

1.1 Simple Model of the Atom

Question Paper

Course	AQA GCSE Chemistry
Section	1. Atomic Structure & the Periodic Table
Topic	1.1 Simple Model of the Atom
Difficulty	Hard

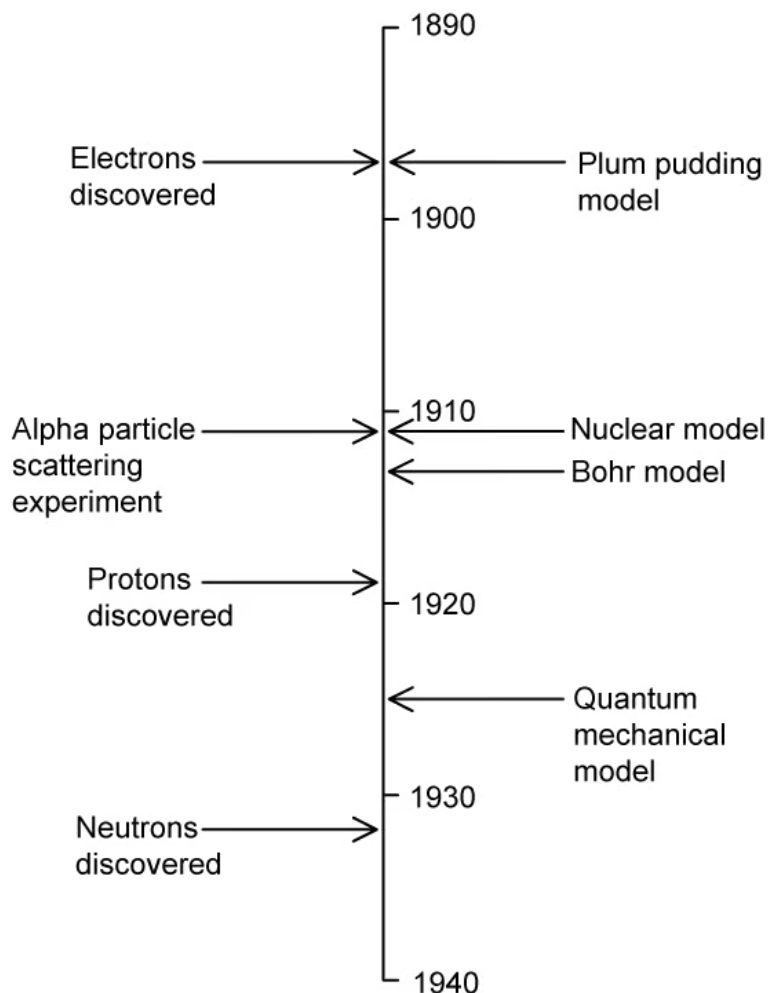
Time Allowed	60
Score	/46
Percentage	/100

Question 1a

This question is about the development of the model of the atom.

Figure 1 shows some important stages in the development of the model of the atom.

Figure 1



Explain how J. J. Thomson's discovery developed the model of the atom.

[2 marks]

Question 1b

Ernest Rutherford adapted the model of the atom.

Explain how evidence from Rutherford's experiment led to a development in the model of the atom.

[4 marks]

Question 1c

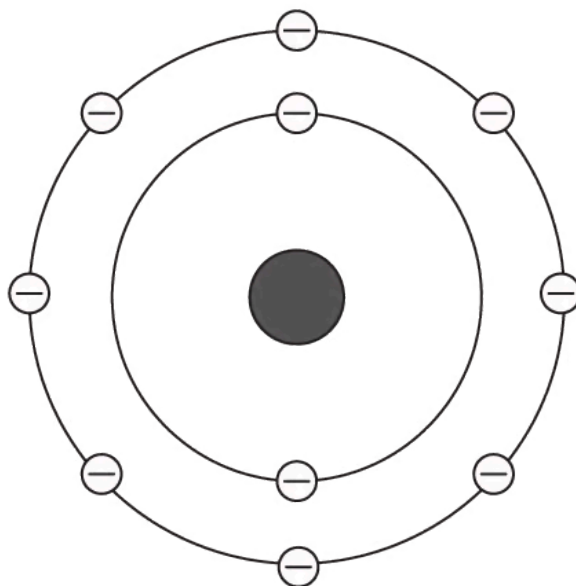
Explain how Chadwick's experimental work further developed the model of the atom and helped scientists better understand isotopes.

[3 marks]

Question 2a

This question is about atomic structure.

A group of students looks at the diagram below showing the arrangement of electrons in a chemical substance.



The students make the following incorrect or incomplete conclusions:

- Student 1 states that the substance is fluorine, neon or sodium
- Student 2 states that it is not possible to determine which atom or ion the diagram represents
- Student 3 states that the mass number is 10

Explain how students 1 and 2 could combine their ideas to produce **one** possible correct conclusion with an appropriate justification.

[3 marks]

Question 2b

Evaluate student 1's suggestions of fluorine and sodium.

[2 marks]

Question 2c

Correct student 3's statement. Explain your reasoning.

[3 marks]

Question 2d

The students are told that the diagram represents ${}_{12}^{25}\text{Mg}^{2+}$.

Describe the additions that should be made to the diagram to show this.

[3 marks]

Question 3a

A scientist produces silicon.

In the first step, the scientist first heats a mixture of sand (silicon dioxide) and magnesium powder.

In the second step, after cooling, the resulting mixture containing magnesium oxide and silicon is placed into a beaker and hydrochloric acid is added.

Write a balanced symbol equation, including state symbols, for the reaction in the first step.

[2 marks]

Question 3b

Write the word equation for the reaction that occurs in the second step.

[1 mark]

Question 3c

Explain how the silicon can be removed from the final reaction mixture.

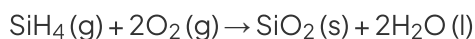
[1 mark]

Question 3d

During the second step, several gases are also produced.

One of the gases produced is silane, SiH_4 , which has a similar structure to methane, CH_4 .

Silane spontaneously reacts with oxygen.



Compare, in terms of energy, the strength of the Si-H bond in silane compared to the C-H bond in methane.

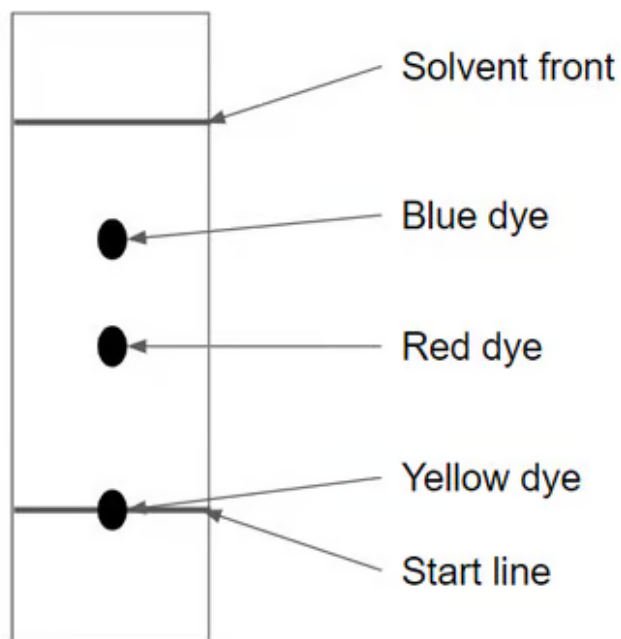
[1 mark]

Question 4a

This question is about mixtures.

Figure 1 shows a chromatogram of the food dyes in a black food colouring.

Figure 1



Describe how a student could obtain a chromatogram similar to the one shown in **Figure 1**.

[6 marks]

Question 4b

Chromatography is performed on another black food colouring.

This new food colouring contains the same individual dyes as those shown in **Figure 1** but in different proportions.

Predict the appearance of this chromatogram. Justify your answer.

[2 marks]

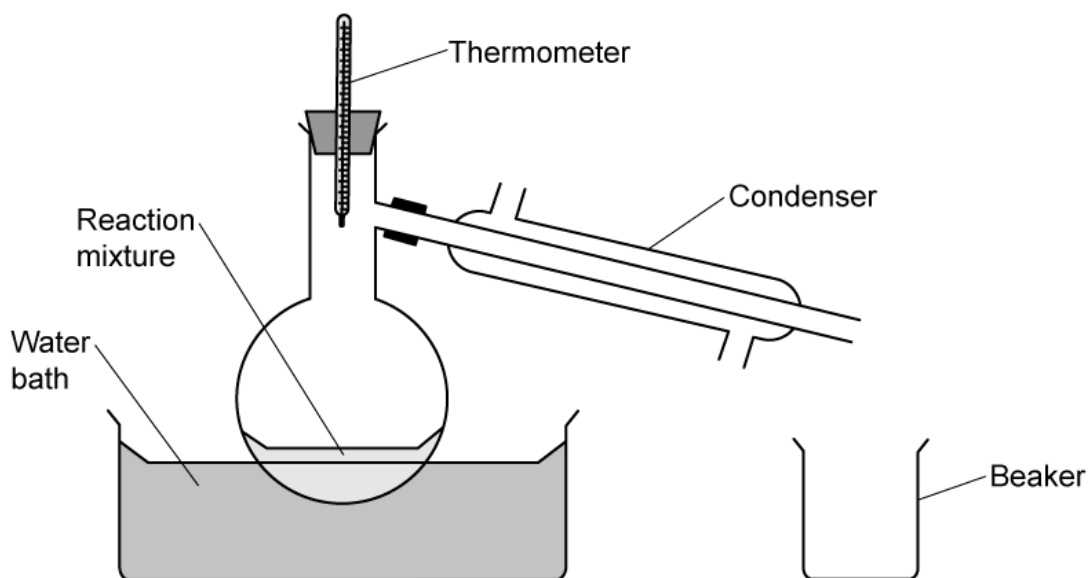
Question 4c

A student prepares a sample of butan-1-ol, which has a boiling point of 118 °C.

The sample contains an impurity with a boiling point of 125 °C.

The student plans to purify the sample using the equipment shown in **Figure 2**.

Figure 2



Explain why this equipment is unsuitable for separating the reaction mixture.

[2 marks]

Question 4d

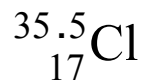
Explain why cold water should enter the condenser at the lowest point.

[2 marks]

Question 5a

This question is about chlorine.

Explain the information given by the numbers in the chemical symbol for chlorine



[3 marks]

Question 5b

Calculate the number of atoms that are present in one mole of chlorine gas.

[2 marks]

Question 5c

Complete the dot and cross diagram to show the covalent bonding in a chlorine molecule, Cl_2 .

Show only the electrons in the outer shell.

[2 marks]

Question 5d

The radius of a chlorine atom is approximately 1×10^{-10} m.

State and explain the difference, if any, between the radius of a chlorine atom and a chloride ion.

[2 marks]