f - block elements ($(n-2)f^{1-14}(n-1)d^{0-1}ns^{1-2}$)

(Inner Transition Elements)

Lanthanoids Actinoids

Lanthanoids :-

Those element which involve the filling of electrons in 4f orbital are known as Lanthanoids or Lanthanons these are also known as "rare earth metals"

Ce (z=58) Pr Nd Pm Sm Eu Gd Tb Dy Ho Er Tm Yb Lu (z=71)

Physical Properties :-

① Density :-

Lanthanoids are heavier elements and they possesses density from 6.77 to 9.74 g/c.c.

② Oxidation state :-

All Lanthanoids show stable O.S. of +3 because value of their $(IE_1 + IE_2 + IE_3)$ are very low.

Some Lanthanoids also shows +2 & +4 O.S but they readily convert to their stable O.S (+3) in aqueous medium.

eg:- Cerium shows +4 O.S. which convert to +3 O.S. in aqueous medium

⇒ Ce^{4+} salt act as good oxidising agent NEET II 2016

other Lanthanoid which shows +4 OS ⇒ Pr^{4+} & Tb^{4+}

Lanthanoid which show +2 OS. ⇒ Sm^{2+}, Eu^{2+}, Tm^{2+}, Yb^{2+}

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(3) Atomic Radii & Lanthanoid contraction :-

There is a steady decrease in atomic as well as ionic size as we move from Ce to Lu in case of Lanthanoids. This is due to Lanthanoid contraction.

$Ce^{3+} > Pr^{3+} > Nd^{3+} > Pm^{3+} > \dots\dots\dots > Lu^{3+}$

Lanthanoid contraction

Cause of Lanthanoid contraction :-

As we move from Cerium ($z=58$) to lutetium ($z=71$) there is a increase in nuclear charge due to progressive addition of protons. Thus nuclear charge ↑ by +14 unit

In case of Lanthanoids 14 $e^{\ominus}$'s are filled in 4f orbitals which possesses poorest shield/screening effect due to their highly diffused shape.

As a result of which the increase in nuclear charge pulls the electron cloud of 5d & 6s towards itself thus causing contraction in size known as Lanthanoid contraction.

Consequences of Lanthanoid contraction :-

① Similarity in size of 5d & 4d series elements

4d	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn
		‖	‖	‖	‖	‖	‖	‖	‖	‖	‖	‖
5d	La ----	Hf	Ta	W.	Re	Os	Ir	Pt	Au	Hg	Tl	Pb

$Z=57$ ↑ $Z=72$

Ce to Lu
58 71

$3d > 4d \tilde{\sim} 5d$

Those elements which are coming after Lu ($Z=71$) i.e. from Hf ($Z=72$) to Pb ($Z=82$) are having the effect of Lanthanoids contraction. due to which atomic size of 5d series elements is nearly equal to 4d elements.

② Effect on the Basic Characters of hydroxides in case of Lanthanoids :-

As we move from Ce ($Z=58$) to Lu ($Z=71$) with the ↓ in atomic and ionic radii M–OH bond length ↓ from Ce to Lu thus tendency to give $OH^{\ominus}$ ions ↓ and hence basic characters of hydroxides ↓.

$Ce(OH)_3 > Pr(OH)_3 > Nd(OH)_3 > \text{-------} > Lu(OH)_3$

M—OH M—OH

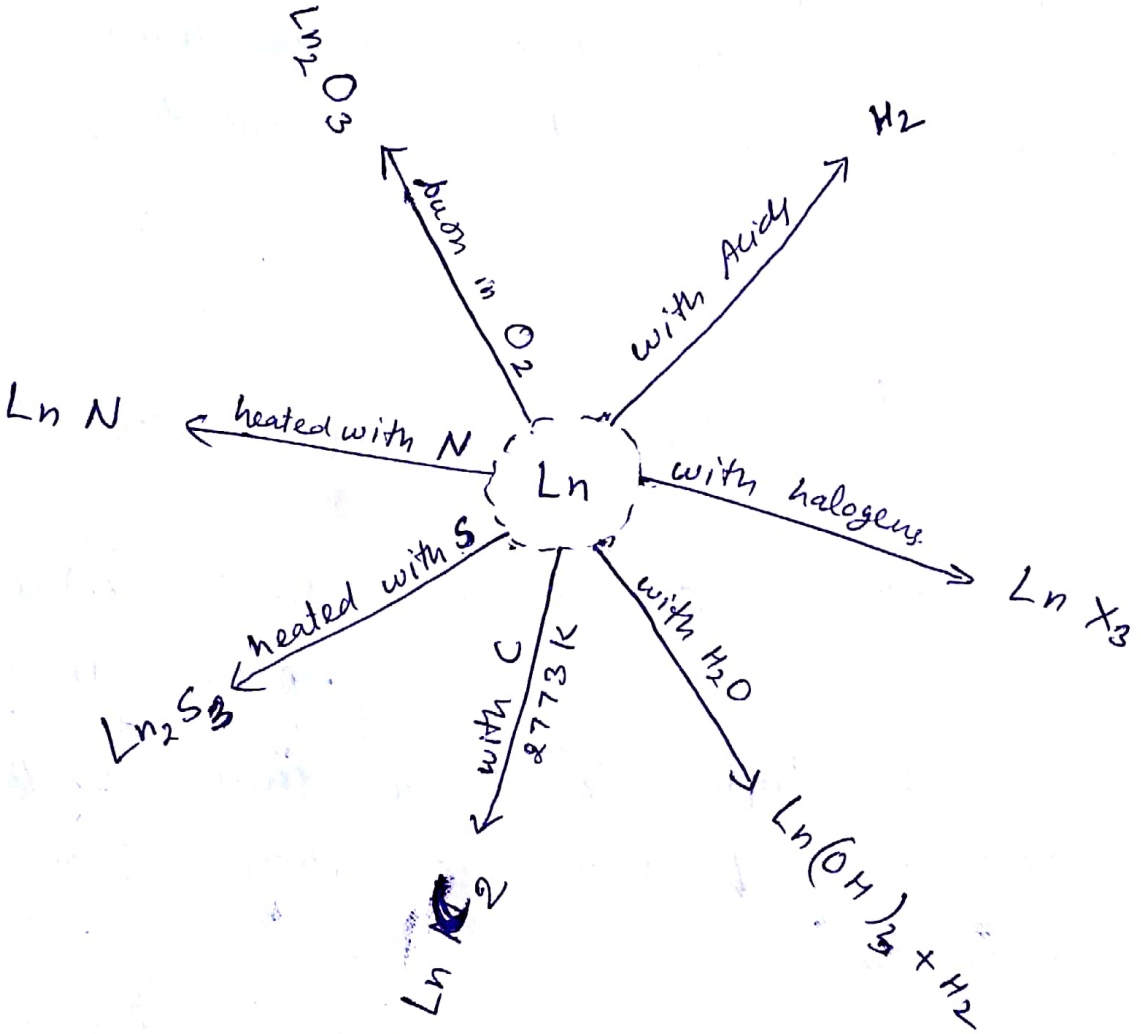
order of Basic ↓

④ **Colour :-**

like that of d-block elements Lanthanoids also show color due to f-f transition,

⇒ La^{3+} (f^0) & Lu^{3+} (f^{14}) do not show f-f transition and are colorless.

⑤ **Rxns of Lanthanoids (Ln)**



Actinoids :-

Those elements which involve the filling of $e^{\ominus}$ in 5f orbital are known as actinoids.

Th (Z=90) Pa U Np Pu Am Cm Bk Cf Es Fm Md No Lr (Z=103)

* Actinoids are radioactive elements.

Actinoid contraction :-

Like that of Lanthanoids there is a decrease in atomic and ionic radii. As we move from Th (Z=90) to Lr (Z=103) in case of actinoids, this is known as Actnoid contraction.

⇒ It is due to poor shielding effect of 5f electron

Oxidation state :-

Actinoids show +3 O.S. like that of Lanthanoids but actinoid show more O.S. as compase to Lanthanoid.

Because in case of Actinoid electrons participate from 5f orbital also ~~which~~ which is extended beyond 6p & 7s orbitals.

while in case of Lanthanoids, ~~electron~~ $e^{\ominus}$ do not take part from 4f orbitals which is totally shielded from 5d & 6s orbitals.

Hence actinoids show more O.S. as compase to Lanthanoids.