Exercise

1. Tick (✓) the correct answer

(i) What is the maximum number of electrons that can be accommodated in the third shell of elements?
(a) 8
(b) 18✓
(c) 10
(d) 32

(ii) What information was obtained from the discharge tube experiments?
(a) The structure of the atom was discovered.
(b) Neutrons and protons were discovered.
(c) Electrons and protons were discovered. ✓
(d) The presence of the nucleus in the atom was discovered.

(iii) Why are isotopes not shown in the periodic table?
(a) The periodic table cannot accommodate the large number of isotopes of different elements.
(b) Some isotopes are unstable and form different elements.
(c) All isotopes have the same atomic number, so there is no need to give them separate places. ✓
(d) Isotopes do not show any periodic behavior.

(iv) Which particle is present in a different number in isotopes?
(a) Electron
(b) Neutron✓
(c) Proton
(d) Both neutron and electron

(v) In which isotope of oxygen are the numbers of protons, electrons, and neutrons equal?
(a) ^{17}O
(b) ^{16}O✓
(c) ^{18}O
(d) None of these

(vi) If the abundances of nitrogen isotopes ^{14}N and ^{15}N are 99.64 and 0.35 respectively, what will be the relative atomic mass of nitrogen?
(a) 14.0210✓
(b) 14.0021
(c) 14.2100
(d) 14.1200

(vii) How is radiocarbon dating useful for archaeologists?
(a) It helps to find the age of organic materials. ✓
(b) It helps to find the composition of the material.
(c) It helps to find the usefulness of the material.
(d) It finds out whether the material is radioactive or not.

(viii) What holds the particles in the nucleus together?
(a) Strong nuclear force ✓
(b) Weak nuclear force
(c) Electrostatic force
(d) Dipolar force

(ix) How do electrons stay away from the nucleus even though they have opposite charges?
(a) By staying fixed in place
(b) By revolving around the nucleus ✓
(c) Because of their wave-like nature
(d) Because of the magnetic field around the nucleus

(x) Rubidium has two isotopes. If the percentage abundance of the lighter isotope is 72.2%, what will be the abundance of the heavier isotope?
(a) 15%
(b) 27.8% ✓
(c) 37%
(d) 72%

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2. Short Answer Questions

i. Why is it said that almost all the mass of an atom is concentrated in its nucleus?
→ Because protons and neutrons, which are heavy particles, are all present in the nucleus, while the electron has very little mass.

ii. Why are elements different from each other?
→ Because each element has a different number of fundamental particles (protons, neutrons, electrons) in its atoms.

iii. How many neutrons are there in ^{210}Bi?
→ 210 – 83 = **127 neutrons**

iv. Why is tritium (H) a radioactive element?
→ Because tritium has more neutrons in its nucleus, which makes it unstable and causes it to emit radiation.

v. How does an atom absorb and release energy?
→ When an electron moves from one shell to another, it absorbs or releases energy.

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3. Long Answer Questions

i. Why does the energy of an electron increase as we move from the first shell to the second shell?
→ Because each shell is at a certain distance from the nucleus. The farther a shell is from the nucleus, the more energy its electrons have.

ii. Why is it important to reduce the gas pressure inside a discharge tube?
→ To reduce the number of gas molecules so electrons can move easily and show their properties.

iii. What was the classical concept of an electron? How did it change over time?
→ According to the classical concept, an electron is a small particle that revolves around the nucleus.
→ According to the modern concept, an electron has a wave-like nature, and its exact location cannot be known with certainty. We can only estimate where it might be near the nucleus.

iv. Why are the nuclei of radioactive elements unstable?
→ Because the balance between protons and neutrons in their nuclei is disturbed, so they emit radiation to become stable.

v. How did scientists conclude during discharge tube experiments that all elements contain the same type of electrons and protons?
→ Because when different gases were tested, the same type of electrons and protons were found, having the same properties (mass, charge, etc.) in every element.

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4. Descriptive Questions

i. Describe the structure of a hydrogen atom.
→ A hydrogen atom has only one proton in the nucleus and one electron revolving in a specific shell around the nucleus.
→ Ordinary hydrogen has no neutron.
→ The electron's energy level near the nucleus is called the ground state.

ii. How does the theory of atomic structure explain the ionization of atoms by radioactive isotopes?
→ When radiation from a radioactive isotope hits an atom, it can remove an electron.
→ This causes the atom to lose an electron and become a positive ion (cation).
→ In this way, the atom gets ionized.

iii. What is radioactivity? State three uses of radioactive isotopes.
→ Radioactivity is the process in which an unstable nucleus emits radiation to become stable.
Three uses:

1. In medicine: For treatment of cancer and thyroid
2. In industry: To test the strength of metals and concrete
3. In archaeology: To find the age of ancient objects using radiocarbon dating

iv. Find the relative atomic mass of mercury from the given data.

Isotope	Relative Abundance
^{196}Hg	0.0146%
^{198}Hg	10.02%
^{199}Hg	16.34%
^{200}Hg	23.13%
^{201}Hg	13.22%
^{202}Hg	29.80%
^{204}Hg	6.85%

→ Relative atomic mass =
(196 × 0.0146 + 198 × 10.02 + 199 × 16.34 + 200 × 23.13 + 201 × 13.22 + 202 × 29.80 + 204 × 6.85) ÷ 100
→ = **200.59 amu (approximately)**

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5. Investigative Questions

i. How do scientists synthesize new elements in the laboratory?
→ Scientists use particle accelerators to synthesize new elements. In these, light nuclei are collided at very high speeds to form heavier nuclei.
→ This is done through nuclear reactions.

ii. "A system just like our Solar System also exists in an atom." Comment on this statement.
→ Yes, just like planets revolve around the sun in our solar system, electrons revolve in specific shells around the nucleus.
→ The nucleus is at the center like the sun, and electrons orbit it like planets.
→ Because of this similarity, an atom is often called a "mini solar system," especially in Bohr's atomic model.