PRAYAS

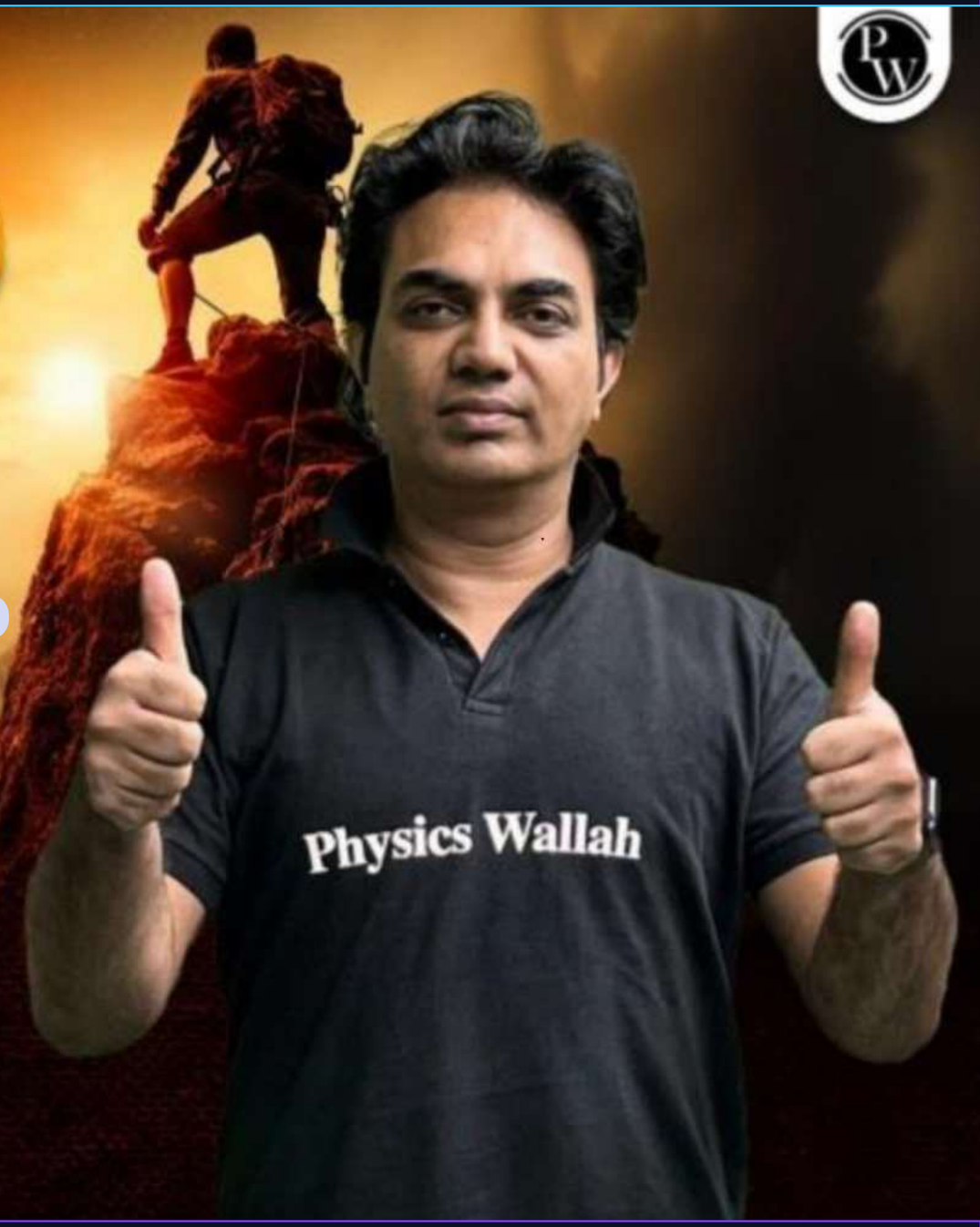
JEE 2026

PHYSICAL CHEMISTRY

REDOX REACTION

Lecture – 02

FAISAL RAZAQ



Topics to be covered

A Concept of Oxidation and Reduction

B Oxidation State

ATDB.uno

TELEGRAM GROUP BY FAISAL SIR

@FAISALSIRPW

Khoobsurat Baat

$$\text{Yield} = \frac{\text{Jitna bana}}{\text{Jitna banna chahiye tha}} \times 100\%$$

reaction likho lekin balance karna bhul gye toh bed bilkul garg

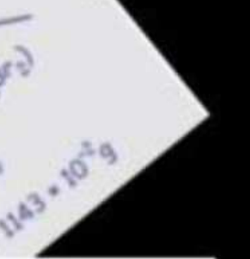
dimag ki jali batti

adv mei aaya hai, ignore karne ki galti mat karna

104. Number of grams of bromine that will completely react with 5.0 g of pent-1-ene is $\times 10^{-2}$ g. (Atomic mass of Br = 80 g/mol) (Nearest integer)

[JEE Mains 25 June, 2022, Shift-I]

Sol. First write the reaction



$\text{Moles of } C_5H_{10}$ $= 1143 \times 10^{-2}$ g

Common Mistake

Avg. at. wt. = (54 + 56 + 57)/3

This is possible only when all the isotopes are in same percentage.

143. The mole fraction of urea in an aqueous urea solution containing 900 g of water is 0.05. If the density of the solution is 1.2 g cm^{-3}, the molarity of urea solution is ____.

(Given data: Molar masses of urea and water are 60 g mol^{-1} and 18 g mol, respectively)

[JEE Adv.-2019]

Sol. $X_{urea} = 0.05 = \frac{n}{n+50}$, $19n = 50$, $n = 2.6315$

$V_{sol} = \frac{(2.6315 \times 60 + 900)}{1.2} = 881.5789$ ml

$\text{Molarity} = \frac{2.6315 \times 1000}{881.5789} = 2.9849$

A compound H_2X with molar weight of 80 g is dissolved in a solvent having density of 0.4 g mL^{-1}. Assuming no change in volume upon dissolution, the molality of a 3.2 molar solution is

[JEE Adv.-2014]

Sol. $M = 3.2 = \frac{n_B}{V_{solution}}$

$W_{Solvent} = 0.4 \times 1000 = 400g = W_A$

3.2 moles of H_2X in 1000 ml of Solution

$\text{Molality} = \frac{n_B}{W_A} \times 1000 = 3$

NO_3^-

0.5 of nitrogen atom = +5

0.5 of bath oxygen atoms = -2

$K_2Cr_2O_4$

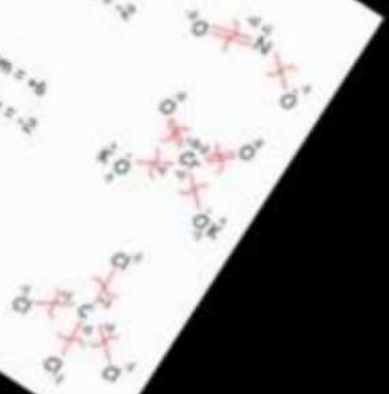
0.5 of chromium atom = +6

0.5 of all oxygen atoms = -2

CCl_4

0.5 of carbon atom = +4

0.5 of all chlorine atoms = -1



n-Factor Calculation for acids

$$\text{Eq wt} = \frac{\text{Mol wt}}{n}$$

$K_xH_y(C_2O_4)_z \xrightarrow[\text{(Base)}]{NaOH} E_1$

(M)

$= \frac{M}{y}$

$KMnO_4$
(oxidising agent)

E_2 = Hume nahi Pata !

if the equivalent weight of $K_xH_y(C_2O_4)_z$ is E_1 and E_2 then find out the value of E_1 and E_2 in terms of M.

$KHC_2O_4 \cdot H_2C_2O_4 \cdot nH_2O \xrightarrow[(\text{Base})]{NaOH} E_1 = \frac{M}{3}$

$\downarrow K_2Cr_2O_7$ $(O \cdot A)$

E_2 = Hume wahi pata !

Question

F S1: The n-Factor of acid is always equal to its Basicity (True / False)

F S2: The n-Factor of HCl is always 1 (True / False)

A) T, T

B) T, F

C) F, F

D) F, T

Some acid like HCl behaves like a reducing agent.

n-Factor Calculation for Base

replaceable $\bar{O}H$ (hydroxyl ions)

or

acceptable H^+ ions

	Acidity	n-Factor
$NaOH \longrightarrow$	1	1
$Ca(OH)_2 \longrightarrow$	2	1, 2
$Al(OH)_3 \longrightarrow$	3	1, 2, 3

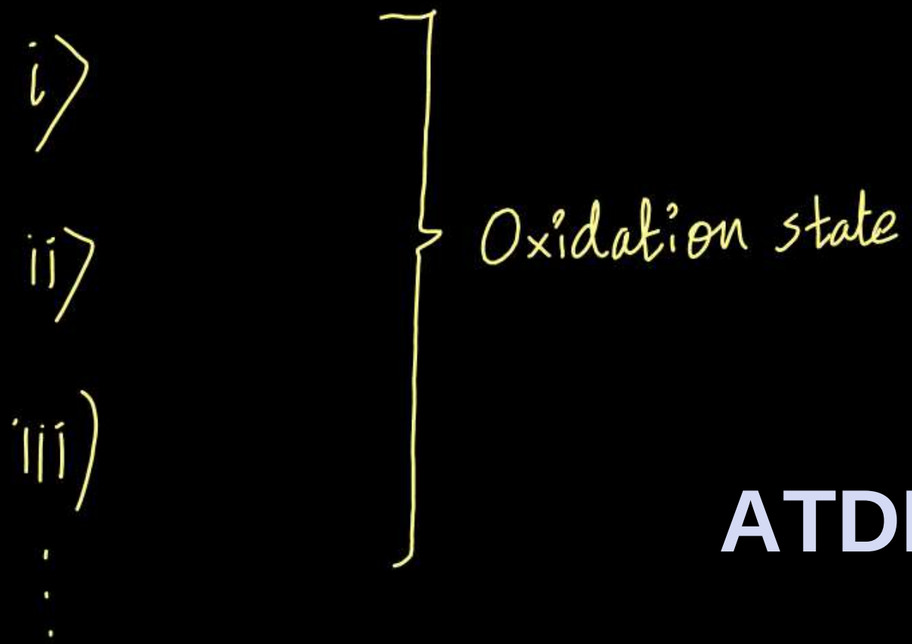
(Base) Na_2CO_3 + HCl ⟶ $Na\underline{H}CO_3$ + $NaCl$

$(n = 1)$ (Acid)

(Base) Na_2CO_3 + HCl ⟶ $\underline{H_2}CO_3$ + $NaCl$

$(n = 2)$ (Acid)

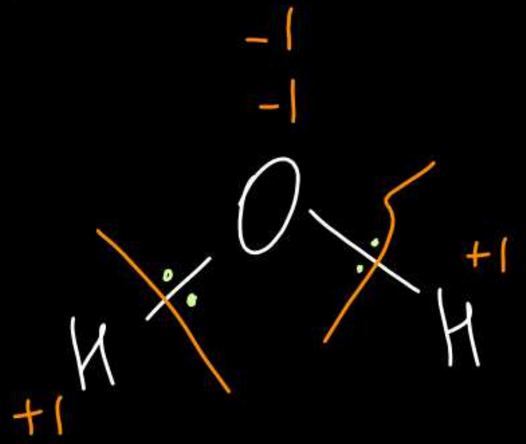
n-factor Calculation for Salts



Oxidation State

"The oxidation state of an atom can be defined as the hypothetical charge that would be held by that atom if all of its bonds to other atoms were completely ionic in nature."

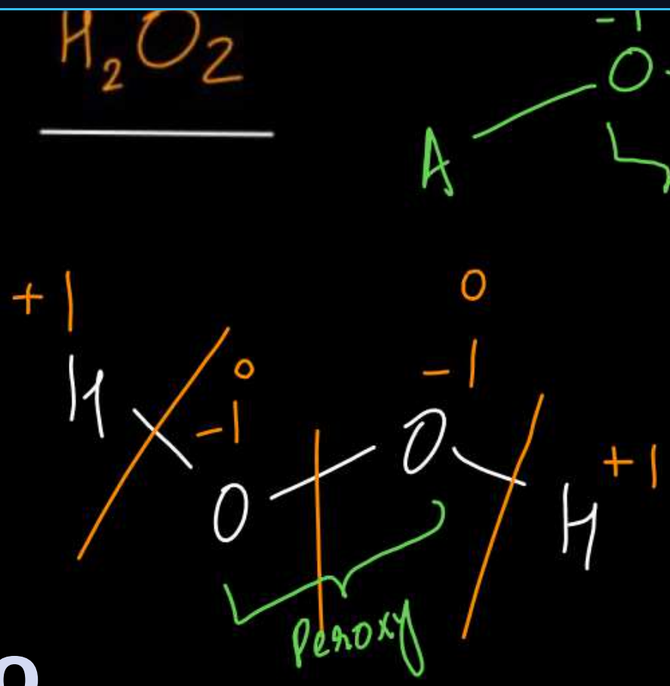
H_2O



O·S of O atom = −2

O·S of both H-atoms = +1

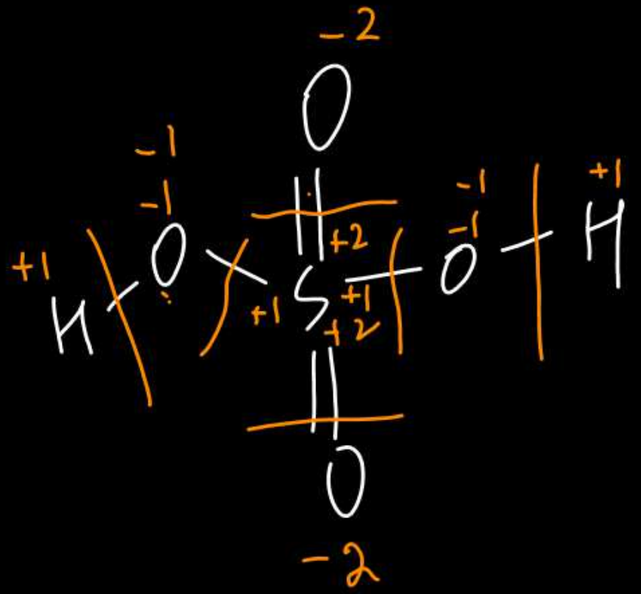
H_2O_2



O·S of both O-atoms = −1

O·S of both H-atoms = +1

H_2SO_4

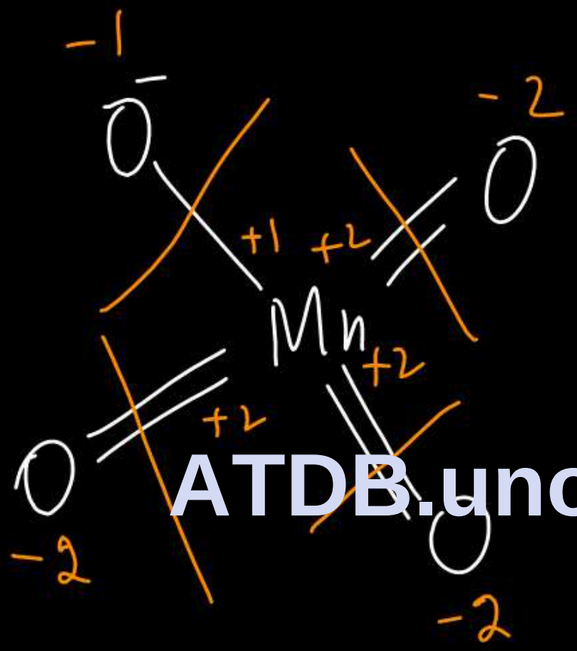


$S = +6$

$H = +1$

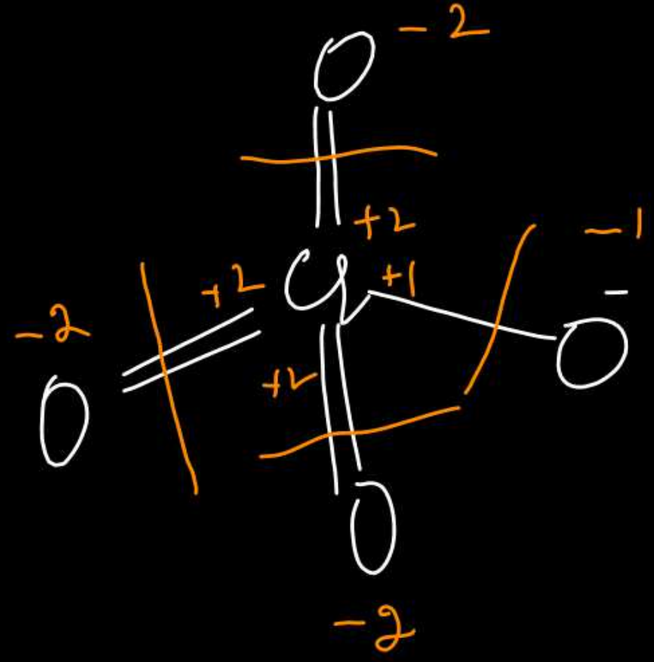
$O = -2$

MnO_4^-



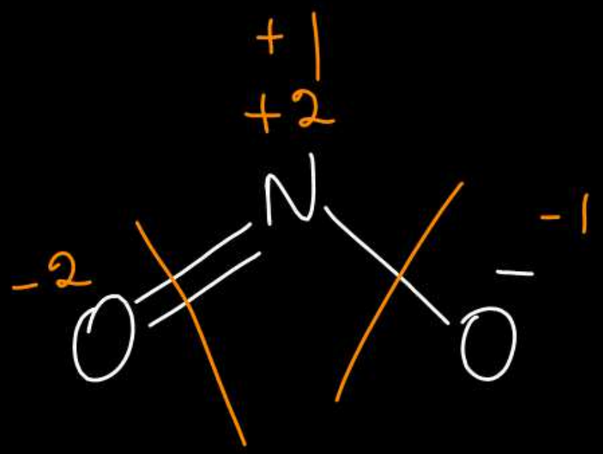
$Mn = +7$

ClO_4^-

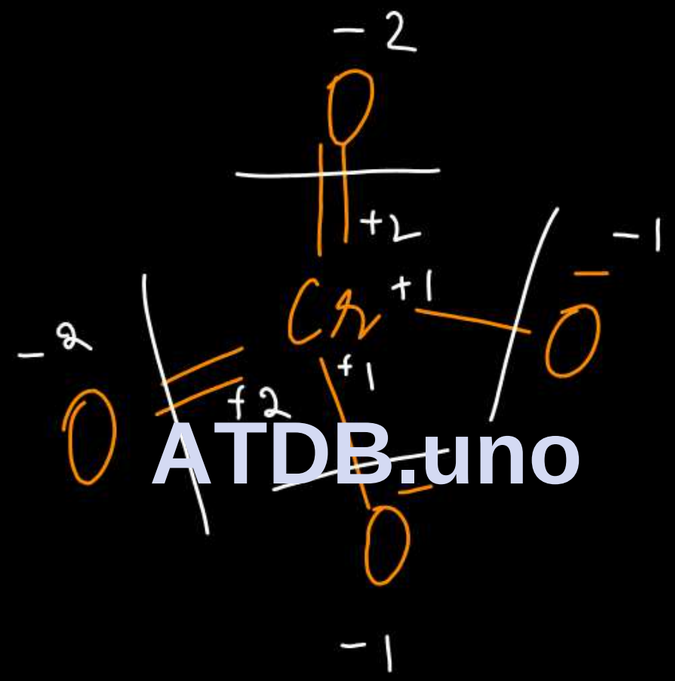


$Cl = +7$

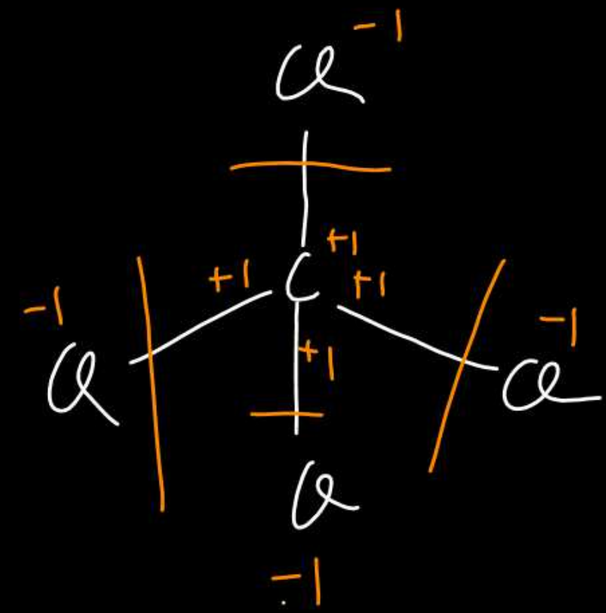
NO_2^-



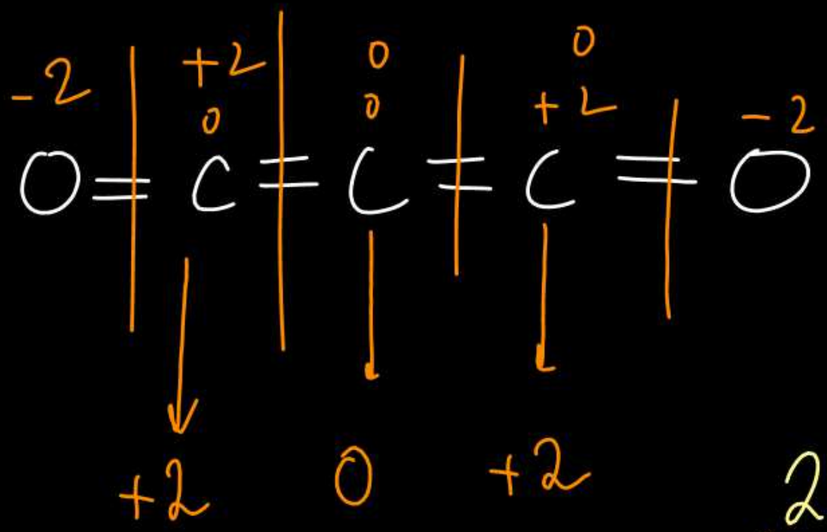
K_2CrO_4



CCl_4



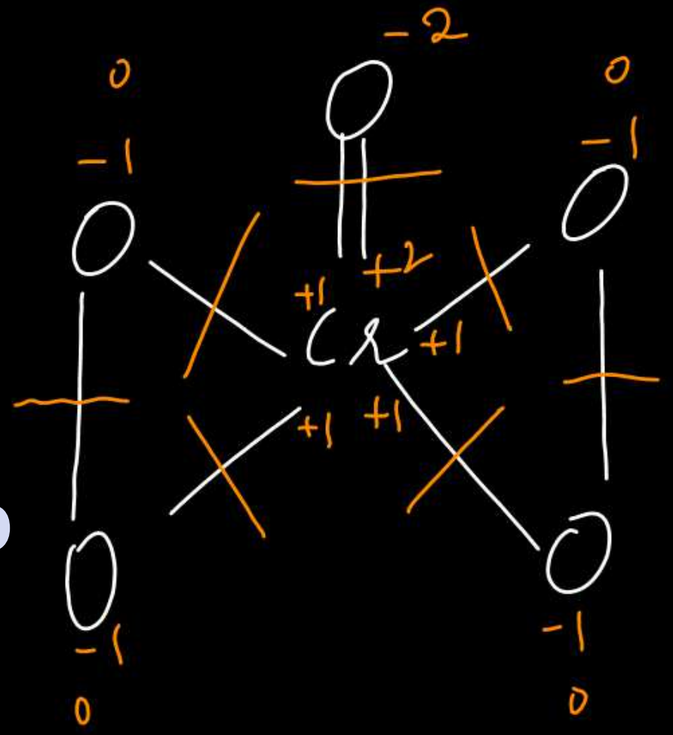
Carbon Suboxide (C_3O_2)



among 3-carbons $\begin{cases} 2C = +2 \\ 1C = 0 \end{cases}$

Avg O.S. of $C = \frac{2+0+2}{3} = +\frac{4}{3}$

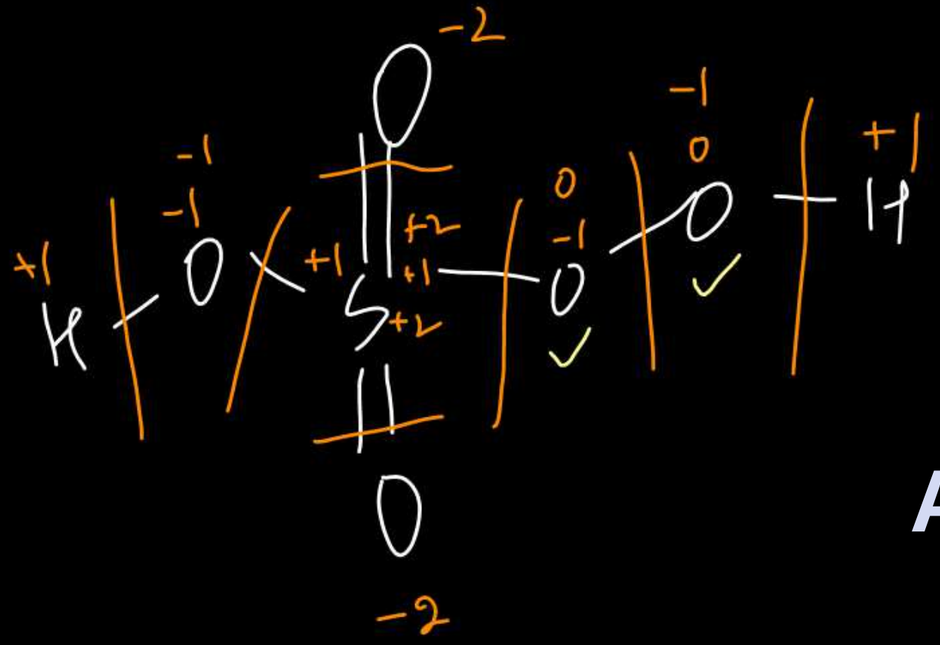
CrO_5 (Butterfly str)



O.S of Cr = +6

Among 5 O atoms $\begin{cases} 4O = -1 \\ 1O = -2 \end{cases}$

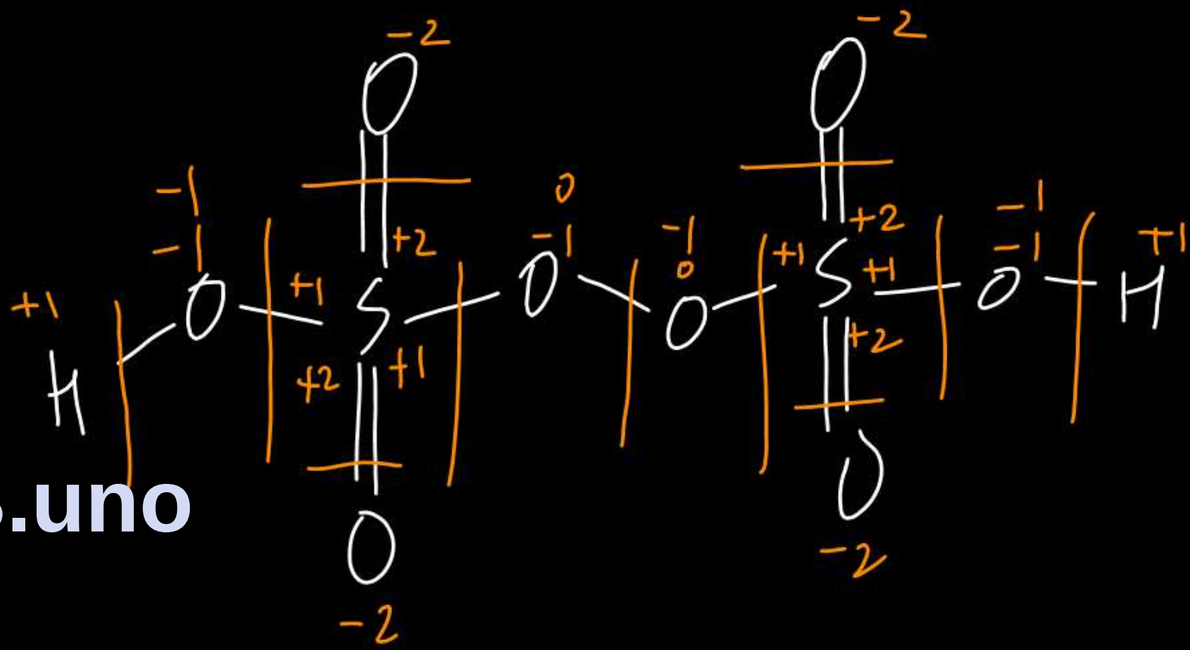
Caro's Acid (H_2SO_5)



0·5 of S atom = +6

Among 5 - O - atoms → 30 = -2, 20 = -1

Marshal's Acid ($H_2S_2O_8$)

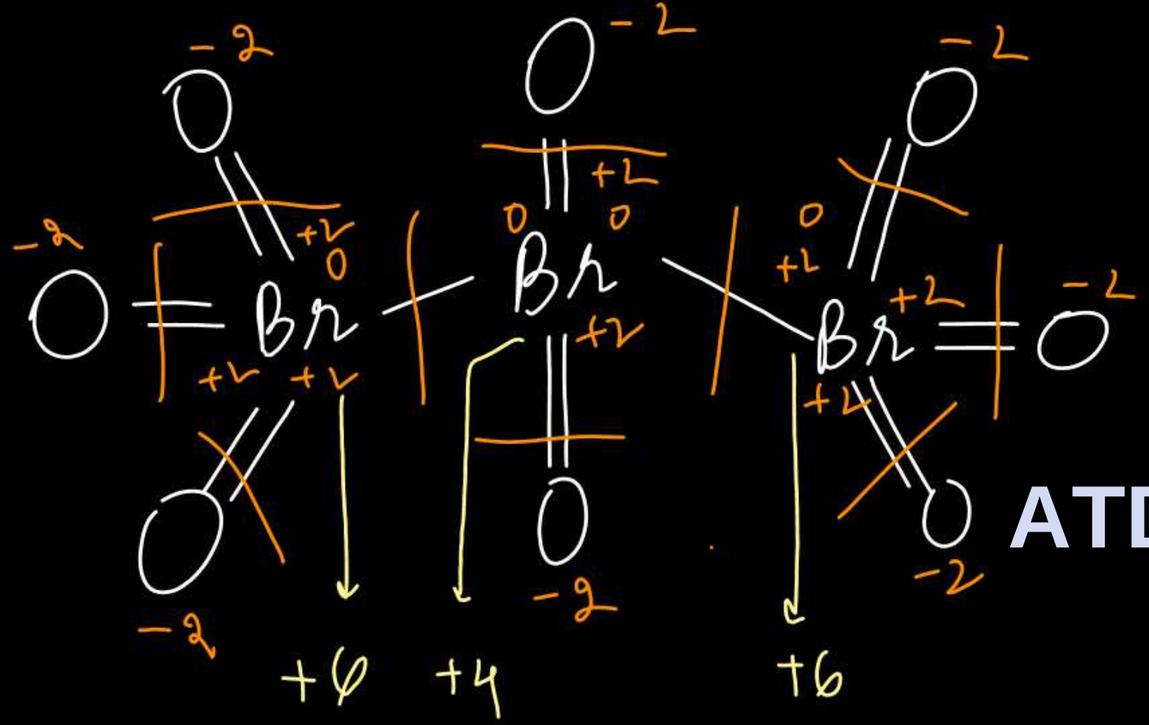


Among 2 S atoms both are +6

$$\text{Avg} = \frac{+6+6}{2} = +6$$

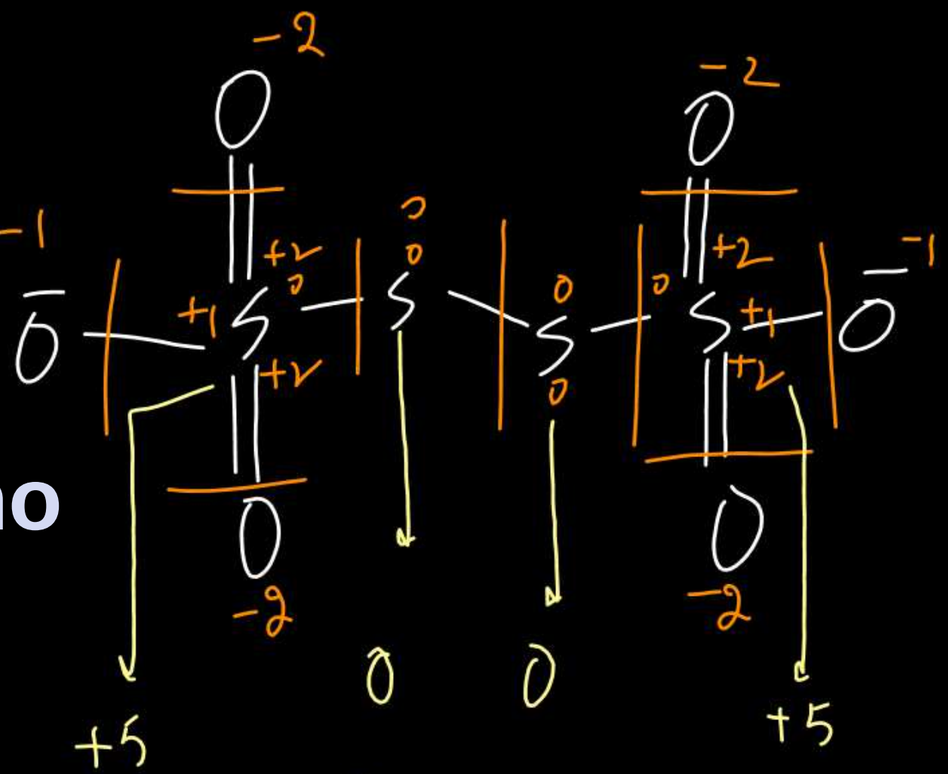
Among 8 O-atoms → 6O = -2, 2O = -1

Tribromooctaoxide (Br_3O_8)



$$\text{Avg} = \frac{+6+4+6}{3} = +\frac{16}{3}$$

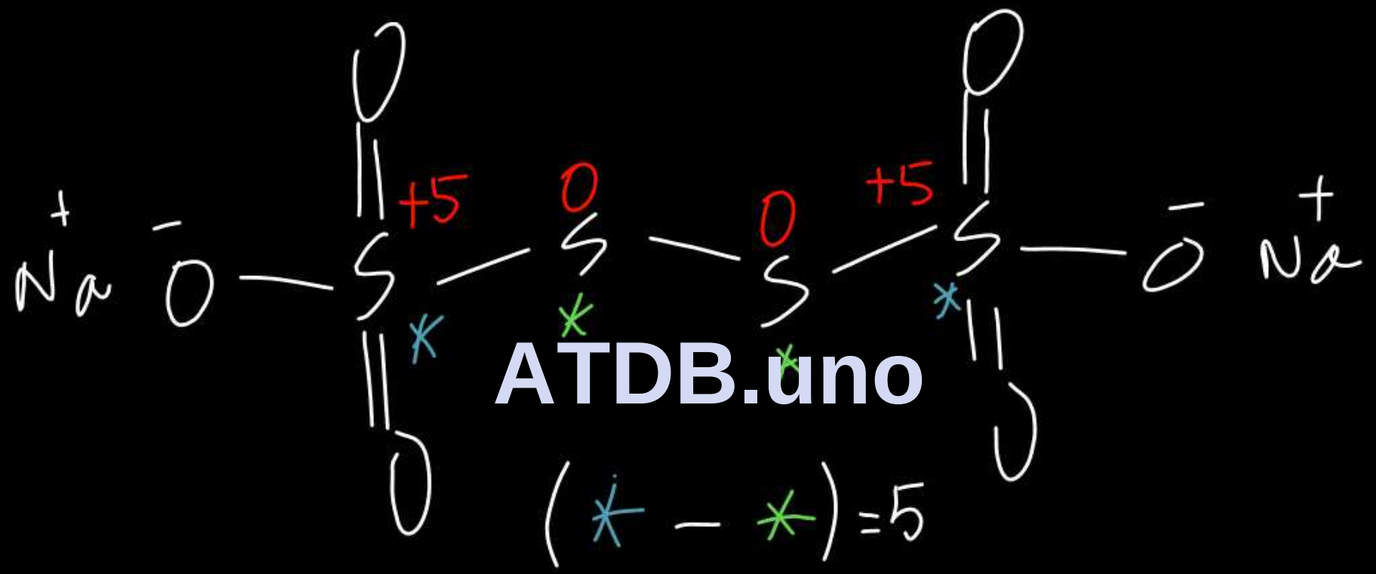
Tetrathionate ion ($S_4O_6^{2-}$)



$$\text{Avg} = \frac{5+0+0+5}{4} = \frac{5}{2} = 2.5$$

JEE Adv. 2011 Paper 1

The difference in the oxidation states of two types of sulphur atoms in $Na_2S_4O_6$ is



Rules governing Oxidation state

i) Fluorine Atom

* Fluorine is most electronegative element. It always has oxidation number equal to -1 in all its compounds.

* In case of F_2 it is zero.

ii) Oxygen Atom

$O \neq O$

a) In general as well as in its oxides $= -2$

b) In Peroxide (H_2O_2, Na_2O_2 etc) $= -1$

c) In superoxide (KO_2 etc) $= -\frac{1}{2}$

d) In ozonide (KO_3 etc) $= -\frac{1}{3}$

e) In O_2F_2 and OF_2 $= +1, +2$ respectively

f) In Oxygen molecule (O_2) $= 0$

iii) Hydrogen Atom

* In general hydrogen atom has oxidation number equal to +1.
* In metallic hydrides (NaH, KH etc) it is −1.
* In H_2 the O.S of H = 0

(V) Halogen Atom

* In general halogen (Cl, Br, I) has oxidation number = −1

* When halogen is attached with more electronegative element then it will show positive oxidation state.

$\overset{+5}{KClO_3}$ $\overset{+5}{HIO_3}$ $\overset{+5}{KBrO_3}$ $\overset{+7}{HClO_4}$

V) Metals

* Alkali metals (Li, Na, K, Rb ...) = +1

* Alkaline Earth metals (Be, Mg, Ca, Sr ...) = +2

* Aluminium always has +3 oxidation number.

vi) Oxidation number of an element in free state or in allotropic forms is always zero. S_8, P_4, $Fe_{(s)}$, $Na_{(s)}$

vii) Sum of charges of elements in a molecule is zero.

viii) Sum of charges of all elements in an ion is equal to the charge on that ion.

LIST OF IONS

P.W.o

Cl^-	chloride	$C_2O_4^{2-}$	oxalate
Br^-	bromide	NO_3^-	nitrate
F^-	fluoride	N^{3-}	nitride
I^-	iodide	NO_2^-	nitrite
CO_3^{2-}	carbonate	ClO_4^-	perchlorate
CN^-	cyanide	ClO_3^-	chlorate
NC^-	isocyanide	ClO_2^-	chlorite
SO_4^{2-}	sulphate	ClO^-	hypochlorite
SO_3^{2-}	sulphite	CrO_4^{2-}	chromate
$S_2O_3^{2-}$	thiosulphate	$Cr_2O_7^{2-}$	dichromate
S^{2-}	sulphide	MnO_4^-	permanganate
P^{3-}	phosphide	PO_4^{3-}	phosphate

H_2SO_4

$2(+1) + x + 4(-2) = 0$

$\boxed{x = +6}$

$KMnO_4$

$+1 + x + 4(-2) = 0$

$\boxed{x = +7}$

Br_3O_8

$3x + 8(-2) = 0$

$\boxed{x = +\frac{16}{3}}$

Question

If three electrons are lost by a metal ion M^{3+}, its final oxidation number should be :

A 0

B +6

C +2

D +4

Question

Oxidation number of Sulphur in Na_2SO_4 is

A −2

B +6

C +2

D −6

JEE Main 2 Sep 2022 Shift-2

The oxidation states of transition metal atoms in $K_2Cr_2O_7$ KMnO4 and K_2FeO_4, respectively, are x, y and z. The sum of x, y and z is _____.

Question

Oxidation number of Sulphur in S_2Cl_2 is :

A +1

B 0

C −1

D +6

JEE Main 2019

N_2O_3, NO, NO_2, N_2O arrange the increasing order of O.S. of nitrogen –

A N_2O, NO, N_2O_3, NO_2

B N_2O, NO_2, N_2O_3, NO

C NO_2, N_2O_3, N_2O, NO

D N_2O_3, NO, N_2O, NO_2

Question

In which of the following compound oxidation number of Cl is +3?

A ICl

B ClO_3

C ClF_3

D $HClO_4$

Question

Which of the following is the correct oxidation number of phosphorus in $Mg_2P_2O_7$

A −3

B +2

C +5

D +3

Question

Oxidation numbers of the two nitrogen atoms present in ammonium nitrate are respectively ?

A +3 and +3

B 0 and 0

C −3 and +5

D −1 and −1

Question

The oxidation number of cobalt in $[Co(CN)_6]^{3-}$ is –

A +3

B −3

C +6

D −6

Question

Oxidation number of Sulphur in $S_2O_2^{2-}$ is :

A −2

B +1

C +6

D 0

Question

In which of the following compound oxidation number of iron is not +3

A Fe_3O_4

B Fe_2O_3

C $FeCl_3$

D $FePO_4$

Question

In which of the following compound oxidation number of iron is not +3

A Fe_3O_4

B Fe_2O_3

C $FeCl_3$

D $FePO_4$

Question

Oxidation number of Sulphur in H_2SO_5 is

A +2

B +4

C +8

D +6

Question

Oxidation number of Fe in $K_3[Fe(CN)_6]$ is

A +2

B +3

C +1

D +4

Question

In which of the following compound, iodine is in its highest oxidation state

A KI

B KIO_4

C KI_3

D IF_5

H·W Module

Prabal + Prarambh

Mole Concept

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