Nov 2021

HYDROGEN & ITS COMPOUNDS

(Read from sheet and NCERT)

D-block:-

Compare heat of atomisation for d-block elements

	3	4	5	6	7	8	9	10	11	12
	IIIrd B	IV B	V B	VI B	VII B	VIII			IB	II B
4th period	Sc	Ti	V	*Cr	Mn	Fe	Co	Ni	*Cu	Zn
	Y	Zr	*Nb	*Mo	Tc	*Ru	*Rh	*Pd	*Ag	Cd
	*La	Hf	Ta	W	Re	Os	Ir	*Pt	*Au	Hg

* → exception electronic config.

Fe → most abundant element in earth's crust in d-block.

1st Properties of d-block elements are transitional b/w s & p block so that they are called transition elements. D-block elements start from 3rd group & 4th period. Tc is 1st synthetic element. In d-block tungsten has highest MP & Hg has lowest MP. In 3d-series V has highest (in NCERT Cr) and Zn has lowest M.P,

Os, Ir are most dense metals of d-block. D-block elements have vertical as well as horizontal similarities because most of the properties of elements depends on electronic configuration of outermost shell. Most of them have 1 or 2 elements in outermost shell, So that they have horiz. similar. Vertical similarities are more common than horiz. similarities.

which has more?

* **Enthalpy of atomisation:-**

For 3d-series,

V > Ti > Ni > Co > Fe > Cr > Cu > Sc > Mn > Zn

Acronym for remembering

V (వం) (highest)
Ti (టుల్లు)
Ni (ని)
Co (క్కొన్నం)
Fe (ఫిల్మ్ స్టార్ని)
Cr (క్రాంతి)
Cu (కుప్పం)
Sc (ఎస్.ఎస్.ని)
Mn (మన్)
Zn (జన్) (least)

Valence e^- in Zn $\neq 12$
$= 2$ ✓✓
Mn_2O_7 → yellow green oily liquid.

* Properties:-

* Variable oxidation state :-

$$M(s) \xrightarrow{+SE} M(g) \xrightarrow{+IE_1} M^+(g) \xrightarrow{IE_2} M^{+2}(g) \xrightarrow{-HE} M^{+2}(aq)$$

So we need E° values to compare tendency to form particular oxid. states.

Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn
	+2	+2	+2	+2	+2	+2	+2	+1, +2	+2
+3	+3	+3	+3	+3	+3	+3	+3		
	+4	+4	+4	+4	+4	+4	+4		
				+6	+6				

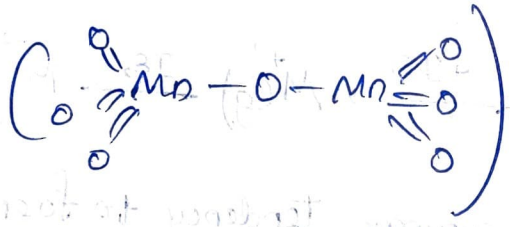
Stable

* Most of d-block elements show more than one oxidation state. Their variable state is due to outermost 's' & penultimate 'd' in bonding. Participation of penultimate 'd' electrons in bonding is possible because of less energy difference b/w ns & (n-1)d subshell. Stability of oxidation state of d-block metals depends on various factors like sublimation energy (heat of atomisation), IE, hydration energy, electronic distribution in t_{2g}, e_g etc (collectively E_o, (or ΔC_o)). Most common oxidation state of 3d series is +2 (Sc^{+2} is virtually unknown)

→ Most stable Oxidation state of 3d series is +3. Highest oxidation state of 3d series is +7 (by Mn). Tendency to show higher oxidation state increases to Mn then decreases.

MnF_7 (नहीं बनते) due to steric crowding

Mn_2O_7



$$CrO_4^{2-} \quad MoO_4^{2-} \quad WO_4^{2-}$$

decreasing order of Oxidising nature

$$MnO_4^- \quad TcO_4^- \quad ReO_4^-$$

* On increasing oxidation state covalent character increases. Higher oxidation generally stabilised by O, F & some time Cl (CrO_2Cl_2).

* In higher oxidation state, oxocompounds are more stable as compared to fluoro compounds because of steric factor.

* d-block elements also produce compounds in negative or zero oxidation state when π-acid/π-acceptor ligands are present.

* Most reactive metal $(M \rightarrow M^{+2})$ of 3d-series is 'Ti'. and least reactive metal is Copper.

* V^{+2}, Cr^{+2} and Ti^{+2} react with dil HCl & evolve H_2. Cr^{+2} is most reducing.

* Out of all +3 ions of 3d-series Co^{+3} is strongest oxidising agent.

* Highest Oxidation state of d-block is +8 (Os, Ru)

* Colouration:-

⇒ $Cr^{+3}_{(aq)}$ = blue

⇒ $Co^{+3}_{(aq)}$ = blue

⇒ $Co^{+2}_{(aq)}$ = pink

⇒ $Mn^{+3}_{(aq)}$ = violet

⇒ $Ti^{+3}_{(aq)}$ = violet

~~f-block:~~