Chemistry Notes

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🌟 Key Concepts

- **Periodic Table: Arrangement of elements by chemical properties.**
- **Uncertainty Principle (Heisenberg): Impossible to know both position & velocity of an electron exactly → limitation of Bohr model.**
- **Orbitals: Regions where electrons are most likely found.**

🔢 Quantum Numbers

1. **Principal (n):**
    - **Represents shell (K=1, L=2, M=3, N=4).**
    - **Max orbitals in a shell = n^2; Max electrons = $2n^2$.**
2. **Azimuthal (l):**
    - **Shape of orbital; subshells: s, p, d, f.**
    - **Value of l = 0 to (n−1).**
3. **Magnetic (m):**
    - **Orientation of orbitals.**
    - **For each l, m has (2l+1) values.**

⚡ Electron Filling Rules

- **Energy order: s < p < d < f.**
- **Filling order (Aufbau principle):**
  1s < 2s < 2p < 3s < 3p < 4s < 3d < 4p < 5s < 4d < 5p < 6s < 4f < 5d < 6p < 7s …
- **Exceptions:**
  - **Chromium (Cr): $3d^5 4s^1$ (stable half-filled).**
  - **Copper (Cu): $3d^{10} 4s^1$ (stable full-filled).**
  - **The completely filled configuration (d^{10}) and the half filled configuration (d^5) are more stable than other configurations.**

🔍 Identifying Blocks, Periods & Groups

- **Block: Depends on where the last electron fills (s, p, d, f).**
- **Period: Highest principal quantum number (n).**
- **Group:**
  - **s-block: No. of outermost s-electrons.**
  - **p-block: s+p+ 10.**
  - **d-block: s + d electrons.**

📈 Periodic Trends – Ionisation Enthalpy

- **Definition: Energy needed to remove the outermost electron from a gaseous atom.**
- **Down a Group: Decreases (more shells → weaker attraction).**
- **Across a Period: Increases (nuclear charge ↑, same no. of shells).**
- **Lowest: Cs, Fr. | Highest: Noble gases.**

🧩 Block Elements

S-block

- **electrons of "s" subshell take part in chemical reactions**
- **When s block elements take part in chemical reactions, the electrons of outermost s subshell are donated**
- **Caesium ($_{55}$Cs) is a metal having very low melting point (28.40° C)**
- **Hence it exists in liquid state on warm days**
- **The elements Francium (87Fr) and Radium (88Ra) are radioactive in nature.**
- **Groups 1 & 2; reactive metals.**
- **Oxidation states: +1, +2.**

- **Exist mostly as solids.**

P-block

- **the groups 13 to 18 include p block elements**
- **p block elements include metals, non metals and metalloids.**
- **These elements exist in solid, liquid and gaseous states.**
- **p block elements exhibit both positive (+) and negative (−) oxidation states.**
- **Gallium is an element having a very low melting point (29.77o C). On warm days, it exists in a liquid state.**
- **s block and p block elements are main group elements.**
- **Groups 13–18; metals, non-metals, metalloids.**
- **Show both + and – oxidation states.**

d-block (Transition elements)

- **d block elements are known as transition elements.**
- **They are placed in groups 3 to 12.**
- **The electrons are being gradually filled up in the penultimate shell.**

- All the d block elements are metals.
- show similarities in properties in their corresponding groups
- The outermost subshell electron configuration of the elements of 5th period will be generally $5s^2$.
- The electron configuration of the outermost subshell of d block elements (transition elements) along a period is generally the same (ns^{1-2}).
- , they show similarities in properties not only within the groups but also along the periods.
- In transition elements there is only a slight energy difference between the outermost s subshell and the penultimate d subshell.
- As a result, under favourable conditions, electrons from the d subshell also take part in chemical reactions.
- That is why transition elements show variable oxidation states.

Coloured compounds

- Copper sulphate ($CuSO_4 . 5H_2 O$), potassium permanganate ($KMnO_4$), potassium dichromate ($K_2 Cr,O_7$).
- The presence of ions of transition elements (eg:- Cu^{2+} , Co^{2+}) or the ions which contain transition elements (eg:- $MnO_4 -$, $Cr_2 O_7 2-$) are generally responsible for the colour of the compounds.
- But the compounds of zinc ($_{30}Zn$) are colourless.

- **The compounds of transition elements are generally coloured.**

f-block (Inner transition elements)

- **located in two separate rows at the bottom of the periodic table, below the main body of the table**
- **the filling of electrons takes place in the anti-penultimate**
- **They are known as inner transition elements.**
- **The f-block elements of the 6th period are known as the Lanthanides**
- **The f-block elements of the 7th period are known as the Actinoids**
- **They show variable oxidations states.**
- **Actinoids are radioactive elements.**
- **These include man-made elements as well.**
- **Certain isotopes of elements like Uranium (U), Thorium (Th) and Plutonium (Pu) are used as fuel in nuclear reactors**
- **Neodymium (Nd) is used for making strong magnets.**
- **Some elements are used as catalysts in the petroleum industry.For example:- Cerium (Ce), Lanthanum (La).**