

Chapter = 19

Atomic Structure

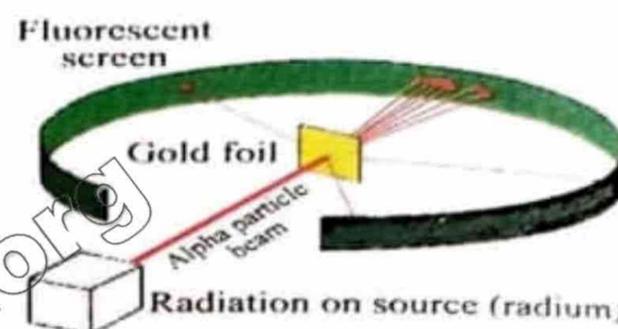


Q1. What is an Atom? Also describe the structure of atom

Atom is the smallest unit into which matter can be divided without releasing electrically charged particles.

The structure of an atom in terms of a nucleus and electrons

- The central hard-core of an atom is the nucleus which is the small, dense region consisting of closely packed protons and neutrons.
- Around the nucleus, electrons revolve at high speed. The number of particles (electrons and protons) depends on the type of atom.
- Most of the atom is empty space.
- Electrons are bound by a positively charged nucleus with the electrostatic force.



Experimental arrangement of Geiger and Marsden α -scattering

Q2. Explain the Geiger and Marsden α -scattering

Experiment

Geiger and Marsden α -scattering Experiment

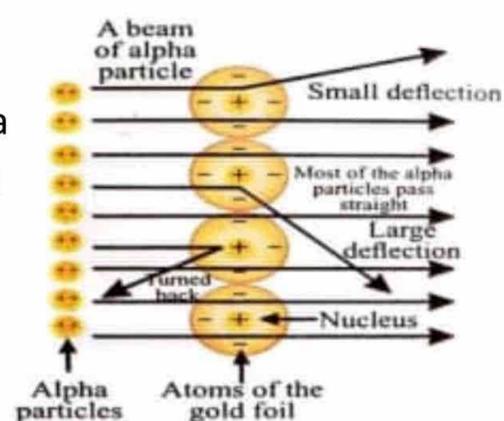
Introduction:

This experiment was conducted by Geiger and Marsden, two scientists.

Experiment: Geiger and Marsden used a beam of positively charged α -particles to bombard a thin gold foil placed in a vacuum surrounded by a ring-shaped fluorescent screen. After bombarding the foil, the scattered α -particles were detected using a rotating detector. When α -particles hit the screen of light was observed through the detector;

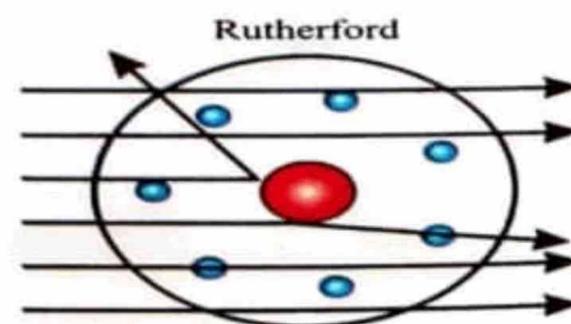
Observations:

- The most of the α - particles were not deflected or only a few deflected through small angles.
- A small number of the α -particles were deflected through considerable large angles of more than 90° .



Scattering of α -particles by a nucleus

- A few of the α -particles were even deflected back through nearly 180° .



Close up view of scattering of α -particles by a nucleus

Q3. What are the Rutherford's postulates?

Rutherford's postulates based on this experiment:

- The nucleus carries all the positive charge of atom and nearly all its mass.
- As a large number of α -particles passing through the foil undeflected suggest that there exist large empty spaces in an atom.
- Those positively charged α -particles that deflected through large angles had come very close to the positively charged nucleus. However, a few were repelled so strongly that they bounced back.

Q4. Define Nuclear physics.

Nuclear physics The branch of Physics concerned with the study and understanding of the atomic nucleus, including its composition and the forces which bind it together, is called nuclear physics.

Q5. Describe the composition of the atom

The composition of the atom Atoms consist of three elemental particles:

- ✓ Electrons
- ✓ Protons
- ✓ Neutrons.
- The outermost region of the nucleus is called electron shell.
- It contains electrons.
- Electrons have a negative (-) charge.
- The nucleus contains the neutrons and the protons bound tightly together by the nuclear forces (gluons) .
- Neutrons carry no charge.
- The mass of a neutron is slightly larger than that of a proton.
- Proton has an equal positive (+) charge that of an electron in magnitude.
- An atom usually has an equal number of protons as electrons, so its net charge is zero.

Q6. Define Atomic number, Nucleons, Nucleon Number.

Atomic number

The number of protons in the nucleus of an atom element is called atomic number.

Representation

Atomic number is represented by Z.

Atomic number tells number of electrons

It is the atomic number which tells about the number of electrons.

Nucleons

The protons and neutrons are collectively called nucleons.

Nucleon Number or Atomic Mass:

The number of protons and neutrons is known as nucleon number or atomic mass.

Representation

It is represented by atomic number A.

Mathematically:

Where;

Z: Atomic number

N: Number of neutrons

$$A = Z + N$$

Representation of nucleus

A nucleus is represented symbolically by ${}_Z^AX$

Where **X** represents the nuclide of a chemical element, **A** is the nucleon number, and **Z** is the atomic number.

Example

${}_6^{12}\text{C}$ represents the carbon nucleus with six protons and twelve nucleons. Thus, the total orbiting electrons are also six, and the neutron number is

$$A = Z + N$$

$$N = A - Z$$

$$N = 12 - 6$$

$$N = 6$$

Q7. What is an Isotopes. List the isotopes of hydrogen.

Isotopes Two or more species of atoms of an element with the same atomic number (Z) but have different atomic mass (A) are called Isotopes.

The hydrogen atom (atomic number 1) has three isotopes with atomic masses 1, 2, and 3.

Name of isotope	Symbol	Proton number Z	Neutron number N	Atomic mass
Protium	1	0	1	${}_1\text{H}^1$
Deuterium	1	1	2	${}_1\text{H}^2$

Tritium	1	2	3	${}^3_1\text{H}$
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Multiple Choice Questions (MCQs)



Choose the correct answer from the following choices:

- ${}_1\text{H}^2, {}_1\text{H}^3$ are:
 - Isotopes
 - Isobars
 - Isotones
 - Isochores
- The neutral atoms of all of the isotopes of the same element have
 - different numbers of protons.
 - exact numbers of neutrons.
 - An exact number of protons.
 - An exact number of nucleons.
- Consider the species ${}_{17}\text{Cl}^{35}$ and ${}_{17}\text{Cl}^{35}$ These species have:
 - the exact number of nucleons
 - the exact number of protons
 - the exact number of neutrons.
 - the exact mass number.
- Atomic mass of an element is equal to
 - Mass of protons and neutrons
 - Mass of protons and electrons.
 - Mass of electrons and neutrons
 - Mass of protons only
- The maximum mass of an atom is concentrated in:
 - nucleus
 - neutrons
 - protons
 - electrons
- Consider isotope ${}_{92}\text{U}^{237}$ of uranium. The number of neutrons in it is:
 - 92
 - 237
 - 145
 - 145
- The symbol denotes the proton number is:
 - P
 - A
 - N
 - Z
- The number of neutron(s) in Protium is:
 - no
 - one
 - two
 - three
- In an atom, the nucleus when compared to the extra-nuclear part, is
 - More significant in volume and heavier in mass
 - smaller in volume but heavier in mass
 - More significant in volume but lighter in mass
 - Smaller in volume and lighter in mass
- If an element B has five protons and six neutrons what will be the symbol of element B
 - ${}_6\text{B}^{11}$
 - ${}_{11}\text{B}^6$
 - ${}_{11}\text{B}^5$
 - ${}_5\text{B}^{11}$

Ans:

1. Isotopes	2. An exact number of protons.	3. the exact number of protons	4. Mass of protons and neutrons	5. nucleus
6.145	7. Z	8. no	9. smaller in volume but heavier in mass	10. ${}_5\text{B}^{11}$