"Inorganic Chemistry." — (Important Topics for Exams)—

*Actinides and Lanthanides:- "Actinides and Lanthanides are Chemical elements that are found in the f block of the periodic table of elements. This means their valence e⁻ are in the f orbital of their atoms. These Chemical elements are found as metals and are called as inner transition metals. The f block consists only of the Lanthanides and Actinides."

The Actinide Series named as "Actinides" because it starts from a Chemical named as Actinium.

The Lanthanide Series named as "Lanthanides" because it starts from a Chemical named as Lanthanum.

Actinides Vs Lanthanides -

(i) Actinides — Actinides are the Chemical elements that can be found in the 'Actinides' series of the f block in the periodic table of elements.

- Atomic No. from 89 - 103.
- Radioactive Elements.
- Can have maximum +6 oxidation State.
- Valance e⁻ are in the 5f orbital.

(ii) Lanthanides — • Lanthanides are the Chemical elements that can be found in the 'Lanthanide' series of the f block in the periodic table of elements.

THE VIDYARTHI

- Atomic No. from 57 to 71.
- Non Radioactive Elements. (except Promethium)
- Can have a maximum of +4 Oxidation State.
- Valance e^- are in the 4f Orbital.

Electronic Configuration –

Lanthanides, Actinides } $(n-2)f^{1-14}(n-1)d^{0-1}ns^2$.

"Explaination"

Lanthanides – "Lanthanides are the 'Rare Earth Elements' of the morden periodic table" "Atomic No. from 58-71."

"Lanthanides are the Chemical elements that can be found in the Lanthanide Series of the elements in the periodic Table."

The elements are known as Lanthanides, because it starts from a element named as Lanthanum.

Properties of Lanthanide Series –

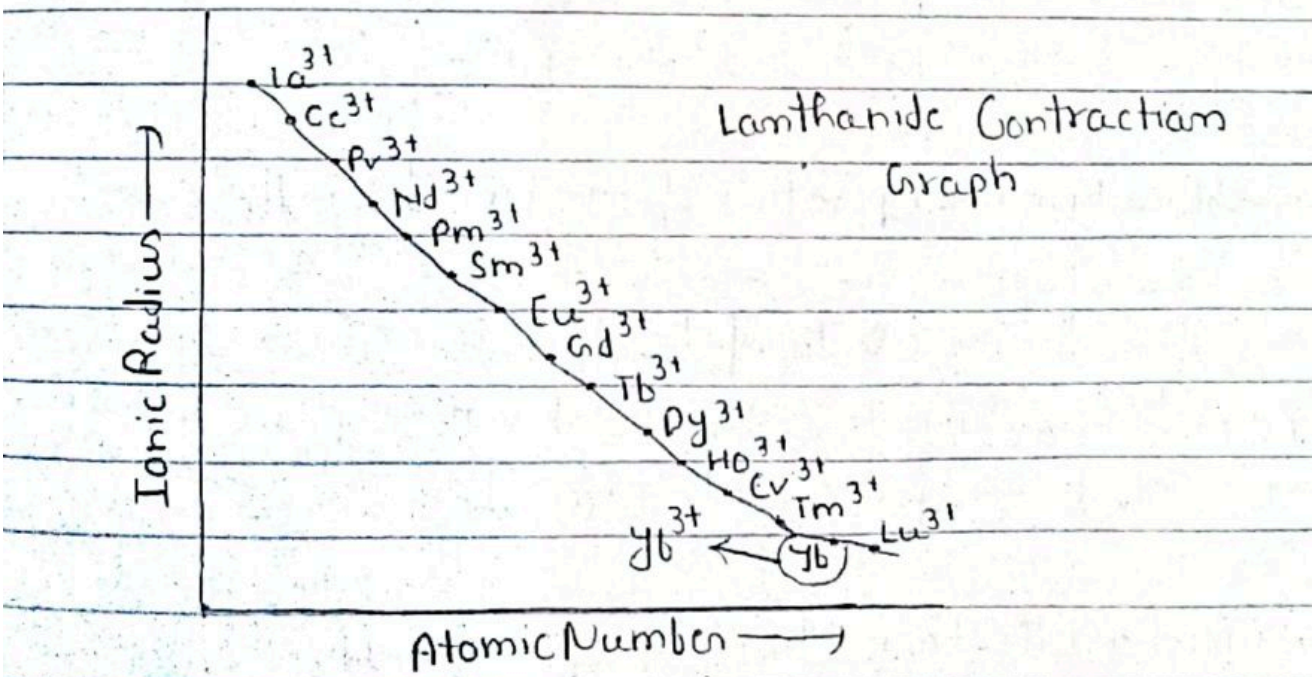
- They have a lustre and are Silvery in appearance.
- They are Soft metals and can even be cut with a knife.
- The elements have different reaction tendencies depending on basicity
  (Some are highly reactive and Some takes time to react.)

THE VIDYARTHI

Lanthanide Contraction – "The atomic Size or the ionic radii of tripositive lanthanide ions decreases steadily from La to Lu due to increasing nuclear charge and e^- entering inner (n-2) f orbital, This gradual decrease in the Size with an increasing atomic Number is Called Lanthanide Contradiction."

Or "with atomic number (increasing), there is a progressive decrease in the ionic radii of tri positive lanthanides, known as Lanthanide Contraction."

Or "With increasing atomic Number, progressive decrease in the ionic radii of tri positive lanthanides is known as Lanthanide Contraction."



Atomic Numbers increasing = Ionic Radius Decreasing

Consequences of Lanthanide Contraction - "following points will clearify depict the effect of Lanthanide Contraction"

- Atomic Size
- Difficulty in the separation of Lanthanides
- Effect on the basic Strength of hydroxides
- Complex formation
- The ionization Energy of d block Elements.

(i) Atomic Size - "Size of the atom of third transition series is nearly the same as that of the atom of the Second transation Series."

for eg - radius of Zr = radius of Hf.
radius of Nb = radius of Ta

(ii) Difficulty in the Seperation of Lanthanides - "As there is an only small change in the ionic radii of Lanthanides, their chemical properties are Simmilar, this masks the Seperation of the elements in the pure state difficult."

(iii) Effect on the basic Strength of hydroxides - "As the size of Lanthenides decreases from La to Lu, the Covalent character hydroxide increases and hence their basic stren-

glof decreases. Thus, $La(OH)_3$ is more basic and $Lu(OH)_3$ is the leaf basic."

(iv) Complex formation - "Because of the Simmilar size but higher nuclear charge tendency to form coordinates, Complex increases from La^{3+} to Lu^{3+}."

(v) Electronegativity - "It increases from La to Lu."

(vi) Ionization Energy - "Attraction of e^- by the nuclear charge is much higher and hence Ionization energy of 5d elements are much large then 4d and 3d, In 5d Series, all elements except Pt and Au have filled s shell."

Elements from Ha to Rh have Same Ionization Energy and after ionization energy increases with the number of shared d-electrones such that Iridium and gold have the maximum ionization energy.

"Care Study" Mercury The Liquid Metal - "Mercury, is the only metal that exists in its liquid state at room temprature."

Mercury are more closely pulled by the nucleus (lanthanide contraction) such that outer s-electrones are less involved in metallic bonding."

(vii) Formation of Complex – "Lanthanides exhibiting 3+ oxidation state is the larger and hence low charge to radius ratio. This reduces the complex forming ability of lanthanides compared to d block elements

Electronic Configuration of Lanthanides - "Lanthanides of first f-block have a terminal electronic configuration of $[Xe]^{}4f^{1-14}5d^{0-1}6s^{2}$ of the fourteen lanthanides. Pm (Promethium) with atomic no. 61 is the only synthetic radioactive element. The Energy of 4f and 5d electrones are almost close to each other and so 5d orbitals remains vacant and the electrones enter into the 4f orbital."

Exceptions - "Exceptions are in the case of gadolinium Gd (Z = 64) where the e^- enters the 5d orbital due to the presence of a half filled d orbital and lutchium (Z=71) enters the 5d orbital."

Oxidation State of Lanthanides - "All the elements in the Lanthanide Series Show an oxidation state of +3. Earlier it was believed that some of metals (Sa, Eu, Yt) also show +2 oxidation states." A few metals in Lanthanide Series occasionally Show +4 oxidation states. The uneven distribution of oxidation

state among the metals is attributed to the high stability of empty, half filled and fully filled f subshells.
The stability of f subshell affects the oxidation state of lanthanides in such a way that the +4 oxidation state of cerium is favoured as it acquires a noble gas configuration but it reverts to a +3 oxidation state and thus reacts as a strong oxidant and can even oxidize water, although the reaction will be slow.