

The History of The Atom

Warm-Up

For the following statements, circle whether they are **true** or **false**.

New experimental evidence can disprove models

True Or False

Scientific models can be based on existing theories and new experimental evidence

True Or False

Older scientific theories must be ignored when new ones are adopted

True Or False

1 Models of the atom have changed over time.



1.1 Which of the following statements is the best description of what scientists thought an atom was like before the electron was discovered?

Tick **one** box.

☐ Tiny solid spheres that can't be divided.

☐ Formless 'clouds' of matter.

☐ Flat geometric shapes.

☐ Discrete packets of energy.

[1]

1.2 Draw one line from each atomic model to the correct description of that model.

Atomic Model

Description

Plum pudding model

A positively charged 'ball' with negatively charged electrons in it.

Bohr's model

A small positively charged nucleus surrounded by a 'cloud' of negative electrons.

Electrons in fixed orbits surrounding a small positively charged nucleus.

Rutherford's nuclear model

Solid spheres with a different sphere for each element.

[3]

1.3 In 1932, James Chadwick discovered a neutral sub-atomic particle found in the nucleus. Give the name of this particle.

.....

[1]

[Total 5 marks]

- 2 In 1911, Ernest Rutherford fired alpha particles at gold foil. Most of the alpha particles passed straight through the gold foil without being deflected. Only a few of the particles bounced back at 180° .



2.1 Explain why most of the alpha particles passed through the foil.

.....

.....

[1]

2.2 Name the scientist that adapted Rutherford's nuclear model by suggesting that electrons orbit the nucleus at specific distances.

.....

[1]

[Total 2 marks]

- 3 In 1897, J. J. Thomson discovered the electron. This discovery led Thomson to propose the 'plum pudding' model of the atom.



3.1 Thomson realised that there must be positive charge in an atom as well as the negative charge of the electrons. Suggest how Thomson could have worked this out using his knowledge of the atom and its charge.

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[2]

3.2* Describe similarities and differences between the plum pudding model and the modern nuclear model of the atom.

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[6]

[Total 8 marks]

Exam Practice Tip

When looking at the history of the atom, it's not only important that you know the different theories of atomic structure — you also need to understand why, and describe how, scientific theories develop over time. So make sure you go through your notes on Working Scientifically before the exam. And then why not relax with some plum pudding...



Electronic Structure

- 1 Calcium is a reactive metal with an atomic number of 20.



- 1.1 What is the electron configuration of a neutral calcium atom? Tick **one** box.

☐ 2, 18

☐ 2, 16, 2

☐ 2, 8, 8, 2

☐ 2, 2, 8, 8

[1]

- 1.2 Calcium has two electrons in its innermost shell. Explain why.

.....

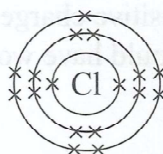
[2]

[Total 3 marks]

- 2 Electronic structures can be represented in different ways.



Figure 1

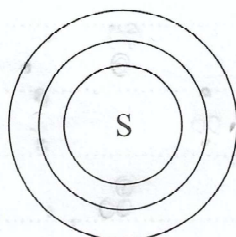


- 2.1 **Figure 1** shows the electronic structure of an atom of chlorine.
 Give the electronic structure of chlorine in number form.

Chlorine:

[1]

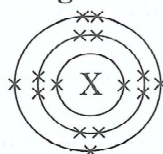
- 2.2 Draw the electronic structure of sulfur.



[2]

- 2.3 **Figure 2** shows the electronic structure of an atom of an element, X. Identify element X.

Figure 2



Element X:

[1]

[Total 6 marks]

Exam Practice Tip

Electronic structures are the key to understanding lots of chemistry, so it's really important that you know how to work them out. Definitely make sure you know, or can work out, the electronic structures for the first 20 elements in the periodic table before going into your exam. It'll help you in all manner of questions, believe me.



Development of The Periodic Table

- 1 Mendeleev, guided by atomic masses, grouped elements with similar properties to form an early version of the periodic table. He used his table to predict properties of undiscovered elements such as eka-silicon, now called germanium.



Table 1 shows some predictions.

Table 1

	Silicon (Si)	Eka-silicon (Ek)	Tin (Sn)
Atomic Mass	28	72	119
Density in g/cm ³	2.3	D	7.3
Appearance	grey/silver non-metal	grey metal	grey metal
Formula of oxide	SiO ₂	E	SnO ₂
Formula of chloride	SiCl ₄	F	SnCl ₄
Reaction with acid	None	G	Slow

- 1.1 Mendeleev left gaps in his periodic table. Suggest why.

.....

.....

[1]

- 1.2 Predict properties D to G.

D

E

F

G

[4]

[Total 5 marks]

- 2 Before the development of the modern periodic table, scientists classified elements according to their atomic masses.



- 2.1 Why did early scientists use atomic mass and not atomic number?

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.....

[1]

- 2.2 Use the periodic table to identify two elements that would be in the wrong positions if the elements were ordered by atomic mass rather than atomic number.

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[1]

- 2.3 How did the discovery of isotopes explain why atomic weights do not always give the correct order of elements?

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[2]

[Total 4 marks]



The Modern Periodic Table

- 1 Chemical elements are arranged in the periodic table.



- 1.1 How are the elements ordered in the periodic table?

[1]

- 1.2 Why is the table called the periodic table?

[1]

- 1.3 Why do elements in groups have similar chemical properties? Tick **one** box.

They have the same number of shells of electrons.

☐

They have the same number of outer shell electrons.

☐

They all have at least one full inner shell of electrons.

☐

The atoms of the elements are similar in size.

☐

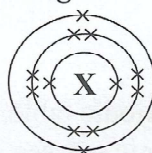
[1]

[Total 3 marks]

- 2 **Figure 1** below shows the electronic configuration for a neutral atom of element X.



Figure 1



- 2.1 What group in the periodic table is element X in? Justify your answer.

[2]

- 2.2 Which period is element X in? Explain your answer.

[2]

- 2.3 Identify element X.

[1]

- 2.4 Name one element that will have similar chemical properties to element X.

[1]

[Total 6 marks]

