

ULTIMATE KCET

CRASH COURSE 2026

Chemistry

Lecture - 01

→ 03-05

D and f block elements

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Physics Wallah



Recap *of previous lecture*

1

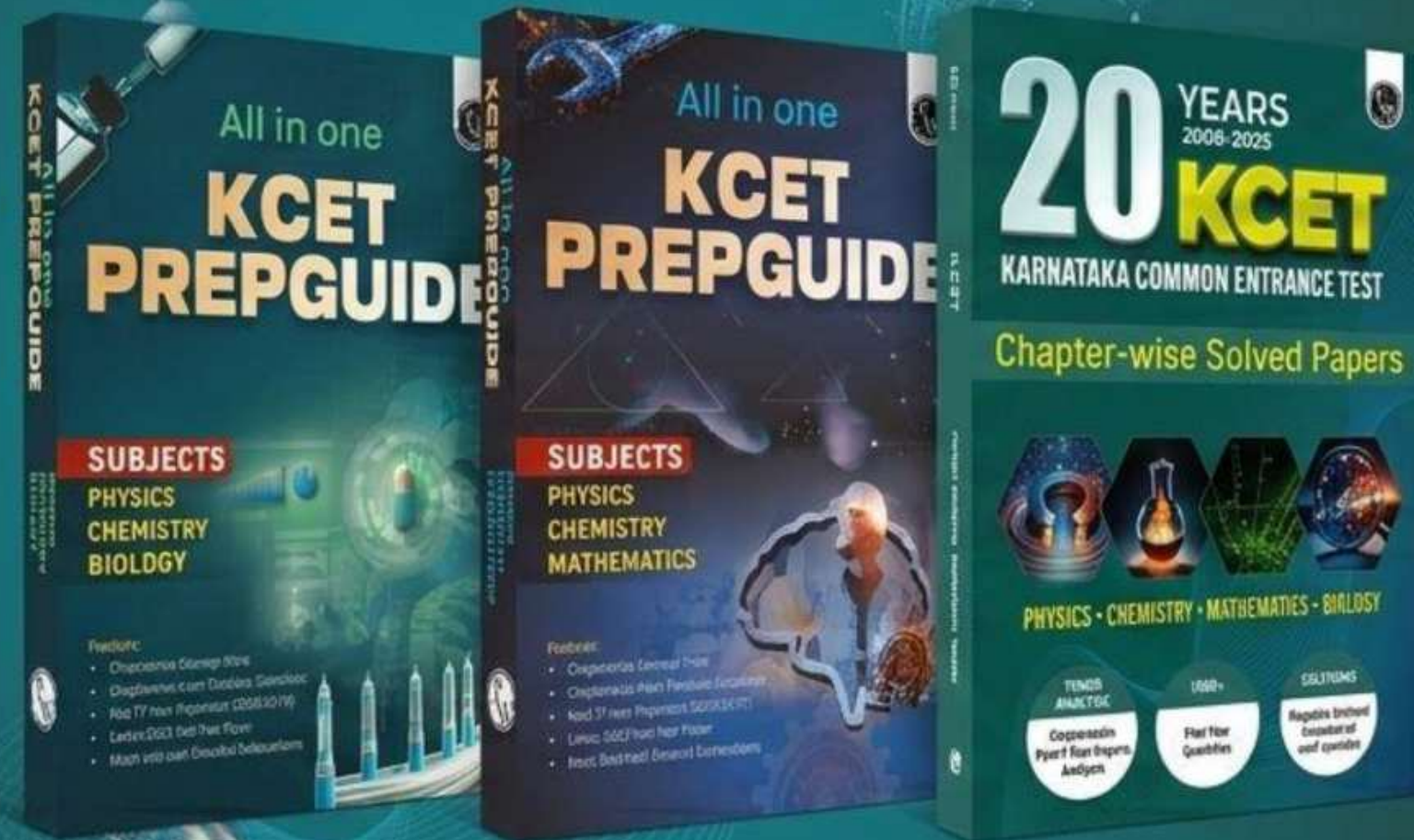
Classification of elements and periodicity in properties –
Synopsis and MCQ








Topics to be covered

1. d and f Block – Synopsis and MCQ's





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-  **Class-wise Distribution of Questions**
-  **Chapterwise Most Probable Questions**
-  **Latest 2025 Past Year Paper**
-  **3500+ Previous Year Questions**
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D and f block elements

2026

f block statement / e.c. Magnetic



Year	Topic	No of questions –
2025	Colourless ion, redox reaction of Permanganate ion+ Oxidation of lanthanoid series + Electronic configuration	04
2024	Reaction between SO_2 and KMnO_4 , Color of lanthanoids, Mischmetal composition, Based on unpaired electrons in d orbital – 01, statement based question on lanthanoids	05
2023	Electronic configuration 3d, melting point of 3d	02
2022	Oxidation state and oxidizing agent/Reducing agent, Magnetic moment, Radioactive lanthanoid	03
2021	Physical properties/trends, Electronic configuration, coloured compound,	03
2020	d and f block elements – chemical reaction based, paramagnetic behaviour, Stability of Cu^{+2} , Cu^{+1} , metal reaction with H_2	04
2019	Physical properties based statement type of question, Chromyl chloride test, lanthanoid definition (Extra)	03
2018	Amphoteric oxide, Common oxidation state, electronic configuration V/s atomic number	03

D-block elements

[Noble gas] $(n-1)d^{1-10} ns^{1-2}$

4d block
platinum

Electronic configuration

Exception \rightarrow Pd

[Kr] $4d^{10} 5s^0$

Nice \rightarrow Ni
picture \rightarrow Pd
displace
of Pt
plant
disease Ds

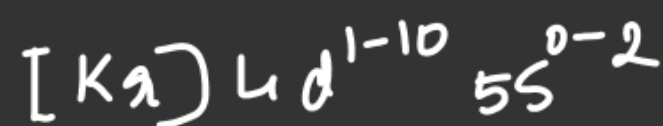
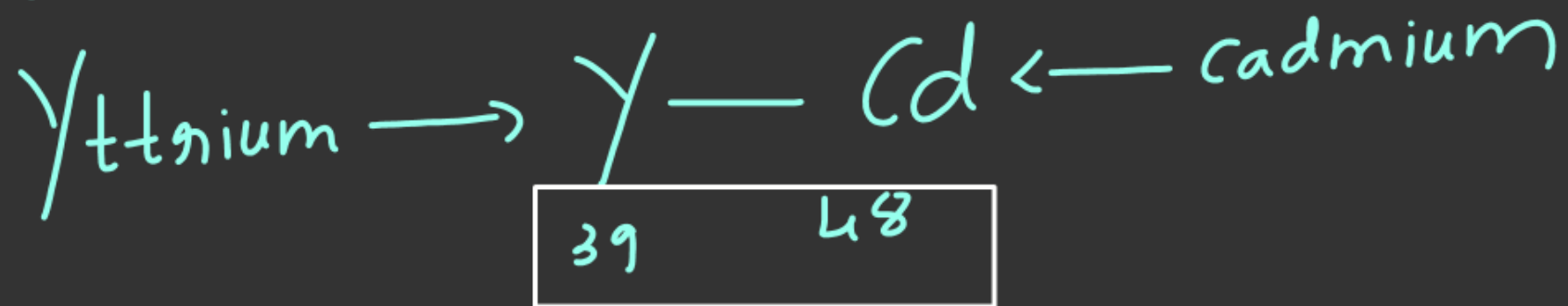
1st transition series \rightarrow 3d \rightarrow [Ar] $3d^{1-10} 4s^{1-2}$

Scandium \rightarrow Zn

(21) Sc \rightarrow (30) Zn

Ni \rightarrow 3d
Pd \rightarrow 4d
Pt \rightarrow 5d
Ds^x \rightarrow 6d

2nd transition series → 4d block.



4d block elements

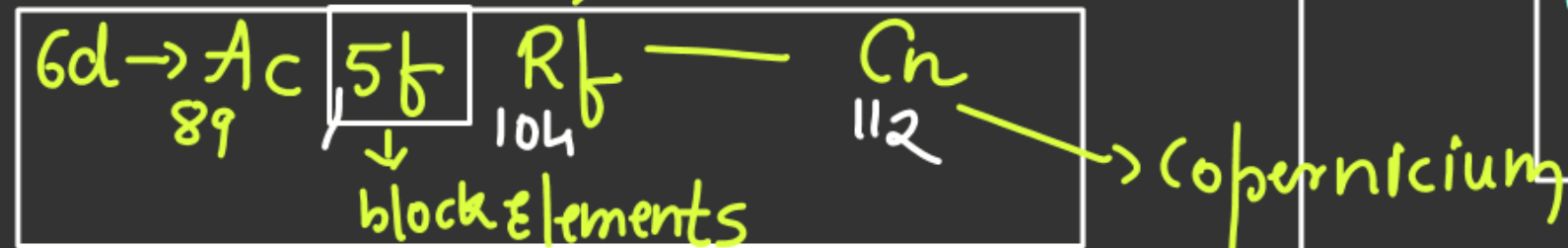
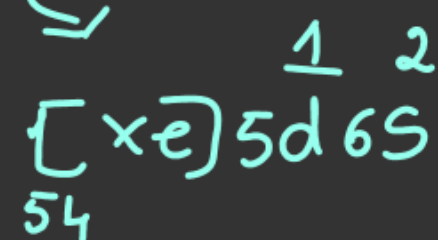
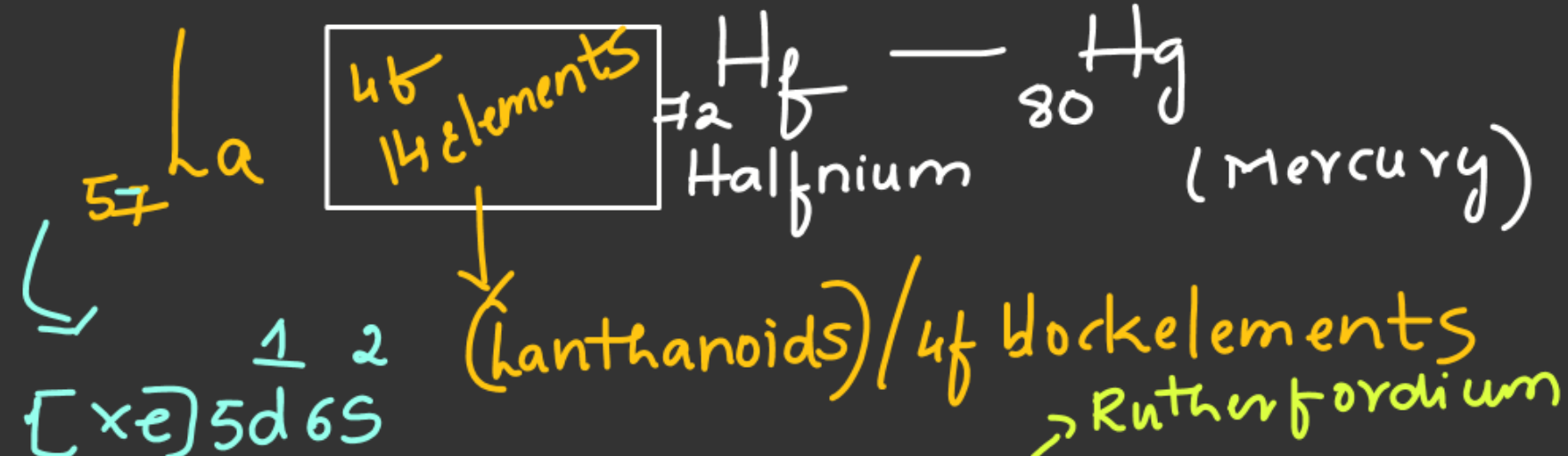
3rd transition series → 5d block elements



f¹⁴

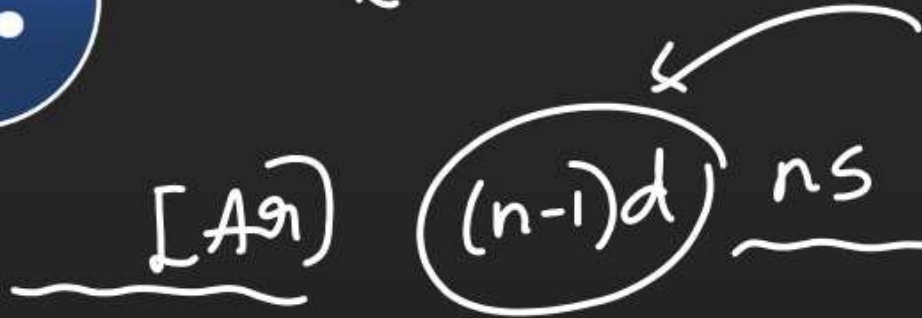
S last
P differentiating
d electron enters into penultimate (last but one) subshell → d

A, Kr, Xe





General Introduction:



- In the modern periodic table elements are classified on the basis of their electronic configuration into s, p, d and f block elements.
- The elements whose differentiating electron enters in (n-1) d sub-level are called d-block elements.
- The d-block elements in which the atoms or ions have incomplete d-orbitals are called transition elements.
 IUPAC definition.
- A typical transition element shall have an incompletely filled d-sublevel either in its elemental form or in any of its chemically significant oxidation states.
- All d-block elements are not transition elements.
 pseudo d-block

Ex: Zn, Cd & Hg are not transitional elements

- The general outer electronic configuration of d-block elements is
- $(n-1)d^{1-10} ns^0$ (or) 1 (or) 2 $pd \rightarrow (n-1)d^{1-10} ns^0$
- The transition elements are placed in between the electropositive (or) metallic elements (s-block) and the electronegative (or) non-metallic elements (p-block)
- The properties of these elements are in between those of highly reactive metallic elements of s-block and those of less reactive non-metallic elements of p-block
- d-block elements are placed in the groups 3 to 12 (i.e, IIB to VIII Band IB&IIB)
- The elements of IB group namely Cu, Ag, Au are called typical transition elements since in these elements electrons from completely filled inner $(n-1)d$ subshell take part in bond formation along with outer s-electrons

d block $\in C \rightarrow$ Except palladium



3d-block \rightarrow General electronic configuration

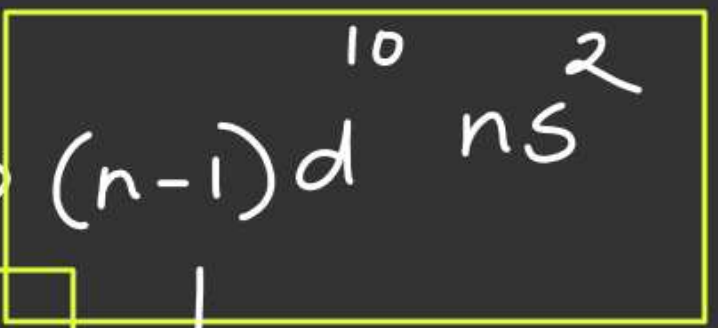
① $(n-1)d^{1-10} ns^{0-2}$ \rightarrow Most accurate answer.

11th group
12th group

Zn	→	Zahin Khan
Cd	→	could
Hg	→	Hug
Cn	→	Team Capt.

Cu, Ag, Au, Rg } coinage elements.

d-block
→ group 3 - group 12.
→ 4 } period.
5 }
6 }
7 }



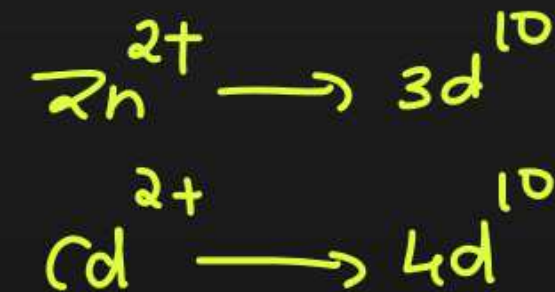
old periodic table

3	4	5	6	7	8	9	10	11	12
Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn
21	22	23	24	25	26	27	28	29	30
↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
III B	IV B	V B	VI B	VII B	↓	↓	↓	↓	↓
					I B	II B			

fully filled d-orbital
↓
Nontransitional elements

f block
→ 6th period
→ 7th period.

- IB group elements copper, silver and gold are called coinage elements. In olden days these metals are used to prepare coins.
- The elements of IIB (Zn, Cd and Hg) are not considered as transition elements as they do not show the properties of transition elements because of completely filled d-orbitals.
- IIB elements have a d^{10} configuration both in elemental form and in their stable oxidation states.
 Zn, Cd, Hg, Cu
- d-block elements are present as 3d, 4d, 5d and
- 6d series in the periodic table.
- 3d series starts with Sc [Z = 21] ends with Zn [Z = 30]
- 4d series starts with Y [Z = 39] ends with Cd [Z = 48]



➤ 5d series starts with La [Z = 57] Hf (Z = 72) ends with Hg[Z = 80]

➤ [Redacted]

➤ Technitium is the first man made element. ✓✓

➤ Elements in VIIB group

➤ Fe, Co, Ni, Ru, Rh, Pd; Os, Ir, Pt; Hs, Mt, Ds



Electronic Configurations

- The elements with exceptional configuration in 3d series are Cr (24) [Ar] 3d⁵ 4s¹ and Cu (29) [Ar] 3d¹⁰ 4s¹

- The elements with exceptional configuration in 4d series are

Nb (41) – [Kr] 4d⁴ 5s¹; Mo (42) – [Kr] 4d⁵ 5s¹ **KCET**
 Ru (43) – [Kr] 4d⁷ 5s¹; Rh (45) – [Kr] 4d⁸ 5s¹ → **JEE/NEET**
 Pd (46) – [Kr] 4d¹⁰ 5s⁰; Ag (47) – [Kr] 4d¹⁰ 5s¹

Cu ✓
 Ag ✓



(s) $\xrightarrow{\text{OOO}}$ (g)
sublimation

Enthalpy of atomisation

highest enthalpy of atomisation \rightarrow Vanadium (V) (more metallic bonding)



lowest enthalpy of atomisation \rightarrow Zn

General properties

melting point according to data

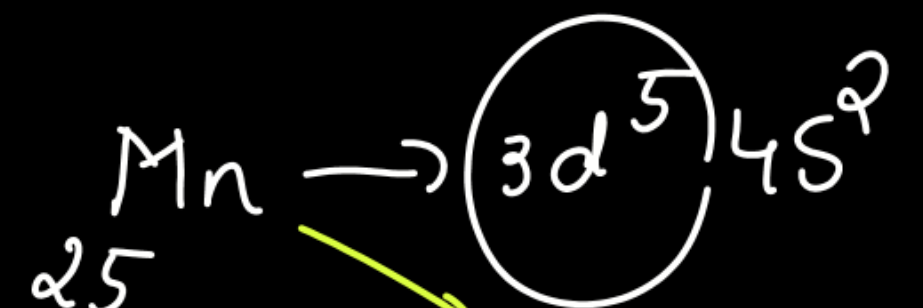
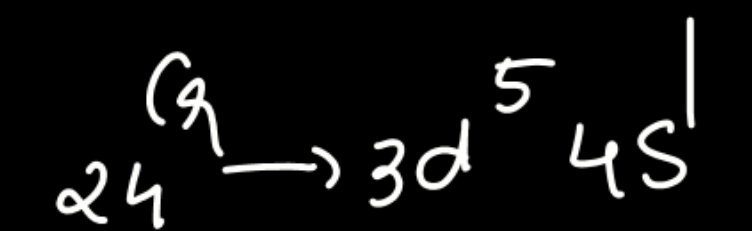
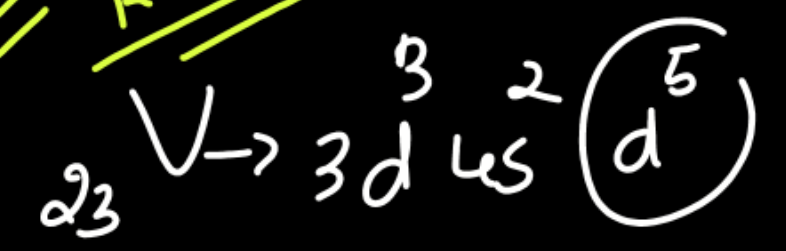
V \rightarrow 1910°C
Cr \rightarrow 1907°C

(Cr \approx V) (MP)

according to NCERT \rightarrow less metallic bonding

V > Cr

KCET



Cr > V
V > Cr

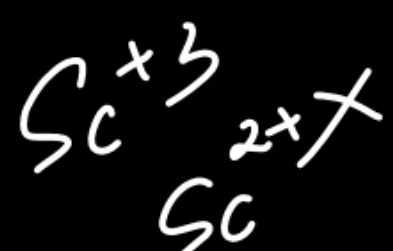
same chemical formula



allotropes

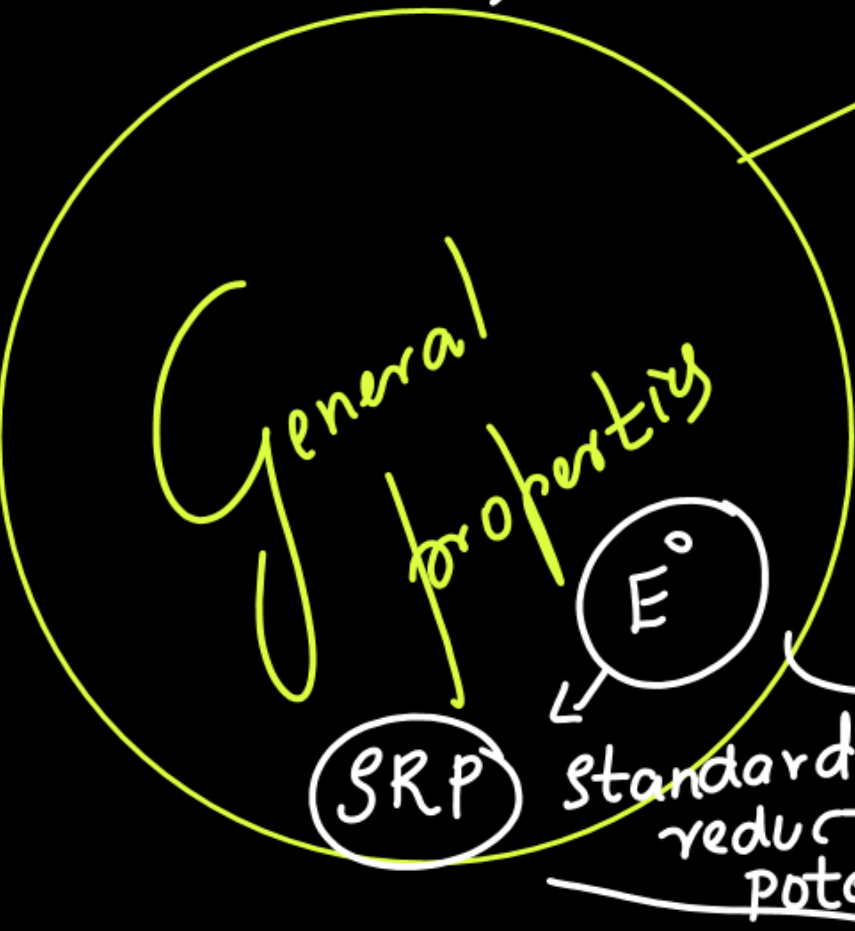
diff. arrangements of atoms

Low

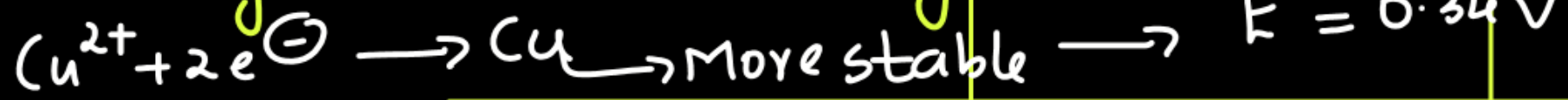
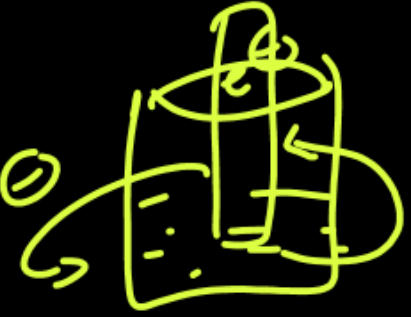
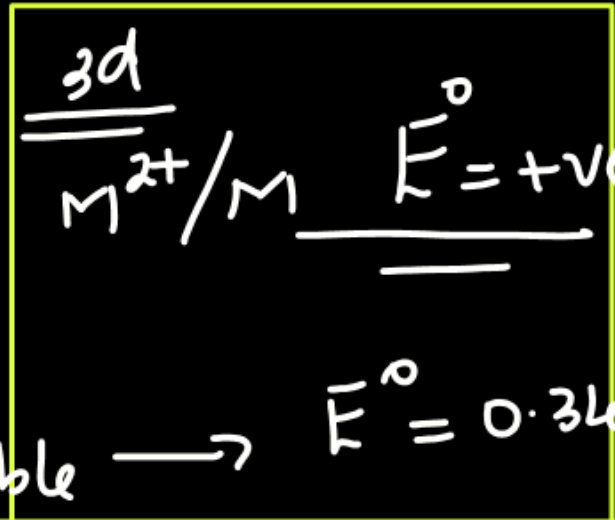


Electrode potential

tendency to lose or gain e^{\ominus}



- Sublimation enthalpy
- Ionisation enthalpy
- Hydration enthalpy



less stable

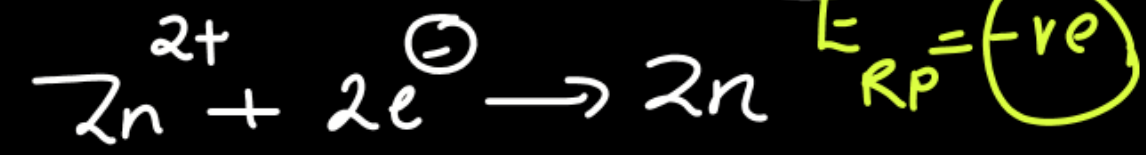
low E^{\ominus} value $\rightarrow M^{2+} \rightarrow M$

Ti \rightarrow bigger size of titanium atom

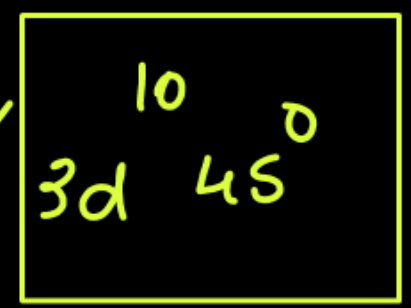
Mn²⁺ \rightarrow More stable $\rightarrow 3d^5$

low value indicates ready to lose e^{\ominus}

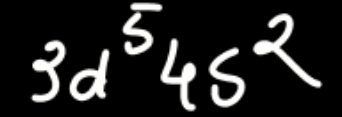
& here oxidation state is more stable

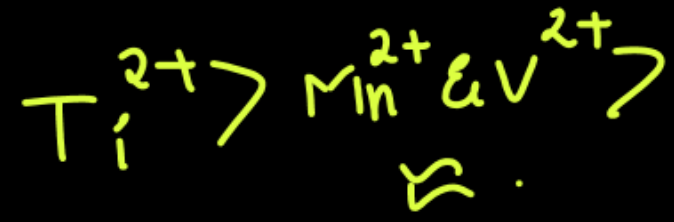


more stable



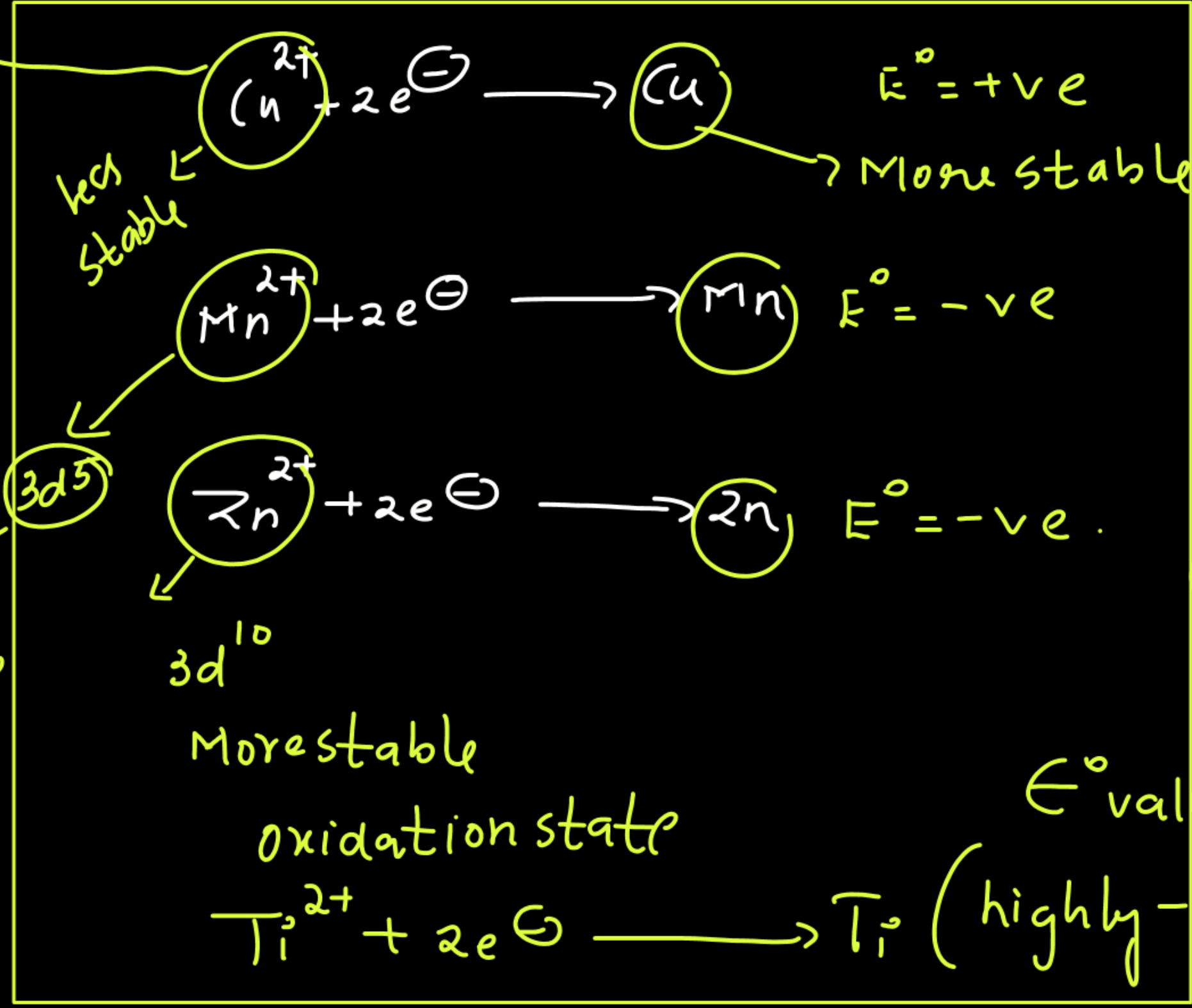
Oxidized state





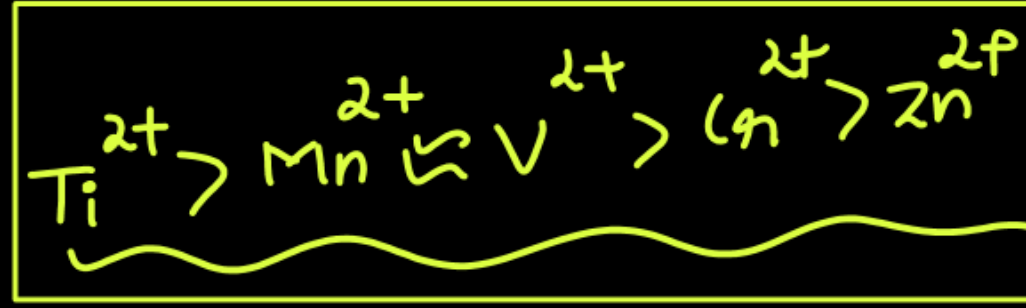
Reduced state.

Oxidized state.



O.A. accept e^-

o.p. \rightarrow range of o.p.



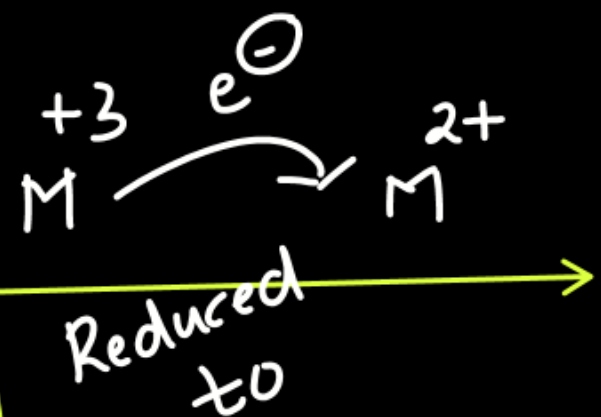
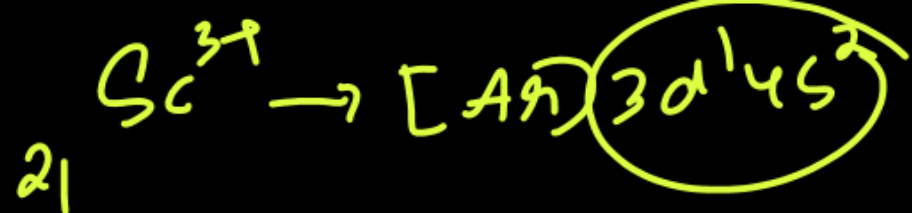
NEET/JEE

$E^\circ = -ve \rightarrow$ Strong R.A

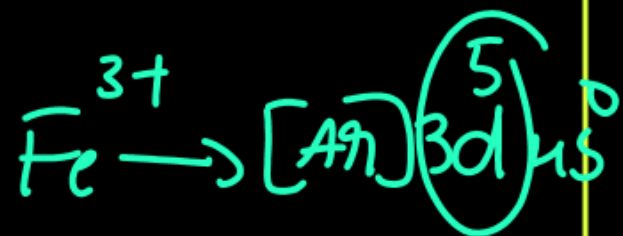
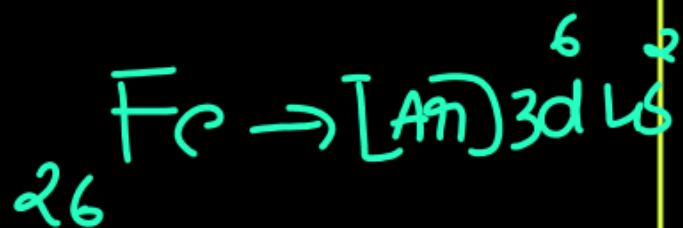
RP \rightarrow $E^\circ = +ve \rightarrow$ Strong O.A.

E° value

oxidation state



General properties



$\text{Sc}^{3+} + e^-$ does not want to change \downarrow More stable $\rightarrow [\text{Ar}] 3d^0 4s^0$, $E^\circ = 1.4 \text{ V} (-ve)$

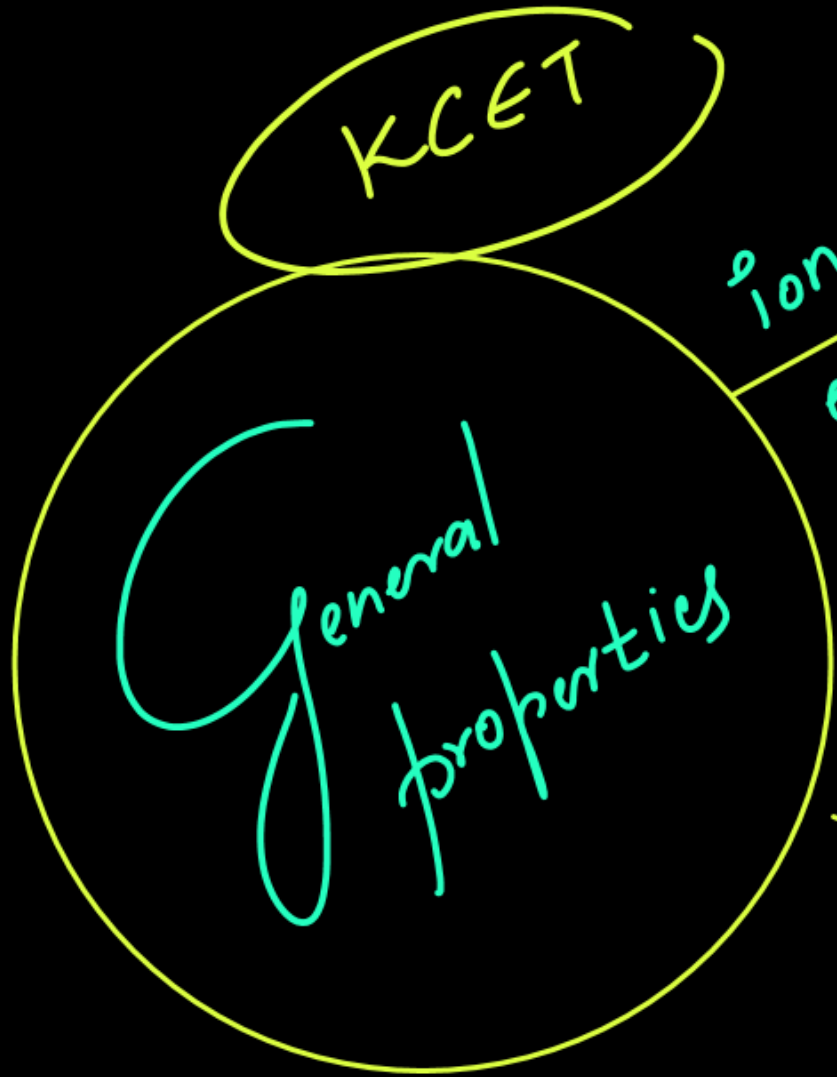
$\text{Fe}^{3+} + e^-$ does not want to change \downarrow More stable $\rightarrow \text{Fe}^{2+}$, $E^\circ = 1.4 \text{ V} (-ve)$

Zn^{3+} easily \rightarrow ready to accept e^- changes $\rightarrow \text{Zn}^{2+}$
 \downarrow less stable

Mn^{3+} easily \rightarrow ready to accept e^- changes $\rightarrow \text{Mn}^{2+}$
 \downarrow less stable

$E^\circ = +ve$
 $E^\circ = +ve$

$3d^5 4s^0$
 $3d^{10}$
 $3d^5$



KCET

ionisation enthalpy

Sc \rightarrow Zn \rightarrow atomic size decreases
 ionisation enthalpy increases from Sc \rightarrow Zn

$Mn^{2+} > Fe^{2+}$
 $Cu^+ > Mn^+$ (IE)

Zn \rightarrow 1st IE is more.
 Zn \rightarrow $3d^{10} 4s^2$

density

highest in 3d block

Cu \rightarrow 2nd IE is more for copper
 $Cu \rightarrow 3d^{10} 4s^1$
 $Cu^+ \rightarrow 3d^{10} 4s^0$, $Cu^{2+} \rightarrow 3d^9 4s^0$

Ni \sim Cu \rightarrow 8.9 g/cm³

lowest density

Scandium

More atomic size

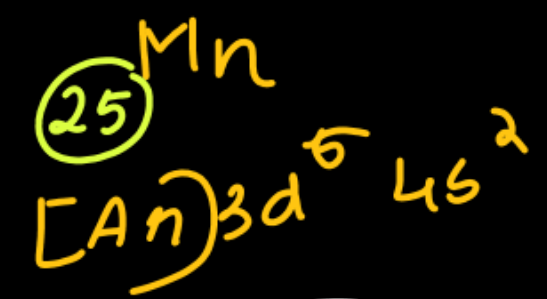
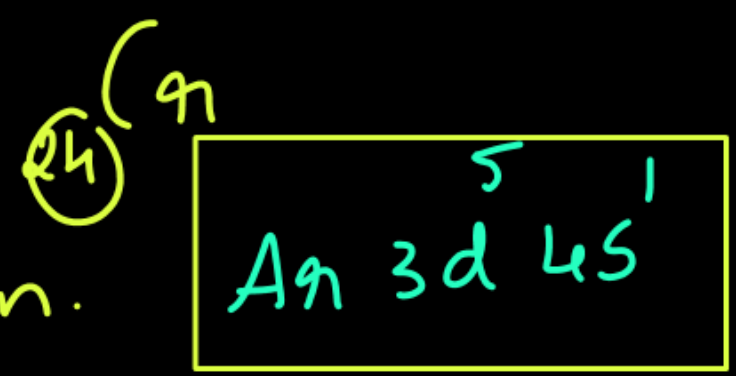
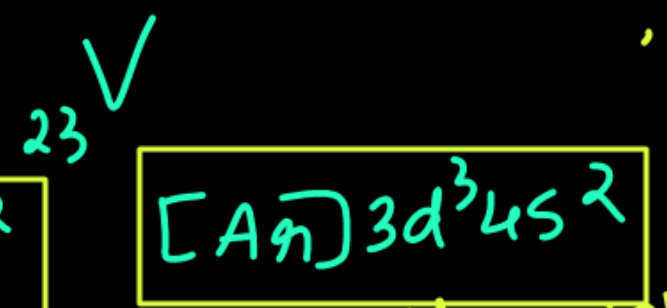
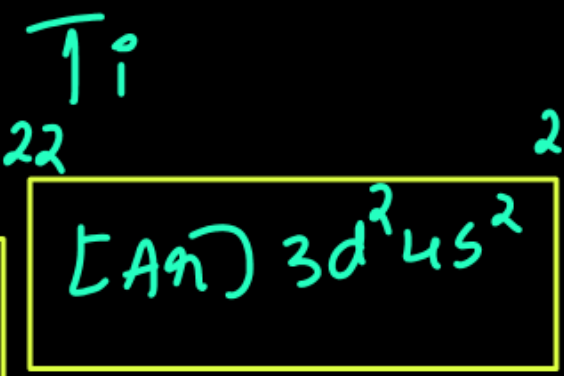
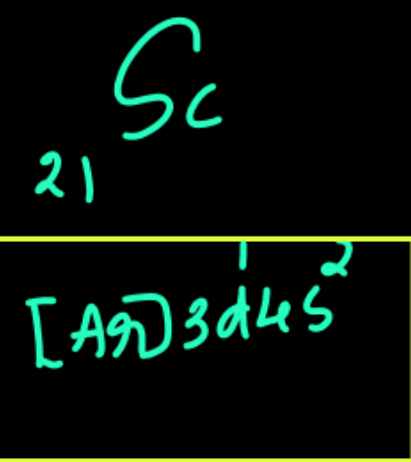
$d = \frac{M}{V}$
 volume

Sc Ti V Cr Mn Fe Co Ni Cu Zn

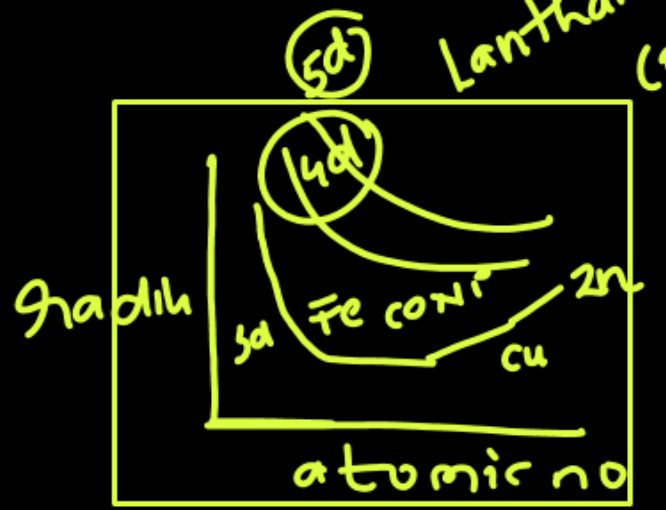
Atomic size \rightarrow decrease atomic size

3rd IE \rightarrow highest is for zinc
 Zn \rightarrow more stable than Zn³⁺
 due to $3d^{10}$

hydration



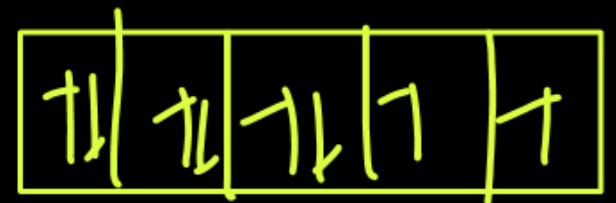
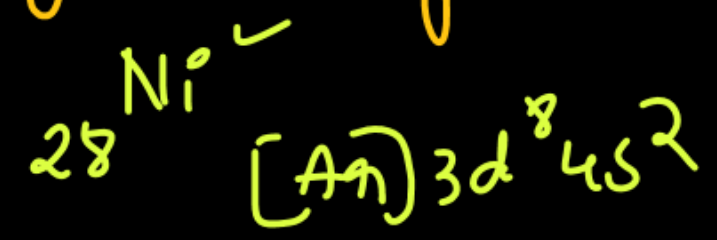
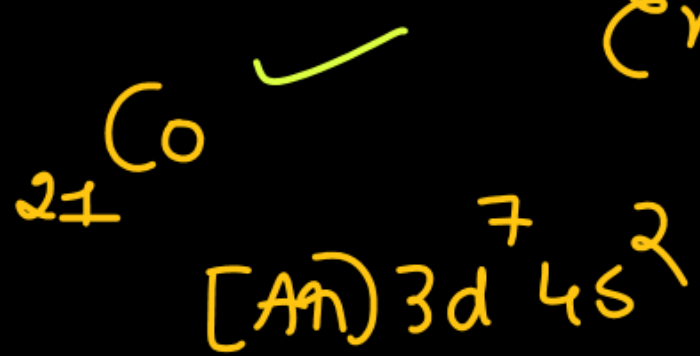
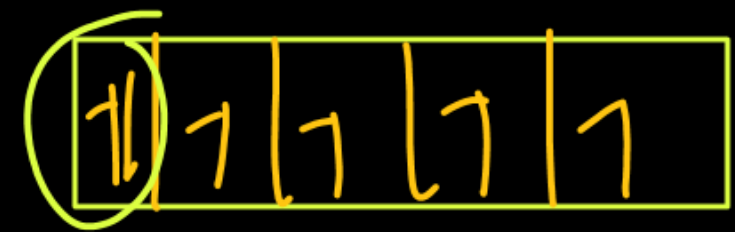
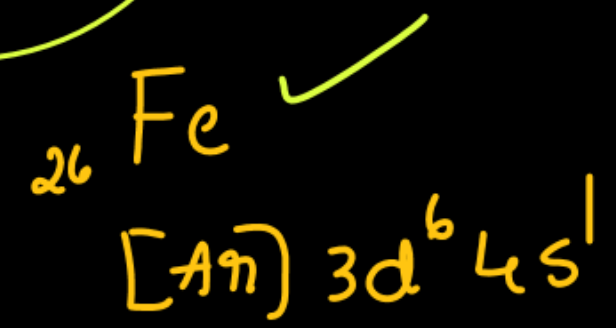
Atomic size



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

Effective nuclear charge

Exchange energy is more.



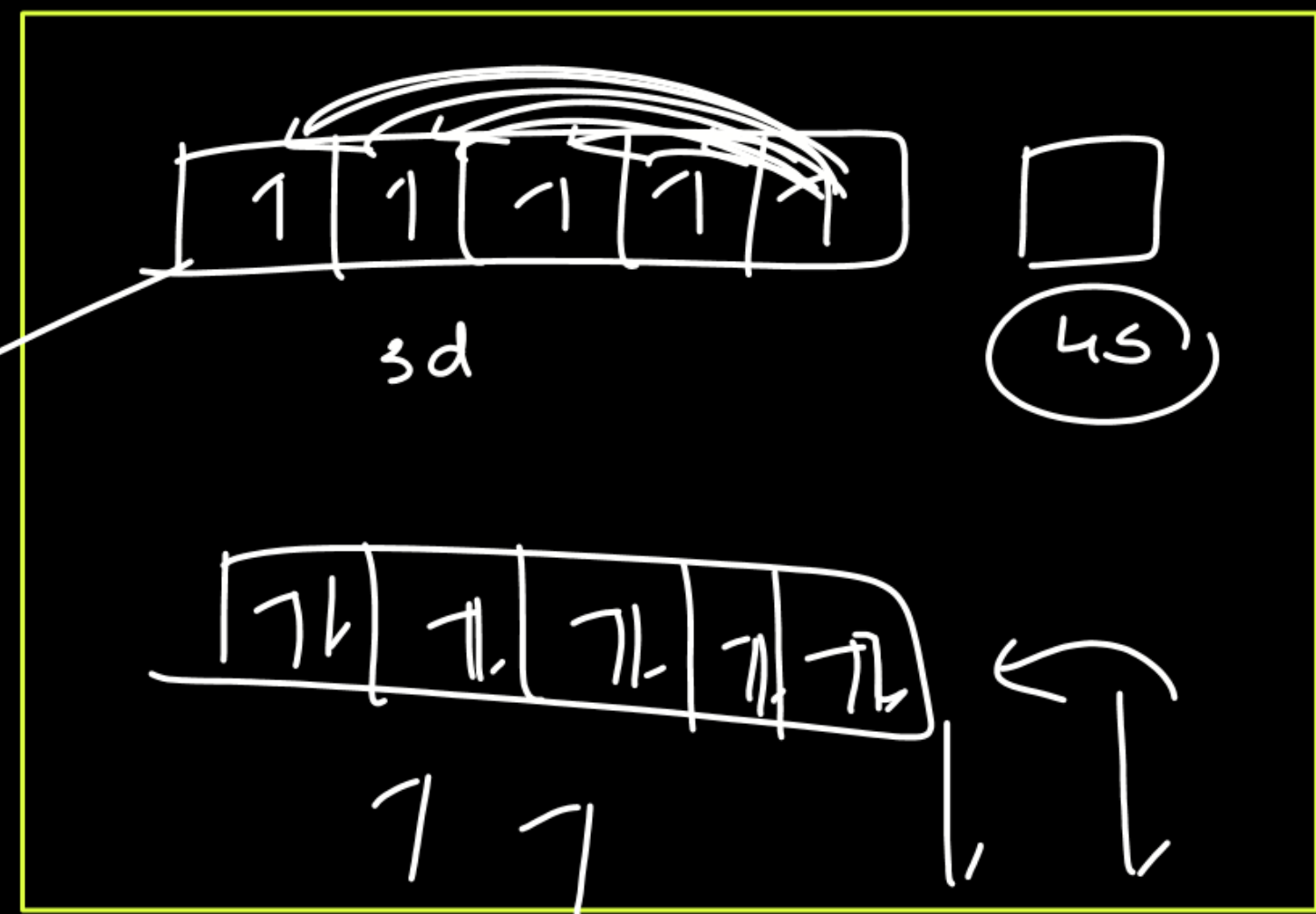
- Nucleus & e^- love
- e^- & e^- hate.
- Exchange energy.

$3d^{10}$

$3d^5$

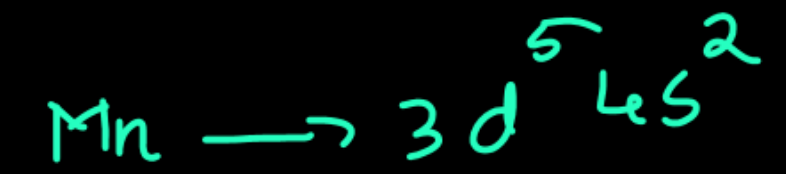
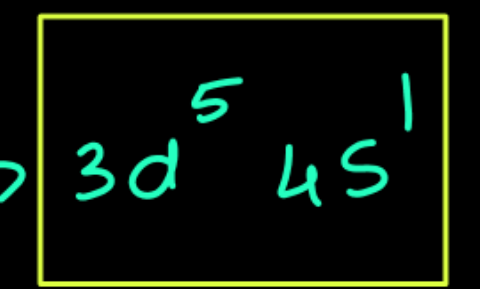
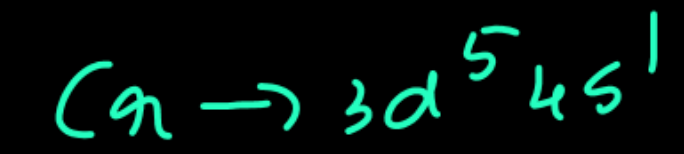
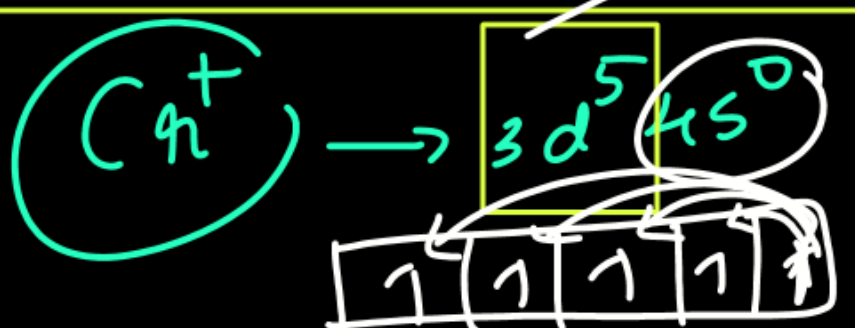
$s=0$
 $p=1$
 $d=2$
 $f=3$

$3d$
 $3+2=5$

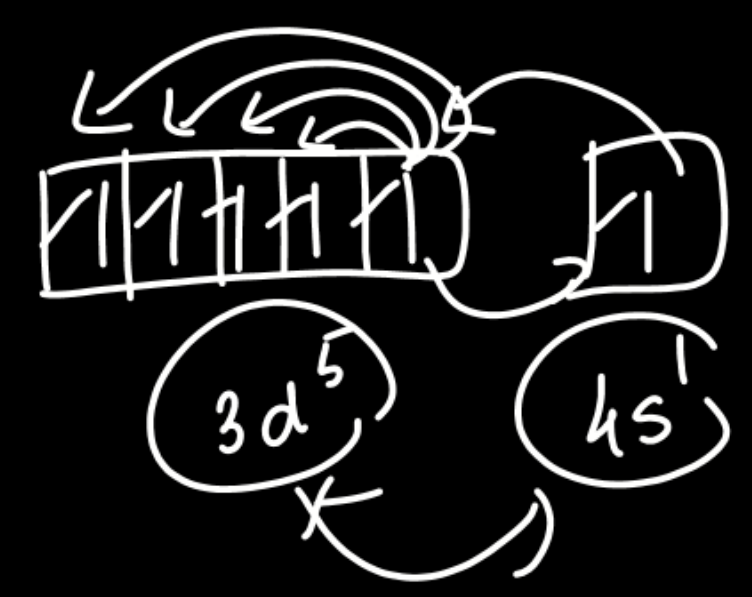


$n+l$
 $4s \rightarrow 4+0=4$

High I.E

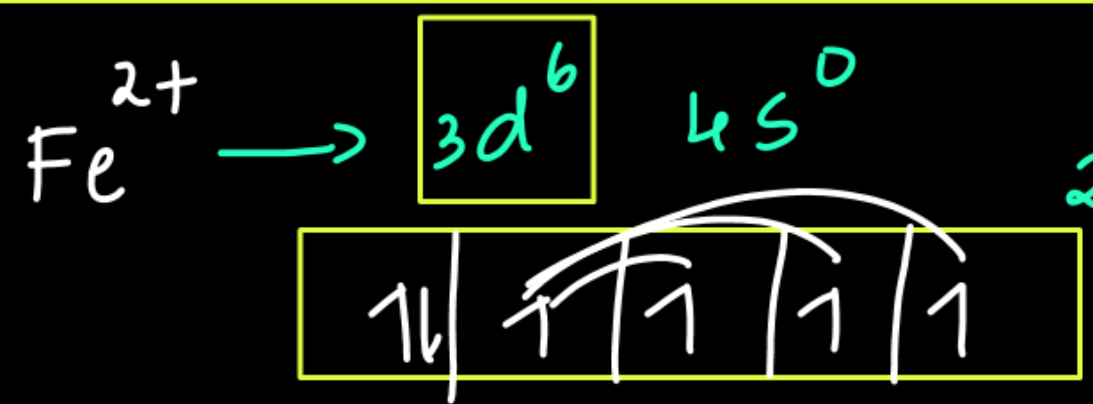


low I.E \rightarrow easily e^- are removable.
less stable.

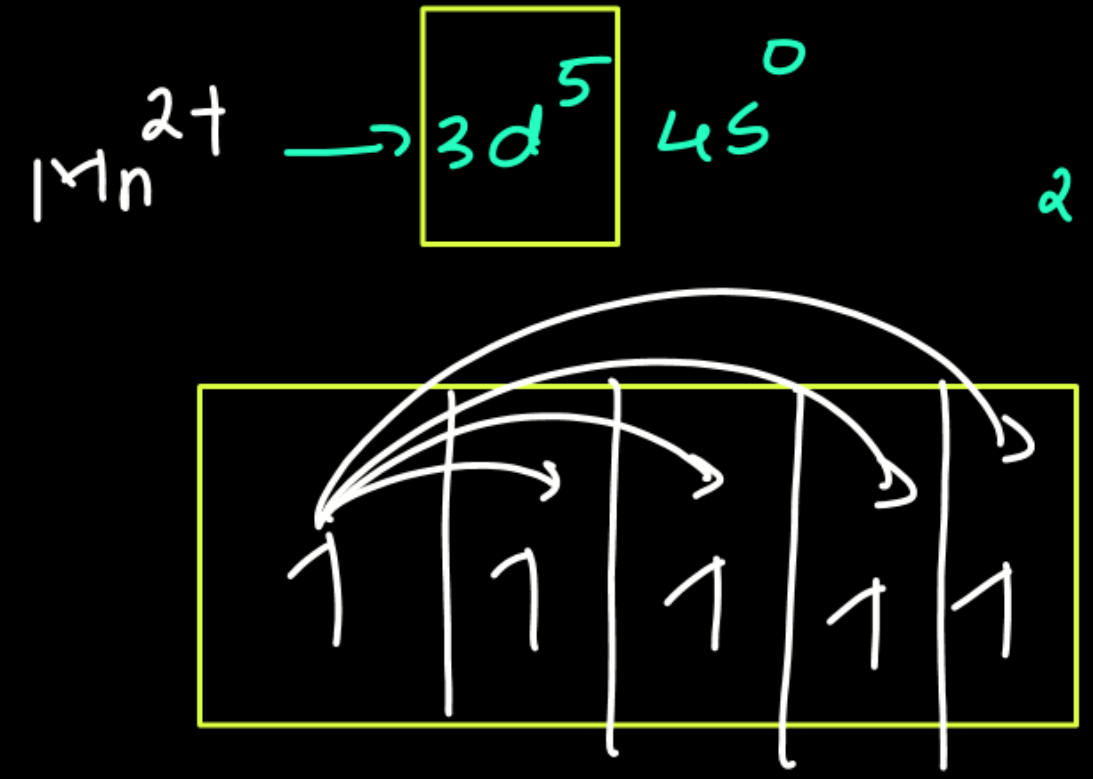


$(n) > Mn^{2+}$
↓
Move IE

$Mn^{2+} > Fe^{2+}$
↓
Move IE



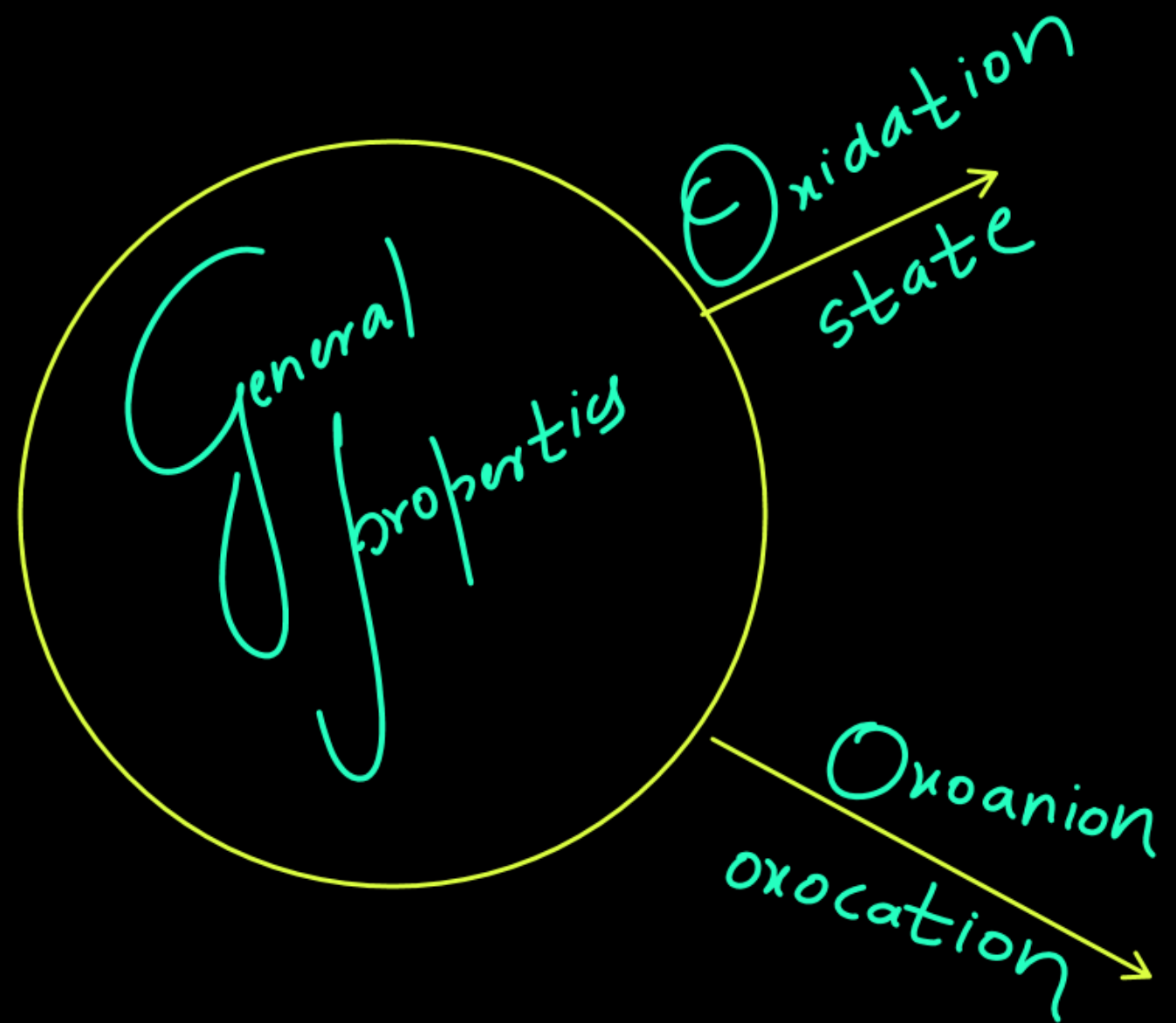
$Fe_{26} \quad 3d^6 4s^2$
→ 3 times exchanged.

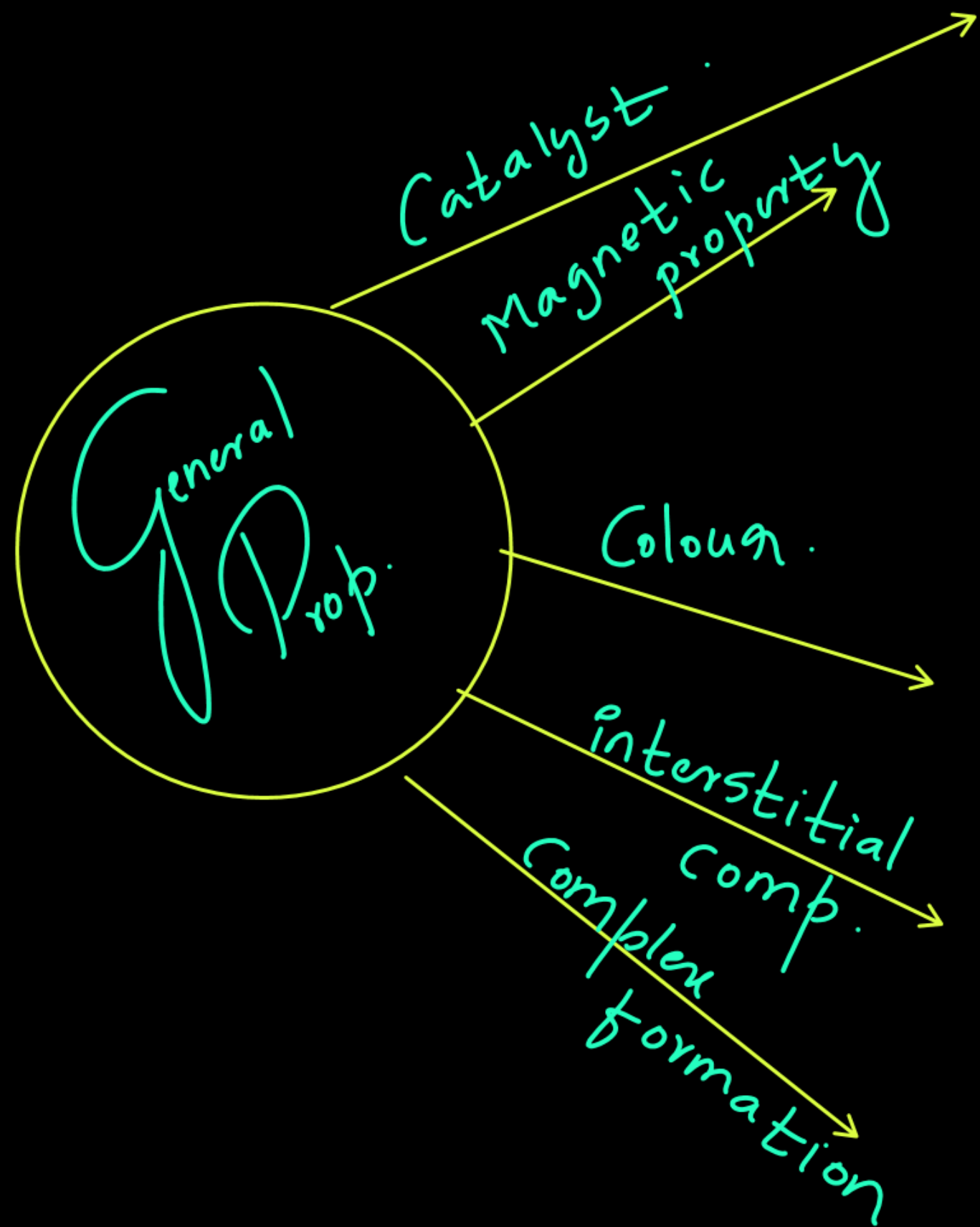


$(n) \rightarrow 3d^5 4s^1$
 24
4 times exchanged.
↓
More stable
less stable.
→ easy to remove ⊖

high IE

↓
More stable





Question



Which of the following does not represent property stated against it?

A $\text{Co}^{2+} < \text{Fe}^{2+} < \text{Mn}^{2+}$ – Ionic size ✓

B $\text{Ti} < \text{V} < \text{Mn}$ – Number of oxidation states ✓

C $\text{Cr}^{2+} < \text{Mn}^{2+} < \text{Fe}^{2+}$ – Paramagnetic behaviour ✗

D $\text{Sc} > \text{Cr} > \text{Fe}$ – Density ✗

Sc Ti V Cr Mn **Fe Co Ni** (Cu Zn)

↓ size same

$\text{Mn} > \text{Fe} = \text{Co}$

$\text{Mn}^{2+} > \text{Fe}^{2+} > \text{Co}^{2+}$

(n = Fe) < Mn²⁺

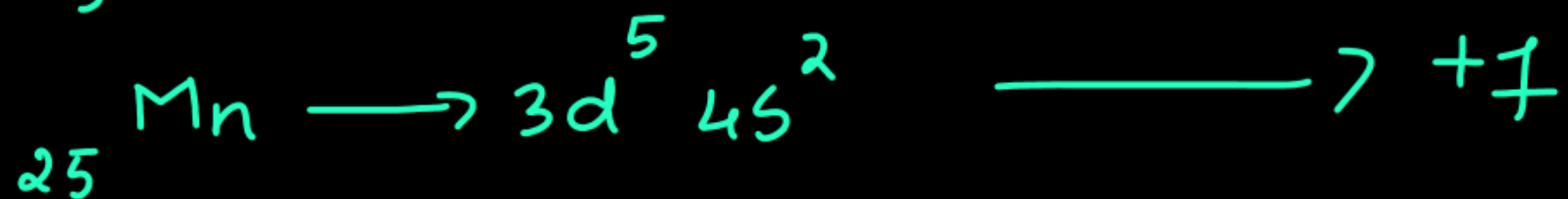
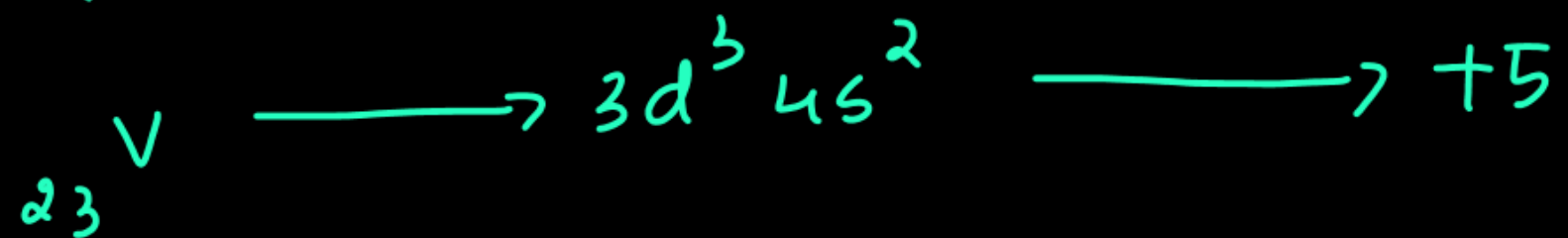
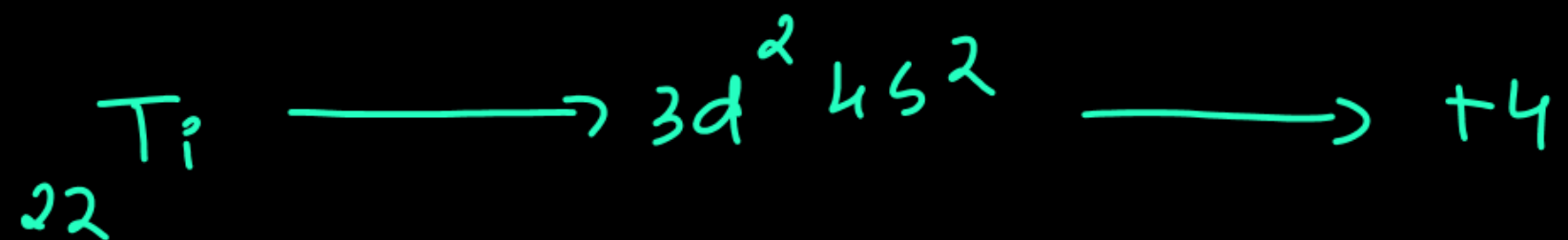
$\boxed{1 \uparrow 1 \uparrow 1 \uparrow 1 \uparrow}$ n=4

$3d^4$ $3d^5 4s^0$ $26 \text{Fe} \rightarrow 3d^6 4s^2$
 $\text{Fe}^{2+} \rightarrow 3d^6$

n=4 $\boxed{1 \uparrow 1 \uparrow 1 \uparrow 1 \uparrow}$ n=5 n=4

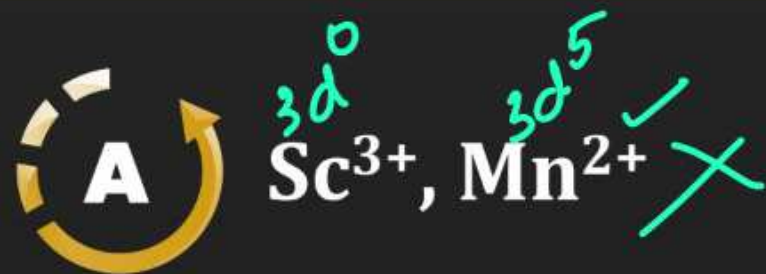
Sc Ti V Cr Mn Fe Co **Ni** Cu Zn
 density increases →

size ↑



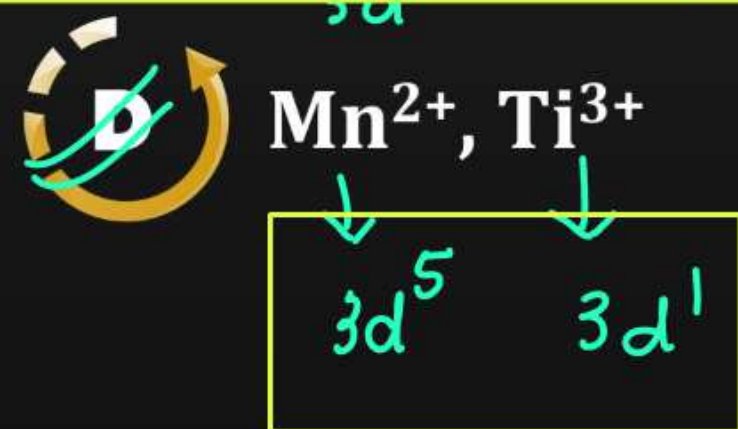
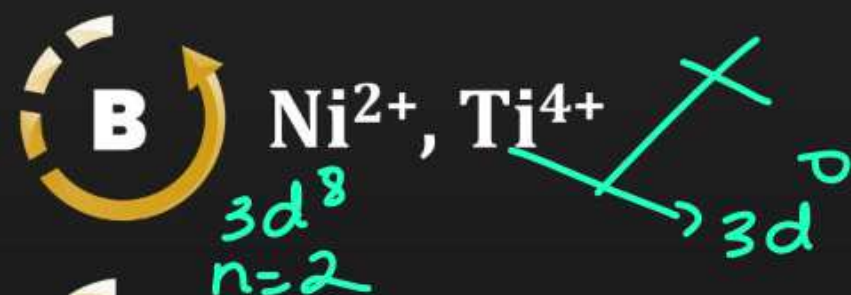
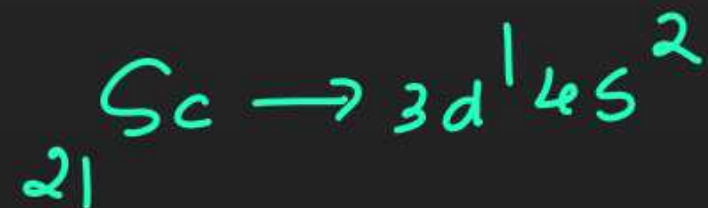
Question

Which of the following pairs has **both the ions coloured** in aqueous solution?
[Atomic numbers of Sc = 21 Ti = 22, Ni = 28 Cu = 29 Mn = 25]



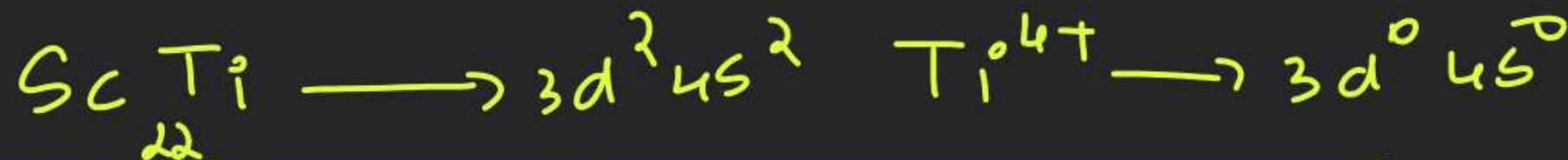
$3d^0 \rightarrow$ colourless

$3d^{10} \rightarrow$ colourless

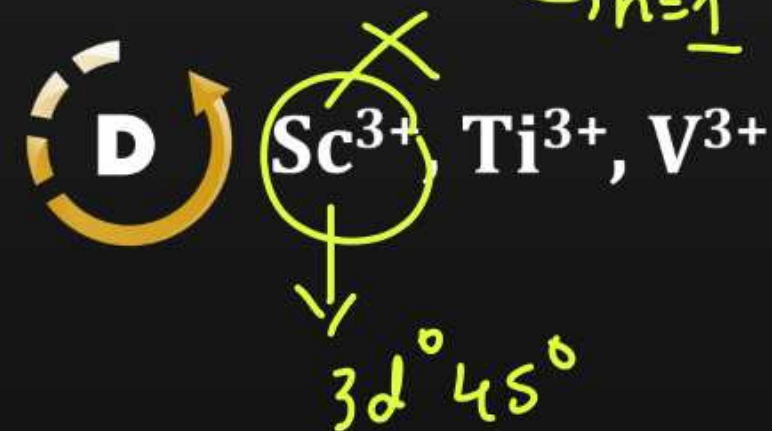
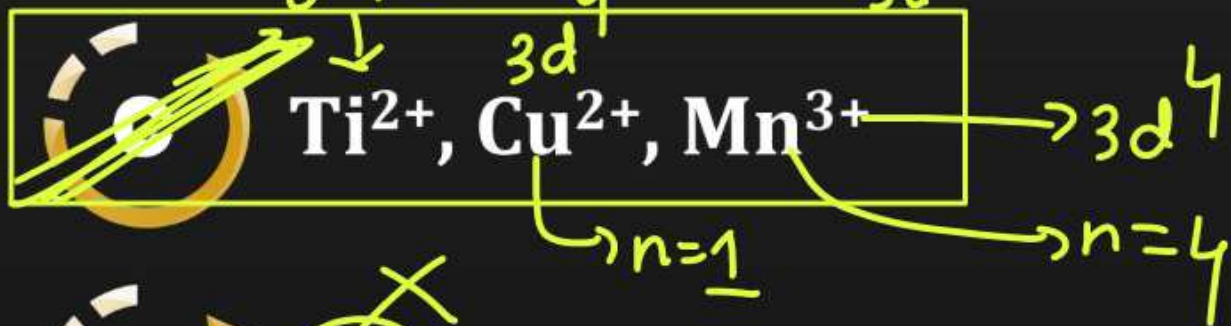
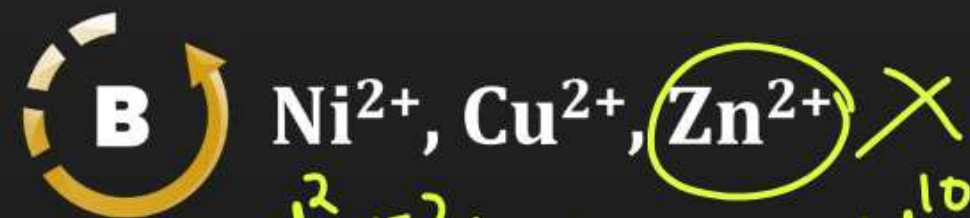
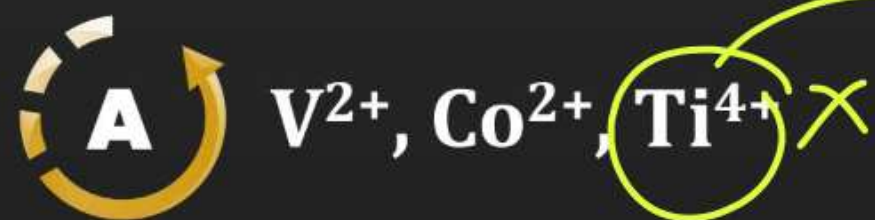


\rightarrow unpaired e^-

Question



Identify the set of paramagnetic ions among the following.



unpaired e^-

$$\mu = \sqrt{n(n+2)}$$

B.M

$n = \text{no of}$
unpaired
 e^-

Question

IE of $Cu^{2+} > IE$ enthalpy of Cu^{+} .



For Cu_2Cl_2 and $CuCl_2$ in aqueous medium, which of the following statement is correct?

A Cu^{2+} Cu^{+}
 $CuCl_2$ is more stable than Cu_2Cl_2

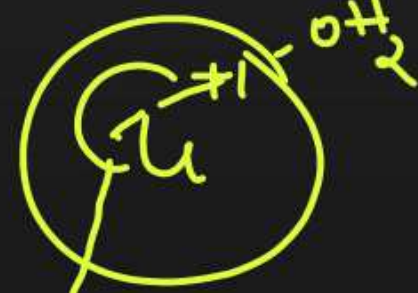
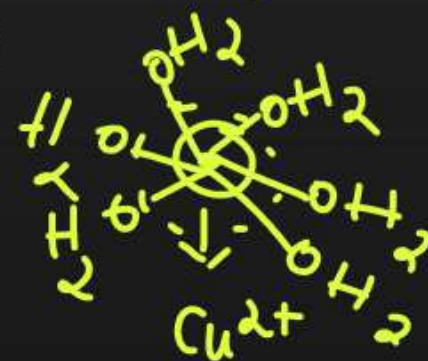
B Stability of Cu_2Cl_2 is equal to stability of $CuCl_2$

C Both are unstable

D Cu_2Cl_2 is more stable than $CuCl_2$

$Cu^{2+} \rightarrow$ more stable in aq. solution

hydration enthalpy



$Cu^{2+} \rightarrow$ small size \rightarrow more water molecule \rightarrow More hydration enthalpy

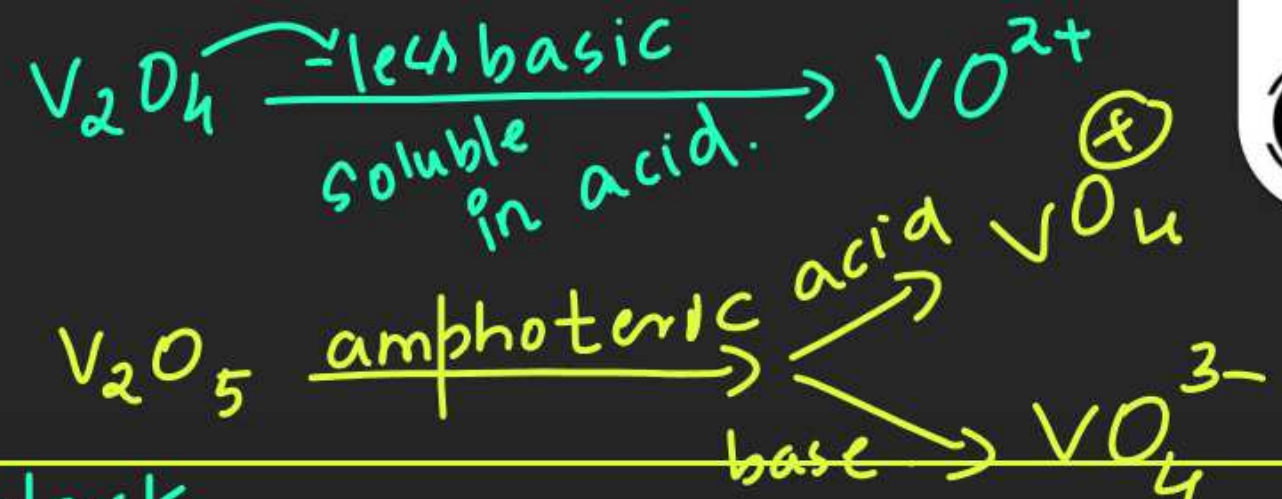


Question

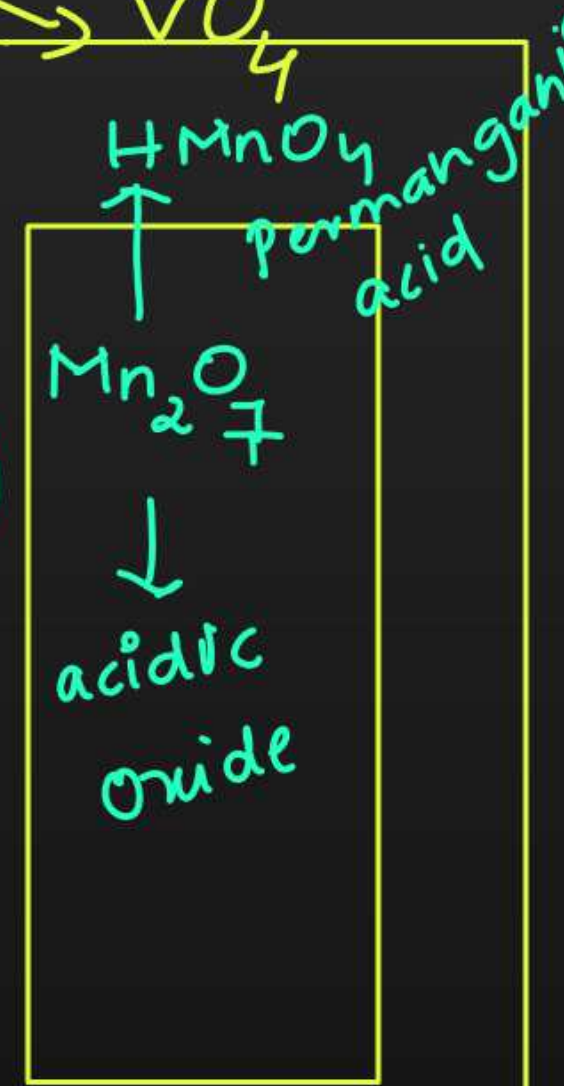
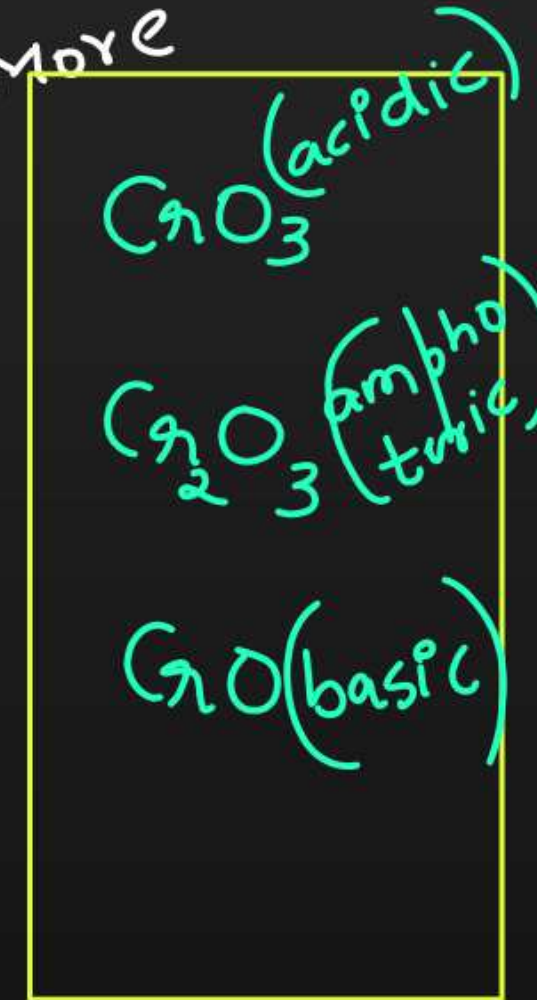
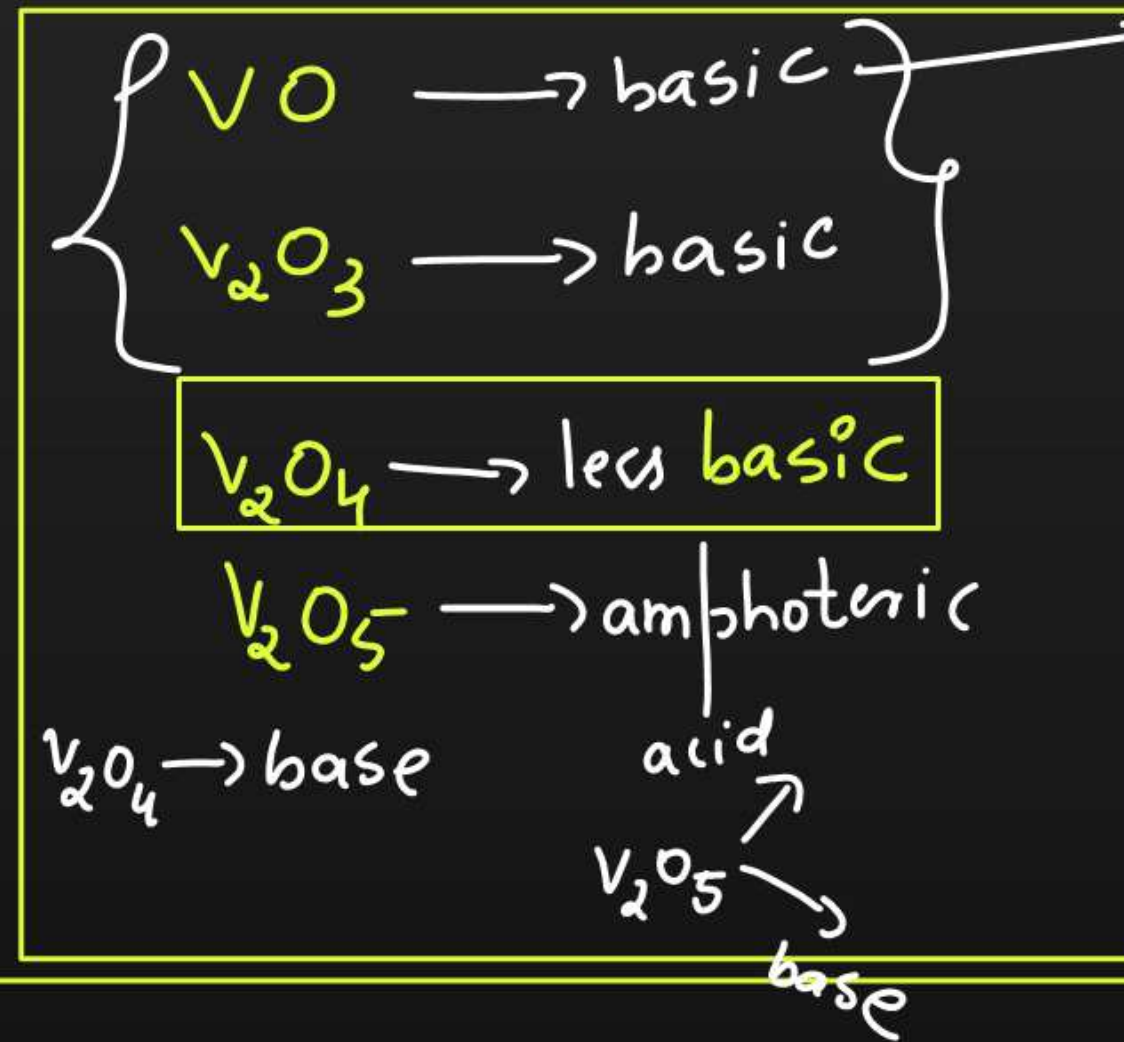


Which following is an amphoteric oxide?

- A** V_2O_5, Cr_2O_3 (ampho, ampho)
- B** Mn_2O_7, Cr_2O_3 (acidic, ampho)
- C** CrO, V_2O_5 (basic, ampho)
- D** V_2O_5, V_2O_4 (ampho, less basic)



Oxides of d block.



Question



Match the statements given in Column I with the oxidation states given in Column II.

Column I

- (i) Oxidation state of Mn in MnO_2 is $+2$
- (ii) Most stable oxidation state of Mn is $+4$
- (iii) Most stable oxidation state of Mn in oxides is $+7$
- (iv) Characteristic oxidation state of lanthanoids is $+3$

Column II

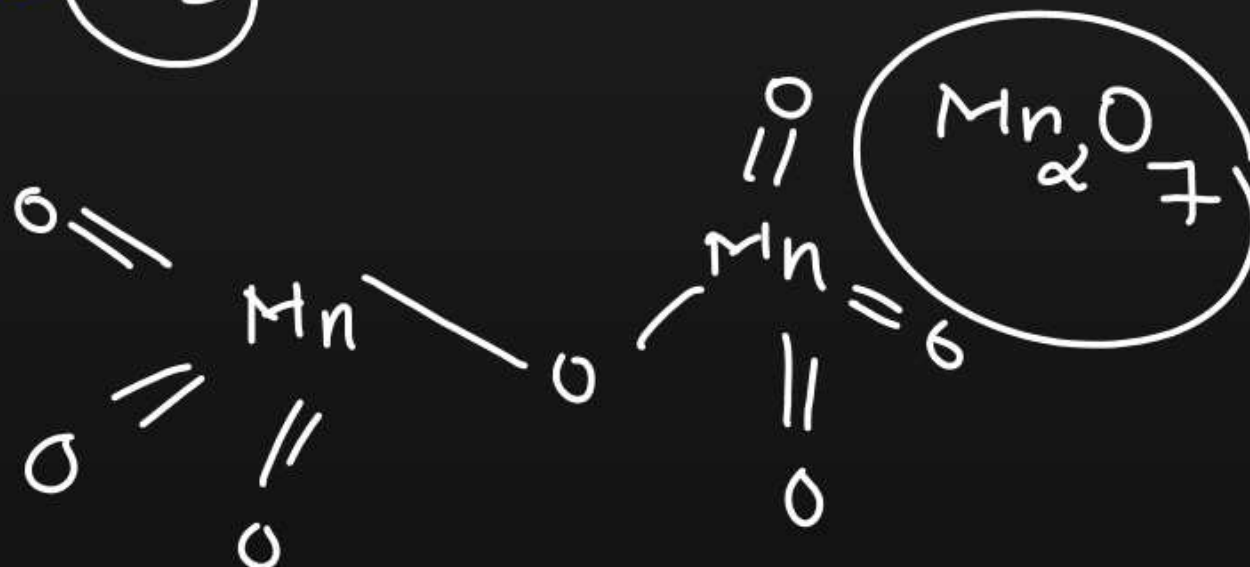
- (a) +2
- (b) +3
- (c) +4
- (d) +5
- (e) +7



$$x + (-2 \times 2) = 0$$

$$x - 4 = 0$$

$$\underline{\underline{x = +4}}$$



Thank

You