NEET Chemistry

Short Notes

s-Block Elements

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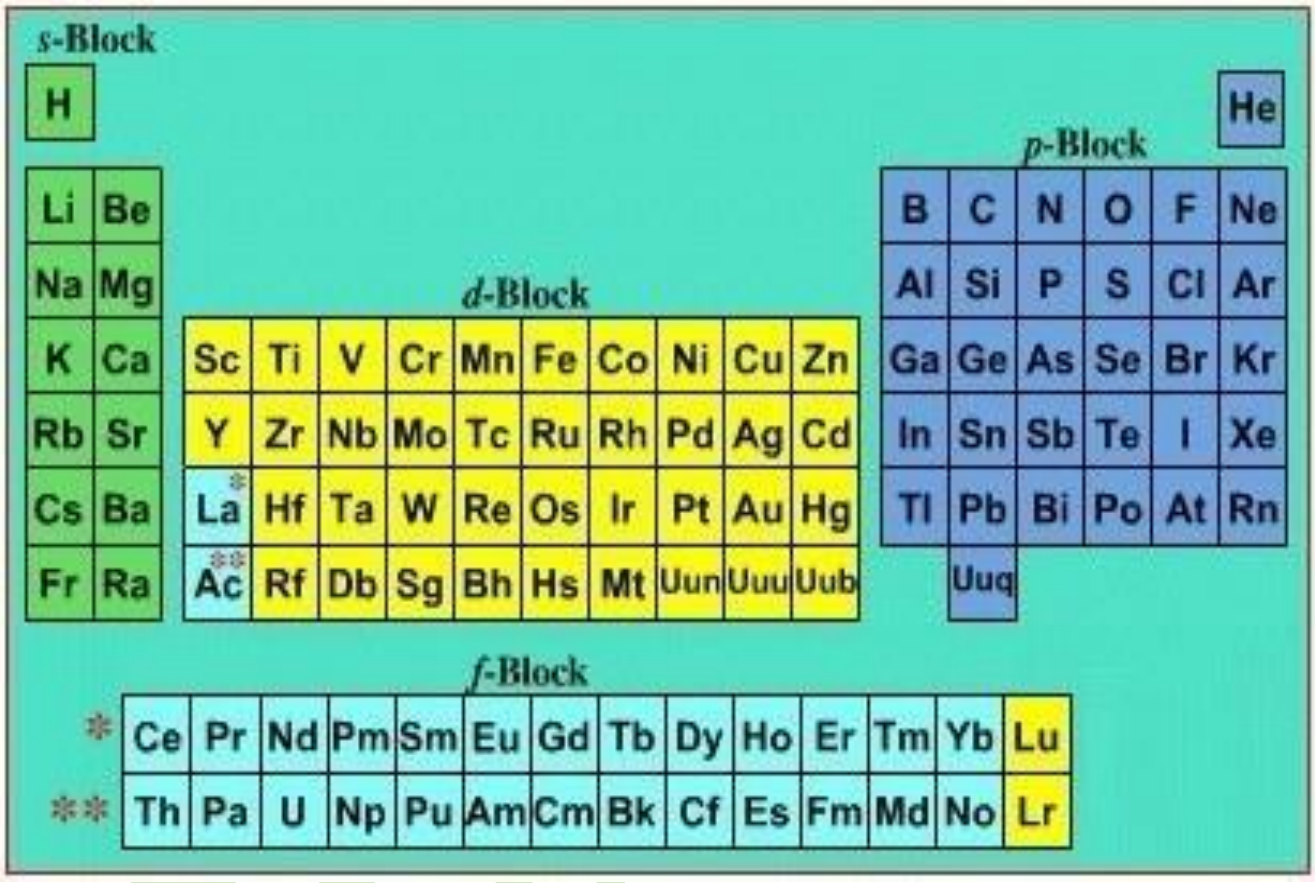
This is a part of in organic chemistry and direct questions will be asked from this topic in NEET and JEE exam. You have to remember most of the points from this topic. So, let us start with the elements present in s block.

Here is the periodic table and you can see the s block elements:



Here, elements of group 1 are known as Alkali Metals (AM) and elements of group 2 are called Alkaline Earth Metals (AEM).

While covering rest of the topic, we will not include Hydrogen, since its position is not so defined in periodic table.

And because the last elements of Group 1 and 2 i.e. Fr and Ra are radioactive in nature, we may not study their properties or characteristics.

Most of the questions will be asked through the properties of elements and exceptional cases in s block elements. Let us start with the properties and their comparison: -

1. **Electronic Configuration:** The general electronic configuration for s block element is ns^{1-2}. Alkali metal elements are half filled and on the other hand alkaline earth metals are fully filled.

Check out the table below:

Period Number	Alkali Metals (ns^1)	Alkaline Earth Metals (ns^2)
2^{nd} Period	Li = $2s^1$	Be = $2s^2$
3^{rd} Period	Na = $3s^1$	Mg = $3s^2$
4^{th} Period	K = $4s^1$	Ca = $4s^2$
5^{th} Period	Rb = $5s^1$	Sr = $5s^2$
6^{th} Period	Cs = $6s^1$	Ba = $6s^2$

2. **Atomic Size:** Atomic size of elements increases when we move from top to bottom. Whereas, when we move from left to right atomic size decreases, because the Z effect increases.

Within the group, atomic size can be represented as:

1. Alkali Metals: Li<K<Rb<Cs
2. Alkaline Earth Metals: Be<Mg<Ca<Sr<Ba

If we compare the size of atoms in the **same period** then the **size of alkali metals > size of alkaline earth** metals for the corresponding elements.

e.g. atomic size of Li > atomic size of Be

atomic size of Na > atomic size of Mg

Important: Till third period, if we avoid the noble gases then the size of alkali metals is largest as compare to other elements in same period. And even after fourth period size of alkali metals is largest even if we include noble gases.

3. **Ionization Energy:** The ionization energy is defined as the amount of energy required to remove the most loosely bound electron, the valance electron of an isolated gaseous atom to form a cation.

As the size of atom increases I.E decreases.

Since we know that when we move from left to right in a periodic table the size of atom decreases, that means the I.E increases.

(IE1) $_{\text{Alkali metals}}$ **< (IE1)** $_{\text{AEM}}$ [First IE of Alkali metals is less than Alkaline earth metals.

Fact: (IE2) $_{\text{Alkali metals}}$ **> (IE2)** $_{\text{AEM}}$

Reason: After losing one electron from the atom, alkali metals will attain the more stable noble gas configuration.

Example: Let us compare Na and K. We know that size of Na is greater than Potassium. Therefore, first IE of Na is more than K. Now after removing one electron, they will become cations Na^+ and K^+ respectively.

Electronic configuration will be:

$Na^+ = 2s^2 2p^6$

$K^+ = 2s^2 2p^6 3s^1$

From the above picture, it is clear that K^+ will attain a stable configuration after donating one electron, so it will donate one electron easily and thus the IE2 will be less for potassium.

4. **Metallic Character or Nature:** Metallic nature of a metal is inversely proportional to the IE. If we talk about IE, we consider IE1 by default.

So, we already discussed that the $(IE1)_{\text{Alkali metals}} < (IE1)_{\text{AEM}}$

Therefore, Alkali metals have greater metallic character than the alkaline earth metals.

Alkali metals are more electropositive.

5. **Crystal Structure:** This is one of the most important properties of metal and will help in defining and determining other properties too. You just need to remember the points.

Alkali Metals	Alkaline Earth Metals
All are having BCC (body centered cubic) packing	Be, Mg are HCP Ca, Ba are FCC and Sr is having BCC packing

Important: Li at low temperature has HCP (Hexagonal Closed Packing).

Alkaline earth metals show more efficient packing than alkali metals. Now, HCP and FCC (Face Centered Cubic) are more efficient packings having efficiency of almost 74%. More efficient packing means the atoms are closely bound and they have strong metallic bond. And strong metallic bond increases the lattice energy, melting point and hardness of metal.

Alkali Metals	Alkaline Earth Metals
They are soft and ductile	They are hard and brittle
They have low melting and boiling point.	They have high melting and boiling point
They have low density	They have high density
They have low lattice energy	They have high lattice energy

6. **Melting and Boiling Point:** We have studied in general about the melting and boiling point. Now, we will do some special cases.

As we move down to the group, size of atoms increases, and the packing efficiency decreases, therefore melting and boiling point decreases.

Order of melting and B.P:

1. Alkali Metals: Li > Na > K > Rb > C
2. Alkaline Earth Metals:
3. Boiling Point: Be > Ba > Ca > Sr > Mg
4. Melting Point: Be > Ca > Sr > Ba > Mg

So, we can see that the trend in AEM is irregular. This happen because of the crystal structure and the impurities in the metal.

7. **Flame Coloration:** Due to high IE of AEM, Be and Mg do not give color to flame, because of their high IE. Apart from them all the elements of s block give flame color test.

Why the elements of s block give flame color test?

Reason: electrons present in the atom absorb energy from the flame and they excite to the higher energy shell/levels. When these electrons fall back to their ground state, they emit energy or radiation of certain wavelength, imparting color to flames.

List to Remember:

Li = Crimson Red	Be = No color
Na = Golden Yellow	Mg = No color
K = Violet	Ca = Brick red
Rb = Red Violet or Ruby	Sr = Dark red
Cs = Blue	Ba = Apple Green

8. **Hydration Energy:** When an ion comes in contact with water, the water molecule surrounds that ion and release some energy to make bonds, that energy is called hydration energy.

For AM hydration energy decrease down the group.

$Li^+ > Na^+ > K^+ > Rb^+ > Cs^+$

Similarly, for AEM:

$Be^{2+} > Mg^{2+} > Ca^{2+} > Sr^{2+} > Ba^{2+}$

These ions make coordination bond with water molecules. So, let us check the coordination number.

For **Li^+** ⇒ it has 2s and 2p shell, where it can make bond with H_2O and sp^3 hybridization takes place. It exists as **$[Li(H_2O)_4]^+$**

Coordination Number: It is defined by the number of water molecules so in case of lithium it is 4.

For **Na+, K+, Rb+, Cs+** ⇒ they all have 3s,3p and 3d shells to make bond. So sp^3d^2 type of hybridization takes place and they exist in a form of **$[M(H_2O)_6]^+$**

Coordination Number is 6 for these metals. On the other hand, for Alkaline earth metals charge will be 2+ and except Be they exist as **$[M(H_2O)_6]^{2+}$**

Coordination number = 6 for M = Ca, Sr, Ba

For Be, **$[Be(H_2O)_4]^{2+}$,** Coordination number is 4.

Coordination number can never be more than 6 for Alkali metals and alkaline earth metals.

All the Best!

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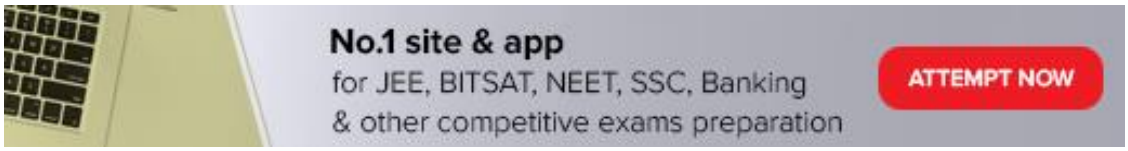

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