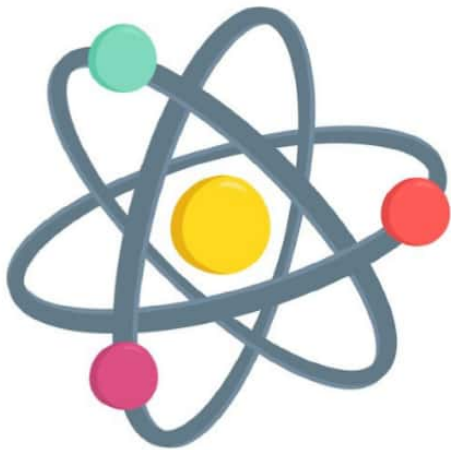


VICTORY ZONE CLASSES



CHEMISTRY



CLASS :- XII



VICTORY ZONE CHEMISTRY CLASSES

ADDRESS – 1ST FLOOR PRADEEP PLAZA, IN FRONT OF CHOPRA PALACE , ADARSH NAGAR DURG

MO 9424168056,8269055301

CHAPTER SCHEDULE

d & f BLOCK ELEMENTS

8 JULY 2025 TO 27 JULY 2025

S. NO	CLASS DETAIL	TOPICS DETAILS	CHECK LIST
1.	LECTURE NO. 1	INTRODUCTION OF D BLOCK ELEMENTS	
2.	LECTURE NO. 2	RADIUS, ATOMIZATION 20Q	
3.	LECTURE NO. 3	INTERSTITIAL COMPOUNDS, MAGNETIC 10Q	
4.	LECTURE NO. 4	COLOR, ALLOY, MELTING POINT 20Q	
5.	LECTURE NO. 5	CATALYTIC PROPERTY, OXIDATION NUMBER 20Q	
6.	LECTURE NO. 6	OXIDE, HALIDE, ELECTRODE POTENTIAL 20Q	
7.	LECTURE NO. 7	KMnO ₄ , K ₂ Cr ₂ O ₇ 10Q	
8.	LECTURE NO. 8	BOARDS PYQS DISCUSSION	
9.	LECTURE NO. 9	BALANCING PYQS 30Q	
10.	LECTURE NO. 10	SELF ANALYSIS PAPER IN CLASS	
11.	TEST NO. 7	26/07/2025 MCQS 30Q MM:120 (YOUR MARKS)	
12.	TEST NO. 8	27/07/2025 THEORY 16Q MM:30 (YOUR MARKS)	
13.	HOME WORK	NUMBER OF QUESTION DONE BY YOUR SELF	
14.	HOME WORK	NCERT BOOK READING & BACK QUESTIONS	

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08/7/2025

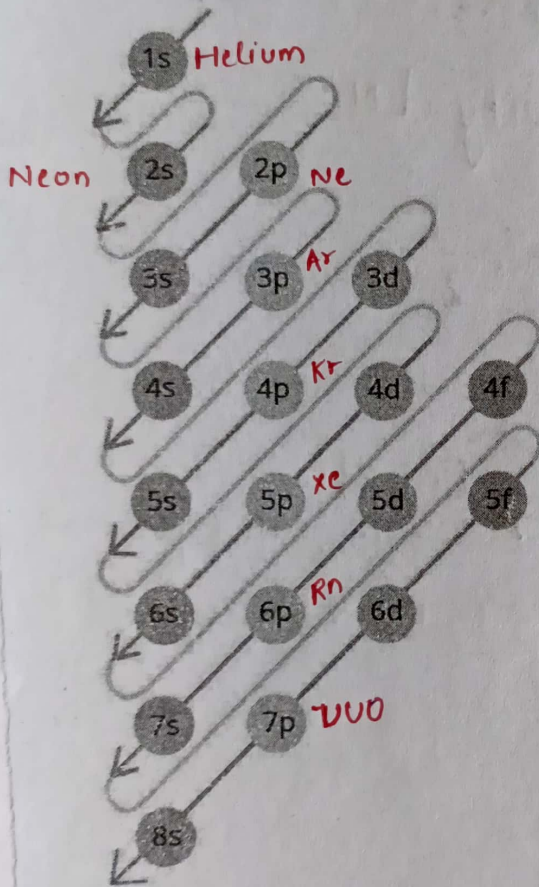
THE d- and f- Block Elements

[Unit - 4]

Periods [7 periods]
Groups [18 groups]

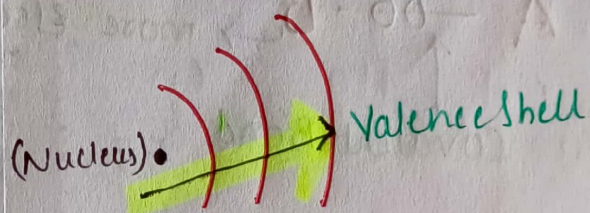
① electrons configuration

Aufbau Rule
Pauli exclusive
Hund's



Aufbau Rule

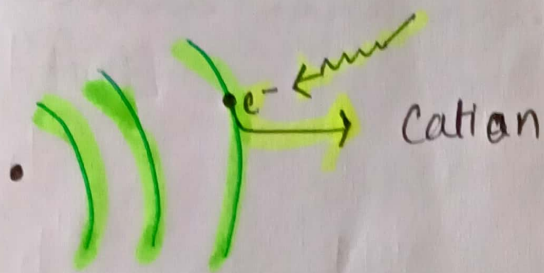
② Radius (Size)



Distance between nucleus to outer most [valence] shell

Radius $\left\{ \begin{array}{l} \text{Atomic } [E] \\ \text{Ionic } [E^+] \end{array} \right.$

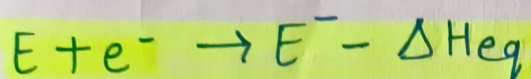
③ Ionization Potential



Energy Required for to remove an electron from outer most shell of isolated gaseous atom

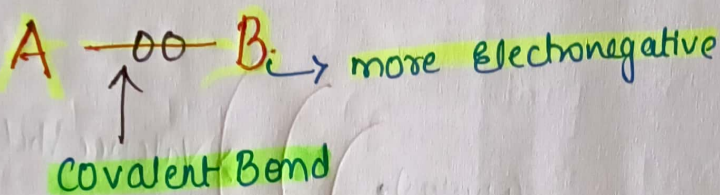
④ Electron Gain Enthalpy / Electron Affinity [EA]

→ Anion



"Energy released during adding of e^- to its outer most shell"

⑤ Electro Negative / Electro Negativity E_N



Periods = 7
radius [↓]
IP, EA, E_N , Z_{eff} [↑]

Groups 18

Radius [↑]

Z_{eff} :- constant

EA, E_N , IP [↓]

Electronic Configuration

s - 2
p - 6
d - 10
f - 14

* Elements

A
Atomic Mass

Charge

Z

Atomic Number

Number

E

① He - $1s^2$

② Ne - $2s^2 2p^6$

③ Ar - $3s^2 3p^6$

④ Kr - $4p^6$

⑤ Xe - $5p^6$

⑥ Rn - $6p^6$

⑦ Uuo - $7p^6$

⑧ Al $1s^2 2s^2 2p^6 3s^2 3p^1$ or $_{10}[\text{Ne}] 3s^2 3p^1$

⑨ Cl $_{17}^{10} [\text{Ne}] 3s^2 3p^5$

⑩ Sc $_{21}^{18} [\text{Ar}] 3d^1 4s^2$

⑪ Ti $_{22}^{18} [\text{Ar}] 3d^2 4s^2$

⑫ V $_{23}^{18} [\text{Ar}] 3d^3 4s^2$

⑬ Cr $_{24}^{18} [\text{Ar}] 3d^5 4s^1$

⑭ Fe $_{26}^{18} [\text{Ar}] 3d^6 4s^2$

⑮ Co $_{27}^{18} [\text{Ar}] 3d^7 4s^2$

⑯ Ni $_{28}^{18} [\text{Ar}] 3d^8 4s^2$

First this electron will remove

~~$3d^4 4s^2$~~ [wrong one]

*

s^2

p^3

d^5

d^{10}

f^7

f^{14}

p^6

Stable

Ques. 1) What is Transition Element?

"All Transition Elements are d Block Element but all d block are not transition elements"

"Elements which have variable Oxidation Number Or multiple Valency". They are called Transition Elements.

"Properties which are variable between s and p block they are called Transition Elements".

Exception

$_{30}Zn$, $_{48}Cd$, $_{80}Hg$, $_{112}Cn$

They are d-block but non transition element.

4th Period → 3d Series :-

$_{21}Sc \rightarrow _{30}Zn$

5th Period → 4d Series :-

$_{39}Y \rightarrow _{48}Cd$

6th Period → 5d Series :-

$_{57}La \rightarrow _{72}Hf \rightarrow _{80}Hg$

7th Period → 6d Series :-

$_{89}Ac \rightarrow _{104}Rf \rightarrow _{112}Cn$

10/7/2025

What is d-block Element?

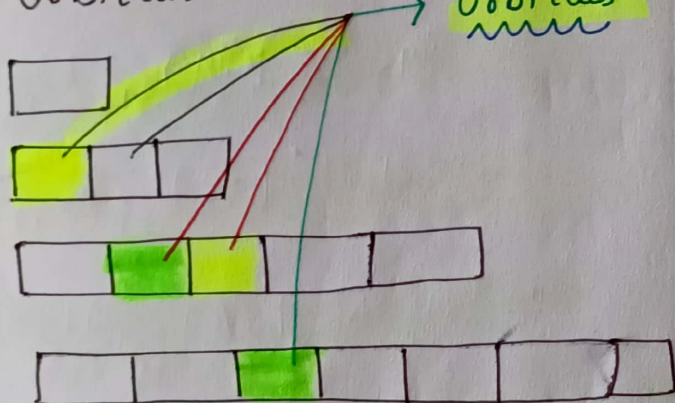
Those Element which outermost shell are filled with d-subshell

n - shell/orbits

$\left. \begin{matrix} s \\ p \\ d \\ f \end{matrix} \right\}$ subshells

s^2, p^6, d^{10}, f^{14}

Orbitals



* Filling of Aufbau Rule

e^- enters in $(n-1)$ subshells

penultimate shell

→ Properties

(A) i) Electronic Configuration
 $(n-1)d^{1-10} ns^{1-2}$

ii) d Block have 4 series

→ 3d → 5d

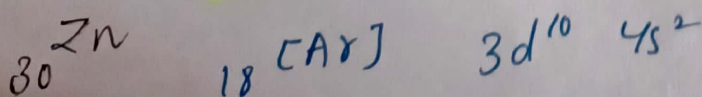
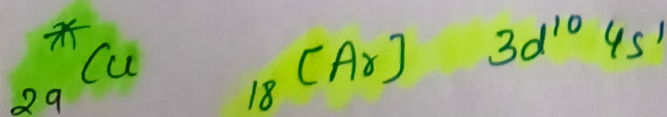
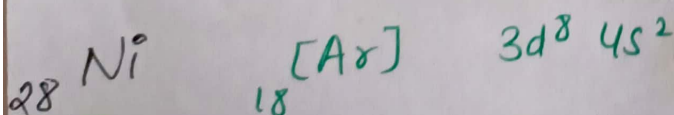
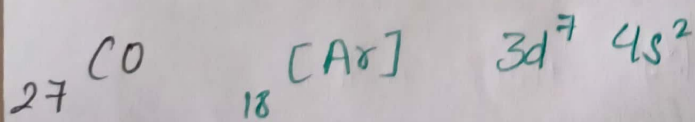
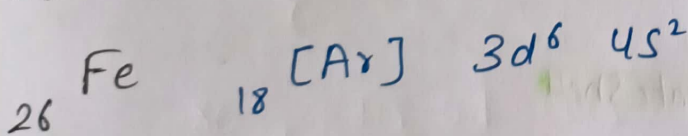
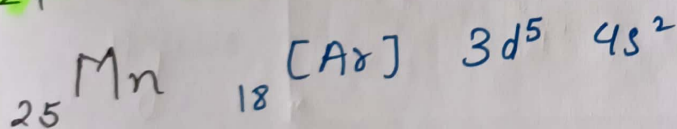
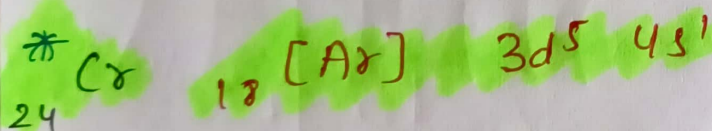
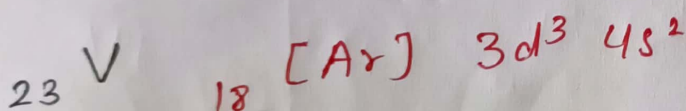
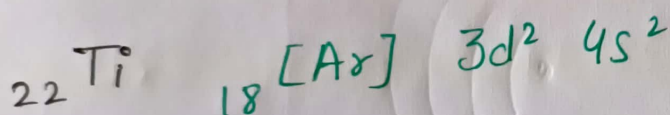
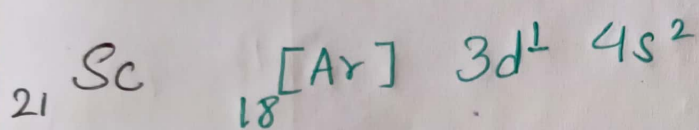
→ 4d → 6d

* Exception of electron configuration

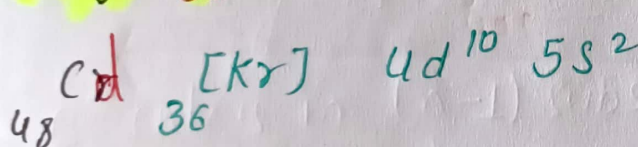
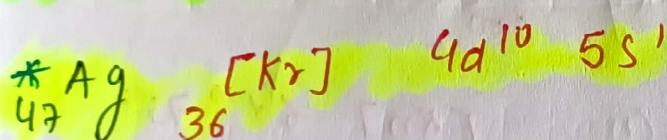
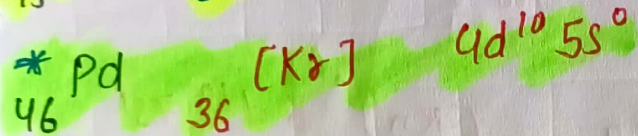
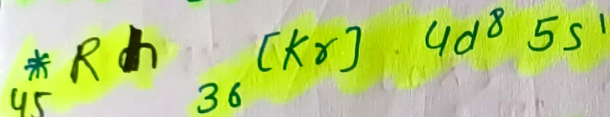
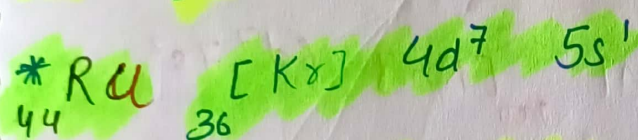
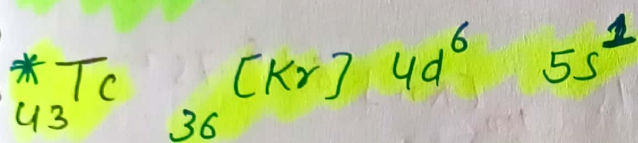
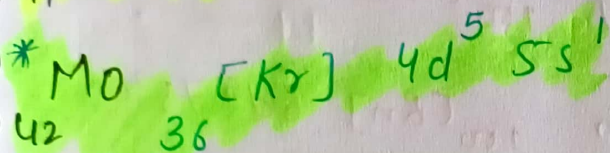
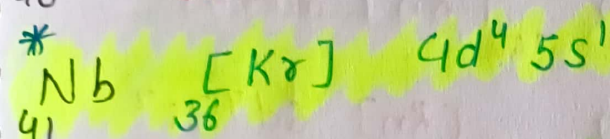
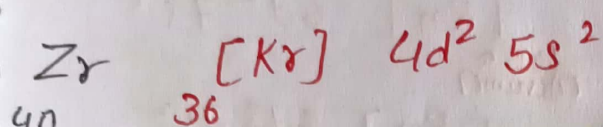
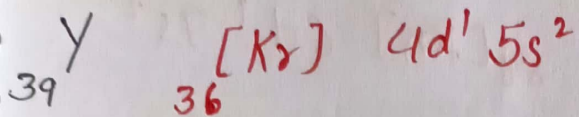
- 1) 3d Series Cr, Cu
- 2) 4d Series Nb, Mo, Tc, Ru, Rh, Pd, Ag
- 3) 5d Series Pt, Au
- 4) 6d series Rg

2
7
2
1

→ 3d Configuration



4d Series



5d Series

57	La	54	[Xe]	5d ¹	6s ²
72	Hf	58	[Xe]	5d ²	6s ²
73	Ta	68	[Xe]	5d ³	6s ²
		(Assume) 54+14			
74	W	68	[Xe]	5d ⁴	6s ²
75	Re	68	[Xe]	5d ⁵	6s ²
76	Os	68	[Xe]	5d ⁶	6s ²
77	Ir	68	[Xe]	5d ⁷	6s ²
78	* Pt	68	[Xe]	5d ⁹	6s ¹
79	* Au	68	[Xe]	5d ¹⁰	6s ¹
80	Hg	68	[Xe]	5d ¹⁰	6s ²

6d Series

89	Ac	86	[Rn]	6d ¹	7s ²
104	Rf	100	[Rn]	6d ²	7s ²
		(Assume)			
105	Db	100	[Rn]	6d ³	7s ²
106	Sg	100	[Rn]	6d ⁴	7s ²
107	Bh	100	[Rn]	6d ⁵	7s ²
108	Hs	100	[Rn]	6d ⁶	7s ²
109	Mt	100	[Rn]	6d ⁷	7s ²
110	Ds	100	[Rn]	6d ⁸	7s ²
111	* Rg	100	[Rn]	6d ¹⁰	7s ¹
112	Cn	100	[Rn]	6d ¹⁰	7s ²

Xe₅₄ For 5d Series 54 + 14 = 68 Xe₆₈

Then Subtract (Z) Given Element with Xe (Z)

The fill e⁻ through given resultant of subtraction

$$\begin{array}{r} 86 + 14 \\ \hline 100 \end{array} \quad \begin{array}{l} Rn \\ 100 \end{array}$$

Property :- Melting Point & Unpaired number of electron

1 → unpaired

1↓	1	1
----	---	---

↓ paired ↘ unpaired

* Hund's Rule

Filling Rule - d 7

1↓	1↓	1	1	1
----	----	---	---	---

→ Cr, Mo, W :- melting point high / Boiling point high
↳ maximum number of unpaired electron

→ Zn, Cd, Hg :- Least melting point / Boiling point :- all paired

Wl = 3400°C ← filament of bulb

Hg = -38°C

21 Sc :- 1 UP

22 Ti :- 2 UP

23 V :- 3 UP

24 Cr :-

1	1	1	1	1
---	---	---	---	---

1

 6 UP

25 Mn :-

1	1	1	1	1
---	---	---	---	---

1↓

 5 UP

26 Fe :- 4 UP

27 Co :- 3 UP

25 Ni :- 2 UP

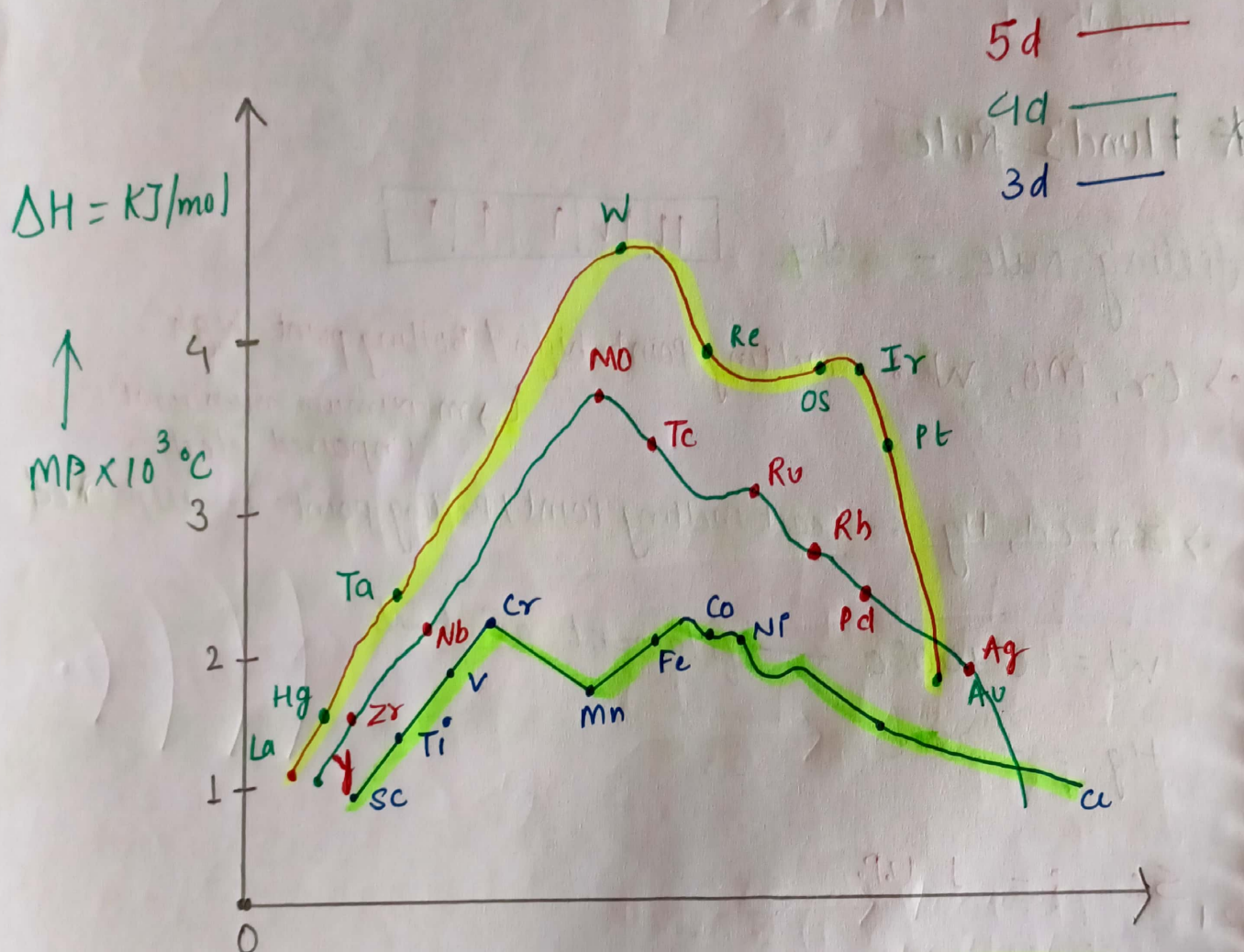
29 Cu :- 1 UP

30 Zn :-

1v	1v	1v	1v	1v
----	----	----	----	----

1v

 - 0 UP



Graph of
melting Point
same as Graph of
Enthalpy of Atomisation

* Enthalpy of Atomization

→ Element

→ Energy required to an element metallic bond break down and convert to atoms.

→ Mn, Tc, Re - half filled stable d^5 electron

→ no electron available for making metallic bond

* Physical Properties of d block Elements

1) Metallic

→ Tensile

→ Ductile

→ Sonorous

→ Lustrous

→ Malleable

→ Good conductor of heat and electricity

→ Cut → sharp edge

"Coinage metal" Group 11 :- Cu, Ag, Au

Ionic and Atomic Radius

In general ions of the same charge in the given series decreases from Group 3 to Group 6 [Sc → Mn]

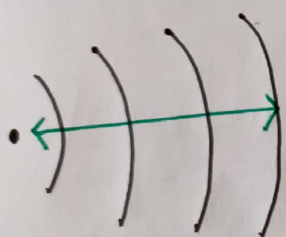
Due to Effective nuclear charge is ~~no~~ greater than Screening Effect [$Z_{eff} > \sigma$]

Then ferrous, Cobalt, Nickel also same Due to Screening Effect counter balance Effective nuclear Charge. So Radius is same.

Size Again Increase from Copper $\rightarrow$ Zinc Because Screening Effect are more than net ~~repulsive force~~ effective nuclear charge. $[\sigma > Z_{eff}]$

From going 3d $\rightarrow$ 4d Size Increases but from going 4d $\rightarrow$ 5d Size are same due to Lanthanoid Contraction.

* Radius / Size



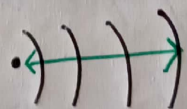
Distance between nucleus and valence shell that is called Radius of that atom

Size $\rightarrow$ Atomic Fe
 Size $\rightarrow$ Ionic [cation] Fe^{+2}

$\rightarrow$ Ionic Radius e^-

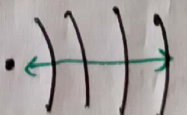
proton

① $_{26}Fe$ 26 26



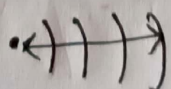
Atomic Size > Cation Size

② $_{26}Fe^+$ 25 26

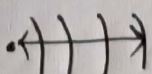


$Fe > Fe^+ > Fe^{+2} > Fe^{+3}$

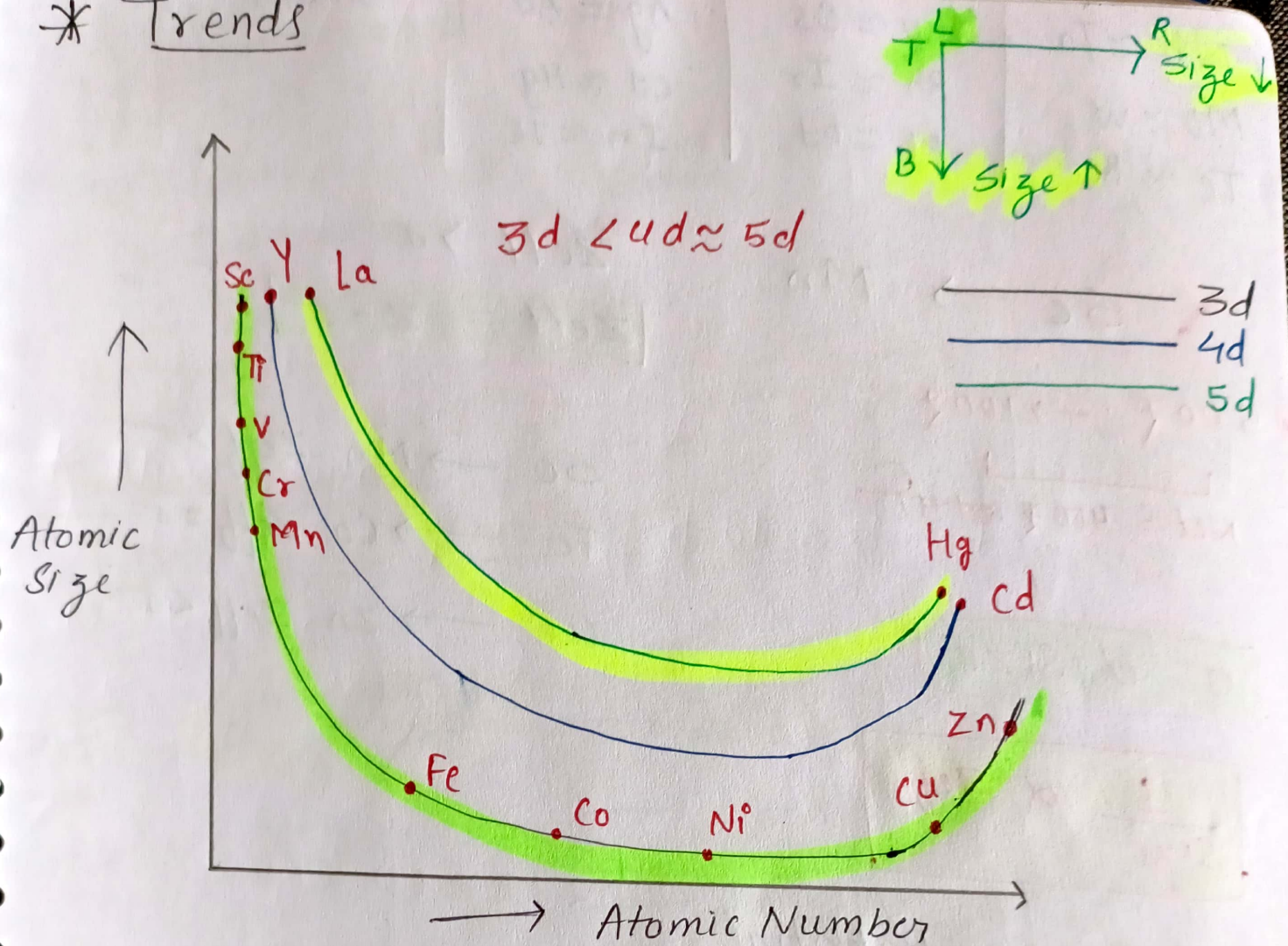
③ $_{26}Fe^{+2}$ 24 26



④ $_{26}Fe^{+3}$ 23 26



* Trends

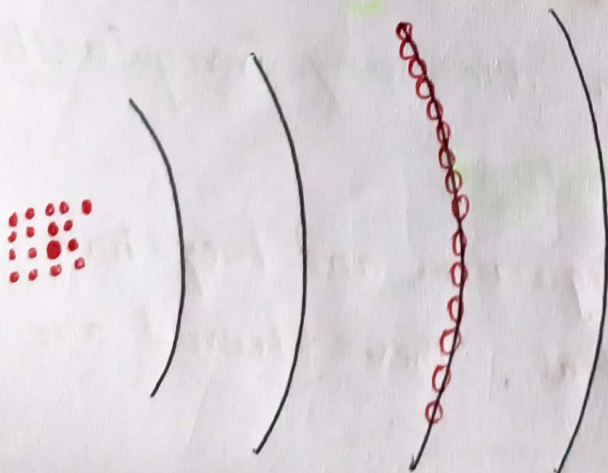


$Zr > Hg$
(160 pm) (159 pm)

→ Lanthanoid contraction

$Y \rightarrow Zr$

$La \rightarrow Hf$
57 72



→ Due to Screening Effect of f orbital attraction increases and size decreases

Nb $\approx$ Ta

Mo $\approx$ W

Tc $\approx$ Re

Ru $\approx$ Os

Rh $\approx$ Ir

Pt $\approx$ Pd

Ag $\approx$ Au

Cd $\approx$ Hg

In $\approx$ Tl

Sn $\approx$ Pb

Sc $\rightarrow$ Mn

$Z_{eff} > \sigma$

$$[Z_{eff} = Z - \sigma]$$

500 ₹ $\rightarrow$ 100 ₹

Net = 400 ₹ खर्च

Sc $\rightarrow$ Mn $Z_{eff} > \sigma$

Fe $\rightarrow$ Co $Z_{eff} = \sigma$

Cu $\rightarrow$ Zn $Z_{eff} < \sigma$

$\sigma \propto \text{Size}$

$$\frac{1}{\text{Size}} \propto Z_{eff}$$

* Ionization Potential

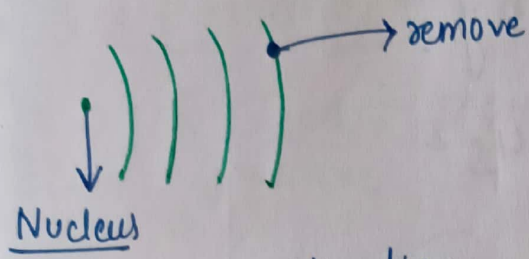
The d-block Element show less Ionization Potential due to ~~metal~~ all are metal and electropositive From

Going left $\rightarrow$ Right I.P. increases then Decreases

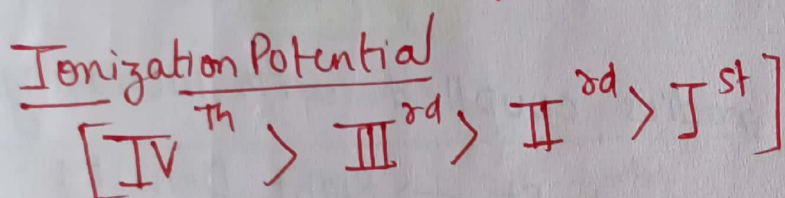
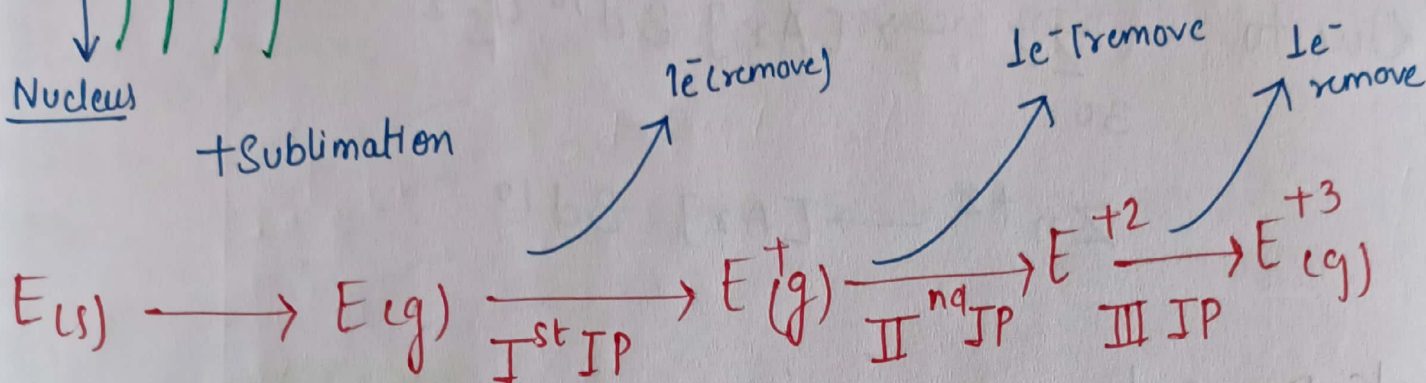
Due to $Z_{effective}$ increases then decreases.

From going Top to Bottom there are many irregularities due to $[d^0, d^5, d^{10}]$ configuration

This is because of stable configuration and they have very very high Ionization Potential. These Element are more stable than other.



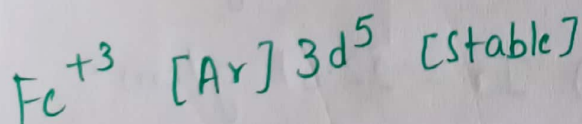
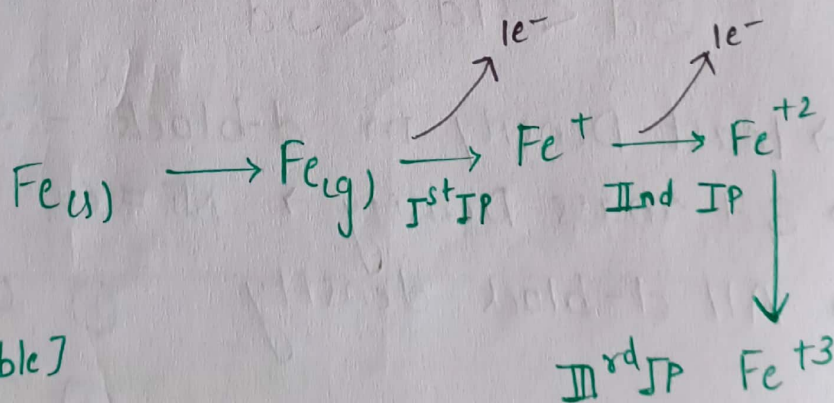
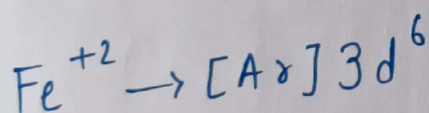
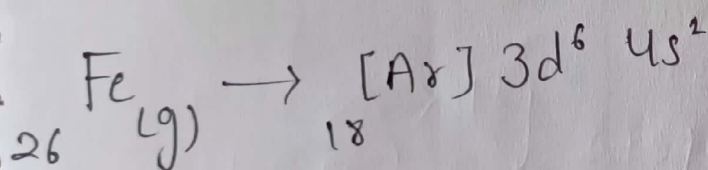
+ Sublimation



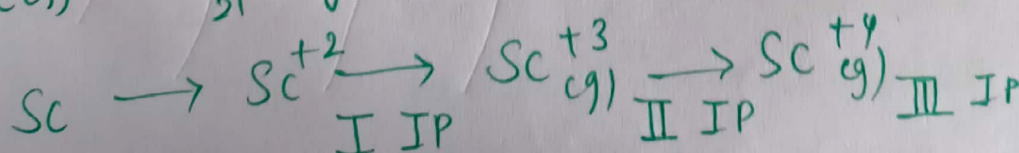
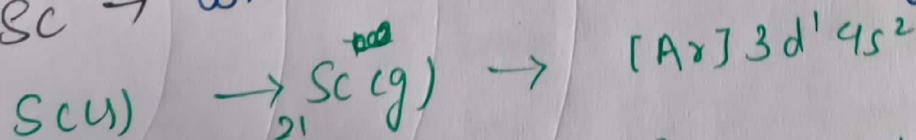
##

d^0, d^5, d^{10}

- IP :- last IP
- Very Very high
- Oxidation State Stable



Sc $\rightarrow$ which IP are very very high



Zn $\rightarrow$ Non Transition Why?

Due to $\text{Zn} \rightarrow [\text{Ar}] 3d^{10} 4s^2$

$\text{Zn}^{+2} \rightarrow [\text{Ar}] 3d^{10}$

* Density

The Density in metallic radius coupled with increasing in atomic mass when we go Left $\rightarrow$ Right Density Increases. Then slightly decreases [Zn] have lower density because of higher volume

$\text{Sc} < \text{Ti} < \text{V} < \text{Cr} < \text{Mn} < \text{Fe} < \text{Co} < \text{Ni} = \text{Cu} > \text{Zn}$

$3d < 4d < 5d$

$\rightarrow$ least Density in d-block - Sc

$\rightarrow$ 3d mass Density $\rightarrow \text{Ni} = \text{Cu}$

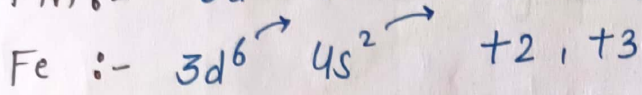
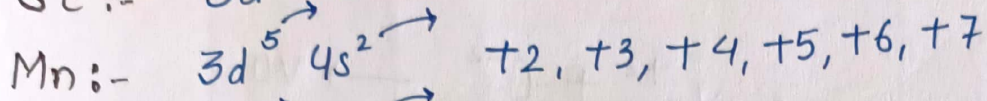
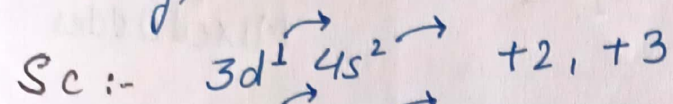
$\rightarrow$ All d-block density

① Os = 22.51 g/cm³

② Ir = 22.61 g/cm³

* Oxidation State

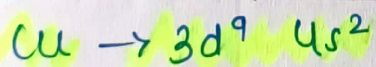
d block Element shows variable oxidation states depends upon stability, where d^0 , d^5 and d^{10} are more stable.



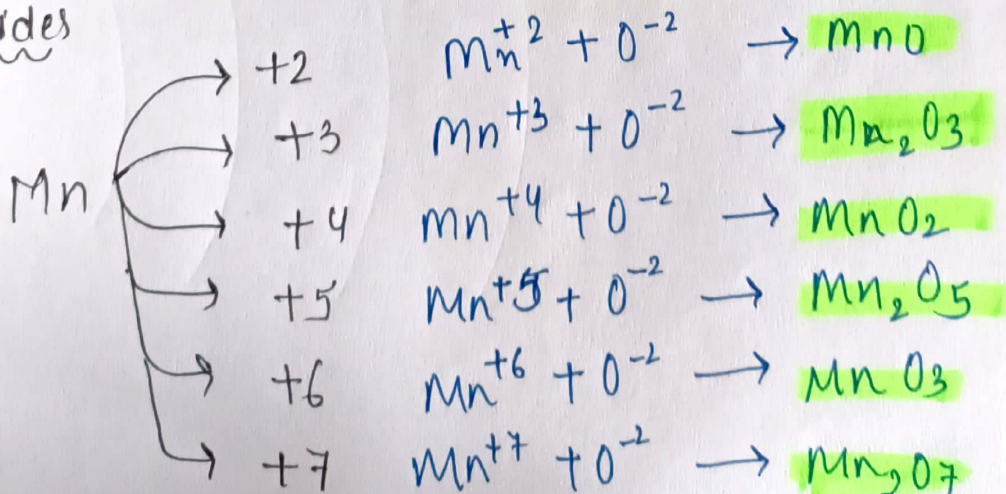
$\rightarrow 3d^5$ stable

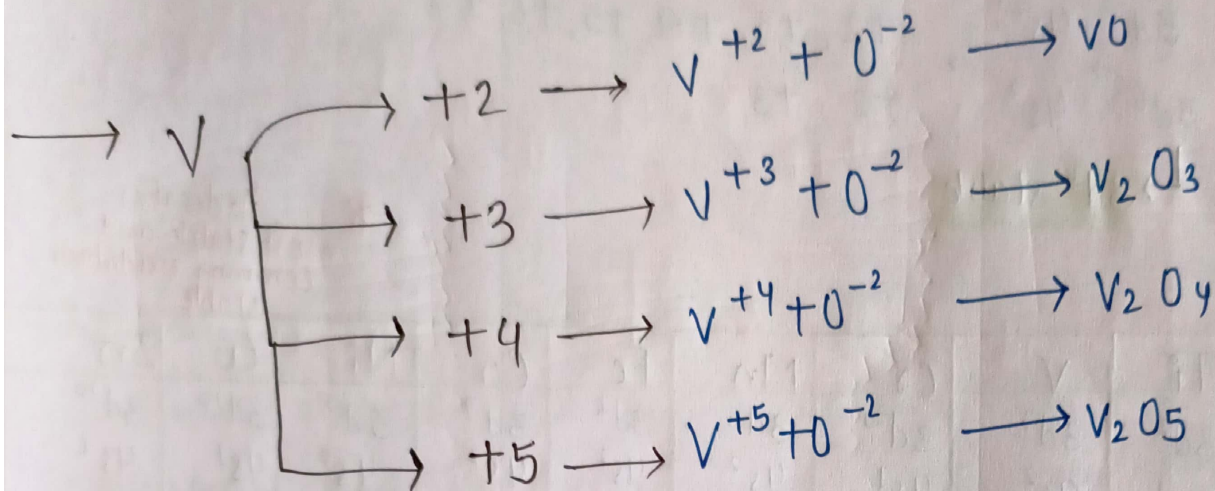
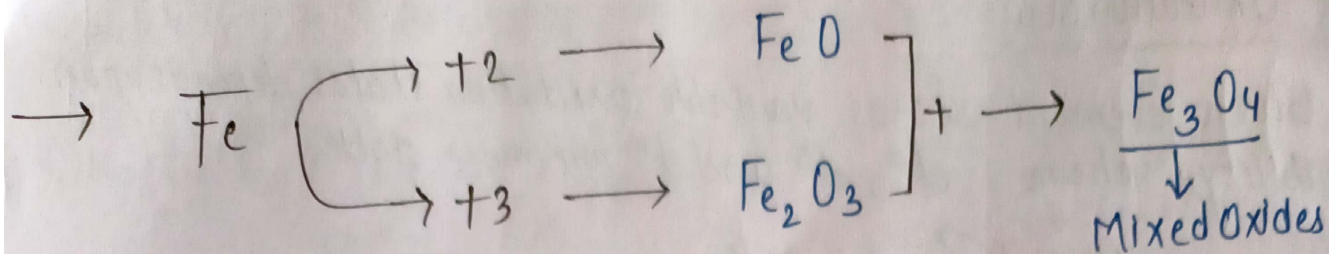
* — indicates most stable and common oxidation state

Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn
$3d^1 4s^2$	$3d^2 4s^2$	$3d^3 4s^2$	$3d^5 4s^1$	$3d^5 4s^2$	$3d^6 4s^2$	$3d^7 4s^2$	$3d^8 4s^2$	$3d^{10} 4s^1$	$3d^{10} 4s^2$
+2	+2	+2	+1	+2	+2	+2	+2	+1	+2
+3	+3	+3	+2	+3	+3	+3	+3	+2	
	+4	+4	+3	+4		+4	+4		
		+5	+4	+5			+5		
			+5	+6					
			+6	+7					

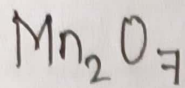


* Oxides

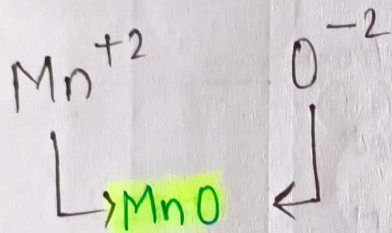
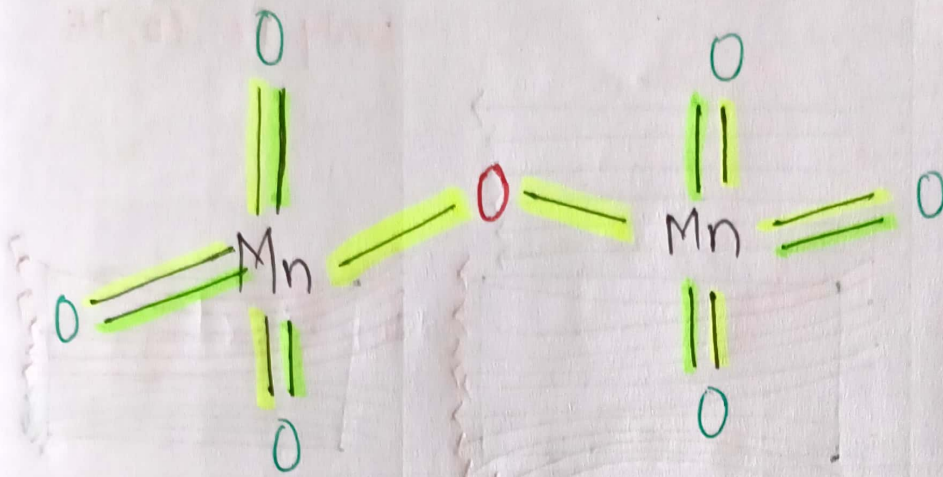




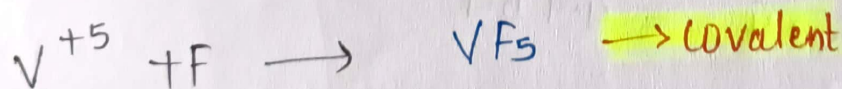
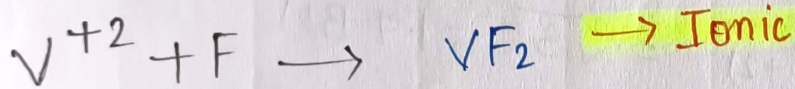
+1, +2, +3	+4, +5	+6, +7
Basic	Amphoteric	Acidic
MnO Mn^{+2} Ionic Bond	MnO_2 Mn^{+4} Amphoteric Bond	Mn_2O_7 Mn^{+7} Covalent Bond



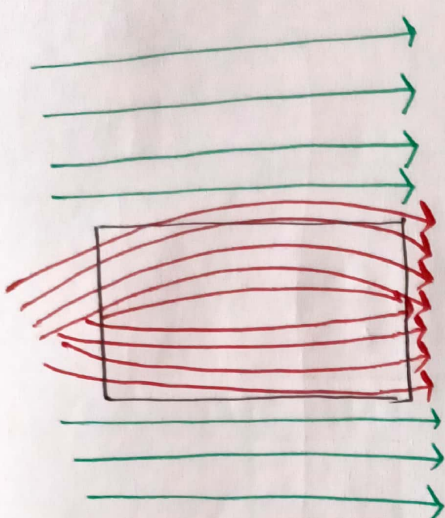
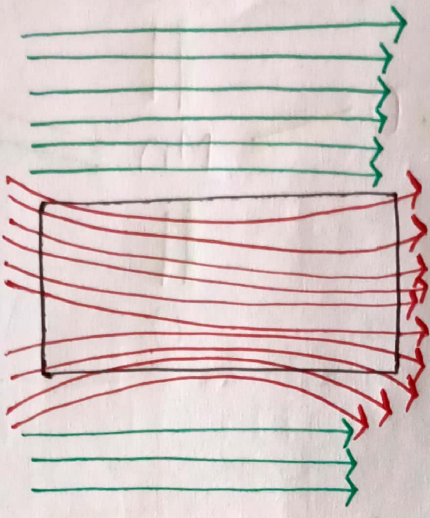
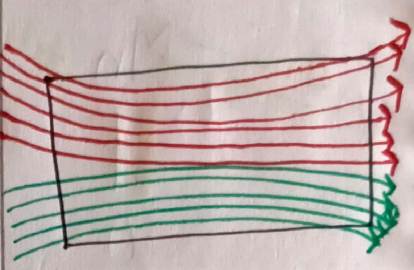
* Tetrahedral



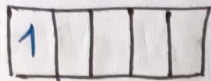
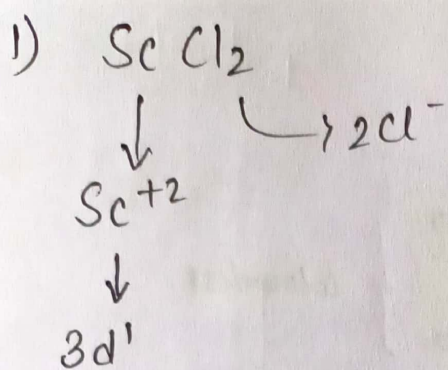
* Halide



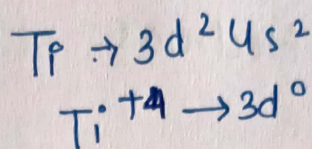
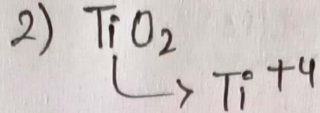
* Magnetic Properties

Diamagnetic	Paramagnetic	Ferromagnetic
 Slightly repulsion → All paired electron $\mu \rightarrow$ magnetic moment $\downarrow$ $\mu_{net} = 0$	 Slightly attraction → minimum 1 unpaired $\mu = \sqrt{n(n+2)} \text{ BM}$ BM = Bohr magneton $n = \text{no. of up. } e^-$	Only Fe, Co, Ni 

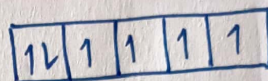
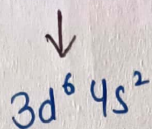
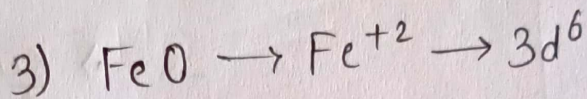
- 1) $n=0$ $\mu = \sqrt{1(1+2)} = \sqrt{3} = 1.7 \text{ BM}$
- 2) $n=2$ $\mu = \sqrt{2(2+2)} = \sqrt{8} = 2.8 \text{ BM}$
- 3) $n=3$ $\mu = \sqrt{3(3+2)} = \sqrt{15} = 3.8 \text{ BM}$
- 4) $n=4$ $\mu = \sqrt{4(4+2)} = \sqrt{24} = 4.9 \text{ BM}$
- 5) $n=5$ $\mu = \sqrt{5(5+2)} = \sqrt{35} = 5.9 \text{ BM}$



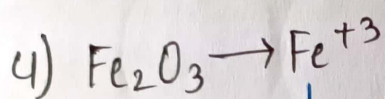
$\mu = \sqrt{3} \text{ BM}$
 paramagnetic



$\mu = 0$ Diamagnetic

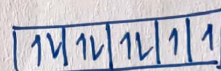
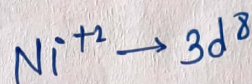
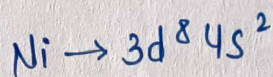
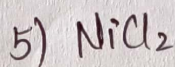


paramagnetic $\sqrt{24} \text{ BM}$



Paramagnetic

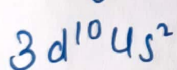
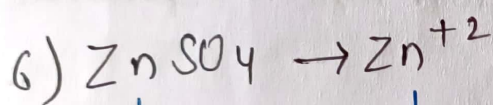
$\mu = \sqrt{35} \text{ BM}$



paramagnetic

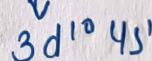
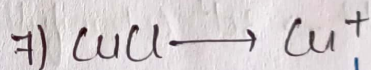
UP = 2

$\sqrt{8} \text{ BM}$



Diamagnetic

$\mu = 0$



Diamagnetic

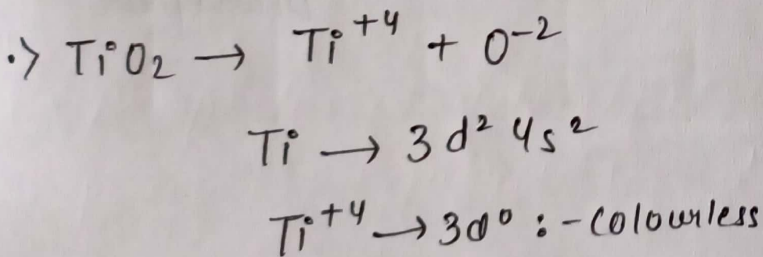
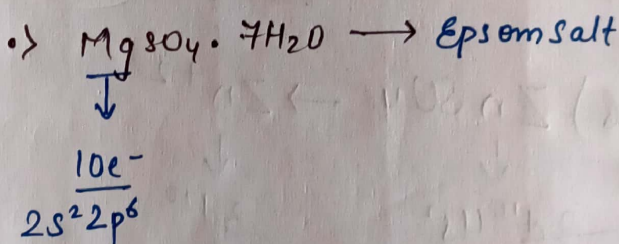
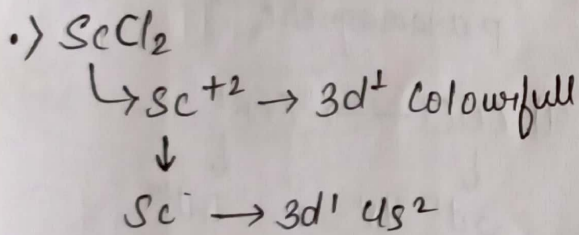
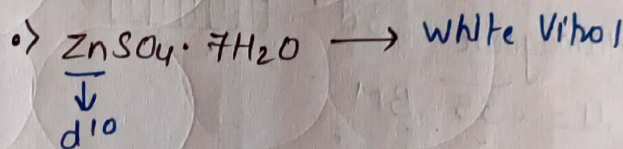
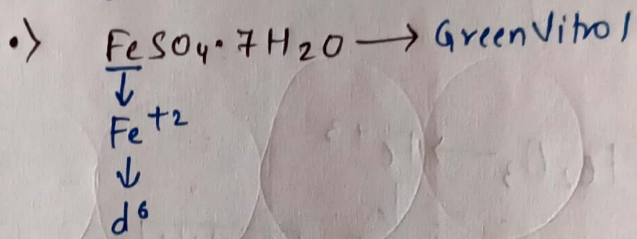
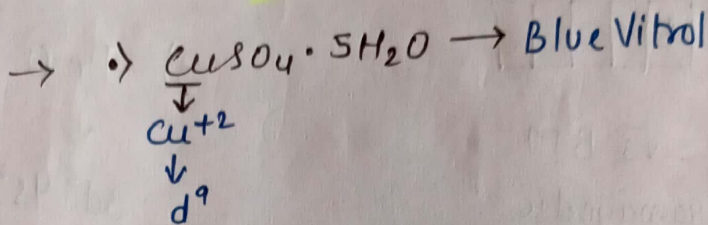
* Colour Properties

→ Unpaired Electrons

d^1
 d^2
 d^3
 d^4
 d^5
 d^6
 d^7
 d^8
 d^9
 d^9

→ Colourful

d^0
 d^{10} } colourless



Properties

→ Intermetallic Completion

* Defination

Lanthanoid Contraction -

The Overall decrease in atomic and ionic radii from Lanthanum to Lutetium (the ~~the~~ Lanthanoid contraction) is a unique feature of chemistry.

Reason

The Steady decrease in the atomic and ionic radii of the Transition element metals as the atomic number increases. This is because of filling of 4f orbitals before the 5d orbitals. This contraction in size is quite regular. Thus called Lanthanoid contraction.

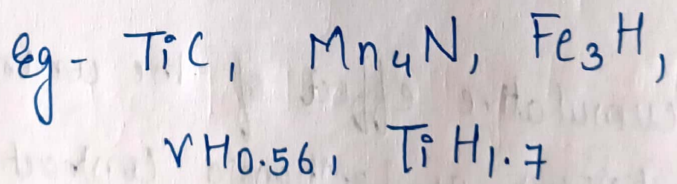
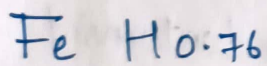
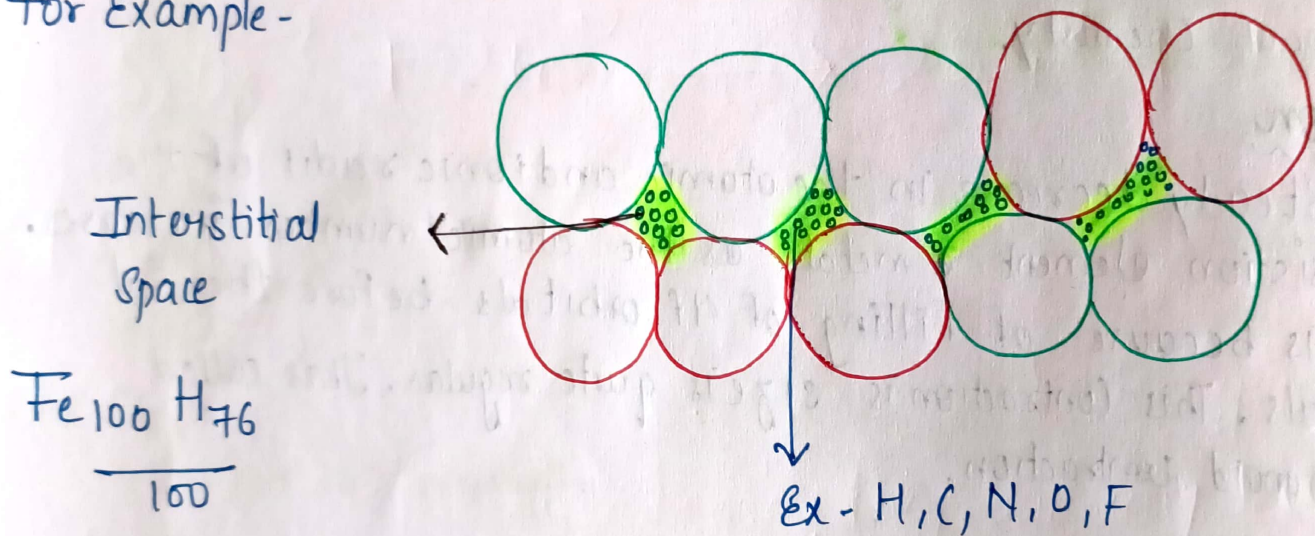
The cumulative effect of the contraction of the Lanthanoid series, known as Lanthanoid contraction.

→ INTERSTITIAL COMPOUNDS

They are those compound which are found when small atoms like hydrogen, carbon, Nitrogen are trapped inside the crystal lattice of metals.

They are usually non stoichiometry neither typical ionic or covalent.

For Example -



"The properties of interstitial compounds are more superior from purest form."

Their Properties are follows:-

- 1) They have High Melting point.
- 2) They have very Hard, some of them are approach their boundary to diamond.

3) They Retain Metallic Conductivity

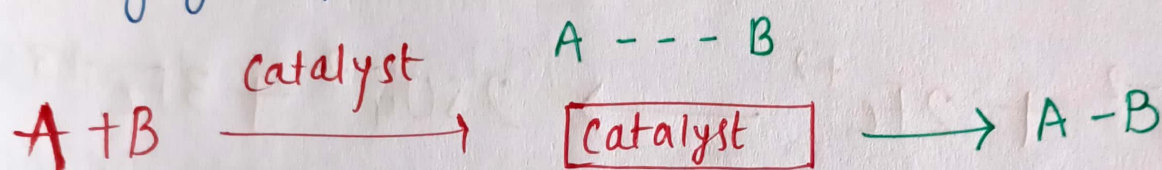
4) They are chemically Inert.

→ Catalytic Properties

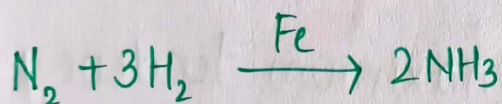
→ Variable Oxidation State

→ Vacant d-orbitals

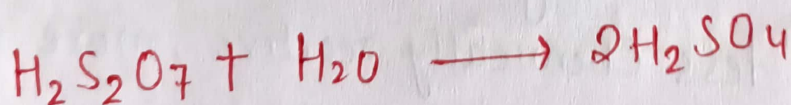
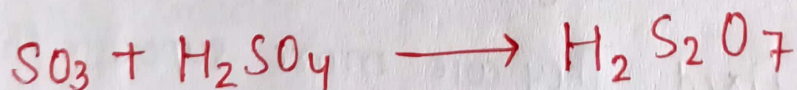
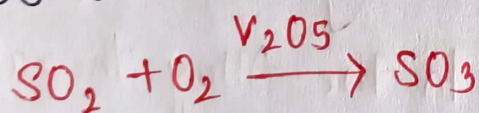
→ They give space to do reaction and form intermediate.



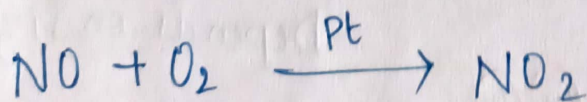
1) Fe :- Habber Process → Making of Ammonia



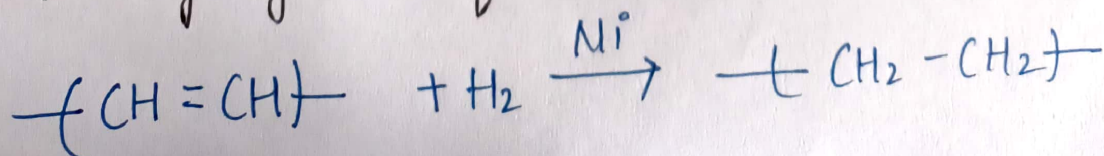
2) V_2O_5 :- Contact Process → Making of H_2SO_4



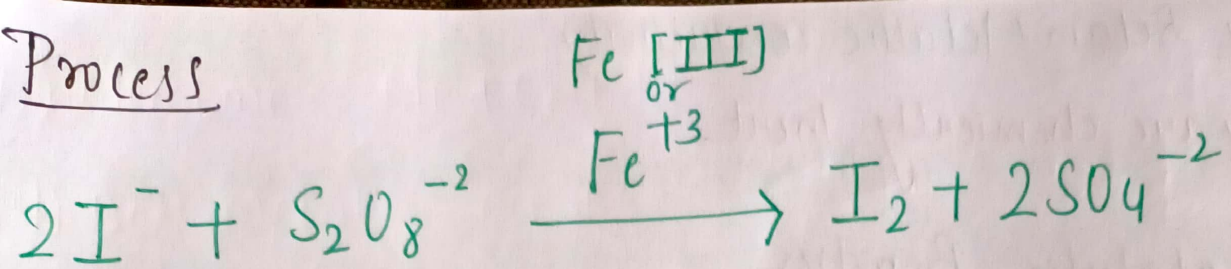
3) Pt :- ~~Old~~ Ostwald Process → Making of Nitric Acid



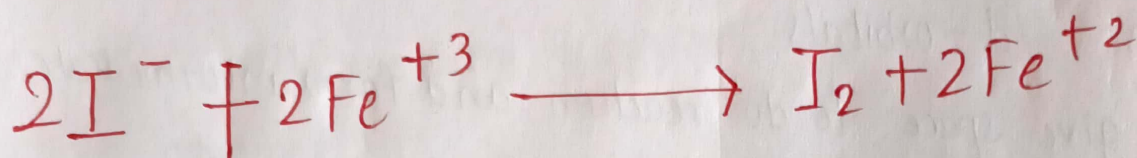
4) Ni :- Hydrogenation of oil



Process



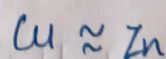
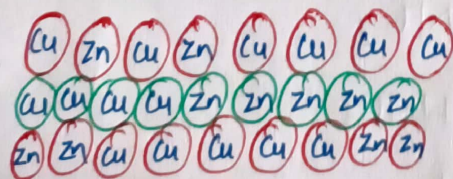
Two Step



* Alloy formation

Transition element have maximum tendency to form alloys. This is because, they are very less reactive and similar size. In the Alloy the ratio of component have fixed. They are more superior than pure metal. [i.e.]:- less Chemically reactive, more melting point, boiling point, more chemical strength etc.

Depends on Size.



$3d \approx 4d \approx 5d \approx 6d$

Due to Actinoid Contraction

Due to
Lanthanoid
Contraction

* 22

1) Bronze - Cu + Sn

2) Brass - Cu + Zn

3) Gun Metals - Cu + Zn + Sn

4) Stainless Steel - Fe + Ni

5) Invar - Ni-36

6) Alnico - Al + Ni + Co

7) Duralumin - Cu + Al + Mn

8) 22 Carat Gold - Au + Ag

9) 18 Carat Gold - Au + Ag + Cu

10) German Silver - Ni + Cu + Zn

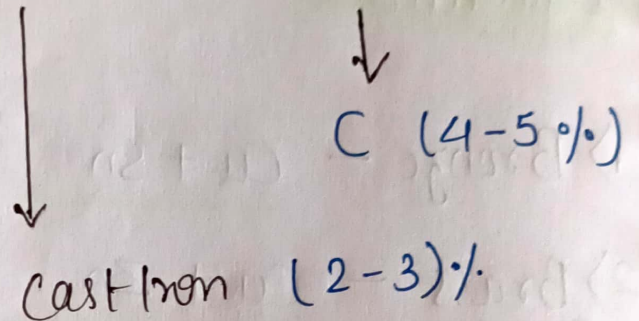
11) White Metal - Li + Pb

12) Solder - Sn + Pb

B) Microme - $\text{Ni} + \text{Cr} + \text{Fe}$

14) Bell metal - $\text{Cu} + \text{Sn}$

15) Iron $\rightarrow \text{Fe} \rightarrow \text{Blast Furnance} \rightarrow \text{Pig iron}$



Purest form of Iron $\leftarrow$ wrought Iron :- (1-2%)

Alloy with Hg - Amalgum

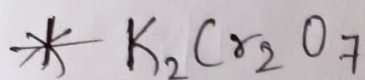
Fe, Co, Ni

$\text{Hg} + \text{Zn} \rightarrow \text{Zinc Amalgum}$

Size very different

$\text{Hg} + \text{Na} \rightarrow \text{Sodium Amalgum}$

Semi Solid



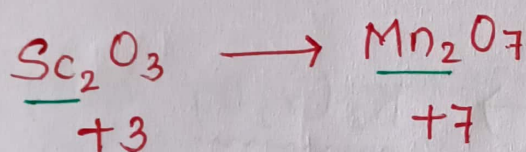
Some Important Compounds of transition Element

1) Oxides and Oxoanions of metals

2) d block Elements have higher tendency to form Bond.

Osmium has maximum valency i.e. - +8.

In 3d series Oxidation number Scandium [Sc] to Manganese [Mn]



$\text{Mn}_2\text{O}_7 \rightarrow$ Green Colour Covalent Oil

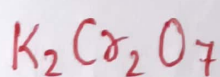
Higher Oxidising state are covalent and lower oxidising state are ionic

Example - CrO_3 and V_2O_3] Low MP.

They also form oxoanions Mn gives $\rightarrow \text{HMnO}_4$

Cr gives $\rightarrow \text{H}_2\text{CrO}_4$
and H_2CrO_7

CrO are basic. and CrO_3 are covalent.

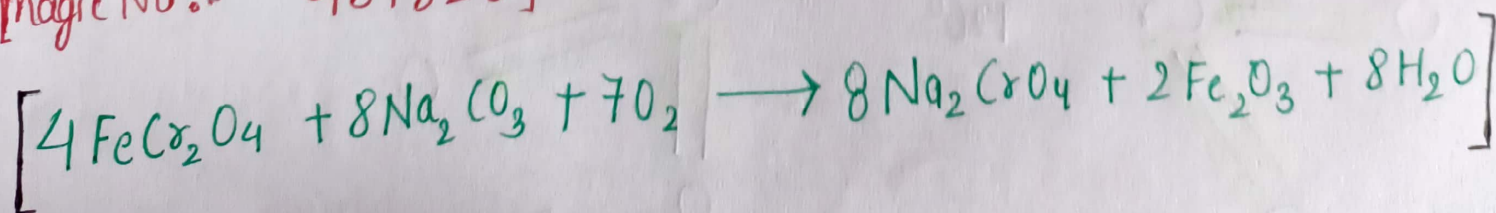


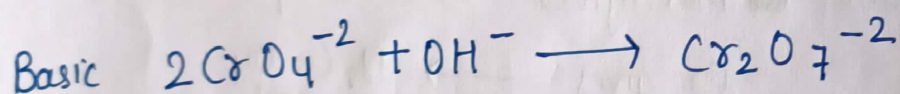
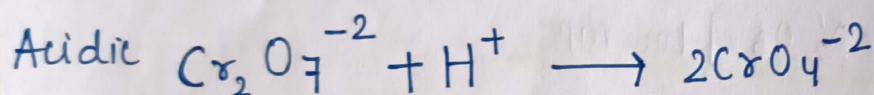
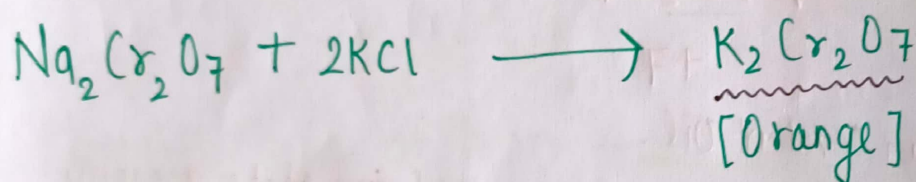
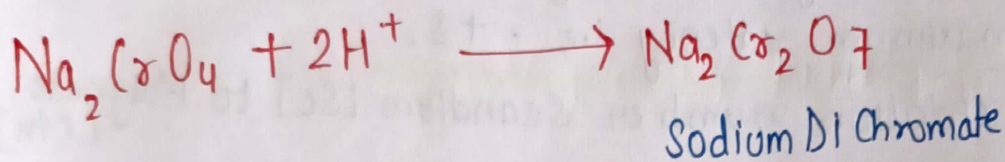
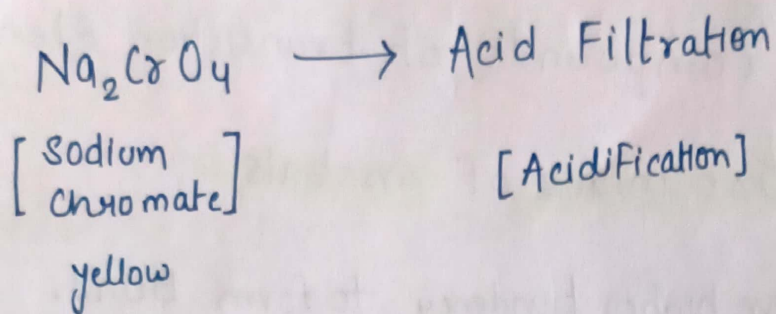
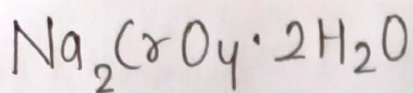
Potassium Dichromate

$\rightarrow$ Formation

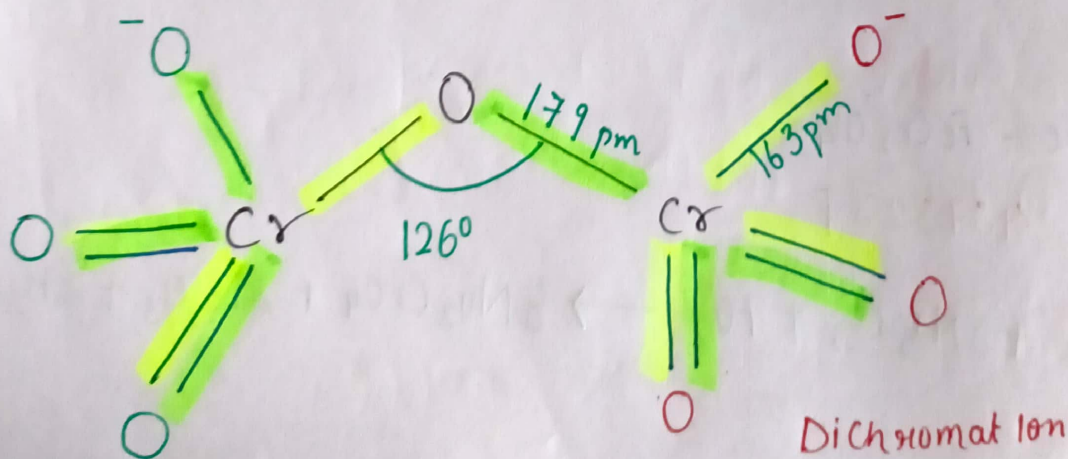
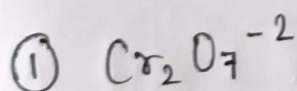
Chromate Ore - FeCr_2O_4

Magic No:- 487828]



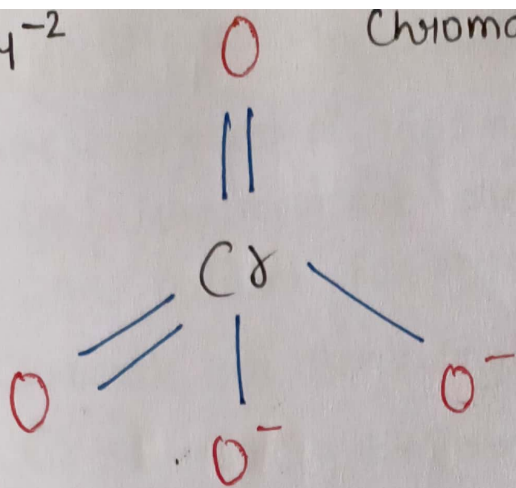


* Structure

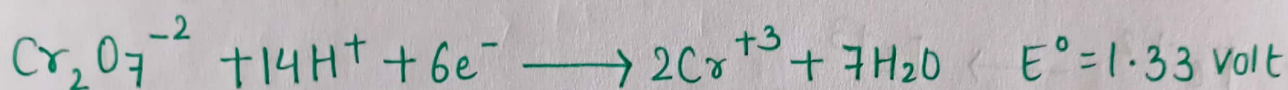
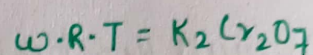


(2) $\text{Cr}_2\text{O}_7^{-2}$

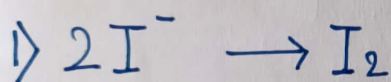
Chromate ion



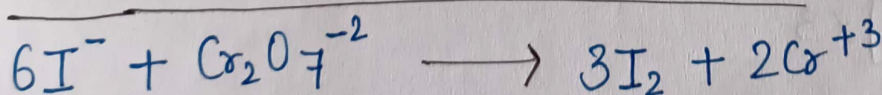
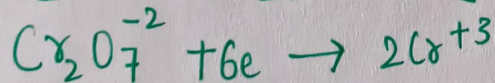
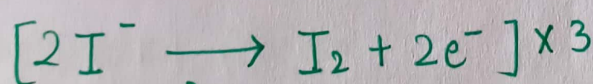
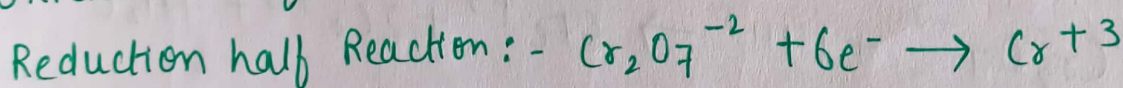
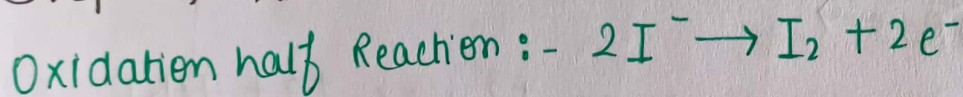
It is very good oxidising agent



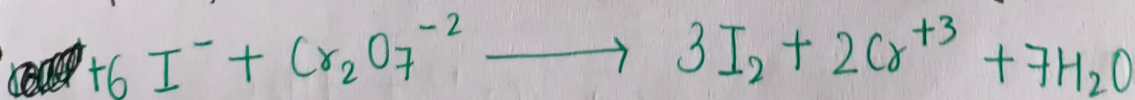
* Redox Reaction Balancing



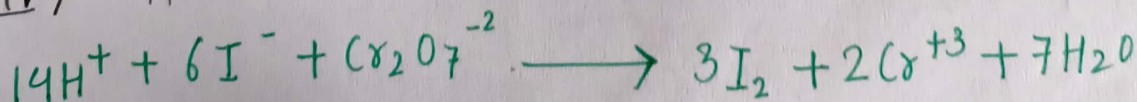
Step - 1) Write Half Reaction + Step - 2) Balance no. of electron

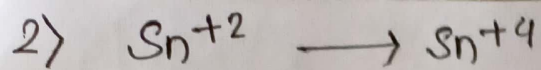


Step - III) Add H_2O Opposite Side of ~~an~~ oxygen atom or molecule

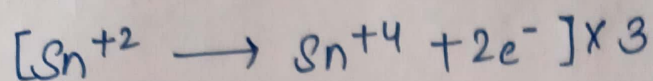


Step - IV) Add H^+ in opposite side of H_2O

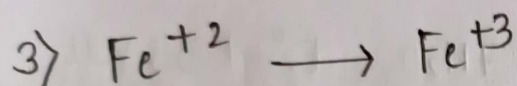
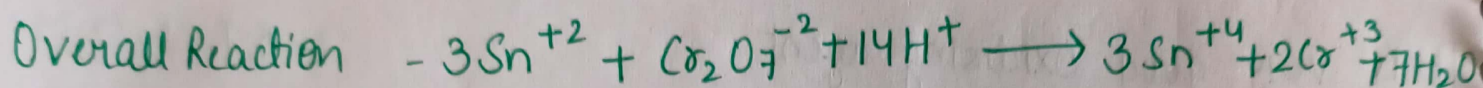
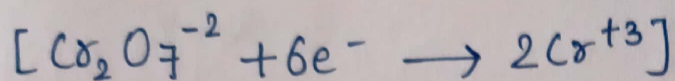




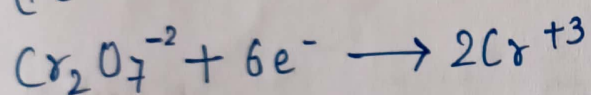
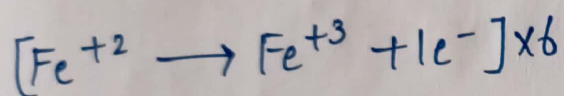
Oxidation half Reaction



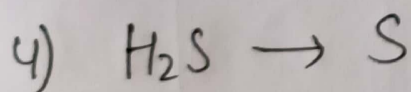
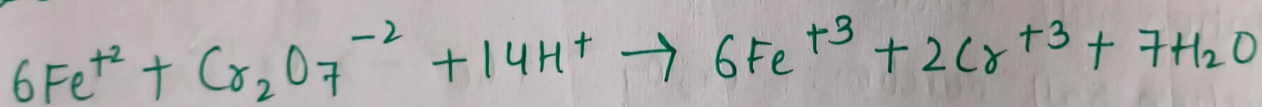
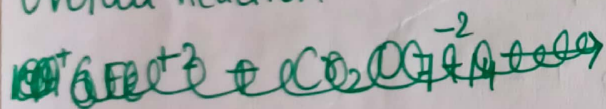
Reduction Half Reaction



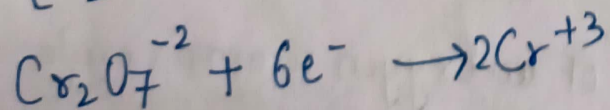
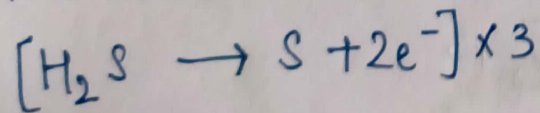
Half Reaction :-



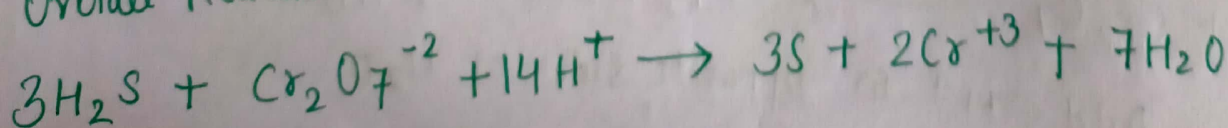
Overall Reaction



Half Reaction

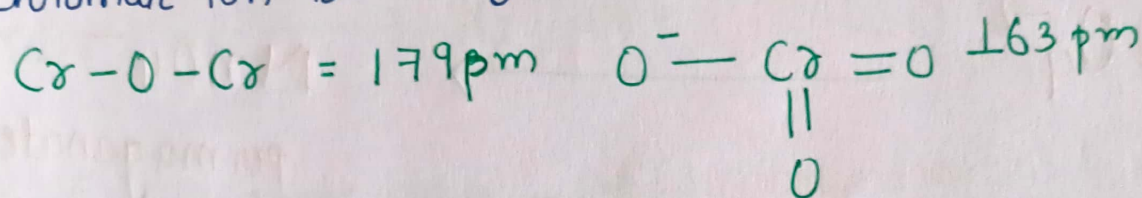


Overall Reaction



$K_2Cr_2O_7$ are use in Volumetric analysis of chemical

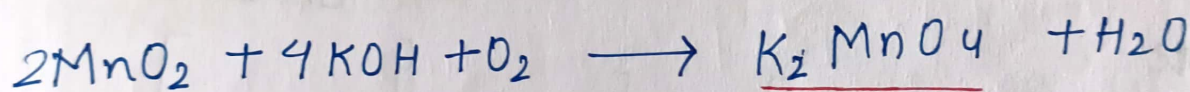
They are used most of the time in acidic medium
It is also very important chemical used in leather industry
and as an oxidant for preparation of Azo compound.
In Dichromate ion Bond Angle are 126° and Bond length are 179 pm



* $KMnO_4$ Potassium Per Manganate

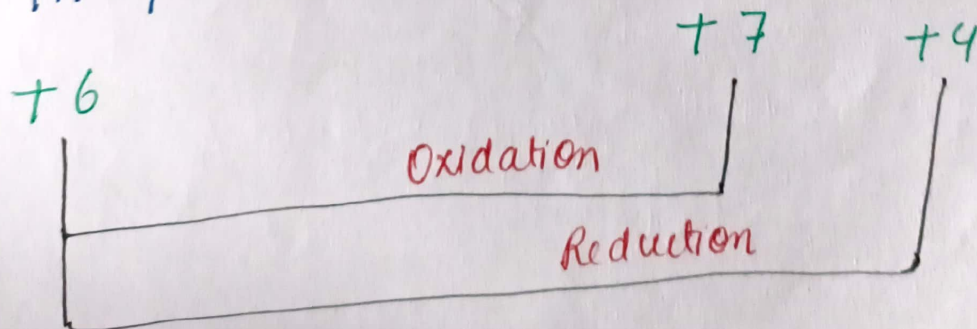
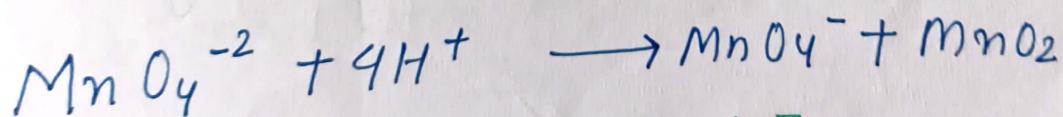
Oxide - MnO_2

Potassium per manganate is prepared by the fusion of MnO_2
with an alkali metal Hydroxide and oxidizing agent
like KNO_3 .

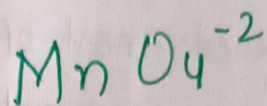
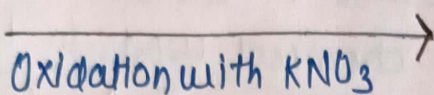
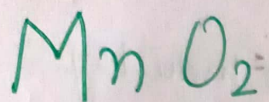


Potassium
manganate
green colour

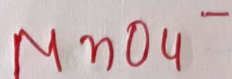
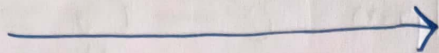
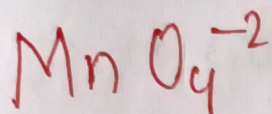
* Disproportionation Reaction



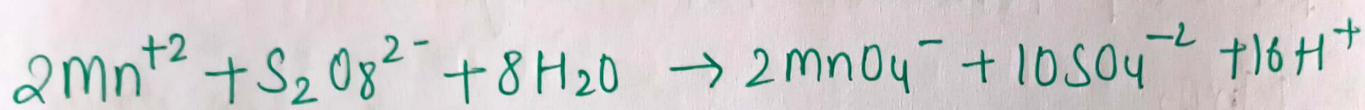
Fusion with HCl



manganate ion



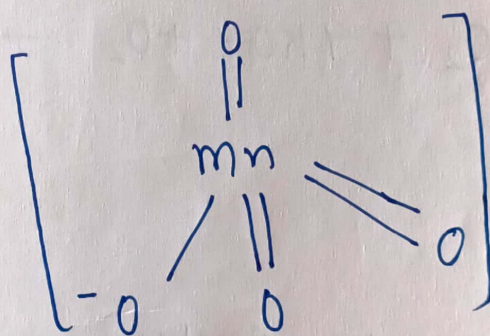
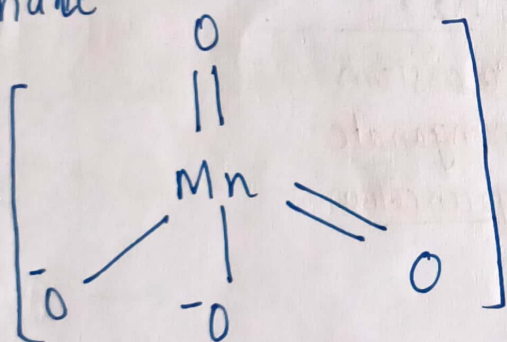
permanganate



↓
peroxo sulphuric acid

It is also iso structure with $\text{KClO}_4 \rightarrow$ Hybridisation
↓
Tetrahedral

manganate

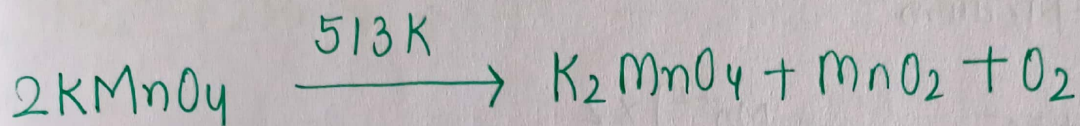


permanganate

Color - Dark Violet Approx Black

Solubility - High

6.4 g/100 gm water at 293 K



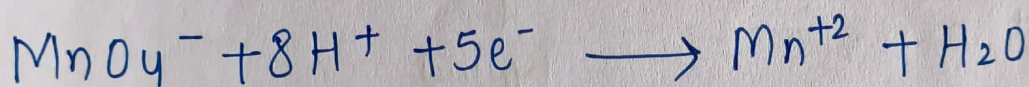
$\text{MnO}_4^{2-} \rightarrow$ green colour - solid $\rightarrow$ paramagnetic

$\text{Mn} = +6$:- 1 unpaired e^-

$\text{MnO}_4^- \rightarrow$ Violet Dark $\rightarrow$ Diamagnetic

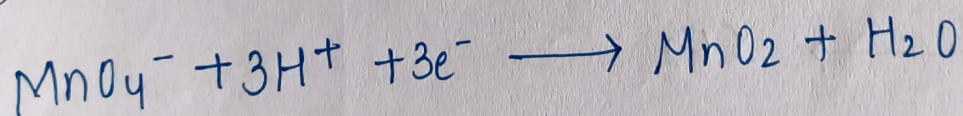
$\text{Mn} = +7$ [d^0]

1) In Acidic medium



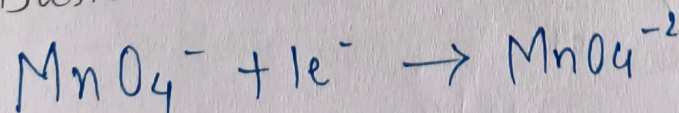
$E^0 = 1.52 \text{ Volt}$

2) In Neutral medium



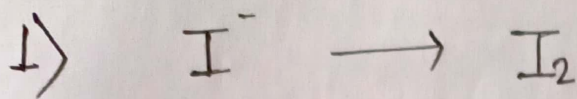
$E^0 = 1.69 \text{ V}$

3) In Basic Medium

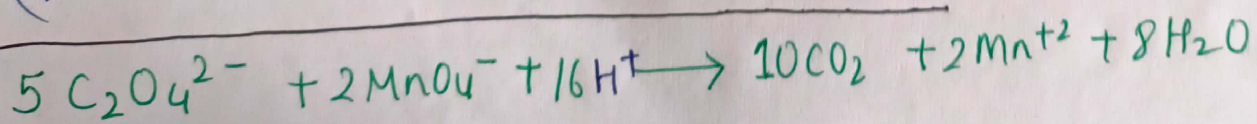
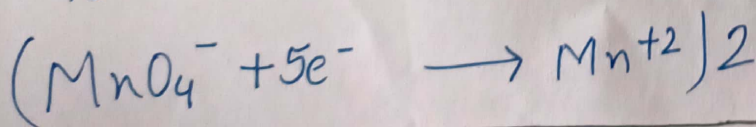
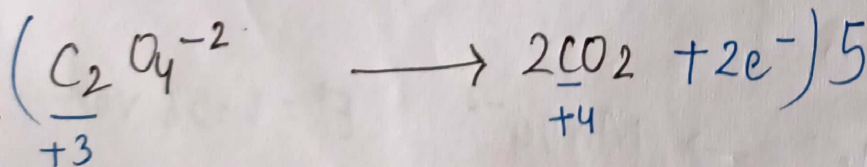
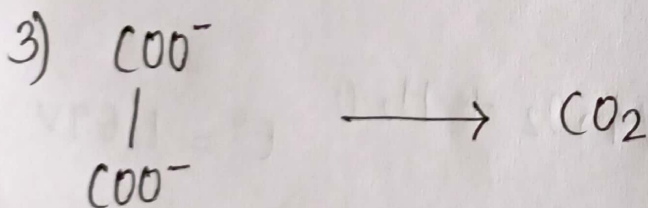
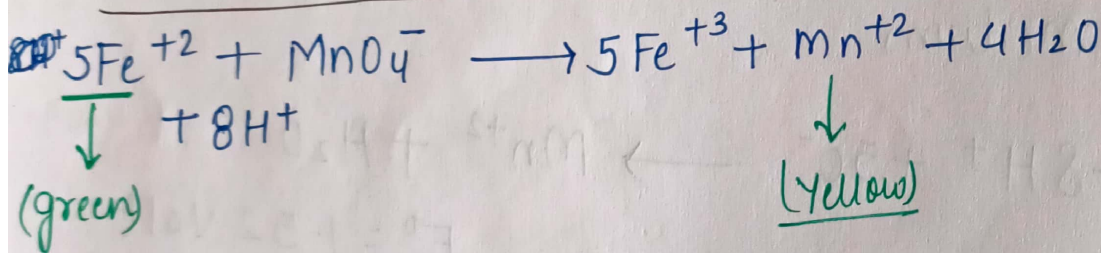
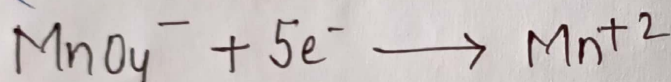
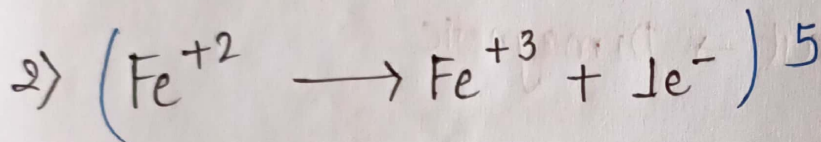
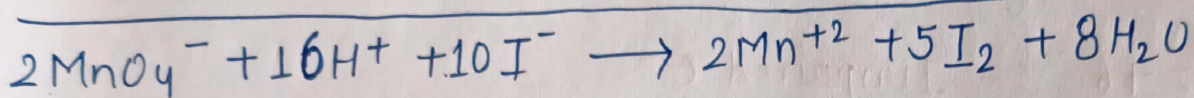
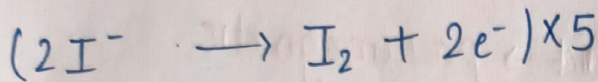
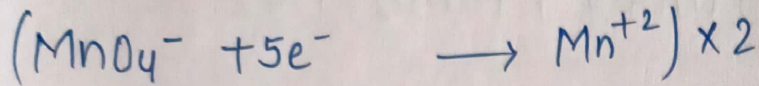


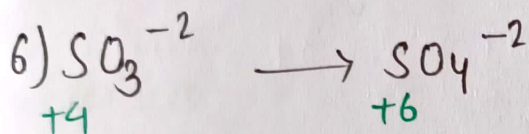
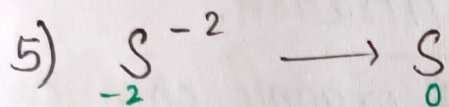
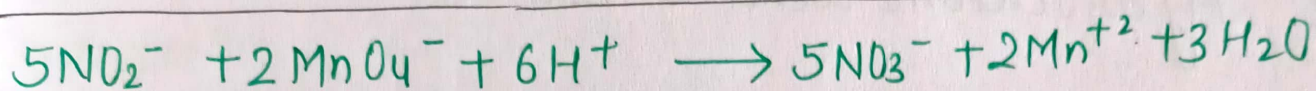
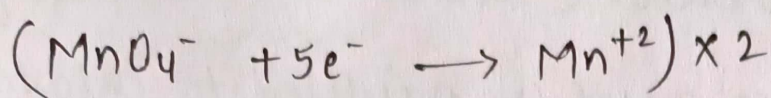
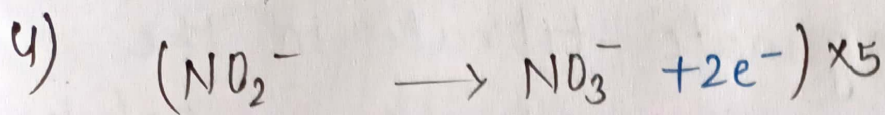
$E^0 = 0.56 \text{ Volt}$

22/7/2025

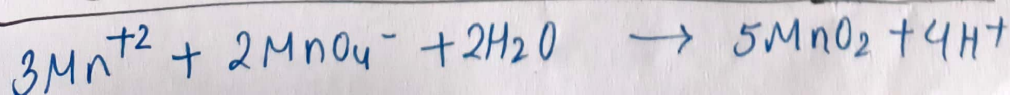
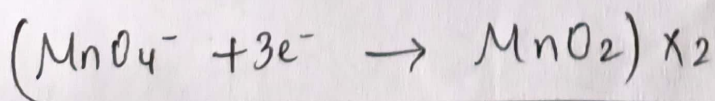
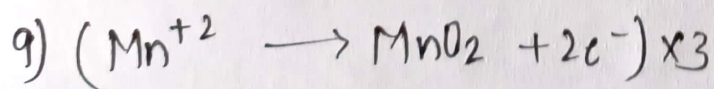
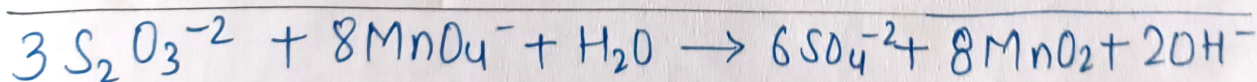
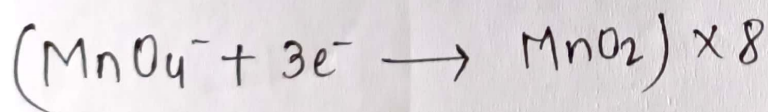
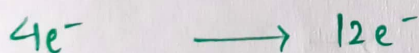
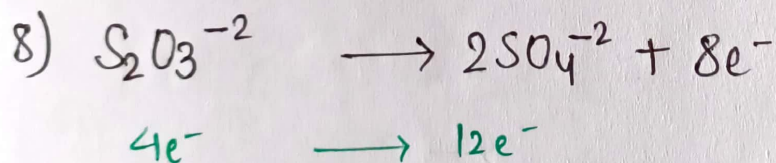
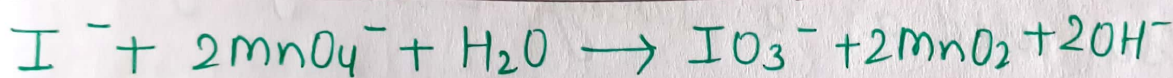
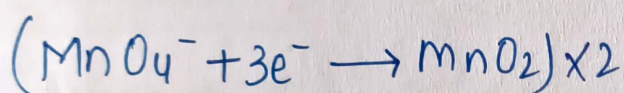
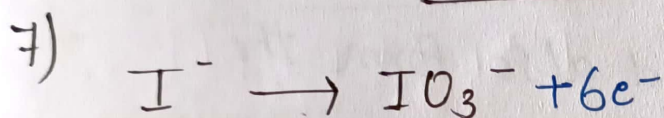


In Acidic Medium





* Neutral / Slightly Basic medium



Potassium Per Manganate titrate in the presence of Hydrochloric acid are unsatisfactory since Hydrochloric acid is oxidised to chlorine

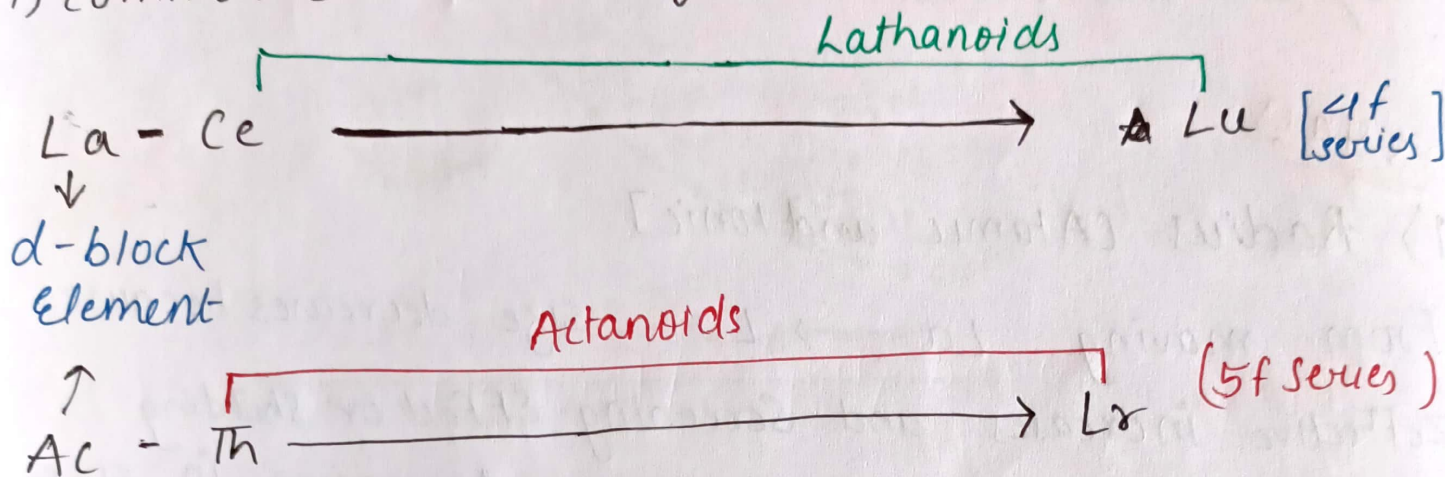
→ Uses OF KMnO_4

- 1) In the Chemical Analysis and Titration.
- 2) KMnO_4 used as preservative ~~as~~ organic chemical
Because it is good oxidant
- 3) It is used for Bleaching of Wool, Cotton, Silk and other textile fabric and also form the de-colourisation of Oils.
- 4) They also used as a strong oxidising agent

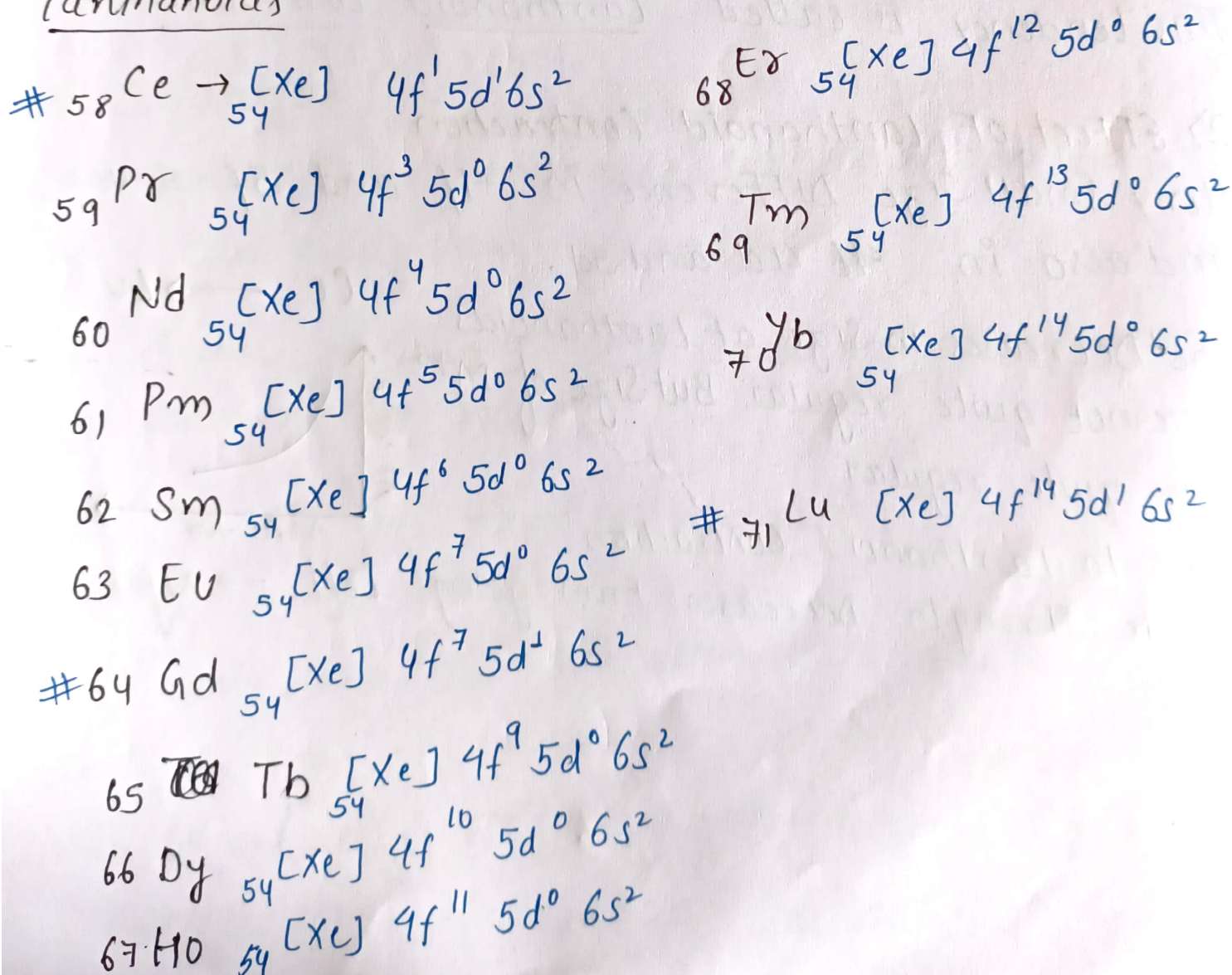
f-Block ELEMENTS

* Properties

1) Common Electronic configuration $(n-2)f^{1-14} (n-1)d^{0-1} ns^2$



Lanthanoids



* Stable Configuration

f^0 f^{14} f^7 are stable configuration

They are also called Inert Transition Element

2.5 Star

1) Radius [Atomic and Ionic]

From moving $\text{La} \rightarrow \text{Lu}$ Size decreases because $Z_{\text{Effective}}$ increases and Screening Effect or Shielding Effect decreases. Due to continuous Decreasing in size This tendency is called Lanthanoid Contraction

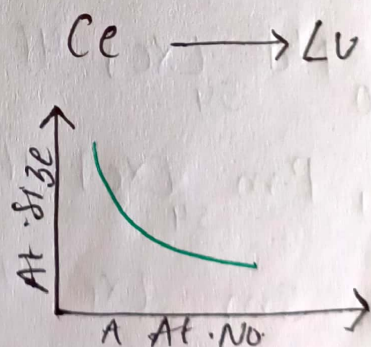
2) Effect of Lanthanoid Contraction

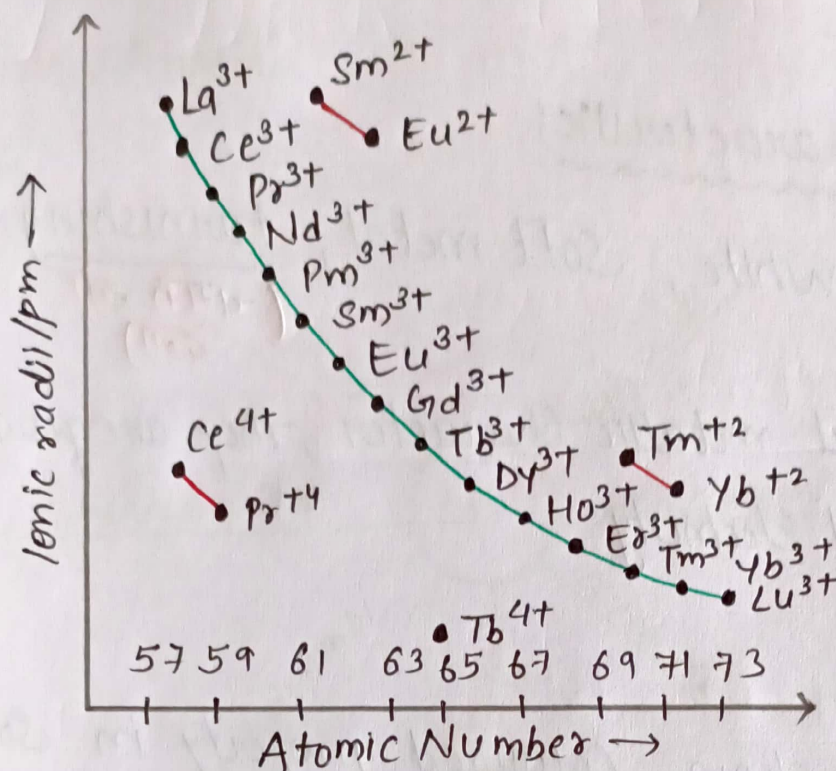
Very Small Size Difference in 4f and 5f series and also in ~~4d~~ 4d and 5d.

The Decreases in Size of Lanthanoids are not quite regular. But Size of M^{+3} are quite regular

Due to Lanthanoid Contraction

Basic Strength Decreases From going Left $\rightarrow$ Right





Trends in ionic radii of Lanthanoids

* Oxidation State

Lanthanoids show commonly +3 oxidation state
But it can also show +2 and +4

1) Ce shows +4, +3 Ce^{+4} acts as oxidant and used in volumetric analysis.

2) Pr, Nb, Tb, Dy $\rightarrow$ +4 and form MO_2 type of oxides.

3) Yb only shows +2 oxidation state due to f^{14} and acts as reductant

4) Tb shows only Tb^{+4} / +4 oxidation due to d^7 configuration and acts as oxidant

5) Sm, Eu shows +2, +3 Oxidation State

* General Characteristics

It is silvery white, soft metal, tarnishing in air
(चमक खो देना)

They show typical metallic character, they are good conductor heat and electricity.

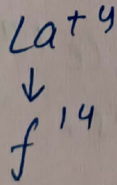
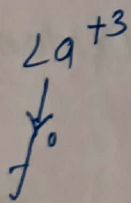
→ magnetic

Many of them show coloured property in solid state and aqueous state (solution).

It is about trivalency. Coloured property is only due to f, f transition which is very narrow band

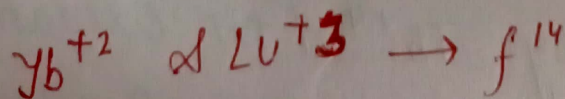
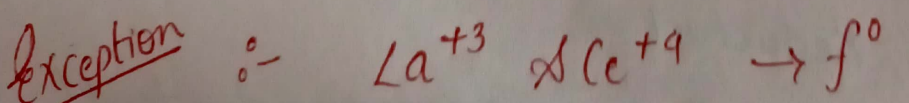
La^{+3} and Lu^{+3} is colorless

Reason:-



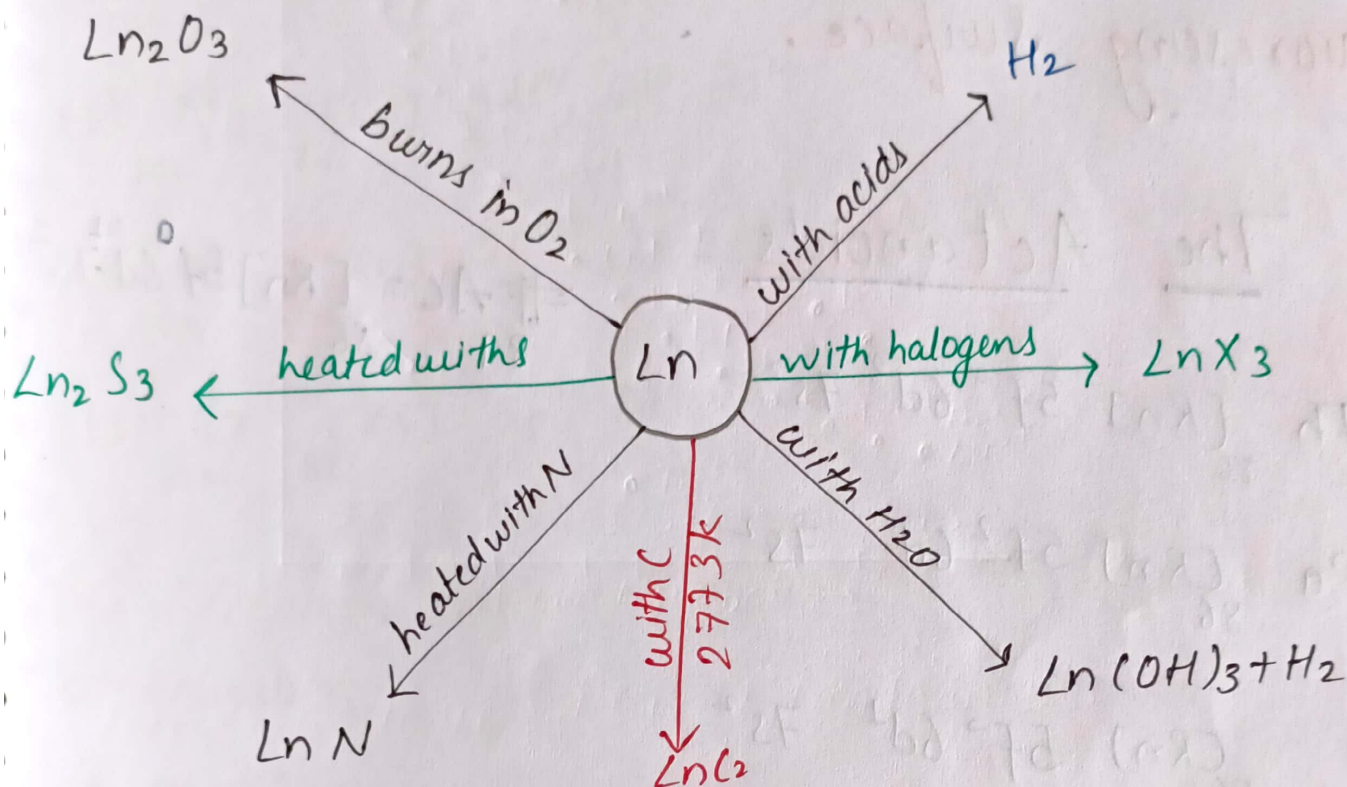
The lanthanoid ions show paramagnetic behaviour due to the availability of number of unpaired electron in ~~outermost~~ inner penultimate shell.

Exception :-



The Paramagnetic behaviour are maximum of Nb.

* Chemical Properties



* Alloy Formation

Lanthanoid Form Misch - metall which have

Ce :- 50%.

La :- 25%.

Nd :- 5-10%.

95% Lanthanoids + 5% iron
and trace of S, C, Al, Ca

* Uses

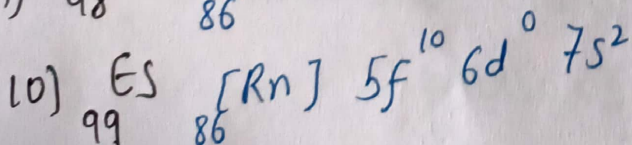
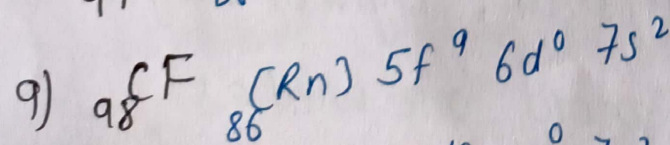
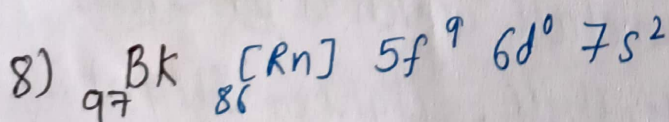
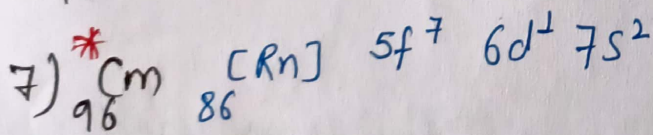
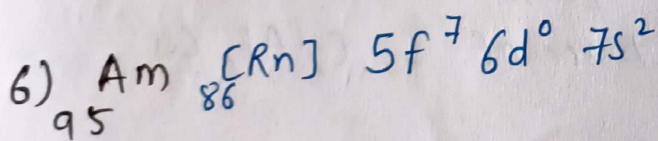
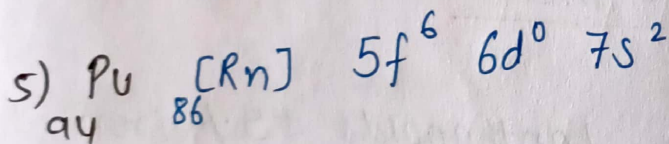
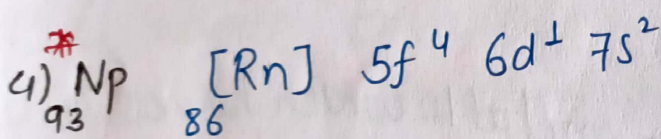
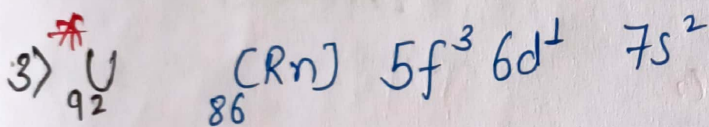
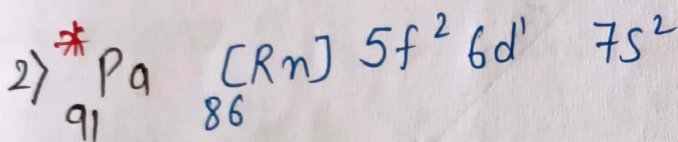
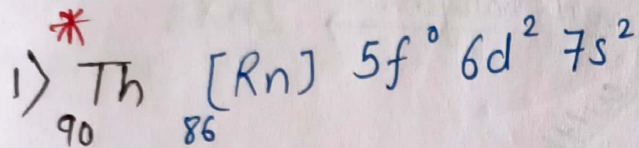
Magnesium based mischmetall which is ~~per~~ used in production of ~~ca~~ Bullets, shell, lighter flight.

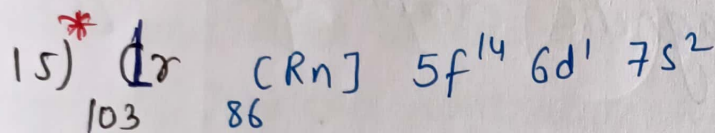
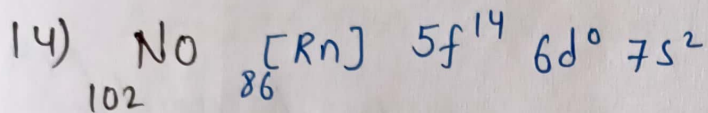
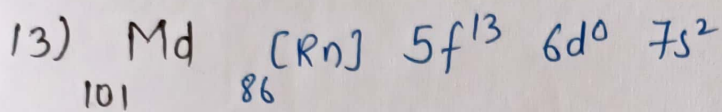
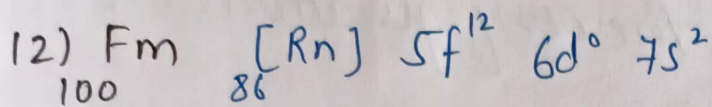
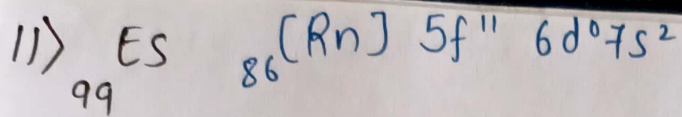
Mixed Oxide of Lanthanoid are used as catalyst in Petroleum Cracking

Some them are used as Phosphors in Television Screen which is similar fluorescing surface.

* The Actanoids

$$\# \text{Ac} = \underset{89}{[Rn]} 5f^{00} 6d^{01} 7s^2$$





The Exception Configuration are because $f^0 f^7 f^{14}$ configuration

→ Ionic Size

Their Atomic Size are quite irregular but like "lanthanoid" the ionic size Ac^{+3} are quite regular and decreases from going left to Right.

→ Actanoid Contraction

Like Lanthanoid, Actanoid also have poor shielding effect of 5f series that's why size decrease but

their size are quite dominating to Lanthanoid i.e.

Lanthanoid Contraction < Actanoid Contraction

→ Colour Properties

Except f^0 f^{14} all the configuration are colour full

→ Magnetic Property

They all are paramagnetic except f^0 and f^{14} contraction.

f^0 and f^{14} are Diamagnetic.

→ Oxidation States

They show commonly +3 Oxidation Number but they can show upto +4, +5 and +6 configuration

Rate of complex compound has been studied in Next Chapter

→ RADIO ACTIVITY

All the actinoid are radio active.

In Lanthanoid only Pm is radio active

→ Application d and f block element

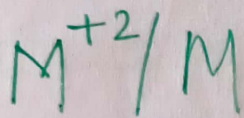
- Iron and ~~steel~~ ~~steel~~ Steel are most construction material, They can form alloy with $[Cr, Mn, Ni, C]$ For Further uses.
- TiO is used in pigment Industry
 $[रंगों]$
- MnO_2 , used in dry cell and Zn, Ni, Cd it used in cell making of battery.
- Group 11 are called as coinage metal.
In UK, Cu coins are made with Cu with Coated Steel and Silver coins are made from Cu/Ni alloy.
- $TiCl_4$ with $Al[CH_3]_3$ used as catalyst For making of Polyethene and It is called Ziegler Natta Catalyst
- Wacker Process → $PdCl_2$ are used which convert Ethylene to Ethanal
- Ni^0 Complex are used as polymerisation of Alkynes and other organic compound like Benzene

→ Ag Br are light sensitive or photosensitive which is used in Photography

500 Stars

* Calculation $E^\circ \rightarrow$ SHE
or

REDUCTION POTENTIAL



more stable

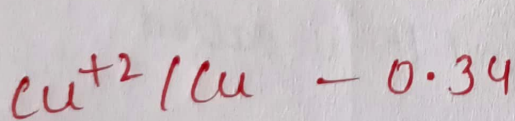
$$E^\circ = -ve$$



↳ more stable

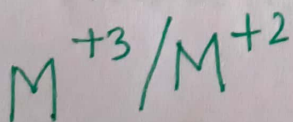
$E^\circ = -ve \rightarrow$ Reducing Agent

$E^\circ = +ve \rightarrow$ Oxidation Agent



↳ more stable

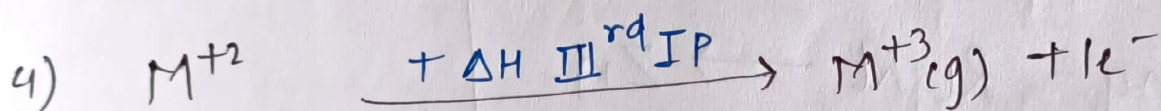
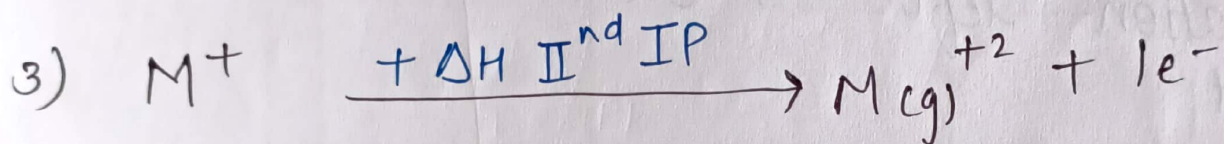
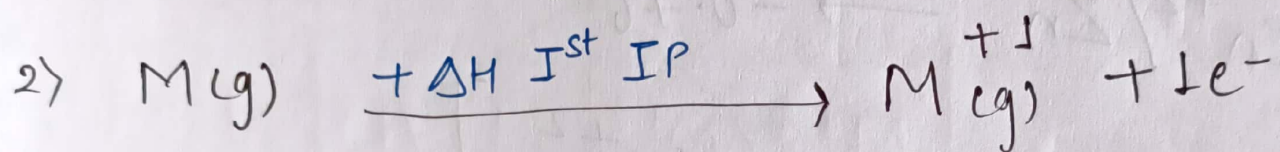
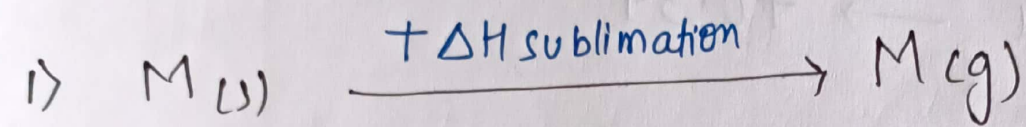
→ Cu^{2+} is good
Oxidation Agent



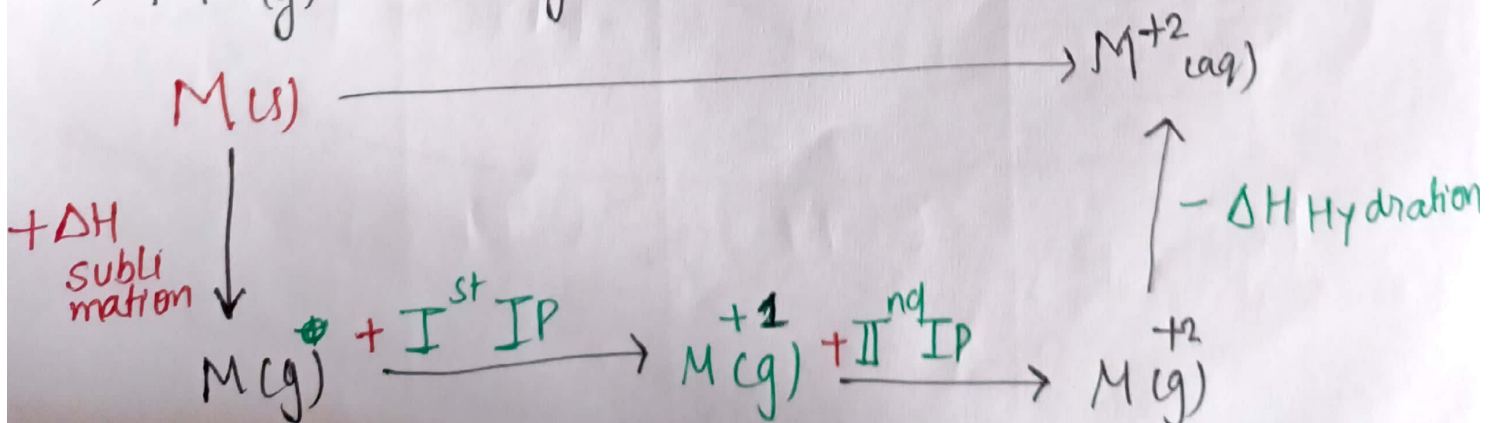
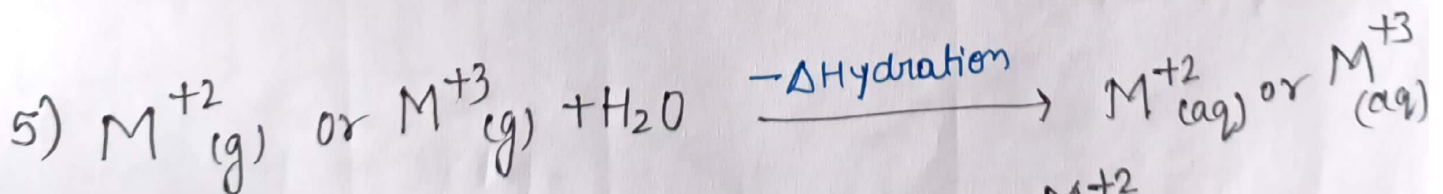
→ (-ve) M^{+3} more stable

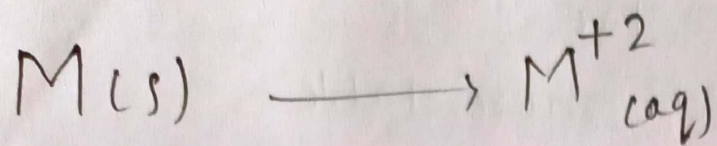
$M^{+3} / M^{+2} \rightarrow +ve$
 $\hookrightarrow M^{+2}$ more stable

* Electrode Potential Reduction Potential



ΔH $\rightarrow$ +ve Endothermic
 $\rightarrow$ -ve Exothermic





$$\# \Delta H = -ve$$

$$\# E = -ve$$

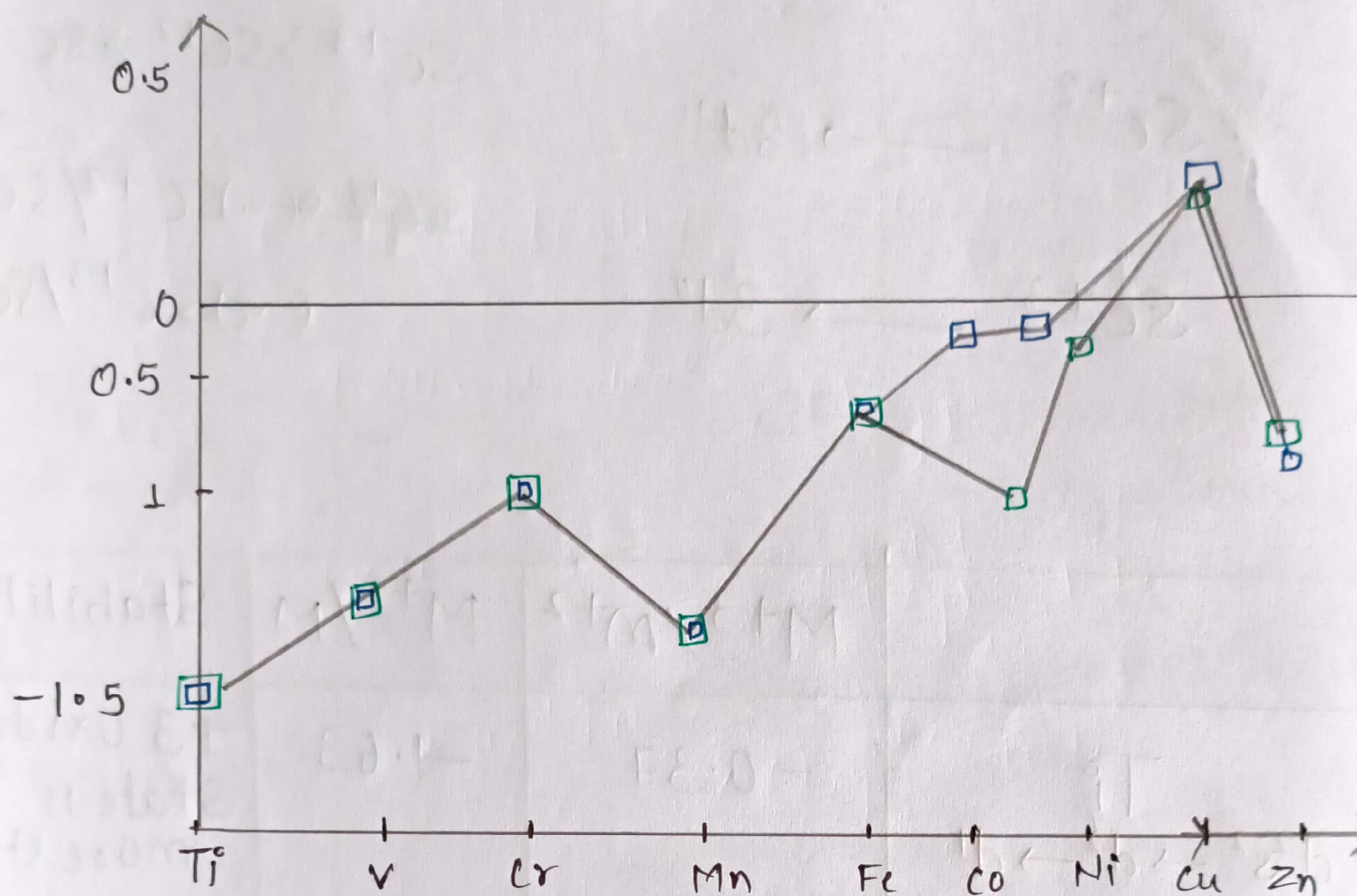
$$E = +ve$$

$$Cu^{+2}/Cu \longrightarrow +0.34$$

$$Zn^{+2}/Zn \longrightarrow -0.76$$

Oxidation left $\longrightarrow Cu^{+2}$
agent

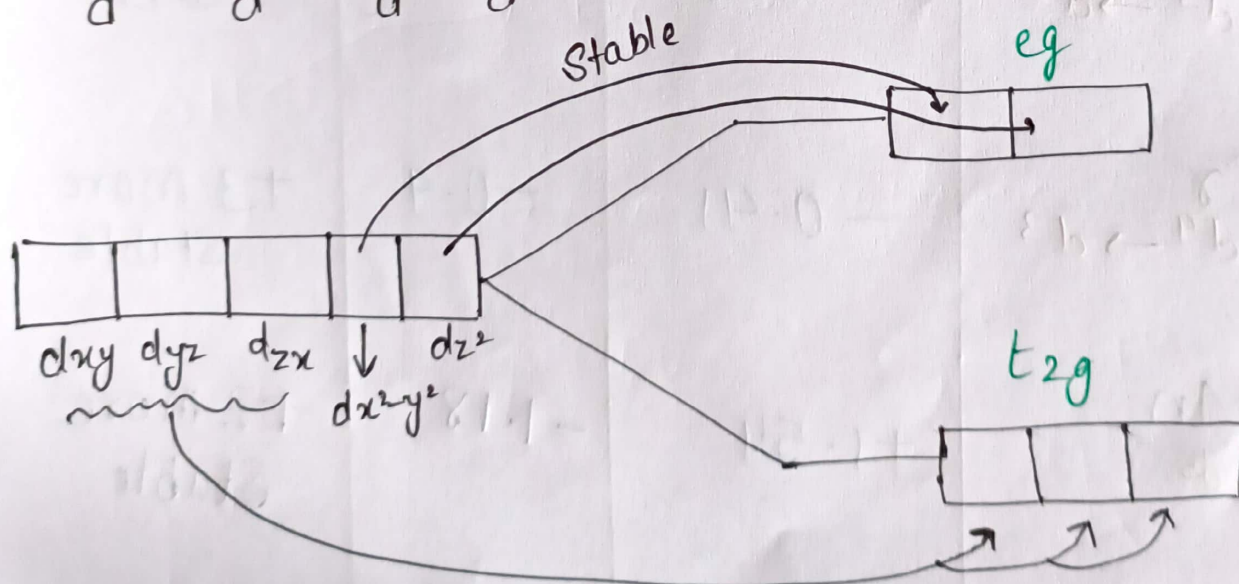
Reducing Right $\longrightarrow Zn$
Agent



□ Observed value

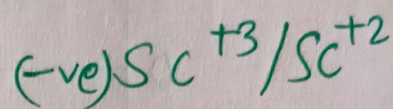
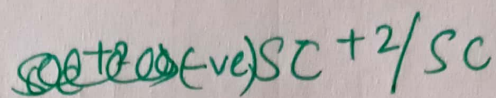
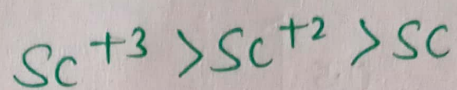
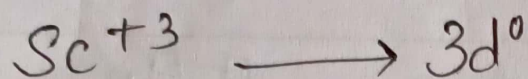
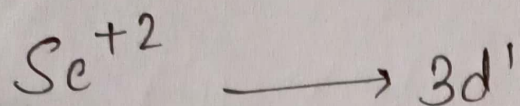
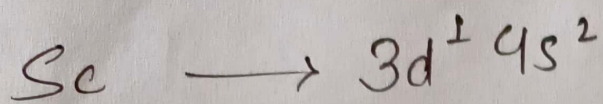
□ calculate value

d^3 d^0 d^5 d^{10}



$d^{10} > d^5 > d^3 > d^0$

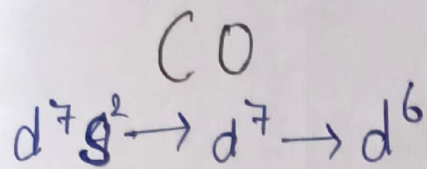
no. of $e^- \propto$ Stability



	M^{+3} / M^{+2}	M^{+2} / M	Stability
Ti $d^2 s^2 \rightarrow d^2 \rightarrow d^1$	-0.37	-1.63	+3 Oxidation State is more stable
V $d^3 s^2 \rightarrow d^3 \rightarrow d^2$	-0.26	-1.18	+3 0.5 more stable
Cr $d^5 s^1 \rightarrow d^4 \rightarrow d^3$	-0.41	-0.9	+3 more stable
Mn $d^5 s^2 \rightarrow d^5$	+1.54	-1.18	+2 more stable
Fe $d^6 s^2 \rightarrow d^6 \rightarrow d^5$	0.77	-0.44	+2 more stable

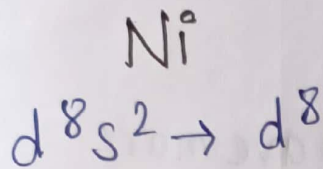
m^{+3}/m^{+2} m^{+2}/m

Stability



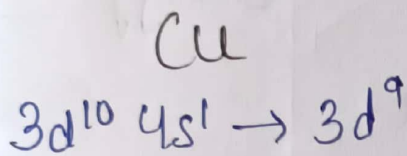
1.97

-0.28

+2 more
stable

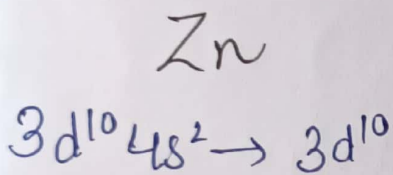
—

-0.25

+2 more stable
+3 doesn't exist

—

0.34

Cu is more
stable

—

-0.76

 Zn^{+2} more
stable

100 Stars

