Tenth Physical Science

Structure of Atom

Electromagnetic waves can have a wide variety of wavelengths. The entire range of wavelengths is known as the electromagnetic spectrum.

Q: What are the rules to be followed while filling the electrons in atoms which contains more than one electron? How do you fill the electrons in degenerate orbitals? Explain. ***(4 Marks)***

A: We follow the following principles while filling the electrons in degenerate orbitals of an atom. a) Pauli's Exclusion Principle b) Aufbau Principle and c) Hund's Rule.

a) Pauli's Exclusion Principle: "No two electrons of the same atom can have all the four quantum numbers the same".

★ If n, l, and m_l are the same for two electrons then m_s must be different. In the Helium atom the spins must be paired.

★ Electrons with paired spins are denoted by '↑↓'. One electron has $m_s = +\frac{1}{2}$ and the other has $m_s = -\frac{1}{2}$. They have anti-parallel spins. so electronic configuration of Helium atom is $\boxed{\uparrow\downarrow}$ $1s^2$

b) Aufbau Principle: In the ground state the electronic configuration can be build up by placing electrons in the lowest available orbitals until the total number of electrons added is equal to the atomic number. This called Aufbau principle.

★ Thus orbitals are filled in the order of increasing energy.

★ Electrons are assigned to orbitals in order of increasing value of $(n + l)$

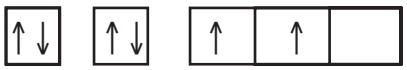
★ For sub-shells with the same value of $(n + l)$, electrons are assigned first to the sub-shell with lower 'n'.

c) Hund's Rule: Electron pairing in orbitals starts only when all empty orbitals of the same energy (degenerate orbitals) are singly occupied.

★ The configuration of Carbon (C) atom (Z = 6) is $1s^2\ 2s^2\ 2p^2$

★ The first four electrons go into 1s and 2s orbitals. The next two electrons go

into separate 2p orbitals, with both electrons having the same spin.



$1s^2$ $2s^2$ $2p_x^1$ $2p_y^1$

Q: Prakash said that 'In an atom electrons occupy stationary orbits of fixed energy at different distances from the nucleus'. Which model of the atom gave this information? Write the postulates and limitations of that model of the atom. ***(4 Marks)***

A: Bohr's model of the atom gave this information.

★ Niels Bohr proposed the following postulates:

a) Electrons in an atom occupy stationary orbits of fixed energy at different distances from the nucleus.

b) When an electron 'Jumps' from a lower energy state (ground state) to higher energy states (excited states) it absorbs energy or emits energy when such a Jump occurs from a higher energy state to lower energy state.

c) The energies of an electron in an atom can have only certain values E_1, E_2, E_3 ...., that is the energy is quantised.

★ The states corresponding to these energies are called stationary states and the possible values of the energy are called energy levels.

★ **Limitations:** 1) Bohr's model failed to account for splitting of line spectra.

★ This model failed to account for the atomic spectra of atoms of more than one electron.

Q: Give an example of visible spectrum in nature. Explain what is a visible spectrum. ***(2 Marks)***

A: The familiar example of the visible spectrum in nature is the formation of a rainbow.

★ Each colour in a rainbow is characterized by a specified wavelength from red (higher wavelength) to violet (shorter wavelength).

★ These colours (wavelengths), that the human nacked eye is sensitive to, are called visible light.

★ The range of wavelengths covering red colour to violet colour is called the visible spectrum.

Q: What is the significance of Planck's proposal? ***(1 Mark)***

A: The significance of Planck's proposal is that electromagnetic energy can be gained or lost in discrete values and not in a continuous manner.

Q: What is an orbital? How is it different from Bohr's orbit. ***(2 Marks)***

A: Orbital	Bohr's Orbit
★ The region or space around the nucleus where the probability of finding the eletron is maximum is called an orbital.	It has a definite bounary and fixed energy at diferent distances from the nucleus.
★ The shape of each orbital is different.	This orbit is circular in shape.
★ An orbital can accommodate only 2 electrons.	This orbit can accommodate a maximum of $2n^2$ eletrons.

Q: How do the vibrating electric and magnetic fields around the charge become a wave that travel through space? ***(1 mark)***

A: A vibrating electric charge creates a change in the electric field. The changing electric field creates a changing magnetic field.

★ This process continues, with both the created fields being perpendicular to each other and at right angles to the direction of propagation of the wave.

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