedded in a positive 'dough'. This is called the 'plum pudding' model of the atom.
The diagram below shows a model of such an atom.



(i) Explain how the 'plum pudding' model of the atom can explain why alpha particle **A** is deflected through a very small angle.

_____

_____

_____

_____

_____

(2)

(ii) Explain why the 'plum pudding' model of the atom can not explain the large deflection of alpha particle **B**.

_____

_____

_____

_____

_____

_____

(3)

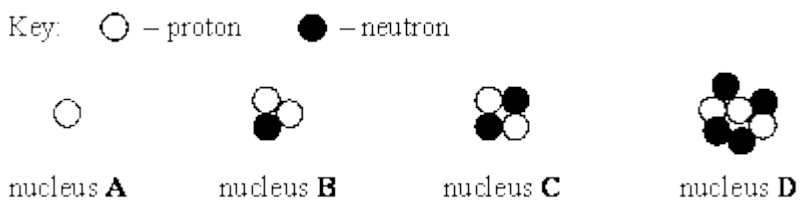
(c) We now believe that atoms are made up of three types of particles called protons, neutrons and electrons.

Complete the table below to show the relative mass and charge of a neutron and an electron. The relative mass and charge of a proton have already been done for you.

PARTICLE	RELATIVE MASS	RELATIVE CHARGE
proton	1	+1
neutron		
electron		

(2)

(d) The diagrams below show the nuclei of four different atoms **A**, **B**, **C** and **D**.



(i) State the mass number of C.

_____

(ii) Which two are isotopes of the same element?

_____ and _____

Explain your answer.

_____

_____

_____

_____

(4)

(Total 14 marks)