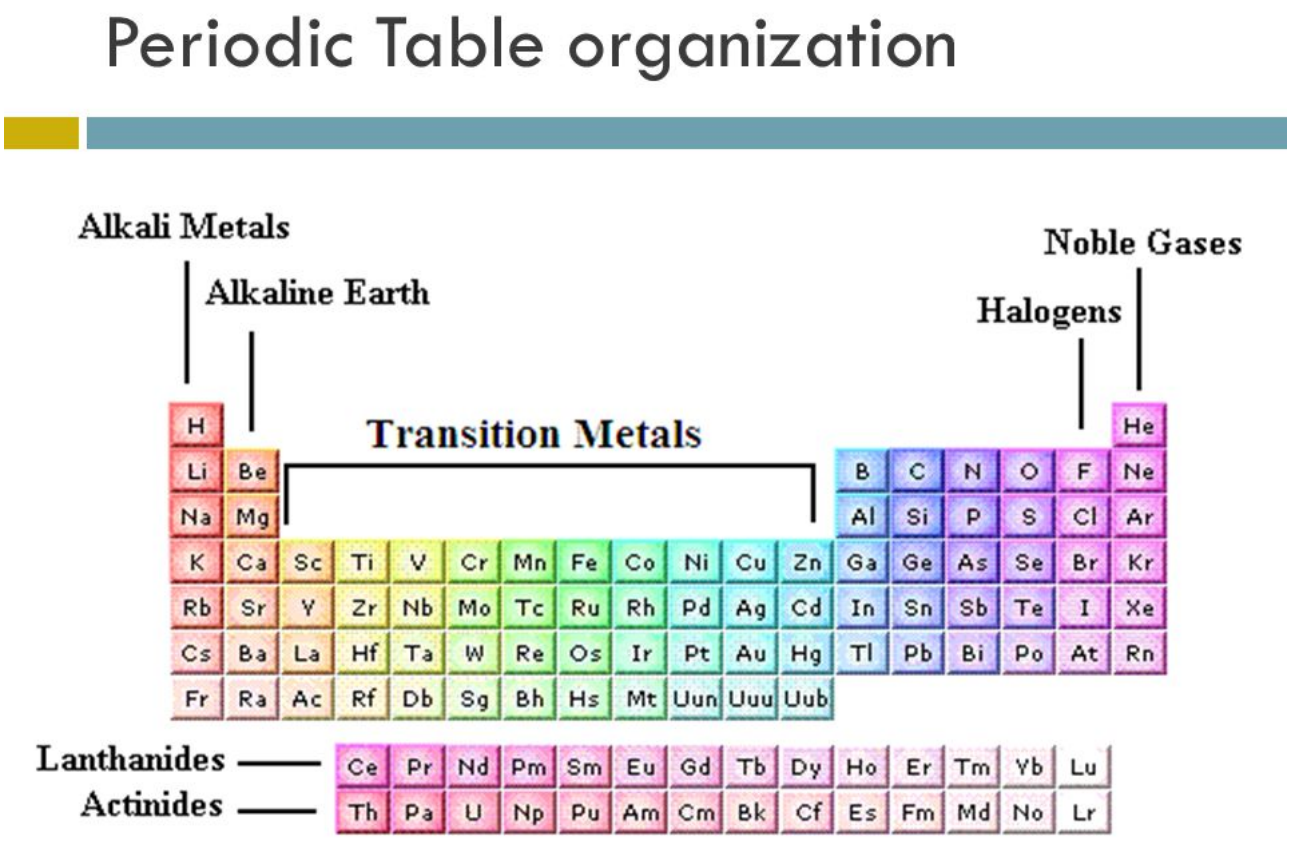
Chemistry Class 11 NCERT Solutions: Chapter 3 Classification of Elements and Periodicity Part 1

Q: 1. What is the basic theme of organisation in the periodic table?



Answer:

The basic theme of organisation of elements in the periodic table is to classify the elements in periods and groups according to their properties. This arrangement makes the study of elements and their compounds simple and systematic. In the periodic table, elements with

similar properties are placed in the same group.

Q: 2. which important property did Mendeleev use to classify the elements in his periodic table and did he stick to that?

Answer:

Mendeleev arranged the elements in this periodic table ordered by atomic weight or mass. He arranged the elements in periods and groups in order of their increasing atomic weight. He placed the elements with similar properties in the same group.

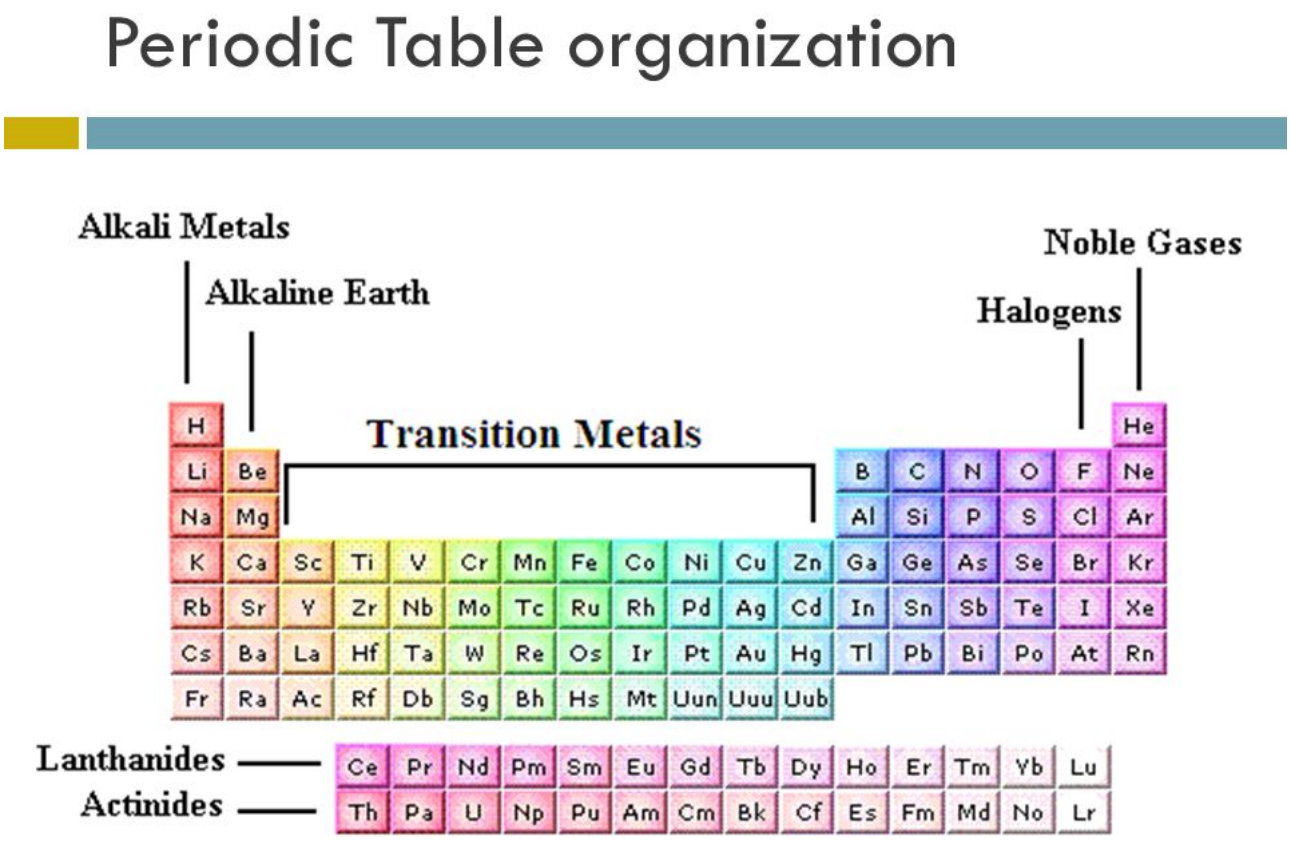
However, he did not stick to this arrangement for long. He found out that if the elements were arranged strictly in order of their increasing atomic weights, then some elements did not fit within this scheme of classification.

Therefore, he ignored the order of atomic weights in some cases. For example, the atomic weight of iodine is lower than that of tellurium. Still Mendeleev placed tellurium (in Group VI) before iodine (in group VII) simply because iodine's properties are so similar to fluorine, chlorine, and bromine.

Q: 3. What is the basic difference in approach between the Mendeleev's Periodic Law and the Modern Periodic Law?

Answer:

Mendeleev's Periodic Law states that the physical and chemical properties of elements are periodic functions of their atomic weights. On the other hand, the Modern periodic Law states that the physical and chemical properties of elements are periodic functions of their atomic numbers.



Q: 4. On the basis of quantum numbers, justify that the sixth periodic table should have 32 elements.

Answer:

In the periodic table of the elements, a period indicates the value of the principal quantum number (n) for the outermost shells. Each period begins with the filling of principal quantum number (n) . The value of n for the sixth period is . For $n = 6$, azimuthal quantum number (l) can have values of $0, 1, 2, 3, 4$.

According to Aufbau's principle, electrons are added to different orbitals in order of their increasing energies. The energy of the 6d subshell is even higher than that of the $_{7s}$ subshell.

In the $_{6^{th}}$ period, electrons can be filled in only 6s, 4f, 5d, and p subshells. Now, 6s has one orbital, 4f has seven orbitals, 5d has five orbitals, and 6p has three orbitals. Therefore, there are a total of sixteen $(1 + 7 + 5 + 3 = 16)$ orbitals available. According to Pauli's exclusion principle, each orbital can accommodate a maximum of electrons. Thus, 16 orbitals can accommodate a maximum of 32 electrons.

Hence, the sixth period of the periodic table should have 32 elements.

Q: 5. in terms of period and group where would you locate the element with $Z = 114$?

Answer:

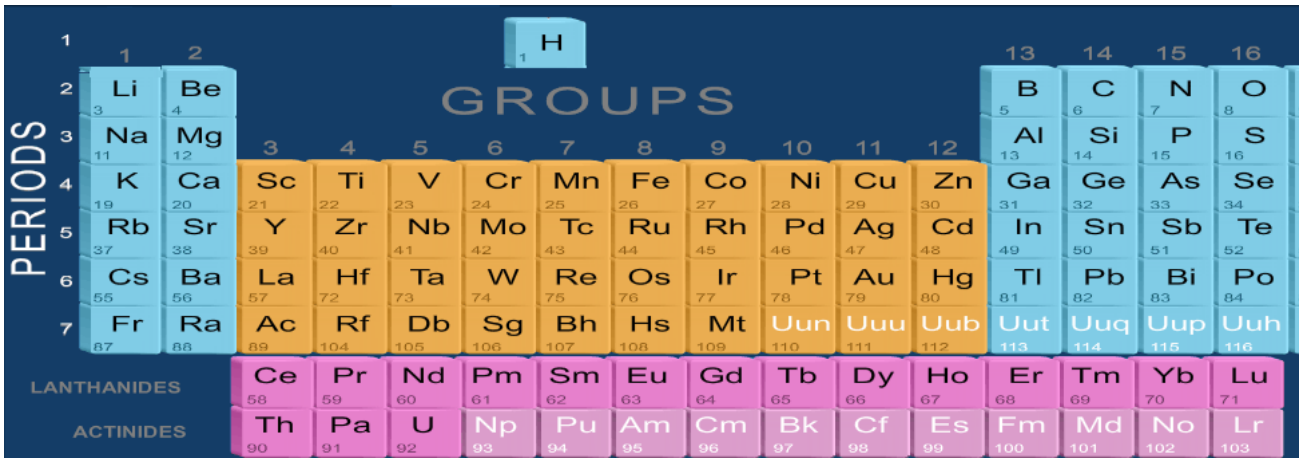
Elements with atomic numbers from $Z = 87 \text{to} Z = 114$ are present in the $_{7^{th}}$ period of the periodic table. Thus, the element with $Z = 114$ is present in the $_{7^{th}}$ period of the periodic table.

In the 7th period, first two elements with $Z = 87$ and $Z = 88$ are s-block elements excluding $Z = 89 i.e.,$ those with $Z = 90 - 103$ are f-block elements, ten elements with $Z = 89$ and $Z = 104 - 112$ are d-block elements, and the elements with $Z = 113 - 118 \text{are}$ p-block elements. Therefore, the element with $Z = 114^{th}$ is the second $p - \text{block}$ element in the $_{7^{th}}$ period. Thus, the element with $Z = 114$ is present in the $_{7^{th}}$ period and 1 $_{4^{th}}$ group of the periodic table.

Q: 6. Write the atomic number of the element present in the third period and seventeenth group of the periodic table.

Answer:

There are two elements in the 1st period and eight elements in the 2nd period. The third period starts with the element with $Z = 11$. Now there are eight elements in the third period. Thus, the 3rd period ends with the element with $Z = 18$ i.e.. , the element in the $_{18^{th}}$ group of the third period has $Z = 18.$ Hence, the element in the $_{17^{th}}$ group of the third period has atomic number $Z = 17$.



Q: 7 Which element do you think would have been named by

(i) Lawrence Berkeley Laboratory

(ii) Seaborg's group?

Answer:

(i) Lawrencium (Lr) with Z = 103 and Berkelium (Bk) with Z = 97

(ii) Seaborgium (Sg) with Z = 106

Q: 8. Why do elements in the same group have similar physical and chemical properties?

Answer:

The physical and chemical properties of elements depend on the number of valence electrons. Elements present in the same group have the same number of valence electrons. Therefore, elements present in the same group have similar physical and chemical properties.

Q: 9. What does atomic radius and ionic radius really mean to you?

Answer:

Atomic radius is the radius of an atom. It measures the size of an atom. If the element is a metal, then the atomic radius refers to the metallic radius, and if the element is a non-metal, then it refers to the covalent radius. Metallic radius is calculated as half the internuclear distance separating the metal cores in the metallic crystal. For example, the internuclear distance between two adjacent copper atoms in solid copper is 256 pm. Thus, the metallic radius of copper is taken as $\frac{256}{2} pm = 128\ pm$

Covalent radius is measured as the distance between two atoms when they are found together by a single bond in a covalent molecule. For example, the distance between two chlorine atoms in chlorine molecule is 198 pm. Thus, the covalent radius of chlorine is taken as $\frac{198}{2} pm = 99 pm$

Ionic radius means the radius of an ion (cation or anion) . The ionic radii can be calculated by measuring the distances between the cations and anions in ionic crystals.

Since a cation is formed by removing an electron from an atom, the cation has fewer electrons than the parent atom resulting in an increase in the effective nuclear charge. Thus, a cation is smaller than the parent atom. For example, the ionic radius of Na^+ ion is 95 pm, whereas the atomic radius os Na atom is 186 pm. On the other hand, an anion is larger in size than its parent atom. This is because an anion has the same nuclear charge, but more electrons than the parent atom resulting in an increased repulsion among the F^- ion is 136 pm, whereas the atomic radius of F atom is 64 pm.