Trusted Table

Elements	oxidation
IA [Li, Na, K, Rb, Cs]	+1
IIA [Be, Mg, Ca, Sr, Ba]	+2
IIIA [Al, Ga, In]	+3
F	-1
H	+1
O	-2
Cl	-1
N	-3
Br	-1
I	-1
S	-2
P	-3

$\overset{+2}{MnO}$

O.No of O = -2

$x + (-2) \times 1 = 0$

$x = +2$

Application (1)

Ex. $FeCl_3$

oxidation No

Cl = -1

$a + (-1) \times 3 = 0$

$a = +3$

$\Rightarrow FeCl_2$

oxidation No of

Cl = -1

$b + (-1) \times 2 = 0$

$b = +2$

Applicable-2 :

HF — oxidation No of F = -1

$x + (-1) = 0$

$x = +1$

oxidation No of H = +1

HCl — oxidation No of H = +1

$(+1) + x = 0$

$x = -1$

oxidation No of chlorine.

Hydrolyth CaH_2 — oxidation No of Ca = +2

$2 + 2x = 0$

$2x = -2$

$x = -1$

Oxidation No of hydrogen

= -1 [hydride]

- C_6H_6 oxidation No of H = +1

$6x + (+1)\times 6 = 0$

$x = -1$

Oxidation No Of C = -1

$C_6H_{12}O_6$

oxidation No of Hydrogen = +1

" " oxygen = -2

$6x + (+1)\times 12 + (-2)\times 6 = 0$

$6x + 12 - 12 = 0$

$6x = 0$

$x = 0$

oxidation No of C = 0

→ if Calculated oxidation No is greater than no of Valence electron then calculated oxidation is wrong

oxidation No = + V.e .

H_2SO_5

Oxidation of H = +1

oxidation No of O = -2

$(+1)\times 2 + x + (-2)\times 5 = 0$

$x = +8$ ~~+8~~ [S] → it have no of v.e = 6

Oxidation No = +6

SO_4^{-2} → oxidation No oxygen = -2

$x + (-2)\times 4 = -2$

$x - 8 = -2$

$x = -2 + 8 = +6$

Q- HW Find the oxidation no for underlined atoms

$\underline{H}Cl$ (+1) $H\underline{O}Cl$ (+1) $H\underline{Cl}O_3$ (+5) $H\underline{Cl}O_4$ (+7) $o\underline{Cl}^-$ (+1)

$\underline{U}Br_3$ (-1) $\underline{U}F_3$ (+3) $\underline{U}F_2$ (+2) $\underline{U}O_2^-$ (+3) $\underline{U}O_2$ (+4)

$\underline{C}O_2$ (+4) $\underline{C}_3O_2$ (+4/3) $H_2\underline{C}O_3$ (+4) $H\underline{C}O_3^-$ (+4) $\underline{C}H_4$ (-4)

$\underline{C}O$ (+2) $\underline{C}O_3^{-2}$ (+4) $\underline{C}Cl_4$ (+4) $H_2\underline{C}_2O_4$ (+3)

$\underline{C}_2O_4^{-2}$ (+3) $Ca\underline{C}_2$ (-1) $Mg_2\underline{C}_3$ (-4/3) $H_4\underline{C}_3$ (-4/3)

$\underline{N}_2O$ (+1) $\underline{N}_2O_3$ (+3) $H\underline{N}O_3$ (+5) $\underline{N}O_3^-$ (+5) $\underline{N}H_3$ (-3)

$\underline{N}O$ (+2) $\underline{N}_2O_4$ (+4) $H\underline{N}O_2$ (+3) $\underline{N}O_2^-$ (+3) $\underline{N}H_4^+$ (-3)

$\underline{N}O_2$ (+4) $\underline{N}_2O_5$ (+5) $H_2\underline{N}_2O_2$ (+1) $\underline{N}O_2^+$ (+5) $\underline{N}_2H_5^+$ (-2)

$\underline{N}_2H_4$ (-2) $Na_3\underline{N}$ (-3) $Na\underline{N}_3$ (-1/3) $\underline{N}_3^-$ (-1/3)

$H\underline{N}_3$ (-1/3) $Al\underline{N}$ (-3)

$Cu_3\underline{P}$ (-3) $\underline{P}H_3$ (-3) $H_3\underline{P}O_2$ (+1) $Na_2H\underline{P}O_3$ (+3)

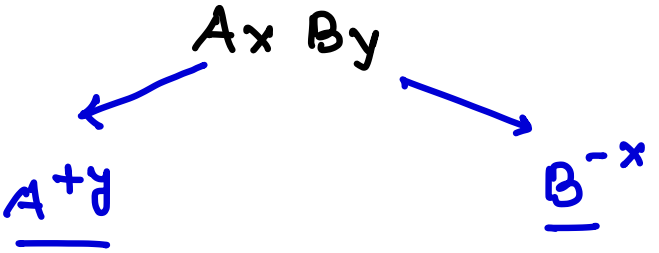
$Ca_3\underline{P}_2$ (-3) $H_3\underline{P}O_4$ (+5) $H_3\underline{P}O_3$ (+3) $Na\,H_2\underline{P}O_2$ (+1)

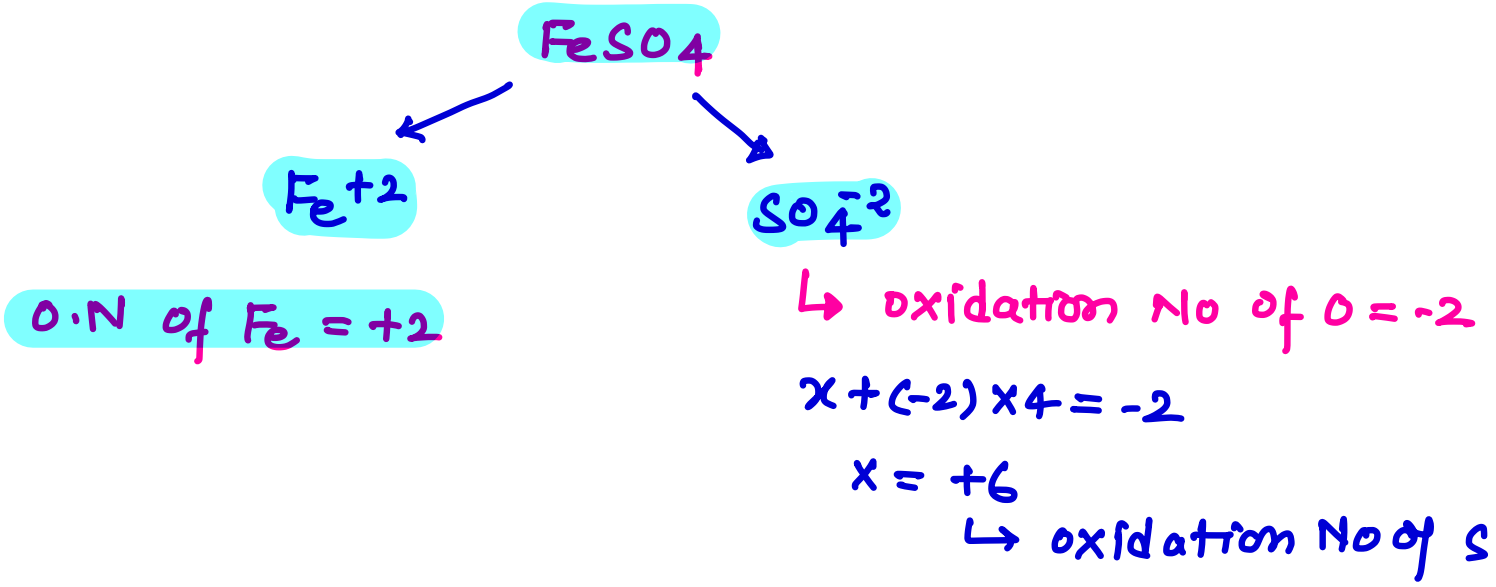
$H_2\underline{S}$ (-2) $\underline{S}O_3$ (+6) $\underline{S}O_4^{-2}$ (+6) $\underline{S}_4O_6^{-2}$ (+2.5) $H_2\underline{S}O_3$ (+4)

$\underline{S}O_2$ (+4) $\underline{S}O_3^{-2}$ (+4) $\underline{S}_2O_3^{-2}$ (+2) $H_2\underline{S}O_4$ (+6) $H_2\underline{S}_2O_3$ (+2)

$Na_2\underline{S}_2O_3$ (+2) $Na_2\underline{S}_4O_6$ (+2.5) $H_2\underline{S}O_5$ (+6) $H_2\underline{S}_2O_7$ (+6) $H_2\underline{S}_2O_8$ (+6)

Oxidation Number for Ionic compounds





$(N_2H_5)_3\ PO_4$

$N_2H_5^+$

Oxidation No of H = +1

$2x + (+1)\times 5 = +1$

$2x + 5 = 1$

$x = -2$

↓

oxidation No of N

PO_4^{-3}

Oxidation No of O = -2

$x + (-2)\times 4 = -3$

$x - 8 = -3$

$x = +5$

oxidation No. of P -

****

$CaOCl_2$ → Bleaching powder

$Ca(OCl)Cl$

Ca^{+2} + Cl^- + ClO^-

Calcium has +2

one chlorine has = -1

Oxidation No of O = -2

$x + (-2) = -1$

$x = +1$

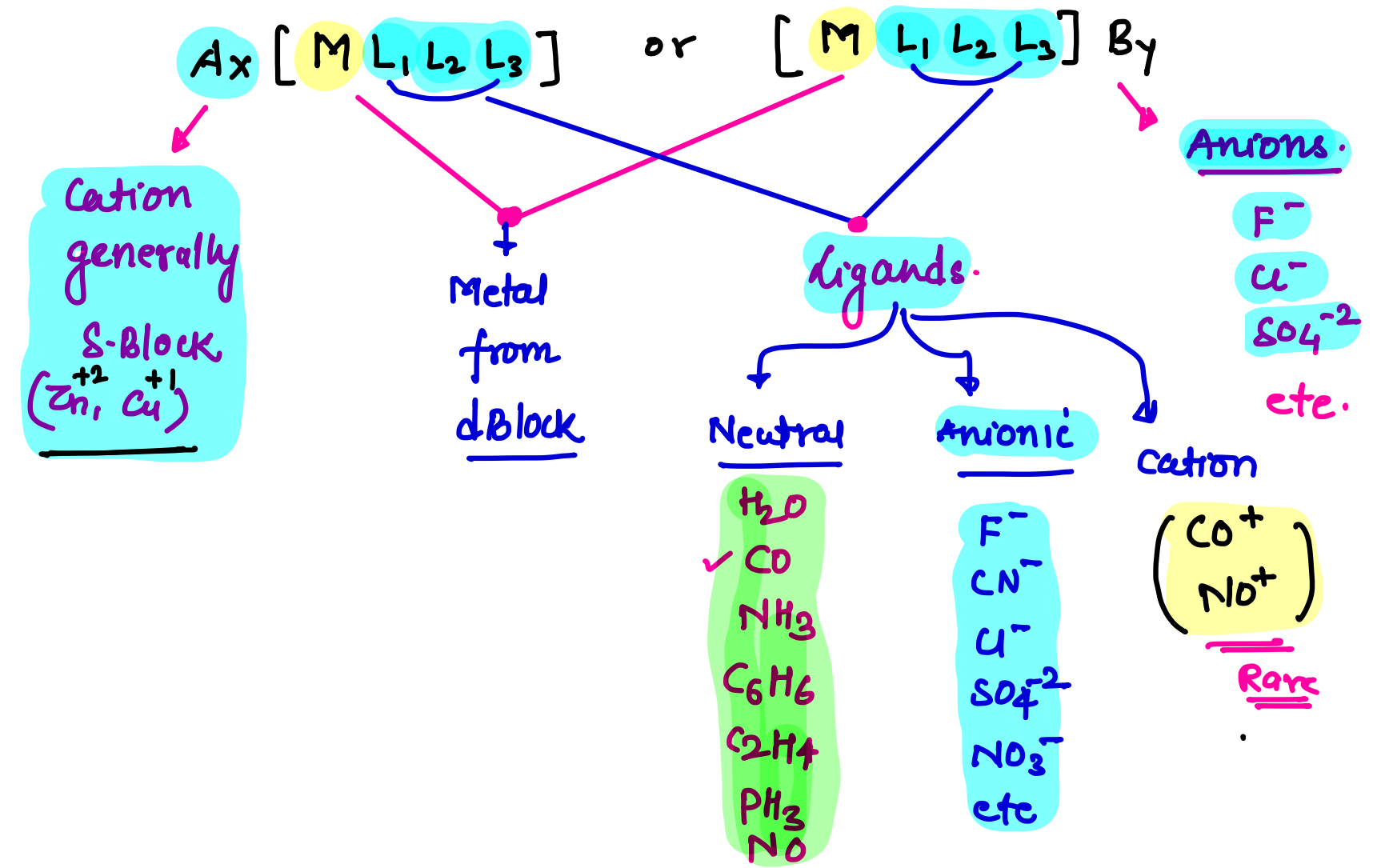
one chlorine has oxidation No = +1

Oxidation Number in Complex Compound ÷

[ ] → neutral complex compound

A_x [ ] → complex part is Anion

[ ] B_y → complex part is Cation


Ax [M L1 L2 L3] or [M L1 L2 L3] By
Cation generally
S-Block
(Zn+2, Cu+1)
Metal from dBlock
Ligands
Anions
F-
Cl-
SO4-2
etc.
Neutral
H2O
CO
NH3
C6H6
C2H4
PH3
NO
Anionic
F-
CN-
Cl-
SO4-2
NO3-
etc
Cation
(CO+ NO+)
Rare

Ex. (i) $[Ni(CO)_4]$ find oxidation No of Ni

$x + 0 \times 4 = 0$

$x = 0$

(ii) $K_4[Fe(CN)_6]$ Calculate oxidation No of Fe

$(+1) \times 4 + x + (-1) \times 6 = 0$

$4 + x - 6 = 0$

$x = +2$

iii) $[Pt(NH_3)_2Cl_2]SO_4$ find oxidation No of each element.

$[Pt(NH_3)_2Cl_2]SO_4$

NH_3 → H = +1, N = -3

$x + (+1)\times 2 = 0$

$x = -3$

$x + (0)\times 2 + (-1)\times 2 + (-2) = 0$

$Cl^- = -1$

$x = +4$

SO_4^{-2} → O = -2, S = +6

$Pt = +4$

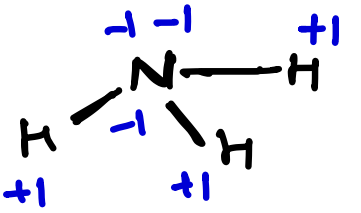
$Na[BH_4]$ $\quad H \rightarrow H^-$

$(+1) + x + (-1)\times 4 = 0$

$x = +3$

individual oxidation No. from structure.

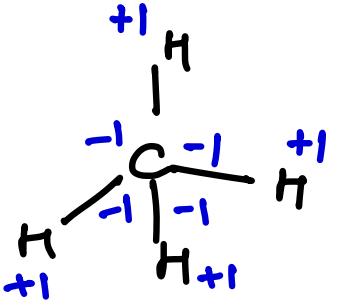
NH_3



N = -3

H = +1

CH_4

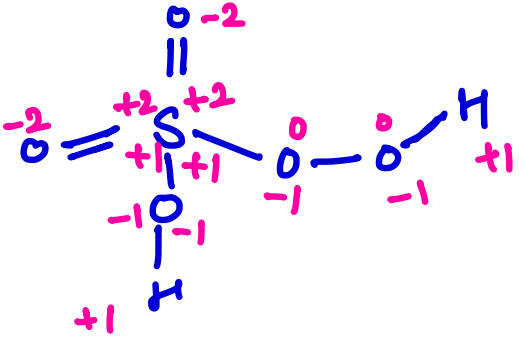


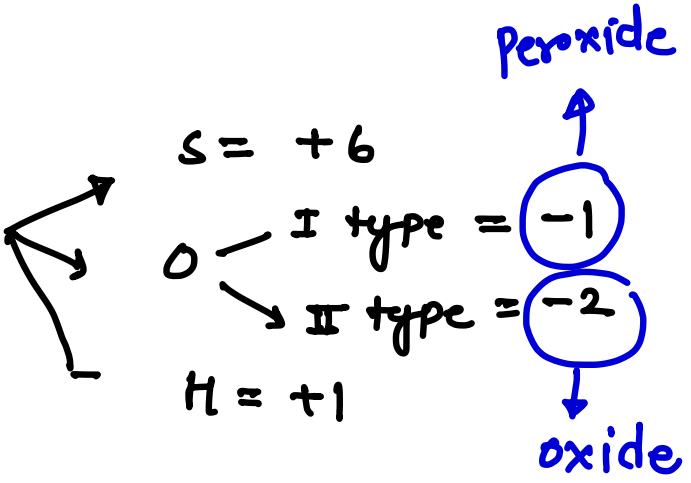
→ C ⇒ -4

H → +1

H_2SO_5 → $(+1)\times2 + x + (-2)\times5 = 0$

$x = +8$ ~~+8~~ V.e = 6 O.N = +6



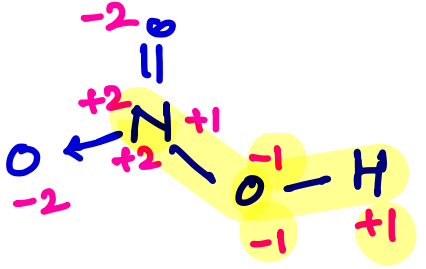


$H_2S(O)_2O_3$

$(+1)\times2 + x + (-1)\times2 + (-2)\times3 = 0$

$x = +6$

HNO_3



N = +5

O = -2

H = +1

HW

Q- Find the oxidation no for underlined atoms

$\underline{H}Cl$ (+1)	$H\underline{O}Cl$ (+1)	$H\underline{Cl}O_3$ (+5)	$H\underline{Cl}O_4$ (+7)	$O\underline{Cl}^-$ (+1)
$\underline{U}Br_3$ (-1)	$\underline{U}F_3$ (+3)	$\underline{U}F_2$ (+2)	$\underline{U}O_2^-$ (+3)	$\underline{U}O_2$ (+4)
$\underline{C}O_2$ (+4)	$C_3\underline{O}_2$ (+4/3)	$H_2\underline{C}O_3$ (+4)	$H\underline{C}O_3^-$ (+4)	$\underline{C}H_4$ (-4)
$\underline{C}O$ (+2)		$\underline{C}O_3^{-2}$ (+4)	$\underline{C}Cl_4$ (+4)	$H_2\underline{C}_2O_4$ (+3)
$\underline{C}_2O_4^{-2}$ (+3)	$Ca\underline{C}_2$ (-1)	$Mg_2\underline{C}_3$ (-4/3)	$Al_4\underline{C}_3$ (-4)	
$\underline{N}_2O$ (+1)	$\underline{N}_2O_3$ (+3)	$H\underline{N}O_3$ (+5)	$\underline{N}O_3^-$ (+5)	$\underline{N}H_3$ (-3)
$\underline{N}O$ (+2)	$\underline{N}_2O_4$ (+4)	$H\underline{N}O_2$ (+3)	$\underline{N}O_2^-$ (+3)	$\underline{N}H_4^+$ (-3)
$\underline{N}O_2$ (+4)	$\underline{N}_2O_5$ (+5)	$H_2\underline{N}_2O_2$ (+1)	$\underline{N}O_2^+$ (+5)	$\underline{N}_2H_5^+$ (-2)
$\underline{N}_2H_4$ (-2)		$Na_3\underline{N}$ (-3)	$Na\underline{N}_3$ (-1/3)	$\underline{N}_3^-$ (-1/3)
$H\underline{N}_3$ (-1/3)		$Al\underline{N}$ (-3)		
$Cu_3\underline{P}$ (-3)	$\underline{P}H_3$ (-3)	$H_3\underline{P}O_2$ (+1)	$Na_2H\underline{P}O_3$ (+3)	
$Ca_3\underline{P}_2$ (-3)	$H_3\underline{P}O_4$ (+5)	$H_3\underline{P}O_3$ (+3)	$NaH_2\underline{P}O_2$ (+1)	
$H_2\underline{S}$ (-2)	$\underline{S}O_3$ (+6)	$\underline{S}O_4^{-2}$ (+6)	$\underline{S}_4O_6^{-2}$ (+2.5)	$H_2\underline{S}O_3$ (+4)
$\underline{S}O_2$ (+4)	$\underline{S}O_3^{-2}$ (+4)	$\underline{S}_2O_3^{-2}$ (+2)	$H_2\underline{S}O_4$ (+6)	$H_2\underline{S}_2O_3$ (+2)
$Na_2\underline{S}_2O_3$ (+2)	$Na_2\underline{S}_4O_6$ (+2.5)	$H_2\underline{S}O_5$ (+6)	$H_2\underline{S}_2O_7$ (+6)	$H_2\underline{S}_2O_8$ (+6)

DESCRIPTION OF PERIOD SUBSHELL

ALLEN CAREER INSTITUTE KOTA (RAJASTHAN) path to success

TABLE

Acidic & Basic Strength :

(F) Nature of Oxide:

(1)Basic Oxides: Metal oxides are basic in nature

$Na_2O, K_2O, Rb_2O, Cs_2O$

MgO, CaO, SrO, BaO

$Na_2O + H_2O \rightarrow NaOH$

$CaO + H_2O \rightarrow Ca(OH)_2$

χ 3.5

E — O

$\Delta EN > 2.3$

Oxide of S-Block are basic in Nature. [exception BeO]

↓

Amphotaric

$M_2O_x + H_2O \longrightarrow M(OH)_x$

$M_2O_x + HCl \longrightarrow MCl_x + H_2O$

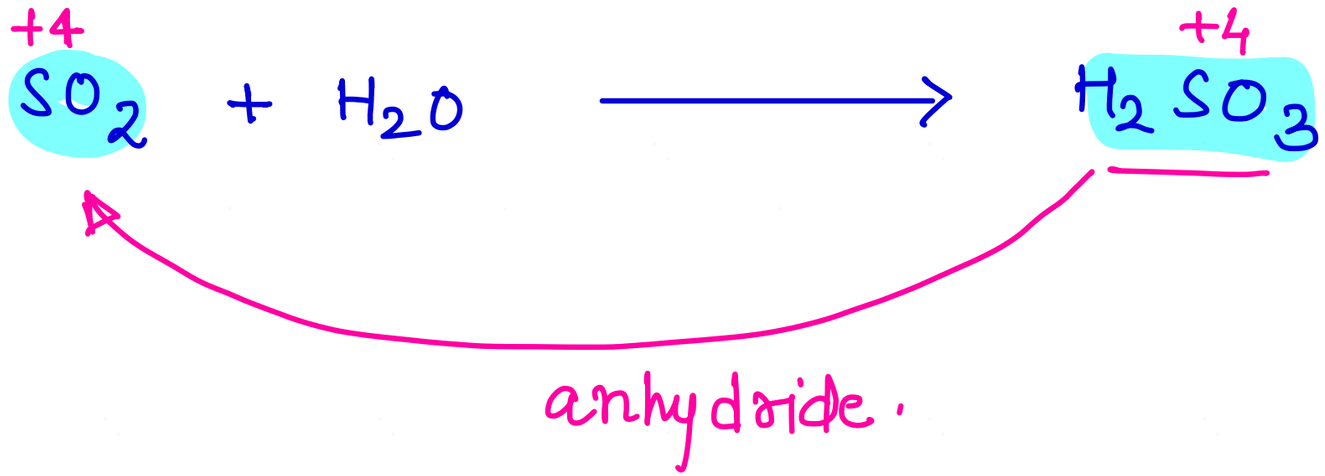
E – O

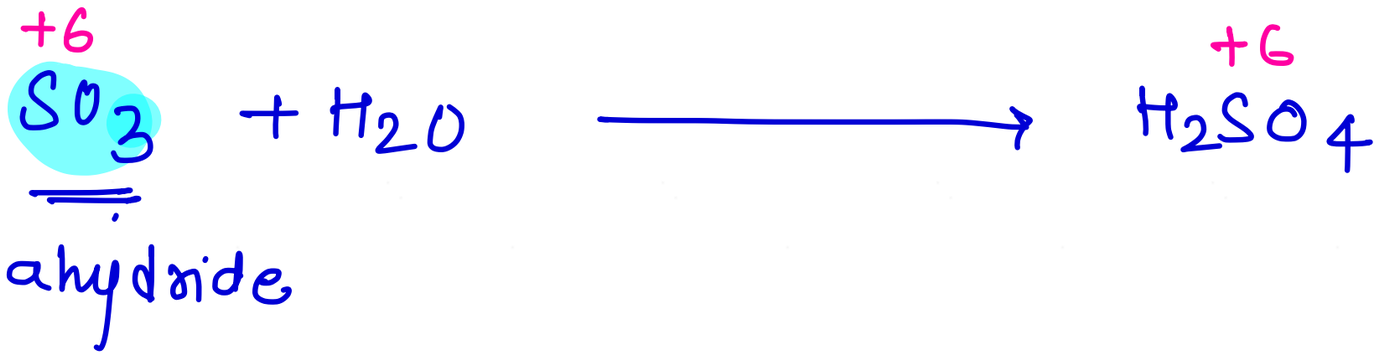
$\Delta EN < 2.3$

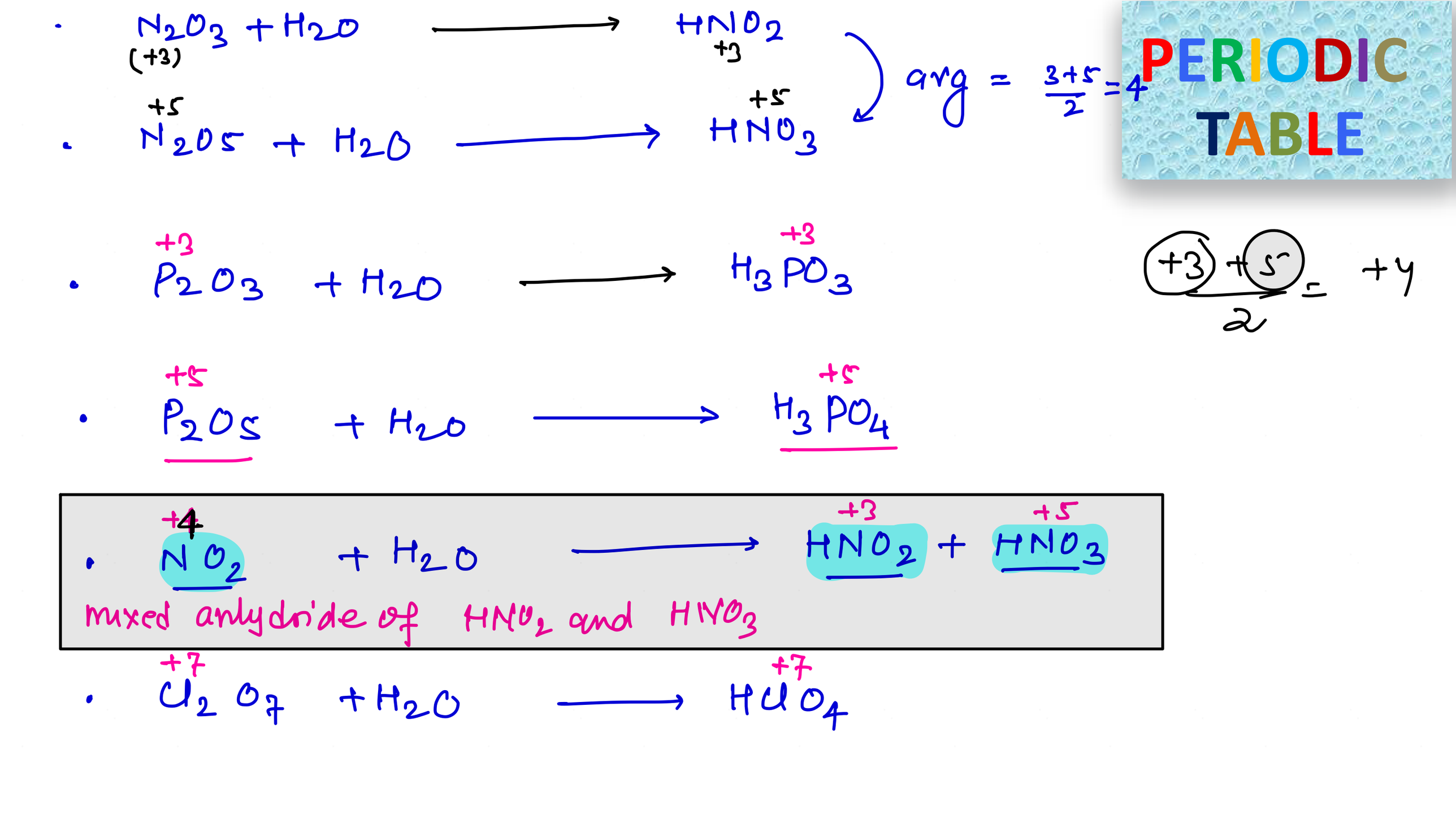
PERIODIC TABLE

Acidic oxides the oxides which reacts with water to produce oxyacid. and react with base to form salt and water.

Ex.







- $N_2O_3 + H_2O \longrightarrow HNO_2$ (N_2O_3: N is +3; HNO_2: N is +3)
- $N_2O_5 + H_2O \longrightarrow HNO_3$ (N_2O_5: N is +5; HNO_3: N is +5)

$avg = \frac{3+5}{2} = 4$

- $P_2O_3 + H_2O \longrightarrow H_3PO_3$ (P_2O_3: P is +3; H_3PO_3: P is +3)

- $P_2O_5 + H_2O \longrightarrow H_3PO_4$ (P_2O_5: P is +5; H_3PO_4: P is +5)

- $NO_2 + H_2O \longrightarrow HNO_2 + HNO_3$ (NO_2: N is +4; HNO_2: N is +3; HNO_3: N is +5)

mixed anhydride of HNO_2 and HNO_3

- $Cl_2O_7 + H_2O \longrightarrow HClO_4$ (Cl_2O_7: Cl is +7; $HClO_4$: Cl is +7)

PERIODIC TABLE

$$\overset{+5}{Cl_2O_5} + H_2O \longrightarrow \overset{+5}{HClO_3}$$

$\frac{7+5}{2} = 6$

$$\overset{+6}{ClO_3} + H_2O \longrightarrow \overset{+5}{HClO_3} + \overset{+7}{HClO_4}$$

↓

mixed anhydride of $HClO_3$ and $HClO_4$

Naming of oxyacid

PERIODIC TABLE

- Prefix
  - Meta
  - Pyro
  - ortho
  - hypo
  - thio
  - per
- Suffix
  - ous
  - ic

ions — ic acid → ate

ous acid → ite

1) oxyacid of chlorine (Halogen)

- $HClO$ → Hypochlorous acid
- $HClO_2$ → Chlorous acid
- $HClO_3$ → Chloric acid
- $HClO_4$ → perchloric acid

PERIODIC TABLE

oxyacid phosphorous

H_3PO_2 → Hypophosphorous acid

H_3PO_3 → Phosphorous acid

H_3PO_4 → Phosphoric acid

H_3PO_5 → Perphosphoric acid

oxyacid acid of S

H_2SO_3 → Suphwrous acid.

H_2SO_4 → Suphwric acid

H_2SO_5 → Persuphuric acid / Caro's Acid

oxyacid of nitrogen

$H_2N_2O_2$ HNO_2 HNO_3 HNO_4

- If we remove 1 water from 1 molecule of acid then if compounds remains acid then meta preffix is applied.

PERIODIC TABLE

$H_3PO_4 \longrightarrow HPO_3 + H_2O$

Phosphoric acid

Meta phophoric acid

$H_2SO_4 \longrightarrow \underline{SO_3} + H_2O$

anhydride

PERIODIC TABLE

- If we remove 1 water from two molecules of acid then Pyro preffix is used.

$2\,H_2SO_4 \longrightarrow H_2S_2O_7 + H_2O$

Sulphuric acid

Pyrosulphuric acid.

Pyrosulphuric acid $\xrightarrow{O}$ $H_2S_2O_8$

peroxydisulphuric acid

$2\,H_3PO_4 \longrightarrow H_4P_2O_7 + H_2O$

Phosphoric acid

Pyrophosphoric acid.

Pyrophosphoric acid $\xrightarrow{(O)}$ $H_4P_2O_8$

perdiphophoric acid

$\Rightarrow$. O $\longrightarrow$ remove and S add करो to preffix this

H_2SO_4 $\xrightarrow[+S]{-O}$ $H_2S_2O_3$

Sulphuric acid — thiosulphuric acid.

NH_2CONH_2 $\xrightarrow[+[S]]{-[O]}$ NH_2CSNH_2

Urea — thio urea

$CaCO_3$ $\xrightarrow[+[S]]{-O}$ $CaCO_2S$

Calcium Carbonate — Calcium thiocarbonate

DESCRIPTION OF PERIOD SUBSHELL

ALLEN CAREER INSTITUTE KOTA (RAJASTHAN)
path to success
TABLE

(2)Acidic Oxides: Non-metal oxides are acidic in nature.

$N_2O_5, SO_3, Cl_2O_7, CO_2, P_2O_5$

$N_2O_5 + H_2O \rightarrow HNO_3$

$SO_3 + H_2O \rightarrow H_2SO_4$

$\Delta EN < 2.3$ (Acidic)

Generally all p-Block oxides are acidic in Nature

*** **(3)Amphoteric Oxides:** Oxides of Al,Sb,Be,Zn,Sn,Pb are amphoteric in nature.

$Al_2O_3, Sb_2O_3, BeO, ZnO, SnO_2, PbO$ ($Cr_2O_3, As_2O_3, Ga_2O_3, MnO_2$)

They can react with both acid as well as base.

ALLEN CAREER INSTITUTE KOTA (RAJASTHAN)

path to success

PERIODIC TABLE

DESCRIPTION OF PERIOD SUBSHELL

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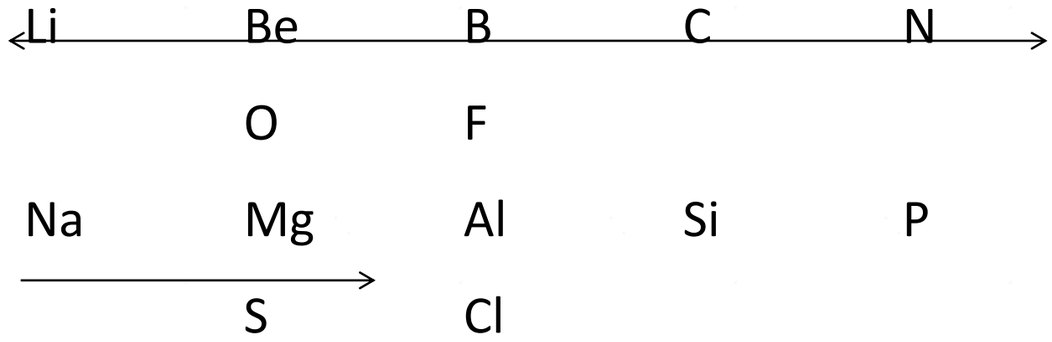
path to success

TABLE

(4) Neutral Oxides: N_2O, NO, CO, H_2O

A. Along a period acidic nature increases.
B. Down the group basic nature increases



Basic Amphoteric

Acidic

ie. when in periodic table the distance between the element and oxygen increases, basic character increases.

$NO_2 > ZnO > K_2O$

acidic character decreases

H_2O
↳ it is neutral as well as Amphoteric oxide

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PERIODIC TABLE

Most Acidic oxide Cl_2O_7

mast Basic oxide Cs_2O

L ⟶ R Acidic Nature of oxide ↑ Increase

T ↓ B Acidic Nature decreases.

For oxide of same element

Acid Nature of oxide ∝ oxidation No of Element.

Ex:→ $\overset{+3}{N_2O_3}$ < $\overset{+5}{N_2O_5}$ [Acidic]

$\overset{+6}{SO_3}$ > $\overset{+4}{SO_2}$ [Acidic]

DESCRIPTION OF PERIOD SUBSHELL

ALLEN CAREER INSTITUTE KOTA (RAJASTHAN)
path to success

TABLE

Acidic strength of oxide and oxyacid $\propto$ Electronegativity

B_2O_3 CO_2 N_2O_5

EN increase, acidic nature increase

Acidic nature $\propto$ oxidation state

Acidic properties increases with increasing oxidation state of an element

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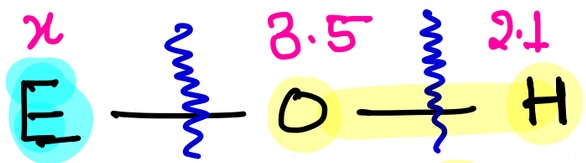
Nature of hydroxide

PERIODIC TABLE

EN



ΔEN $|x-3.5|$ 1.4

Case-1

$|x-3.5| > 1.4$

for S-Block Elements

$E^{+n} + nOH^-$

Nature of hydroxide will be basic

$\Delta EN = |x-3.5| = 1.4$

amphotaric

(d-Block / p-Block)

Case-2

$1.4 > |x-3.5|$

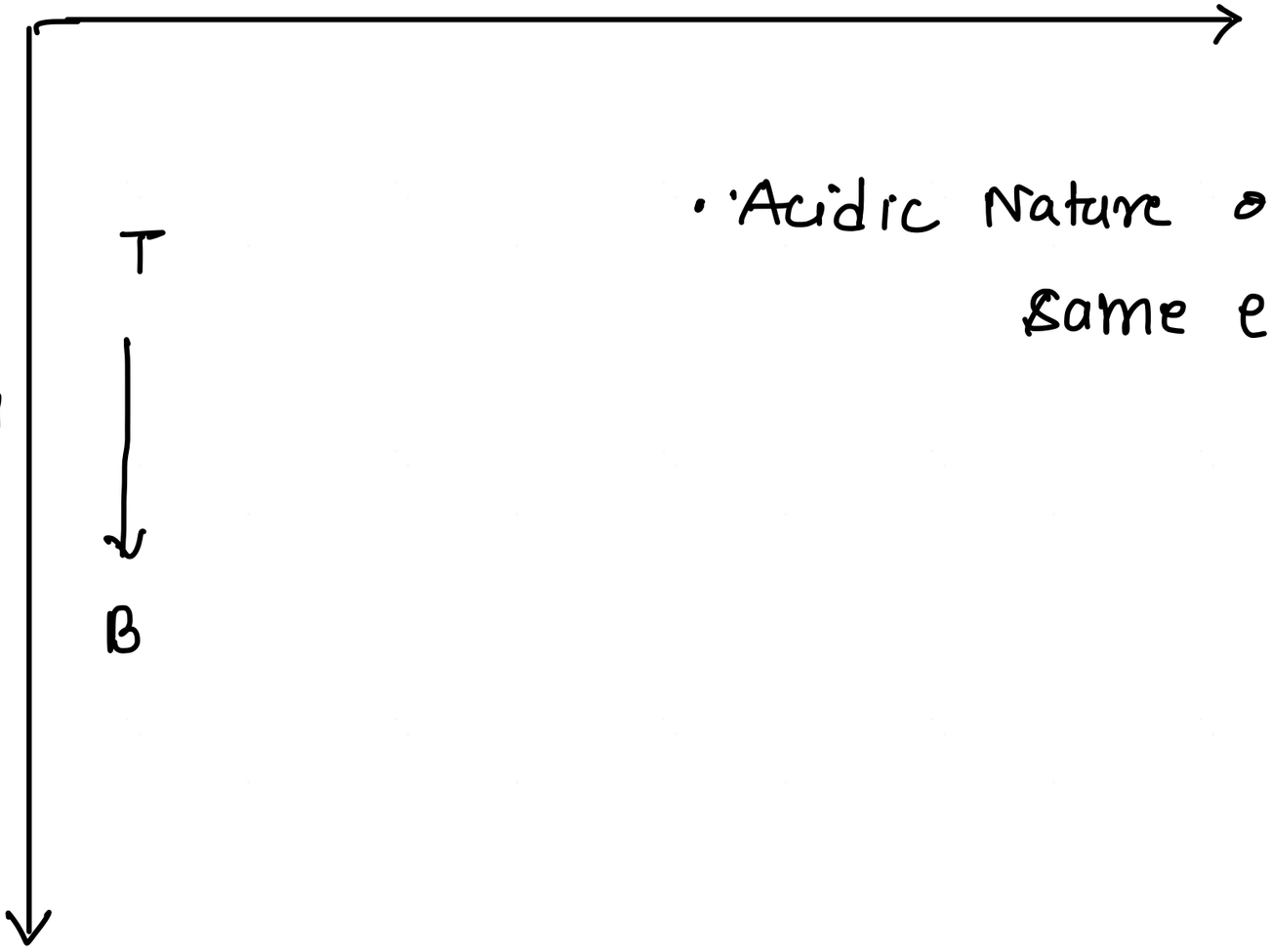
generally from P-Block

$EO^{-n} + nH^+$

Nature of hydroxide is acidic thats why called oxyacid.

L ⟶ R

Acidic Nature of hydroxide/oxyacids increases



Basic Nature increases

T

B

• Acidic Nature of oxyacid of ∝ oxidation No.
Same element

PERIODIC TABLE

Ex. Compare Basic Nature of following hydroxide.?

i) $LiOH < NaOH < KOH < RbOH < CsOH$

ii) $Be(OH)_2 < Mg(OH)_2 < Ca(OH)_2 < Sr(OH)_2 < Ba(OH)_2$

iii) $Li(OH) > Be(OH)_2$

iv) $KOH > Ca(OH)_2 > Cu(OH) > Zn(OH)_2$

v) $NaOH > Mg(OH)_2 > Al(OH)_3$

Ex. Compare acidic Nature of oxyacids.

(i) $\overset{+5}{HNO_3} > \overset{+3}{HNO_2}$

(ii) $\overset{+6}{H_2SO_4} > \overset{+4}{H_2SO_3}$

(iii) $\overset{+1}{HClO} < \overset{+3}{HClO_2} < \overset{+5}{HClO_3} < \overset{+7}{HClO_4}$

(iv) $HClO > HBrO > HOI$

(v) $H_3PO_4 > H_3AsO_4$

HW (vi) H_3PO_4 H_3PO_3 H_3PO_2

Ex. Select the amphotaric species from following.

BeO, Na_2O, Al_2O_3, ZnO, PbO,

PbO_2, P_2O_5, SO_3, $Al(OH)_3$, $NaOH$

$Be(OH)_2$, H_3PO_3, Cr_2O_3, $Mg(OH)_2$, $Zn(OH)_2$

$Pb(OH)_2$, $Ca(OH)_2$ HNO_3, $HBrO_4$, HIO_4

PERIODIC TABLE

- **Inert pair effect** → this effect is observed only in p-Block.

Ve = 3

B [He], $2s^2$, $2p^1$ Valency = +3

Al [Ne], $3s^2$, $3p^1$ Valency = +3

Ga [Ar], $4s^2$, $3d^{10}$, $4p^1$ Valency = +3

In [Kr] $5s^2$, $4d^{10}$, $5p^1$ valency = +3

Tl [Xe], $6s^2$, $4f^{14}$, $5d^{10}$, $6p^1$ Valency = +1

↳ due to very low energy of s electron pair they anounces them self inert

Top
↓
Bottom

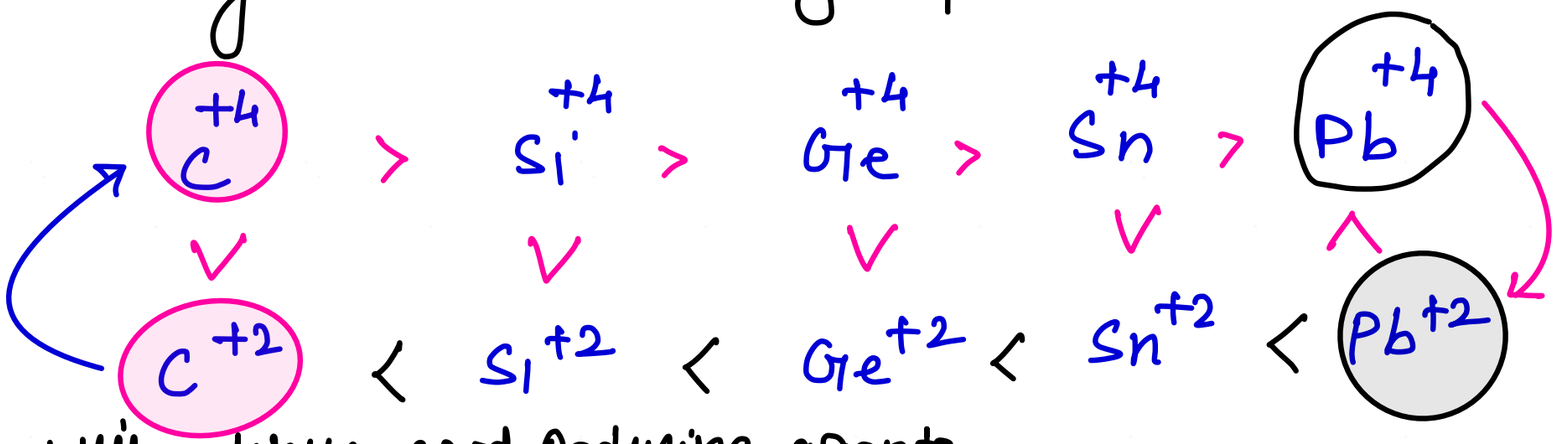
valence s shell electrons becomes inert due to low energy so valency of element reduces by factor ② this effect is know as inert pair effect

PERIODIC TABLE

- $B^{+3} > Al^{+3} > Ga^{+3} > In^{+3} > Te^{+3}$

- $B^{+1} < Al^{+1} < Ga^{+1} < In^{+1} < Te^{+1}$

- Similarly for other groups also



C^{+2} will always good Reducing agents.

whenever Pb^{+4} is there that will be good oxidising agent

- increase in oxidation No is Oxidation
- decrease in oxidation No is Reduction
- Species which get reduced is oxidising agent
- Species which oxidise is Reducing agen

Hydrides

PERIODIC TABLE

S-Block (H^-)

$MH_n \rightarrow M^{+n} + nH^{\ominus}$

↓

Basic Nature

on going

T

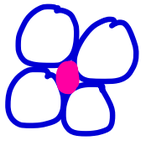
↓

B

(T.S) ↓

Basic Nature of hydride increases

d-Block (adsorbed)



P-Block (H^+) (generally)

$EH_n \rightarrow E^{-n} + nH^{\oplus}$

Acidic

on going top to bottom

thermal stability decreases so more H^+ produces means more acidic

PERIODIC TABLE

Ex. Arrange the following in increasing order of given property.

(a) $NaH < KH < RbH < CsH$ [Basic Nature]

(b) $HF < HCl < HBr < HI$ [Acidic Nature]

(c) $CH_4 > SiH_4 > GeH_4 > SnH_4 > PbH_4$ [thermal stability]

(d) $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$ [Basic Nature]

(e) $H_2O < H_2S < H_2Se < H_2Te$ [Acidic Nature]