

CHAPTER 2
STRUCTURE OF ATOM

VERY SHORT ANSWER (2 MARKS)

1. What is the absolute mass, size and charge of proton, electron and neutron?

Relative size	Name	Mass (Kg)	Charge (C)
	Proton	1.67×10^{-27}	$+1.602 \times 10^{-19}$
	Neutron	1.67×10^{-27}	0
	Electron	9.11×10^{-31}	$+1.602 \times 10^{-19}$

2. What will be the charge on an atom with mass number one and atomic number one?

An atom with a mass number one and atomic number one is a standard hydrogen atom ${}^1\text{H}$.
Proton-1, Electron - 1, Neutron – Zero

3. Neutrons can be found in all atomic nuclei except in one case. Which is the atomic nucleus and What does it consist of?

The only atomic nucleus that does not contain neutron is the Protium nucleus, which is the most common isotope of hydrogen.
Proton -1, Electron –1, Neutron- Zero.

4. Which fact is proved by the following observation in Rutherford Scattering experiment very few alpha particles are deflected back?

Very few alpha particles are deflected back (rebound by 180°) proves that the atom's positive charge and mass are concentrated in a highly dense, extremely small core known as the atomic nucleus.

5. Give one important application of Iodine-131 (I^{131})

One important medical application of the Iodine-131 (I^{131}) isotope is the diagnosis and treatment of thyroid cancer.

6. What is a Valence shell? How many electrons are present in the Valence Shell?

Valence shell is the outermost shell of an atom. Electrons located in this shell are called as valence electrons. A valence shell can hold 1-8 electrons. Atoms are most stable when this outer shell is completely filled (known as the Octet Rule).

Groups 1 & 2: Have 1 to 2 valence electrons.

Groups 13 to 18: Have 3 to 8 valence electrons.

Noble Gases: Have 8 valence electrons (except Helium, which has 2).

7. Why are Bohr's orbits called stationary states?

Bohr's orbits are called stationary states because electrons revolving in these specific paths do not lose or gain energy over time.

8. Why are anode rays called canal rays?

Anode rays are called canal rays because they pass through the holes or "canals" bored into a perforated cathode.

9. What does $^{40}_{18}\text{Ar}$ represent?

It represents a specific isotope of the element Argon, detailing its exact atomic structure.
Atomic Number (Z): It represents the atom has exactly 18 protons in its nucleus.
Because it is a neutral atom, it also has 18 electrons.
Mass Number (A): It represents the total number of protons plus neutrons in the nucleus.

10. What would you conclude from the observation that cathode rays rotate a light paddle wheel placed in their path?

Cathode rays rotate a light paddle wheel placed in their path, so we conclude that cathode rays consist of material particles that possess mass and kinetic energy.

11. What characteristic feature is seen in the configuration of chemically inactive elements?

The characteristic feature seen in the electronic configuration of chemically inactive elements (noble gases) is a completely filled outermost shell, which typically consists of 8 valence electrons (known as a stable octet). This full valence shell represents a state of maximum stability and minimum energy, meaning these elements have no natural tendency to gain, lose, or share electrons.

12. Explain why ^1_1H and ^2_1H are not considered isotopes?

They are not considered isotopes because they belong to completely different chemical elements with different atomic numbers (proton counts).

For $^1\text{H}_3$: This structure is made of three Protium atom

- Total Protons = 3
- Total Neutrons = 0
- Total Nuclear Mass = 3 atomic mass units (amu)

For $^2\text{H}_3$: This structure is made of three Deuterium atoms

- Total Protons = 3
- Total Neutrons = 3
- Total Nuclear Mass = 6 atomic mass units (amu)

13. Give one similarity and one difference between isotopes C^{14} and C^{12} .

Similarity: C^{12} and C^{14} have exactly six protons in their nucleus.

Difference: C^{12} contains six neutrons, while C^{14} contains eight neutrons.

14. Atomic number is defined in terms of protons and not in terms of electrons. Why?

The atomic number is defined by protons because the number of protons in an atom never changes during ordinary chemical or physical processes, whereas the number of electrons constantly changes.

15. Name the radioactive isotope which is used in treatment of cancer.

The radioactive isotope most commonly used in the treatment of cancer is Cobalt-60 (^{60}Co). It is widely used in a medical procedure called radiation therapy (specifically teletherapy) to target and destroy cancerous tumors.

SHORT ANSWER (3 MARKS)

1. Justify the statement atomic number of an element is equal to the number of electrons in a neutral atom only and not in anion.

In neutral atom, No. of protons = No. of electrons = Atomic number.

An anion is formed by gain of one or more electrons by an atom. Therefore, anion contains more electrons than neutral atom (or) number of electrons in anion is greater than atomic number (the number of protons).

2. What is the difference between Electrovalency and Covalency?

Feature	Electro valency	Co valency
Bond type	Ionic or Electrovalent bond	Covalent bond
Bond formation	Complete transfer of electrons	Mutual sharing of electrons
Elements involved	Metals and Non metals	Two Non metals
Forces	Strong electrostatic force	Shared electron force
Physical state	Mostly crystalline solids	Gases, Solids and Liquids
Conductivity	Conduct electricity in molten and aqueous state	Poor conductors of electricity
Example	NaCl	CH ₄ , NH ₃

3. What do you understand by ground state and excited state of an atom.

Ground State: It is the lowest possible energy state of an atom.

It is the most stable configuration.

Electrons occupy the lowest available orbitals.

Atoms naturally exist in this state.

Excited State: State with higher energy than the ground state.

Atom absorbs external energy (like heat, light, or electricity).

One or more electrons jump to higher energy levels.

State is temporary and highly unstable.

Electrons quickly fall back down, releasing energy as light (photons).

4. What will be the composition of the nucleus of the atom of an element with atomic number 19 and mass number 39?

The nucleus of this atom has 19 protons and 20 neutrons. The composition of the nucleus for this element (Potassium, (K)).

1. Identify Number of Protons

Atomic number (Z) = Total number of protons in the nucleus = 19

2. Calculate Number of Neutrons

Mass number (A) = Total of protons and neutrons in the nucleus.

$$\begin{aligned}\text{Number of neutrons} &= A - Z \\ &= 39 - 19 = 20\end{aligned}$$

5. A nucleus is represented as ${}_y\text{X}^{2y}$. Identify the possible elements with such a nucleus.

The expression ${}_y\text{X}^{2y}$ represents any element where the mass number (atomic weight) is exactly double the atomic number (number of protons).

(Atomic Number (Z) = Y, Mass Number(A) = 2Y)

Helium-4 (${}_2\text{He}^4$): $y = 2$

Carbon-12 (${}_6\text{C}^{12}$): $y = 6$

Nitrogen-14 (${}_7\text{N}^{14}$): $y = 7$

Oxygen-16 (${}_8\text{O}^{16}$): $y = 8$

Neon-20 (${}_{10}\text{Ne}^{20}$): $y = 10$

Magnesium-24 (${}_{12}\text{Mg}^{24}$): $y = 12$

Silicon-28 (${}_{14}\text{Si}^{28}$): $y = 14$

Sulfur-32 (${}_{16}\text{S}^{32}$): $y = 16$

Calcium-40 (${}_{20}\text{Ca}^{40}$): $y = 20$

6. An element has 2 electrons in N shell. Identify the element.

Electrons fill in the shell order K, L, M, N. Electrons are filled by Bohr bury Scheme ($2n^2$).
K shell = 2 electrons, L shell = 8 electrons, M shell = 18 electrons, N shell = 2 electrons
Total electrons = 20, Atomic number = 20. So, the element is Calcium.

7. Electronic configuration of a neutral atom X is 2,8,6. What is the electronic configuration of X^{2-} .

The electronic configuration 2,8,6 .Total electrons =16. The element is Sulphur. The 2^- charge atom means atom has gained 2 electrons .So the new configuration of X^{2-} becomes 2,8,8.

8. The atomic species A and B have different number of protons but same number of nucleons. Atomic species X and Y have same number of protons but different number of nucleons. Which pair is an example of isobar and why?

The pair A and B is an example of isobars. Isobars are atoms of different chemical elements that have the same number of nucleons (mass number) but a different number of protons (atomic number). The pair X and y is an example of Isotopes. Isotopes are atoms of same element with same number of protons but different number of nucleons.

9. The electronic configuration of an Al^{3+} ion is $1S^2 2S^2 2p^6$ (Neon).

Atomic number of Aluminium is 13 which means 13 protons and 13 electrons. The Electronic configuration of aluminium is $1S^2 2S^2 2p^6 3S^2 3p^1$. The 3^+ charge means the atom loses 3 electrons from its valence shell. It loses one electron from 3p orbital and 2 electrons from 3s orbital, so the configuration becomes $1S^2 2S^2 2p^6$. This configuration is the stable noble gas configuration of Neon.

10. Give the percentage abundance of isotope $^{20}_{10}Ne$ is 90% and that of isotope $^{22}_{10}Ne$ is 10% . Calculate the average mass of neon.

$$\text{Average Atomic Mass} = \frac{(\text{Mass}_1 \times \text{Abundance}_1) + (\text{Mass}_2 \times \text{Abundance}_2)}{100}$$

$$\text{Average Atomic Mass} = \frac{(20 \times 90) + (22 \times 10)}{100}$$

$$\text{Average Atomic Mass} = \frac{1800 + 220}{100} = \frac{2020}{100} = 20.2$$

The average atomic mass of neon is (20.2u).

11. Will $^{35}_{17}Cl$ and $^{37}_{17}Cl$ have different Valencies. Justify your answer

No $^{35}_{17}Cl$ and $^{37}_{17}Cl$ will not have different valencies, they have the exact same valency. They are isotopes of chlorine. They share the same atomic number (17), but have different mass number (35 and 37). They differ in the number of neutrons.

12. Calculate the mass and charge on one mole of electrons.

1. Calculate the Mass

- Mass of one electron (m_e): 9.109×10^{-31} kg
- Avogadro's number: 6.022×10^{23} electrons/mol
- Mass of 1 mole = $m_e \times N_A$
- Mass of 1 mole = $(9.109 \times 10^{-31} \text{ kg}) \times (6.022 \times 10^{23} \text{ mol}^{-1}) = 5.486 \times 10^{-7} \text{ kg}$

2. Calculate the Charge

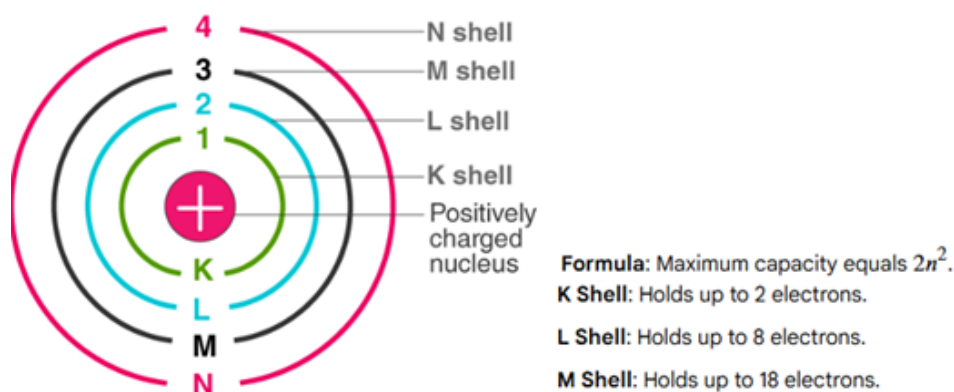
- Charge of one electron (q_e): $-1.602 \times 10^{-19} \text{ C}$
- Avogadro's number: $6.022 \times 10^{23} \text{ electrons/mol}$
- Charge of 1 mole = $q_e \times N_A$
- Charge of 1 mole = $(-1.602 \times 10^{-19} \text{ C}) \times (6.022 \times 10^{23} \text{ mol}^{-1}) = -96,485 \text{ C}$

13. An isotope of Sn^{12} contains 68 neutrons. What will be its mass number?

The mass number of this tin isotope is **118**.

$$A = \text{Protons} + \text{Neutrons} \quad A = 50 + 68 \quad A = 118$$

14. Draw Bohr's model of an atom with three shells. How many electrons L shell can accommodate?



15. How will you find the valency of Nitrogen, Oxygen and Fluorine?

Element	Atomic number	Electronic configuration	Valence Electrons	Valency
Nitrogen (N)	7	2,5	5	$8-5 = 3$
Oxygen (O)	8	2,6	6	$8-6 = 2$
Flourine(F)	9	2, 7	7	$8 -7 = 1$

LONG ANSWER (5 MARKS)

1. Are there elements with the same number of electrons, protons and neutrons. Give few examples.

Yes there are elements with same number of electrons, Protons and Neutrons

- **Helium-4:** 2 protons, 2 neutrons, 2 electrons.
- **Carbon-12:** 6 protons, 6 neutrons, 6 electrons.
- **Nitrogen-14:** 7 protons, 7 neutrons, 7 electrons.
- **Oxygen-16:** 8 protons, 8 neutrons, 8 electrons.
- **Neon-20:** 10 protons, 10 neutrons, 10 electrons.
- **Magnesium-24:** 12 protons, 12 neutrons, 12 electrons.
- **Silicon-28:** 14 protons, 14 neutrons, 14 electrons.
- **Sulfur-32:** 16 protons, 16 neutrons, 16 electrons.
- **Calcium-40:** 20 protons, 20 neutrons, 20 electrons.

2. An ion M^{3+} contains 10 electrons and 14 neutrons. What is the atomic number and mass number of element M. Name the element.

The neutral atom has 13 electrons. The ion carries a $3+$ charge which means 3 electrons are lost from the neutral atom.

Atomic number Z = Number of Protons = 13

Mass number A = Number of Protons + Number of neutrons
= $13 + 14 = 27$

The neutral atom possessing an atomic number of 13 is **Aluminum (Al)**

2.a) Three invisible radiations X, Y and Z are passed through an electric field. X was found to be undeviated. Y deviated towards positive end of the electric field and Z towards negative. Identify the particles present in X, and Z. What is e/m ratio for X?

X is undeviated because it carries no electric charge. So, X is gamma rays

Y is negatively charged because it is attracted to the positive plate. It contains electrons Y is Beta particle.

Z is positively charged because it is attracted to the negative plate. Z has alpha particle

Charge-to-Mass (e/m) Ratio for X

The (e/m) ratio represents the charge of a particle divided by its mass.

Radiation X is electrically neutral.

Its net charge (e) is exactly 0.

Therefore, the (e/m) ratio for X is 0

2.b) Define valency. How it is calculated for various elements?

Rule 1: For elements with 1 to 4 valence electrons.

If the outer shell has 1, 2, 3, or 4 electrons, the valency is equal to the number of valence electrons. These atoms tend to lose or share these electrons.

Rule 2: For elements with 5 to 8 valence electrons

If the outer shell has 5, 6, 7, or 8 electrons, the valency is calculated as 8 minus the number of valence electrons. These atoms tend to gain or share electrons to complete an octet (8 electrons).

Valence Electron	1	2	3	4	5	6	7	8
Formula Used	Valence electron = Valency	Valence electron = Valency	Valence electron = Valency	Valence electron = Valency	8 - Valence Electron	8 - Valence Electron	8 - Valence Electron	8 - Valence Electron
Valency	1	2	3	4	3	2	1	0

3.a). State 2 key points of Bohr's Atomic model.

- Fixed Orbits: Electrons revolve around the nucleus only in specific, non-radiating circular paths called discrete orbits or energy levels (designated as K, L, M, N = 1,2,3,4)
- Quantized Angular Momentum: An electron can only move in an orbit where its angular momentum (mvr) is an integral multiple of $h / 2\pi$ (expressed as $mvr = nh / 2\pi$).

3.b) How did Neil Bohr explain the stability of atom?

When an electron moves from lower-energy level to higher-energy level, it absorbs energy from an external source and gives out energy while jumping from a higher-energy level to a lower-energy level. Thus, he explained the stability of an atom.

4.a) What are octet and duplet rule? How do elements attain octet ?

Octet Rule: Atoms tend to bond with other atoms so that they have eight electrons in their valence shell.

Duplet Rule: The duplet rule applies to the innermost shell (K -shell), which only holds a maximum of two electrons. Lightest elements, like hydrogen and helium, only have one electron shell. These atoms achieve stability by completing this two-electron shell, mimicking the noble gas helium.

4.b). Explain the formation of cation. Give its main characteristics.

A cation is formed when a neutral atom loses one or more valence electrons, resulting in a net positive charge.

Characteristics

- They always carry a net positive electrical charge.
- They are primarily formed by metals (such as sodium, calcium, and iron) and hydrogen.
- A cation is always significantly smaller than its parent neutral atom.
- During electrolysis cations move toward the negatively charged electrode, known as the cathode.
- The loss of valence electrons allows the cation to achieve a stable, lower-energy electron configuration identical to the nearest noble gas.

5.a) What are isotone? Explain with examples.

Isotones are atoms of different chemical elements that have the **same number of neutrons** but different numbers of protons (different atomic numbers) and different mass numbers

1. Sodium and Magnesium

Sodium-23 ($^{23}_{11}\text{Na}$): Mass Number (A) = 23, Atomic Number (Z) = 11.

$$\text{Neutrons } (N) = 23 - 11 = 12$$

Magnesium-24 ($^{24}_{12}\text{Mg}$): Mass Number (A) = 24, Atomic Number (Z) = 12

$$\text{Neutrons } (N) = 24 - 12 = 12$$

2. Carbon and Nitrogen

Carbon-13 ($^{13}_6\text{C}$): Mass Number (A) = 13, Atomic Number (Z) = 6.

$$\text{Neutrons } (N) = 13 - 6 = 7$$

Nitrogen-14 ($^{14}_7\text{N}$): Mass Number (A) = 14, Atomic Number (Z) = 7.

$$\text{Neutrons } (N) = 14 - 7 = 7$$

5.b) List some important uses of isotopes

Medical application

- Cancer therapy: Cobalt-60 is used in radiation therapy to target and destroy malignant cancer cells.
- Thyroid treatment: Iodine-131 is used to diagnose and treat thyroid disorders, including thyroid cancer and hyperthyroidism.
- Diagnostic imaging: Technetium-99 is the most widely used radioactive tracer for imaging organs like the heart, brain, and bones.

Archaeology and Geology

- Carbon dating: Carbon-14 is used by archaeologists to estimate the age of ancient organic materials up to 50,000 years old.
- Rock dating: Uranium-238 and Potassium-40 are used by geologists to date extremely old rocks and estimate the age of the Earth

Industry and agriculture

- Nuclear power: Uranium-235 and Plutonium-239 serve as primary fuels in nuclear reactors to generate electricity.
- Agricultural tracers: Phosphorus-32 is added to fertilizers to track how plants absorb nutrients and optimize crop yields.

SUBJECTIVE QUESTION-COMPETENCY BASED

1. A student observes that an atom with electronic configuration 2,8,8 is chemically inactive. Explain this behavior.

An atom with the electronic configuration 2,8,8 is chemically inactive because it has a completely filled valence shell. The atom has no tendency to lose, gain, or share electrons. It does not react with other elements. The specific configuration (total of 18 electrons) belongs to **Argon (Ar)** which is a noble gas.

2. An atom has mass number 23 and contains 11 protons. Another atom has mass number 24 and also contains 11 protons. Name the relationship between the atoms.

The two atoms are isotopes of each other.

- **Identify atomic number**

Both atoms have (11) protons. Protons determine the atomic number (Z). They represent the same chemical element. Element (11) is sodium (Na).

- **Compare mass numbers**

The mass number is (A). Atom 1 has mass number 23. Atom 2 has mass number 24. They have different mass numbers.

- **Calculate neutron counts.**

Atom 1 has $(23 - 11 = 12)$ neutrons.

Atom 2 has $(24 - 11 = 13)$ neutrons. Their neutron count differs. So, they are isotopes.

2. A teacher asks why Bohr's model is considered better than Rutherford's model for explaining atomic structure. What should a student answer?

Bohr's model is better than Rutherford's because

- It explains why electrons do not crash into the nucleus and how atomic emission spectra is formed.
- Electrons don't orbit arbitrarily. They travel in specific circular orbit called Stationary states.
- The electrons do not radiate energy.

4. A student is told that atoms are neutral though they contain charged particles. How can the student justify this statement?

An atom is neutral because it contains exactly the same number of positively charged protons and negatively charged electrons, which completely cancel each other.

Protons carry a positive charge (+1), Electrons carry a negative charge (-1), Neutrons carry zero charge (they are neutral).

Net Charge Calculation

Net Charge = Total Positive Charge + Total Negative Charge

For an atom with (Z) protons and (Z) electrons

Net Charge = $(+ Z) + (- Z) = 0$

The magnitude of charge on one proton equals one electron. These opposite charges balance each other perfectly. Because the net electrical charge is zero, the atom remains neutral.

5. Why is the knowledge of electronic configuration useful in predicting the chemical behavior of an element?

Electronic configuration is essential because the arrangement of electrons, particularly in the outermost shell, dictates how an atom interacts with other atoms. It directly determines valency, chemical bonding, and reactivity, helping chemists predict whether an element will gain, lose, or share electrons.

6. A student says that atoms are indivisible because early philosophers considered them the smallest particle of matter. Is this statement correct today? Explain.

No, this statement is not correct today.

- **Subatomic Particles:** Discoveries by scientists like J.J. Thomson (electrons), Ernest Rutherford (protons), and James Chadwick (neutrons) proved that atoms are made of smaller particles.
- **Nuclear Fission:** Modern physics demonstrates that we can split the nucleus of heavy atoms (like Uranium-235) into smaller atoms, releasing massive amounts of energy.
- **Quarks:** Advanced particle physics shows that even protons and neutrons are not fundamental, they are made of even smaller elementary particles called quarks.

7. Thomson's model explained that atoms are electrically neutral. How did his model describe this neutrality?

J.J. Thomson described atomic neutrality through his "**Plum Pudding**" model (also known as the **watermelon model**) by balancing equal amounts of positive and negative charges. The model described the neutrality of atom.

- The atom is a uniform, solid sphere of positively charged matter.
- Negatively charged electrons were embedded throughout this positive sphere, like raisins in a pudding or seeds in a watermelon.
- The total amount of negative charge from the embedded electrons was exactly equal to the total positive charge of the surrounding sphere.
- The opposite charges were equal in magnitude, they completely cancelled each other out, making the overall atom electrically neutral.

8. Rutherford's gold foil experiment showed that most alpha particles passed straight through the foil while a few deflected. What two conclusions were drawn from this?

Rutherford's gold foil experiment led directly to the conclusion that

1. Atoms are mostly empty space.

Observation: Most alpha particles passed straight through the gold foil without any resistance or change in direction.

Conclusion: The vast majority of an atom's volume is completely empty space, allowing particles to traverse it freely.

2. A Dense, Positively Charged Nucleus Exists.

Observation: A tiny fraction of the positively charged alpha particles was deflected at very large angles, some even bouncing straight back.

Conclusion: The atom contains a highly concentrated, massive central core that possesses a strong positive charge, which repelled the incoming positive alpha particles.

9. An element has atomic number 13 and mass number 27. Find the number of protons, electrons and neutrons in an atom.

- The number of protons in an atom is always equal to its atomic number.
 - Number of protons = Atomic Number
 - Number of protons = 13
- In a neutral atom, the number of negatively charged electrons equals the number of positively charged protons.
 - Number of electrons = Number of Protons
 - Number of electrons = 13
- The mass number is the total sum of protons and neutrons in the nucleus.
 - Number of neutrons = Mass Number - Atomic Number
 - Number of neutrons = $27 - 13 = 14$ neutrons

10. A neutral chlorine atom has 17 electrons. What is the atomic number? What does the atomic number represent?

The atomic number of the chlorine atom is **17**.

The atomic number represents

- It equals the total number of protons in an atom's nucleus.
- It defines the specific chemical element (e.g., atomic number 17 is always chlorine).
- In a neutral atom, it also equals the total number of electrons.

OLYMPIAD FOLDER

1. There are 15 protons and 16 neutrons in the nucleus of an element. Calculate its atomic number and mass number. How will you represent the element?

Atomic Number (Z) = No of protons = 15.

Mass Number (A) = (15 + 16 = 31).

The atomic number of the element is **15**, and its mass number is **31**. The element is **Phosphorus**, and it is represented as ${}_{15}\text{P}^{31}$.

2. An electron is regarded as universal particle. Explain.

An electron is regarded as a universal particle because it is a fundamental block of all matter in the universe.

- Electron carries negative charge (-1.6×10^{-19} Coulombs) and mass (9.1×10^{-31} kg).
- Electrons emitted from any substance (like gas, metal, or carbon) are identical.
- Neutral atoms contain electrons to balance the positive charge of protons.

3. Most of the space in an atom is empty. Justify.

Most of the space in an atom is empty because its mass is concentrated in a tiny central nucleus. When positively charged alpha particles were fired at a thin gold foil, the vast majority passed straight through without any deflection, proving they traveled through empty space.

4. Why are isotopes of an element chemically similar?

Isotopes of an element are chemically similar because they have the same number of electrons and the same electronic configuration.

- Electron configuration: Atoms of the same element have identical numbers of protons and electrons.
- Valence electrons: They possess the exact same number of outer-shell electrons. Valence electrons alone determine how an atom interacts and bonds with other atoms.

5. The elements are identified by their atomic numbers and not by their mass numbers. Justify.

Elements are identified by their atomic numbers because the number of protons uniquely defines an element's chemical identity, whereas mass numbers can vary for the same element or be identical for different elements. The atomic number is the ultimate blueprint for an element.

6. If an atom contains one electron and one proton, will it carry any charge or not?

An atom containing one electron and one proton will not carry any charge. It will be electrically neutral.

Protons carry a positive electrical charge of (+1).

Electrons carry a negative electrical charge of (-1).

Net charge calculation is $(+1) + (-1) = 0$.

7. Name the 3 subatomic particles of an atom.

The three subatomic particles of an atom are

Protons – Positively charged, Electrons – Negatively charged, Neutrons – No charge (neutral)

8. Helium atom has an atomic mass of 4u and two protons in its nucleus. How many neutrons does it have?

Atomic mass of Helium atom = 4u and Number of protons = 2

Atomic mass = Number of protons + Number of neutrons

$$4 = 2 + \text{number of neutrons}$$

So, number of neutrons = $4 - 2 = 2$. Hence, Helium has 2 neutrons

9. Na^+ has completely filled k and L shells. Explain.

A neutral sodium atom (Na) has an atomic number of 11, meaning it has 11 electrons. These electrons fill the energy levels in order

K shell $n = 1$, Holds a maximum of 2 electrons.

L shell $n = 2$, Holds a maximum of 8 electrons.

M shell $n = 3$, Holds the remaining 1 electron.

Electronic configuration of Na = **2, 8, 1**

To achieve a stable octet configuration, a sodium atom loses its single valence electron from the outermost M shell. This transformation creates a positively charged sodium cation Na^+ . After losing that 1 electron, the Na^+ ion is left with 10 total electrons.

K shell: Retains its 2 electrons (fully filled, maximum capacity is 2).

L shell: Retains its 8 electrons (fully filled, maximum capacity is 8).

M shell: Empty.

Electronic configuration of Na^+ is **2, 8**.

10. If bromine atom is available in the form of say 2 isotopes $^{79}_{35}\text{Br}$ and $^{81}_{35}\text{Br}$. Calculate the average atomic mass of bromine.

$^{79}_{35}\text{Br}$ with an abundance of **49.7%** and $^{81}_{35}\text{Br}$ with an abundance of **50.3%**

$$\text{Average Atomic Mass} = \frac{(\text{Mass}_1 \times \%_1) + (\text{Mass}_2 \times \%_2)}{100}$$

$$\text{Average Atomic Mass} = \frac{(79 \times 49.7) + (81 \times 50.3)}{100}$$

$$\text{Average Atomic Mass} = \frac{3926.3 + 4074.3}{100} = \frac{8000.6}{100} = 80.006 \text{ u}$$

The average atomic mass of the bromine atom is exactly **(80.006)**