متعلقہ سوال کا جواب صرف مختص کردہ جگہ پر دیا جائے۔

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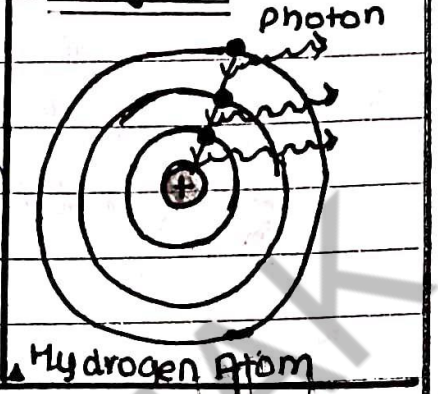
Q. No. 1: Spectrum of hydrogen contains many lines even though it has a single electron

Diagram:



→REASON:

- **Multiple Shells:** Multiple energy levels are present in Hydrogen atom. Electron can be excited by giving it energy to higher energy levels and as it is de-excited, it falls to lower ones.
- **Transitions:** Electron does not come to ground directly rather jumps to lower orbits in **multiple steps**
- **Spectral lines:** Difference of energies between different energy levels correspond to different spectral lines

→CONCLUSION: Thus in any atom, spectral lines obtained depend upon the energy levels and not number of electrons

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Q. No. 2: **→REASON:** The difference in spectral characteristics of solids and hot gases is primarily due to their atomic and molecular structure and the way they emit light

- **Solids (continuous spectrum):** Atoms are closely packed in a regular lattice. Acceleration of charged particles in heated solid results in emission of broad Range of wavelengths creating continuous spectrum because there is large number of energy levels for electrons to transition.
- **Hot Gas (Line Spectrum):** Gases are composed of widely spaced atoms or molecules. When excited electrons fall back to lower energy levels, they emit photons of specific energies corresponding to the energy differences between the levels. Emitted photons form distinct spectral lines resulting in a line spectrum.

Q. No. 3: (a) Incident photon of energy less than 13.6eV **can not** remove electron from ground state

(b) Hydrogen atom in ground state **can** absorb a photon of energy greater than and equal to 13.6eV

→ **REASON:**

- **Ionization Energy:** Minimum amount of energy required to remove electron from hydrogen is 13.6eV.
- **Incident Photon:** 13.6eV energy of incident photon is the minimum limit which can excite electron
- **Energy Greater:** If energy greater than 13.6eV is present then 13.6 eV is utilized to remove the electron from the shell and remaining or surplus energy is taken up by electron as **Kinetic Energy (K.E).**

Q. No. 4: Spectral lines show this behaviour because

→ **REASON:**

- **Energy Difference between orbits:** Energy difference between two orbits becomes smaller as distance from nucleus is increased
- **Spectral lines:** Corresponding to energy levels and their difference, spectral lines become closer together farther away from nucleus due to smaller energy difference

- **Mathematically:**

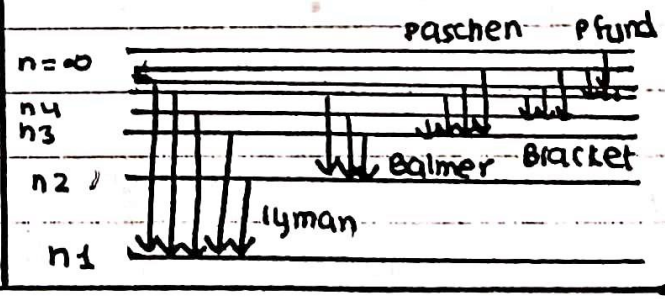
$E_2 - E_1 = -3.4eV - (-13.6eV) = 10.2eV$

$E_3 - E_2 = -1.51eV - (-3.4eV) = 1.89eV$

$E_4 - E_3 = -0.85eV - (-1.51eV) = 0.66eV$

$E_5 - E_4 = -0.54eV - (-0.85eV) = 0.31eV$

Diagram



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Q. No. 5 → **QUANTIZATION OF ANGULAR MOMENTUM:**

According to Bohr's atomic model, angular momentum of electrons orbiting around the nucleus is quantized.

•Restriction for electrons: Electrons move only in those orbitals where angular momentum of an electron is integral multiple of $h/2\pi$

Mathematically: $L_n = n\,h/2\pi$

•Spectrum of Hydrogen Atoms: Quantization of angular momentum helped Bohr to calculate energies of electrons in different orbits and to explain spectrum of hydrogen atom.

• Louis de Broglie's contribution and stability of Atom: According to him an electron moving in an orbit forms stationary waves that don't dissipate energy and thus atom doesn't collapse

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Q. No. 6 → **DIFFERENT PROPERTIES OF X RAYS FROM LIGHT:**

Both are electromagnetic radiations but due to small wave length 10^{-10} m and high energy, properties differ.

(i) Penetration: X rays' penetration power is greater than that of light due to very high energy

(ii) Ionization Power: X rays have greater ionization power

(iii) Diffraction: Due to very small wavelength, X rays can not be diffracted from ordinary diffraction grating but visible light can be.

(iv) Compton's Effect: Compton's scattering demands very high energy which x-rays can provide but light can not.

(v) Imaging Applications: Visible light is used in photography whereas x rays are used in radiography and CT scans.

Q. No. 7 : → **X-Ray's Dependence on Potential Difference:**

Electrons are accelerated towards anode to produce xrays.

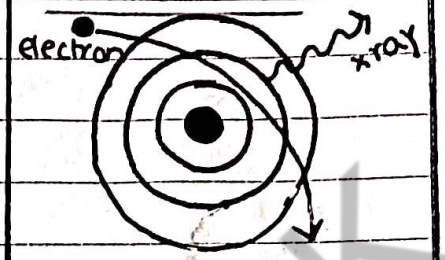
- **Bremsstrahlung Xrays:** Wavelength of xrays depend on accelerating potential and is **independent of target atom.** As

Mathematically: $\lambda = \frac{hc}{ve}$ $\lambda \propto 1/V$

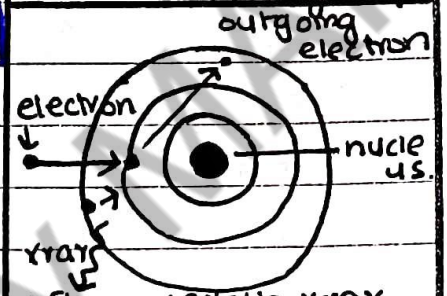
As potential difference **increases, wavelength decreases.**

- **Characteristic Xrays:** Sufficient accelerating potential will remove innermost orbital's electron but, wavelength of xray **depends on target metal** and is **independent of 'V'.**

Diagrams:



▲ Bremsstrahlung Xray



▲ Characteristic Xray

Q. No. 8 : → **EXAMINATION OF CRYSTAL LATTICE:** Crystal lattice can not be examined by UV rays but ca be by Xrays

→ **Reasons:**

- **Wavelength of UV radiations:** UV radiations have wavelength of the order of 10^{-7} m
- **Wavelength of X-rays:** Wavelength of xrays is the order of 10^{-10} m
- **Inter Planar spacing of Crystal:** Interplanar spacing of crystal is also of the order of 10^{-10} m
- **Diffraction by crystal:** Therefore UV rays have wavelength much greater than separation between two layers of crystal and can't be used to examin the crystal but xrays can.
- **Bragg's Equation:** $2d\sin\theta = m\lambda$