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Class	9th	Chapter	02
Subject	Solved	Board	Punjab

CHAPTER 2: ATOMIC STRUCTURE

EXERCISE MULTIPLE CHOICE QUESTIONS (MCQs)

(i) Cathode rays can deflect:

Answer: (c) both in electric and magnetic field

(ii) Which of the following is correct about the charge on neutron?

Answer: (a) zero

(iii) The number of protons in a nucleus is called:

Answer: (b) atomic number

(iv) The total number of protons and neutrons in a nucleus is called:

Answer: (c) mass number

(v) Which one of the following is a heavy particle?

Answer: (d) neutron

(vi) The isotopes of an element have:

Answer: (a) same atomic number but different mass numbers

(vii) The isotope used in nuclear reactors is:

Answer: (b) Uranium-235

(viii) The mass of an electron is about:

Answer: (b) 1/1836 times the mass of a proton

(ix) Which of the following scientists discovered the proton?

Answer: (a) E. Goldstein

(x) Rutherford's alpha particle scattering experiment proved that:

Answer: (c) nucleus is present at the center of the atom

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EXERCISE QUESTIONS FOR SHORT ANSWERS

i. Why is it said that almost all the mass of an atom is concentrated in its nucleus?

Answer: Almost all the mass of an atom is concentrated in its nucleus because protons and neutrons, which reside inside the nucleus, are each about 1836 times heavier than electrons, which orbit outside the nucleus.

ii. How do cathode rays prove that electrons are negatively charged particles?

Answer: Cathode rays are deflected toward the positive plate in an electric field and deflected in a magnetic field in a direction that confirms a negative electrical charge.

iii. Why have isotopes not been shown in the periodic table?

Answer: Isotopes have not been shown separately in the periodic table because they possess the same chemical properties and electronic configuration, occupying the same position in the table.

iv. What are the main defects of Rutherford's atomic model?

Answer: According to classical physics, revolving charged particles should continuously radiate energy and spiral into the nucleus, but atoms are stable. Furthermore, Rutherford's model should produce a continuous spectrum instead of the observed line spectrum.

v. Why do isotopes of the same element have different physical properties?

Answer: Isotopes have different physical properties because physical properties depend on atomic mass, and isotopes have different numbers of neutrons resulting in different masses.

vi. Define atomic number and mass number with examples.

Answer: Atomic number is the total number of protons in the nucleus of an atom, such as carbon having an atomic number of 6. Mass number is the sum of protons and neutrons in the nucleus, such as carbon-12 having a mass number of 12.

vii. What is the role of radioactive isotopes in medical diagnosis?

Answer: Radioactive isotopes act as tracers in medical diagnosis to detect tumors, monitor organ function, and study metabolic pathways, such as Iodine-131 for thyroid disorders and Technetium-99m for imaging various organs.

viii. How did Chadwick discover the neutron?

Answer: Chadwick discovered the neutron by bombarding a beryllium target with alpha particles, which produced highly penetrating, neutral radiation consisting of particles with a mass nearly equal to that of a proton.

EXERCISE CONSTRUCTED RESPONSE QUESTIONS

i. If an atom has atomic number 11 and mass number 23, calculate the number of electrons, protons, and neutrons.

Answer: Number of protons = 11, Number of electrons = 11, Number of neutrons = mass number minus atomic number (23 - 11 = 12).

ii. Why did Rutherford select gold foil for his scattering experiment instead of other metals?

Answer: Gold was selected because it can be beaten into an extremely thin foil only a few hundred atoms thick, minimizing multiple scattering of alpha particles and allowing clear observation of deflection.

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iii. How does Bohr's model overcome the stability defect of Rutherford's model?

Answer: Bohr proposed that electrons revolve only in specific stationary orbits or shells corresponding to fixed energy levels where they do not radiate energy, thus preventing them from spiraling into the nucleus.

iv. Discuss the importance of isotopes using carbon dating and medical imaging as examples.

Answer: Carbon-14 is used in carbon dating to determine the age of ancient organic artifacts by measuring the remaining radioactive decay. Medical imaging utilizes radioactive isotopes like Technetium-99m or Iodine-131 as tracers to detect diseases and visualize internal body structures safely.

v. Why are cathode rays named so?

Answer: Cathode rays are named so because they originate from the cathode (negative electrode) inside a discharge tube when high voltage is applied across low-pressure gas.

vi. What are the characteristics of canal rays?

Answer: Canal rays consist of positively charged particles whose e/m ratio depends on the nature of the residual gas in the discharge tube, they are heavier than electrons, and they travel in straight lines in a direction opposite to cathode rays.

vii. Explain why isotopes have identical chemical properties.

Answer: Isotopes have identical chemical properties because chemical behavior is determined entirely by the number and arrangement of valence electrons, which remains identical for all isotopes of the same element.

viii. How can you calculate the relative atomic mass of an element from its isotopic abundances?

Answer: The relative atomic mass is calculated by multiplying the isotopic masses by their respective percentage abundances, summing the products, and dividing the total by 100.

EXERCISE DESCRIPTIVE QUESTIONS

i. Describe the discovery of electrons with the help of a discharge tube experiment.

Answer: J.J. Thomson used a discharge tube containing gas at low pressure with a high voltage applied across two electrodes. He observed rays traveling from the cathode to the anode that produced a green glow on the glass wall and were deflected by electric and magnetic fields toward the positive plate, proving the existence of negatively charged subatomic particles called electrons.

ii. Explain Rutherford's atomic model and discuss its observations and conclusions.

Answer: Rutherford bombarded a thin gold foil with alpha particles.

Observations: Most alpha particles passed straight through the foil without deflection; a few were deflected at various angles; and very few bounced straight back.

Conclusions: An atom is mostly empty space; there is a dense, positively charged center called the nucleus containing almost all the mass; and electrons revolve around this central nucleus.

iii. Give a detailed account of Bohr's atomic model. What are its postulates?

Answer: Bohr's model is based on quantum theory with the following postulates:

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Electrons revolve around the nucleus in circular orbits called energy levels or shells designated by principal quantum number (n = 1, 2, 3...).

Each orbit has a fixed energy; while in an orbit, an electron does not radiate energy.

Energy is emitted or absorbed only when an electron jumps from one orbit to another, given by the Planck equation Delta E = E2 - E1 = hf.

iv. What are isotopes? Explain the isotopes of Hydrogen and Carbon.

Answer: Isotopes are atoms of the same element that have the same atomic number but different mass numbers due to a different number of neutrons.

Isotopes of Hydrogen: Protium (1H1 with 0 neutrons), Deuterium (2H1 or D with 1 neutron), and Tritium (3H1 or T with 2 neutrons, radioactive).

Isotopes of Carbon: Carbon-12 (98.9%), Carbon-13 (1.1%), and Carbon-14 (trace, radioactive).

v. Describe the properties of neutrons.

Answer: Neutrons are neutral subatomic particles with no electrical charge, have a mass nearly equal to that of a proton (approximately 1.675 x 10^-27 kg or 1.0087 amu), are constituents of all atomic nuclei except ordinary hydrogen (Protium), and are highly penetrating due to their lack of charge.

vi. Compare the location, charge, and relative mass of protons, neutrons, and electrons.

Answer: Electron: Located outside nucleus in shells, charge is -1, relative mass is 1/1836.

Proton: Located inside nucleus, charge is +1, relative mass is 1.

Neutron: Located inside nucleus, charge is 0 (neutral), relative mass is 1.0087.

EXERCISE NUMERICAL PROBLEMS / EXERCISE CALCULATION TASKS

Q1: Calculate the number of neutrons, protons, and electrons in the following atoms: Pt-195 and U-238 (or reference given isotopes).

Given Data & Calculation:

For Platinum (Pt with mass number 195 and atomic number 78): Protons = 78, Electrons = 78, Neutrons = 195 - 78 = 117.

For general isotopic representation: Number of protons = Atomic number (Z), Number of electrons = Atomic number (Z), Number of neutrons = Mass number (A) - Z.

Q2: Calculate the relative atomic mass of an element given its percentage abundances of isotopes.

(Note: Solved using standard formula: Sum of [Isotopic Mass x Percentage Abundance] / 100).

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