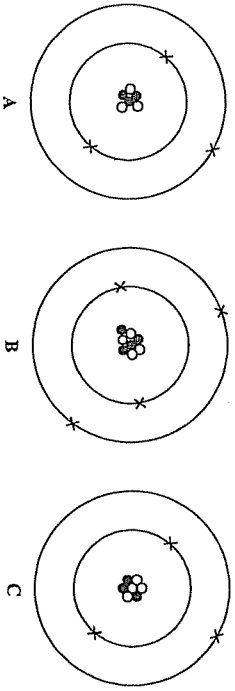


Atomic structure

1. 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.
.....
.....
.....

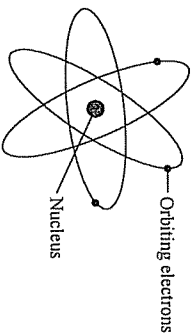
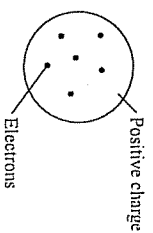
(3)

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

- (i) has a positive charge?
- (ii) has no charge?
- (iii) has the smallest mass?

(3)

2. 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.

(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?
.....
.....
.....

(Total 8 marks)
(2)

Nuclear fission

1. (a) Nuclear power stations use the energy released by nuclear fission to generate electricity.
(i) Explain what is meant by nuclear fission.

- (ii) How does nuclear fission lead to a chain reaction?
You may give your answer as a labelled diagram.

- (b) Although nuclear fuels are relatively cheap the total cost of generating electricity using nuclear fuels is expensive. Why?

- (c) The table compares the energy released from 1 kg of coal and 1 kg of uranium.

Coal	29 MJ
Uranium	580 000 MJ

State one benefit to the environment of using a concentrated fuel like uranium to generate electricity rather than using the energy from coal.

(Total 5 marks)

2. The first commercial nuclear power station in the world was built at Calder Hall in Cumbria.

- (a) The fuel used at the Calder Hall power station is uranium. Natural uranium consists mainly of two isotopes: uranium-235 ($^{235}_{92}\text{U}$) and uranium-238 ($^{238}_{92}\text{U}$). The nucleus of a uranium-235 atom is different to that of a uranium-238 atom.
(i) Where is the nucleus in an atom?

- (ii) Name the two types of particle found in the nucleus.

- (iii) How is the nucleus of a uranium-238 atom different to the nucleus of a uranium-235 atom?

- (b) In the nuclear reactor fission of uranium atoms takes place in reactions such as the one shown below.



The nuclear reactions are carefully controlled in the power station so that a chain reaction takes place.

- Explain, as fully as you can:
(i) how fission of uranium atoms takes place in a nuclear reactor.

- (ii) how this leads to a chain reaction.

- (iii) why it can be used to generate electricity.

(Total 9 marks)