TEST YOUR SELF

TEST YOURSELF 2.1 (THEORIES AN EXPERIMENTS RELATED TO STRUCTURE OF ATOMS)

i) Do you know any element having no neutrons in its atoms?

Ans: Yes the isotope of hydrogen (Protium, ${}^{1}_{0}H$) has no neutron. It has one proton in its nucleus and one electron revolving around it.

ii) Who discovered an electron, a proton and a neutron?

Ans:
a. In 1886, Goldstein discovered positively charged particles called protons.
b. In 1897, J.J. Thomson discovered the negatively charged particles called electrons.
c. In 1932, James Chadwick discovered the neutral particles called neutrons.

iii) How does electron differ from a neutron?

Ans: Difference between electron and neutron.

Electron	Neutron
i. Electron is the negatively charged particle.	**i.** Neutron is the neutral particle.
ii. Electron revolves around the nucleus.	**ii.** Neutron is present in the nucleus.
iii. Mass of electron is 5.486×10^{-4} g amu or 9.106 x 10-28 g.	**iii.** Mass of neutron is 1.0087 amu or $1.674 \times$ 10-24 g

iv) Explain how anode rays are formed from the gas taken in the discharge tube?

Ans: Anode rays do not originate from the anode. In fact these rays are produced when the cathode rays or electrons collide with the residnal gas unolecutes present in the discharge tube and ionize them as follows:

$$M + \bar{e} \longrightarrow M^{+} + 2\bar{e}$$

TEST YOURSELF 2.2 RUTHERFORD'S ATOMIC MODEL AND BOHR'S ATOMIC MODEL

i) How was it proved that the whole mass of an atom is located at its centre?

Ans: Rutherford bombarded alpha particles on a 0.00004 cm thick gold foil. Almost all the particles passed through the foil undeflected, only few bounced back. The complete rebounce of few alpha particles showed that the nucleus is an extremely small positively charged part. It is situated at the center of an atom and it carries nearly the whole mass of an atom.

ii) How was it shown that atomic nuclei are positively charged?

Ans: Alpha particles are helium nuclei $(He)^{2+}$ i.e. doubly positively charged particles. The deflection and rebounding of a few particles showed that atomic nuclei (centre of an atom) are positively charged.

iii) Name the particles which determine the mass of an atom.

Ans: Protons and neutrons present in the nucleus determine the mass of an atom. The sum of number of protons and neutrons is equal to mass of an atom.

iv) What is the classical theory of radiation? How does it differ from quantum theory?

Ans:

Classical theory of radiation	Quartum theory of radiation
According to classical theory of radiation electrons being the charged particles should release or emit energy continuously and they should ultimately fall into the nucleus.	According to quantum theory of radiation, energy is not emitted or absorbed continuously but it is emitted or absorbed in the form of small energy packets or bundles known as quantum or

	photons in case of light energy. Quantum means fixed energy.

v) How can you prove that angular momentum is quantized?

Hint: Le angular momentum (mvr) of 1st orbit is mvr = nh/2π

mvr = $\frac{6.63\times10^{-34}}{2\times3.14}$ 1.0 $\times10^{-34}$ kgm^{2}s^{-1}

Ans: According to Bohr's Model.

Angular momentum (mvr) = $\frac{nh}{2\pi}$ (where n=1,2, 3,….. and it is equal to number of orbit)

For n = 1, Angular momentum of electron = $\frac{1\times h}{2\pi}$

For n = 2, Angular momentum of electron = $\frac{2\times h}{2\pi}$

For n = 3, Angular momentum of electron = $\frac{3\times h}{2\pi}$

The angular momentum of an electron for n = 2 is twice the angular momentum for n=1 whereas the angular momentum of an electron for n = 3 is thrice the angular momentum for n = 1.

Moreover the electron is bound to remain in one of these orbits and not in between them. Hence the angular momentum of electron is quantized.

TEST YOURSELF 2.3 (ELECTRONIC CONFIGURATION)

i) What is the maximum number of electrons that can be accommodated in p-subshell?

Ans: The maximum number of electron that can be accommodated in a p subshell is 6.

ii) How many subshells are there in second shell?

Ans: There are two subshells in second shell i.e. s and p subshells.

iii) Why does an electron first fill 2p orbital and then 3s orbital?

Ans: Electrons are filled around the nucleus in various shells and subshells according to increasing energy. The energy of 2p orbital is less than that of 3s orbital. Therefore 2p orbital is filled first than that of 3s orbital.

iv) If both K and L shells of an atom are completely filled; what is the total number of electrons present in them?

Ans: The maximum capacity of shells to accommodate electrons is:

K shell = 2 electrons

L shell = 8 electrons

Therefore, the total number of electrons present in K and L shell = 2+8=10 electrons.

v) How many electrons can be accommodated in M shell?

Ans: The maximum number of electrons that can be accommodated in M shell is 18. It can be calculated by the formula $2n^2$. As for M shell value 'n' is 3.

Therefore,

Maximum number of electrons in M shell = $(2n^2) = 2\times3^2 = 2\times9 = 18$ electrons.

vi) What is the electronic configuration of a hydrogen atom?

Ans: The electronic configuration of hydrogen atom is $1s^1$.

vii) What is atomic number of phosphorus? Write down its electronic configuration.

Ans. Atomic number of phosphorous (P) =15

Electronic configuration of phosphorous (p) = $1s^2, 2s^2, 2p^6, 3s^2, 3p^3$

viii) If an element has atomic number 13 and atomic mass 27; how many electrons are there in each atom of the element?

Ans: In a neutral atom, atomic number = number of protons = number of Electrons = 13.

Therefore,

Each atom of this element has 13 electrons.

ix) How many electrons will be in M shell of an atom having atomic number 15?

Ans: Atomic number = Number of electrons =15

Electronic configuration = $1s^2, 2s^2, 2p^6, \mathbf{3s^2, 3p^3}$.

Therefore, M shell contains electrons = 2+3=5 electrons.

x) What is maximum capacity of a shell?

Ans: The maximum capacity of a shell to accommodate electrons can be calculated by the formula = $2n^2$

Where

n = 1, 2, 3, 4, ... and it represents the shell

Maximum capacity of K shell = 2 electrons

Maximum capacity of L shell = 8 electrons

Maximum capacity of H shell = 32 electrons

TEST YOURSELF 2.3 (ISOTOPES)

i) Why do the isotopes of an element have different atomic masses?

Ans: The isotopes of an element have same number of electrons and protons while different number of neutrons. Therefore the isotopes of an element have different atomic masses due to different number of neutrons.

ii) How many neutrons are present in C-12 and C-13?

Ans: Number of neutrons present in C-12=12-6=6 neutrons

Number of neutrons present in C-12=13-6=7 neutrons

(The atomic number of carbon is 6)

iii) Which of the isotopes of hydrogen contains greater number of neutrons?

Ans: Tritium isotope of hydrogen contains greater number of neutrons. It has 2 neutrons.

iv) Give one example each of the use of radioactive isotope in medicine and radiotherapy.

Ans: In medicine:

The radioactive isotope iodine-131 is used as a tracer in medicine. It is used to diagnose presence of tumors in the human body.

In radiotherapy:

Co-60 is used to treat cancer inside the body. P-32 and Sr-90 are used to treat skin cancer.

v) How is the goiter in thyroid gland detected?

Ans: Iodine-131 is used for diagnosis of goiter in thyroid gland.

vi) Define nuclear fission reaction.

Ans: *"A reaction that involves the splitting of heavy nucleus into two or more higher nuclei with a release of huge amount of energy is called a nuclear fission reaction."*

Example:

$$^{235}_{92}U + ^{1}_{0}n \longrightarrow ^{139}_{56}Ba + ^{94}_{36}K + 3\,^{1}_{0}n + \text{huge amount of energy}$$

During this reaction, released neutrons continue to bombard other uranium -235 atoms.

vii) When U-235 breaks up, it produces a large amount of energy. How is this energy used?

Ans: In this reaction a large amount of energy is released which may be used to convert water into steam in boilers. The steam then drives the turbines to generate electricity.

$$^{235}_{92}U + ^{1}_{0}n \longrightarrow ^{139}_{56}Ba + ^{94}_{36}K + 3\,^{1}_{0}n + \text{energy}$$

viii) How many neutrons are produced in the fission reaction of U-235?

Ans: In the fission reaction of U-235, three neutrons are produced.

$$^{235}_{92}U + ^{1}_{0}n \longrightarrow ^{139}_{56}Ba + ^{94}_{36}K + 3\,^{1}_{0}n + \text{energy}$$

ix) U-235 fission produces two atoms of which elements?

Ans: U-235 fission produces one atom of barium-139 and one atom of krypton-94.

$$^{235}_{92}U + ^{1}_{0}n \longrightarrow ^{139}_{56}Ba + ^{94}_{36}Kr + 3\,^{1}_{0}n + \text{energy}$$