PRAYAS

JEE 2026

PHYSICAL CHEMISTRY

REDOX REACTION

Lecture – 02   FAISAL RAZAQ

Topics to be covered

A Concept of Oxidation and Reduction

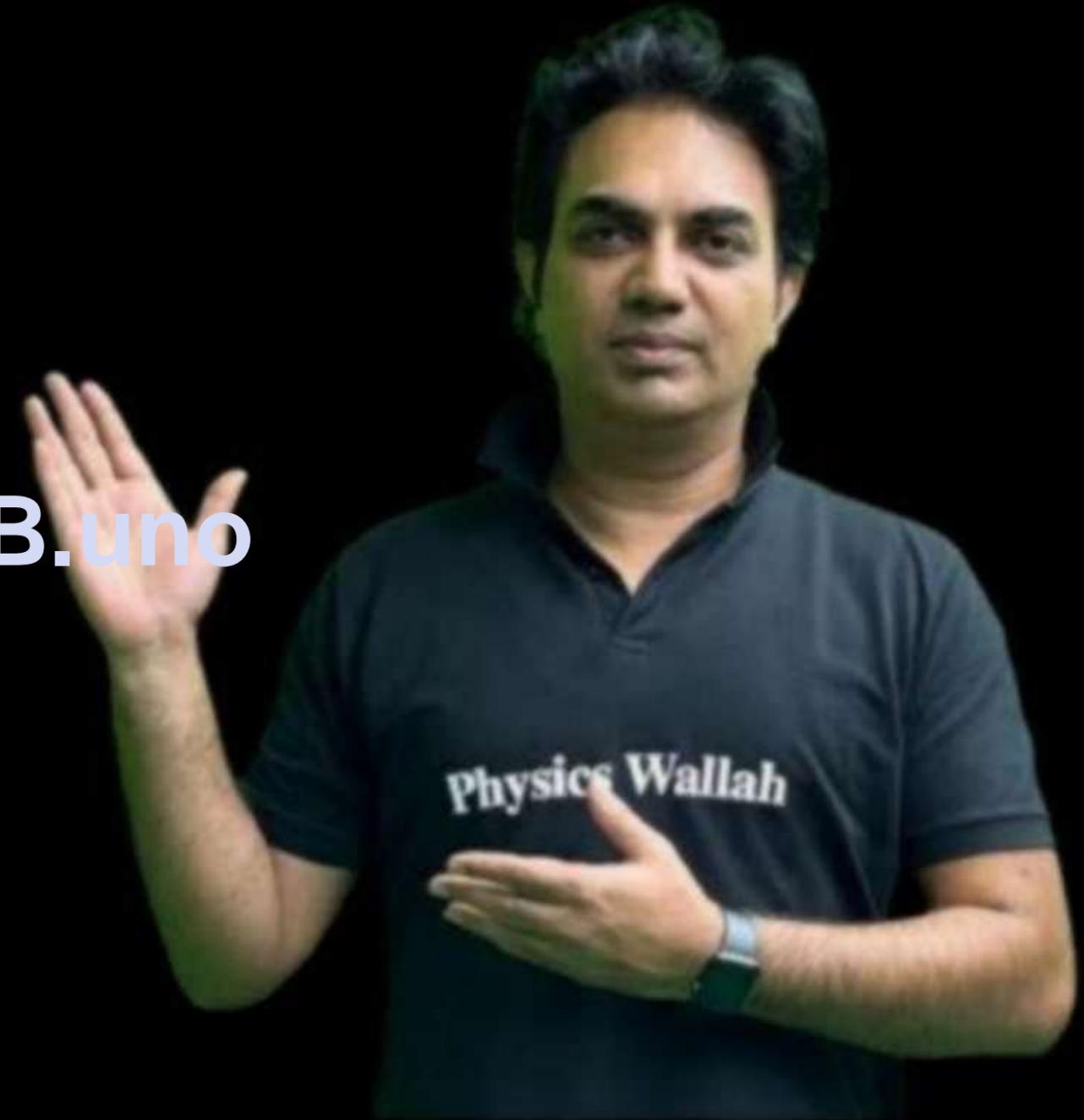**B** Oxidation State

ATDB.uno

Khoobsurat Baat 🙂

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

reaction likho lekin balance karna bhul gye toh beda bilkul garg ✌️ 😎

adv mei aaya hai, ignore karne ki galti mat karna

dimag ki jali batti 🤯

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

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

First write the reaction

$$\underset{(C_5H_{10})}{\text{——}} + Br_2 \longrightarrow \underset{(C_5H_{10}Br_2)}{\text{——}}$$

Moles of C_5H_{10} = 1143 × 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 = $\dfrac{n}{n+50}$, 19n = 50, n = 2.6315

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

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

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 = $\dfrac{n_B}{V_{solution}}$

$W_{Solvent}$ = 0.4 × 1000 = 400g = W_A

3.2 moles of H_2X in 1000 ml of Solution

Molality = $\dfrac{n_B}{W_A} \times 1000 = 3$

NO_2^-
0.5 of nitrogen atom : +3
0.5 of both oxygen atom : -3

$K_2Cr_2O_7$
0.5 of chromium atom : -2
0.5 of all oxygen atom : +6

CCl_4
0.5 of carbon atom : +4
0.5 of all chlorine atom : -1

ATDB.uno PDFZ

ATDB.uno | Studyprayas à FOR PERSONAL STUDY USE ONLY. DO NOT SHARE OR REDISTRIBUTE.

ATDB PDFZ

https://ATDB.uno | Unauthorised redistribution is strictly prohibited

ATDB.uno

ATDB.uno

n-factor Calculation for acids

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

$$K_x H_y (C_2 O_4)_z \xrightarrow[\text{(Base)}]{NaOH} E_1$$

(M)

$$\downarrow KMnO_4$$
$$(oxidising\ agent)$$

$$= \frac{M}{y}$$

$E_2 = $ Humne Dahi Pata !
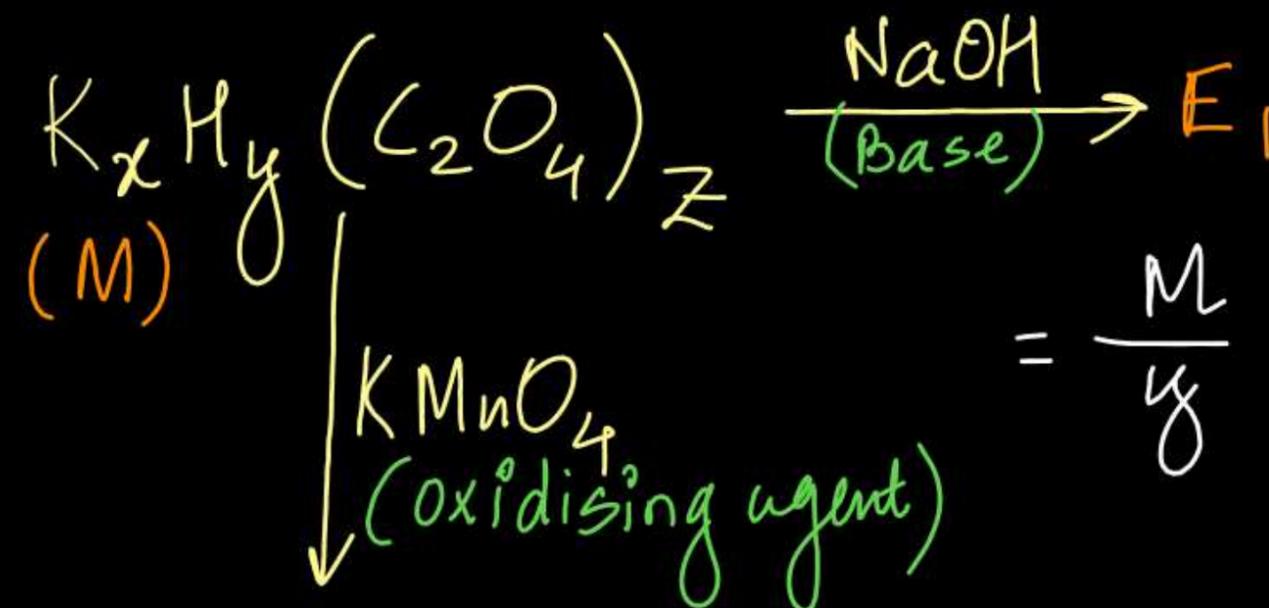
ATDB.uno

if the equivalent weight of $K_x H_y (C_2 O_4)_z$ is E_1 and E_2 then find out the value of E_1 and E_2 in terms of M.

$$KH\underline{C_2O_4} \cdot \underline{H_2}C_2O_4 \cdot nH_2O \xrightarrow[(Base)]{NaOH} E_1 = \frac{M}{3}$$

$$\downarrow \begin{array}{c} K_2Cr_2O_7 \\ (O.A) \end{array}$$
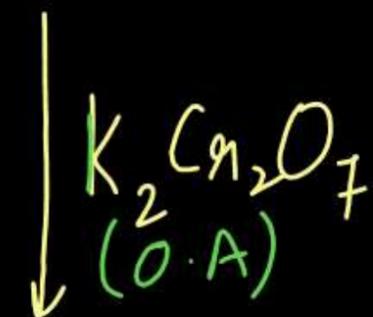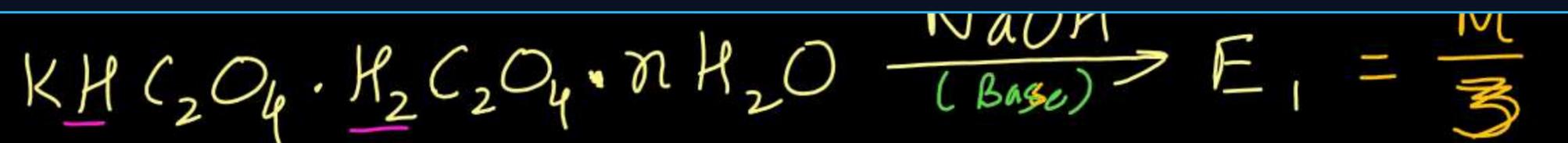
$$E_2 = \text{Hume wahi pata !}$$

ATDB.uno

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

Sometimes HCl behaves like a reducing agent.

ATDB.uno FZ

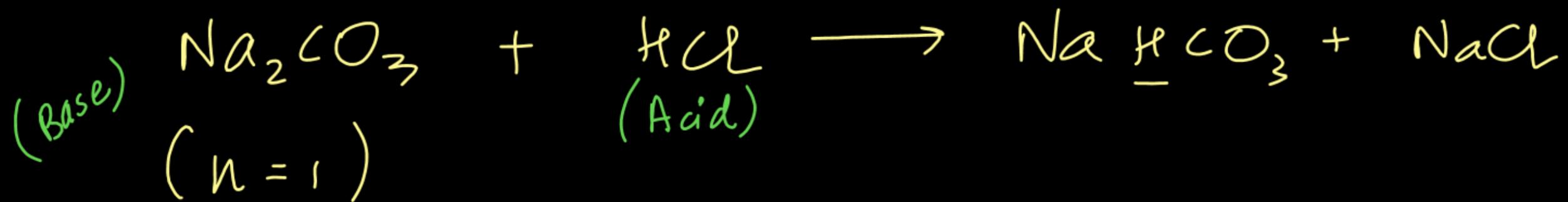ATDB.uno | Studyprayas â FOR PERSONAL STUDY USE ONLY. DO NOT SHARE OR REDISTRIBUTE.

ATDB PDFZ

https://ATDB.uno | Unauthorised redistribution is strictly prohibited
ATDB.uno

ATDB.uno

n-Factor Calculation for Base

replaceable $\overline{OH}$ (hydroxyl ions)

or

acceptable H^+ ions

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

ATDB.uno

ATDB.uno | Studyprayas â FOR PERSONAL STUDY USE ONLY. DO NOT SHARE OR REDISTRIBUTE.

ATDB PDFZ

ATDB PDFZ

$$\text{(Base)} \quad Na_2CO_3 \quad + \quad HCl \quad \longrightarrow \quad NaHCO_3 \quad + \quad NaCl$$
$$\text{(Acid)}$$
$$(n=1)$$

$$\text{(Base)} \quad Na_2CO_3 \quad + \quad HCl \quad \longrightarrow \quad H_2CO_3 \quad + \quad NaCl$$
$$(n=2) \qquad \text{(Acid)}$$

ATDB.uno

n-Factor Calculation for Salts

i)

ii)

iii)

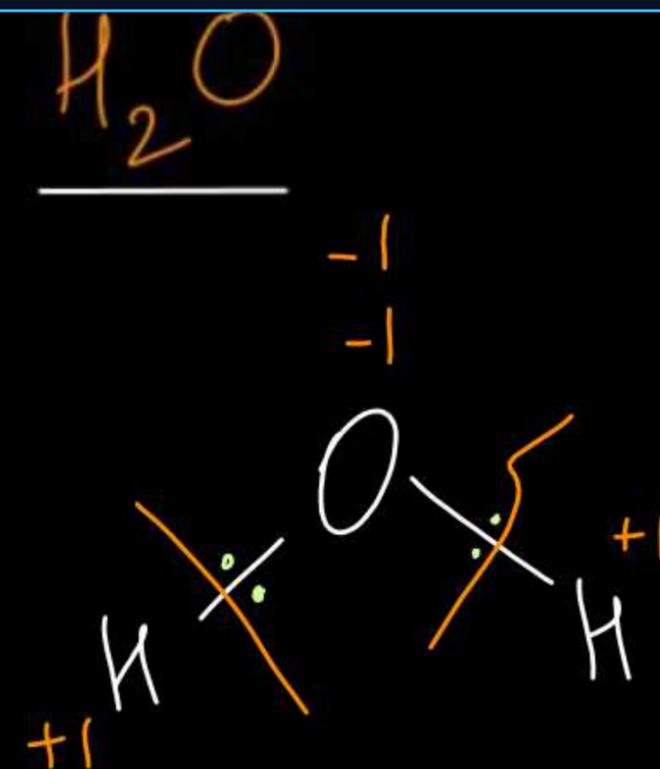$\left.\begin{array}{l} \\ \\ \\ \\ \\ \end{array}\right\}$ Oxidation state

ATDB.uno

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."
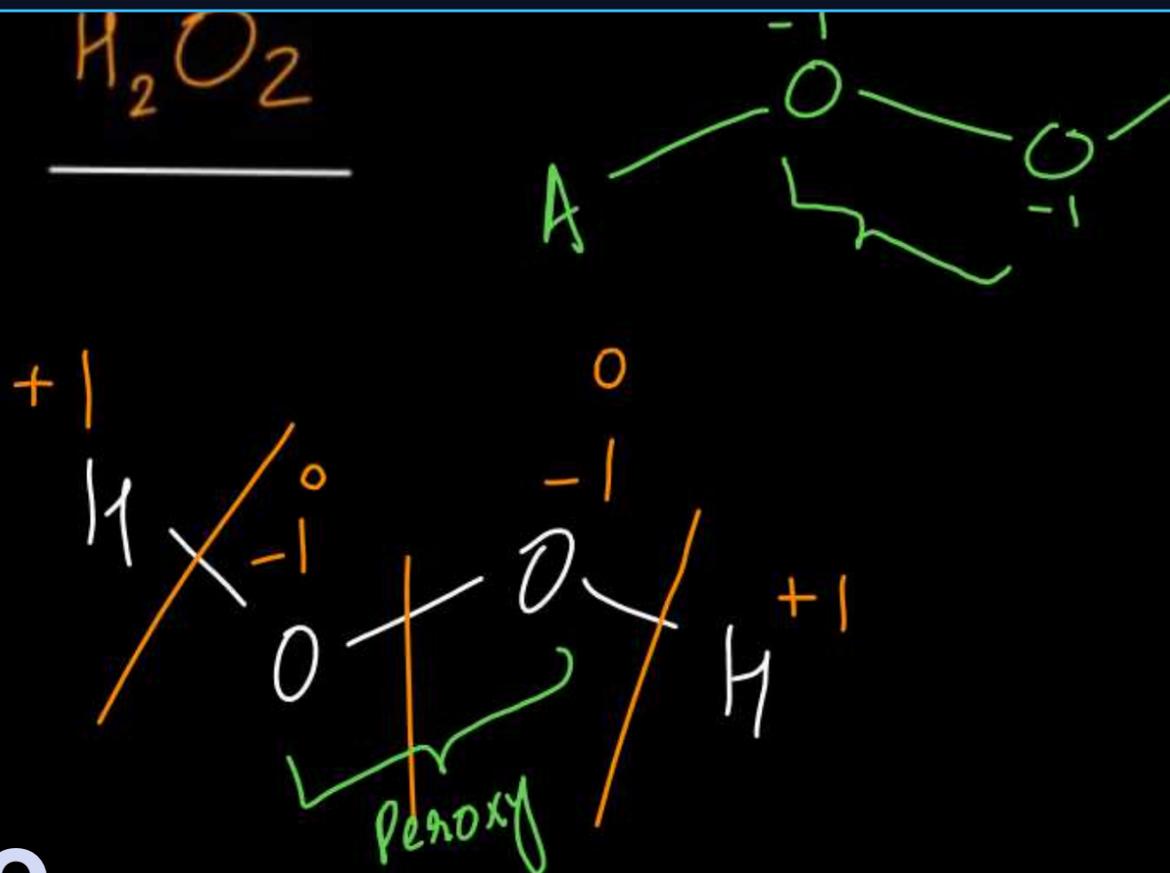
H_2O

$$-1$$
$$-1$$

$$+1$$
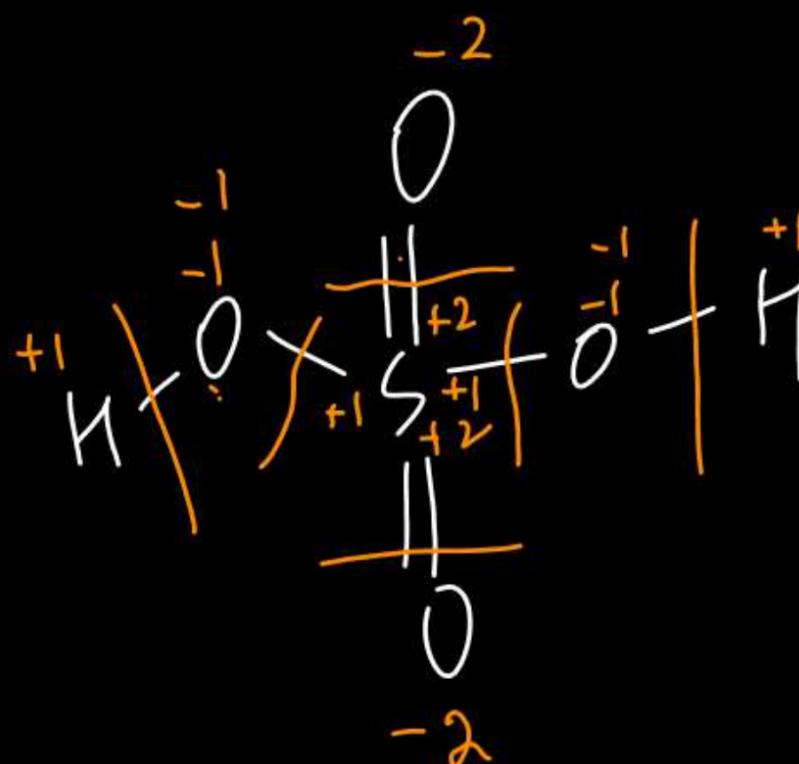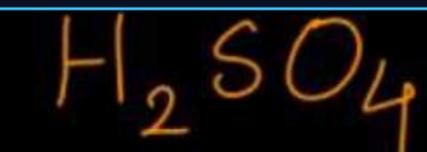
H—O—H $+1$

$+1$

O.S of O atom = -2
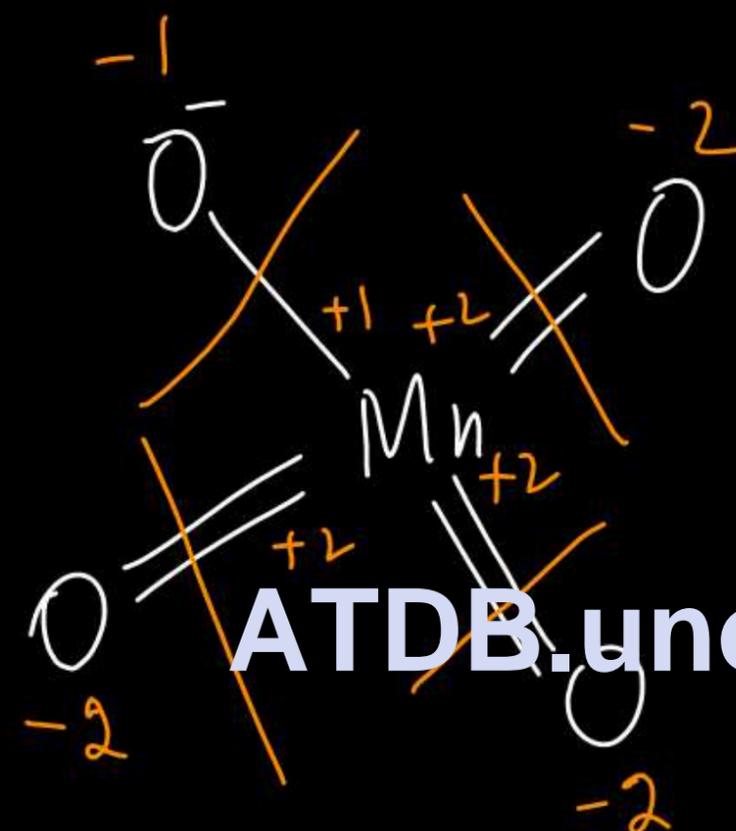
O.S of both H-atoms = $+1$

H_2O_2

A

$+1$

-1

-1

O

$$-1$$

peroxy

$+1$

O.S of both O-atoms = -1

O.S of both H- atoms = $+1$

$$H_2SO_4 \qquad MnO_4^- \qquad ClO_4^-$$

$$S = +6$$

$$H = +1$$

$$O = -2$$

$$Mn = +7$$

$$Cl = +7$$

ATDB.uno PDFZ

ATDB.uno | Studyprayas à FOR PERSONAL STUDY USE ONLY. DO NOT SHARE OR REDISTRIBUTE.

ATDB PDFZ

$$NO_2^-$$

$$+1$$
$$+2$$

$$^{-2}O \overset{N}{=} O^{-1}$$

$$K_2CrO_4$$

$$-2$$
$$+2$$
$$Cr^{+1}$$
$$+1$$
$$+2$$
$$-1$$
$$-1$$

$$CCl_4$$

$$-1$$
$$+1$$
$$^{-1}Cl \overset{+1}{\underset{+1}{C}} Cl^{-1}$$
$$-1$$

ATDB.uno

ATDB.uno
ATDB.uno | Studyprayas FOR PERSONAL STUDY USE ONLY. DO NOT SHARE OR REDISTRIBUTE.
ATDB PDFZ
https://ATDB.uno | Unauthorised redistribution is strictly prohibited
ATDB.uno
ATDB.uno
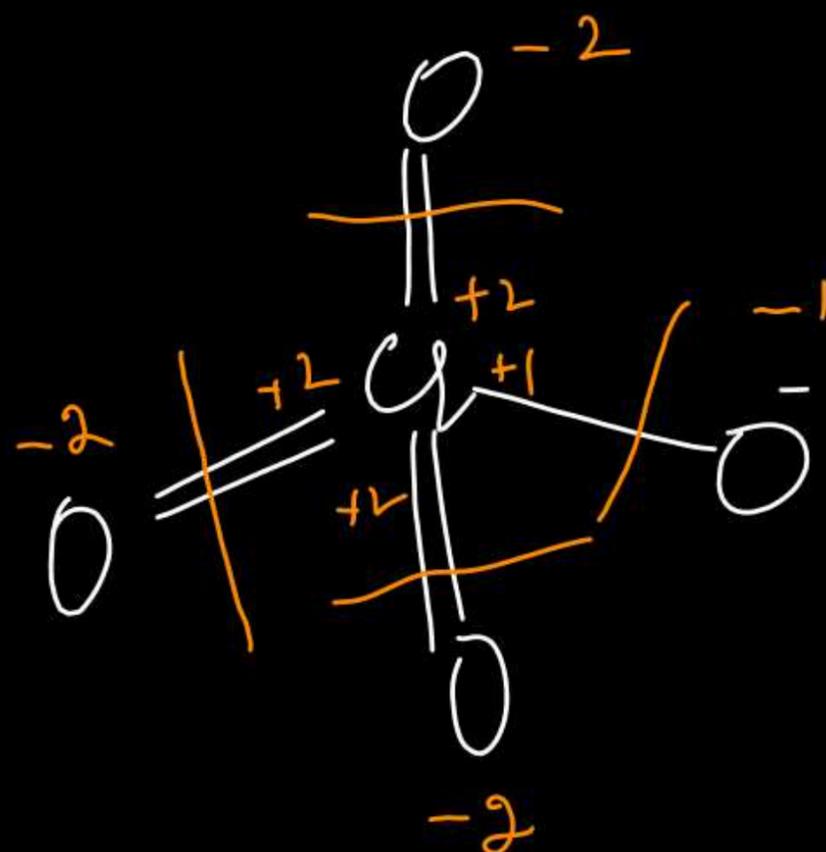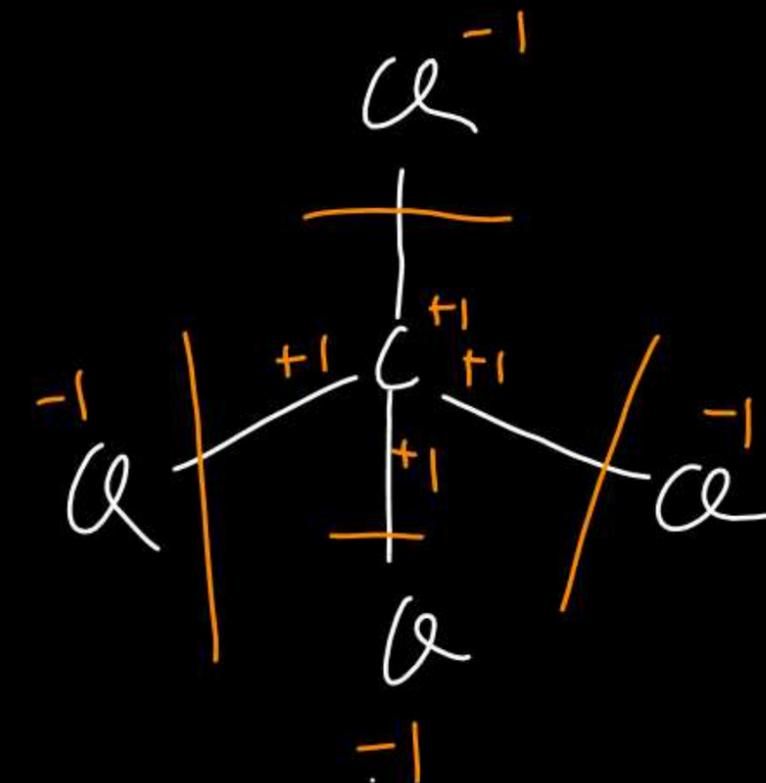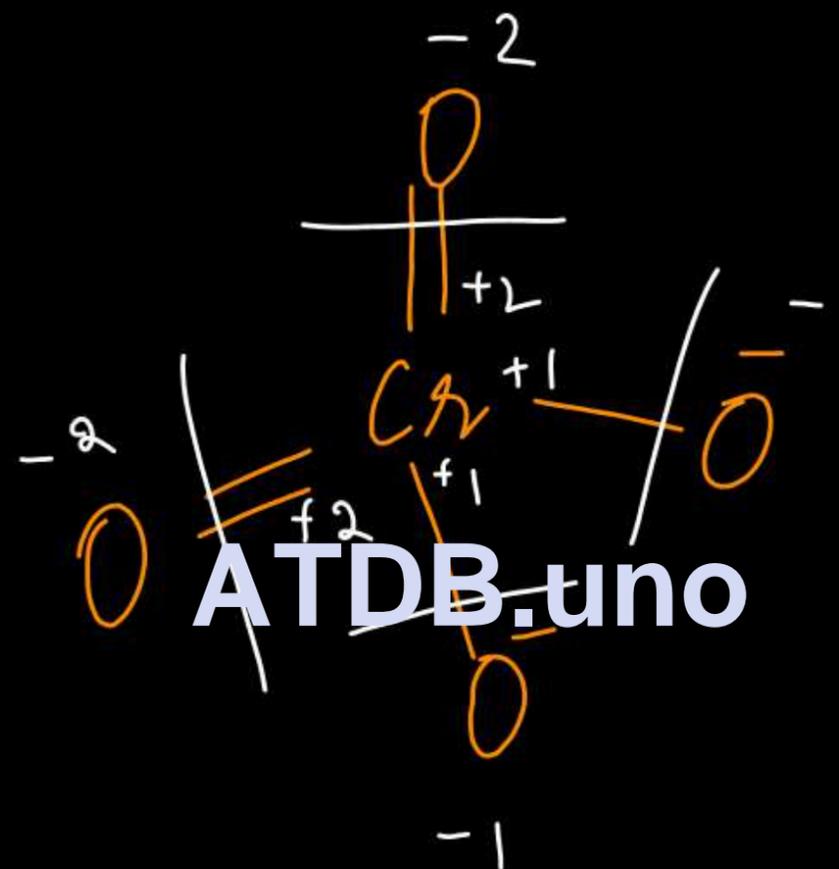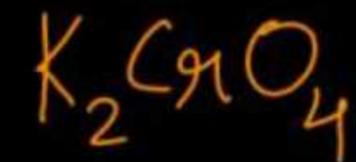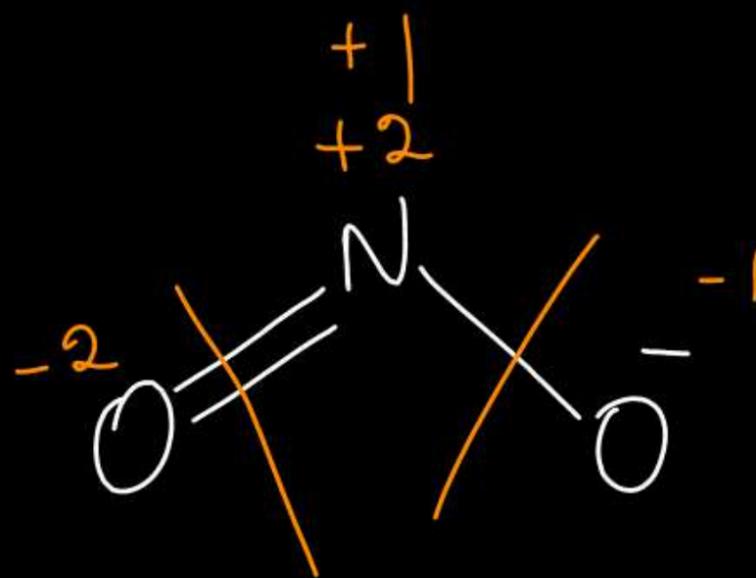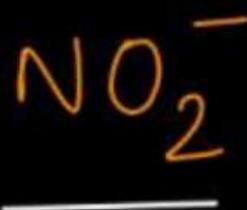
Carbon Suboxide (C_3O_2)

$$\overset{-2}{O} = \overset{+2}{\underset{0}{C}} = \overset{0}{\underset{0}{C}} = \overset{+2}{C} = \overset{-2}{O}$$

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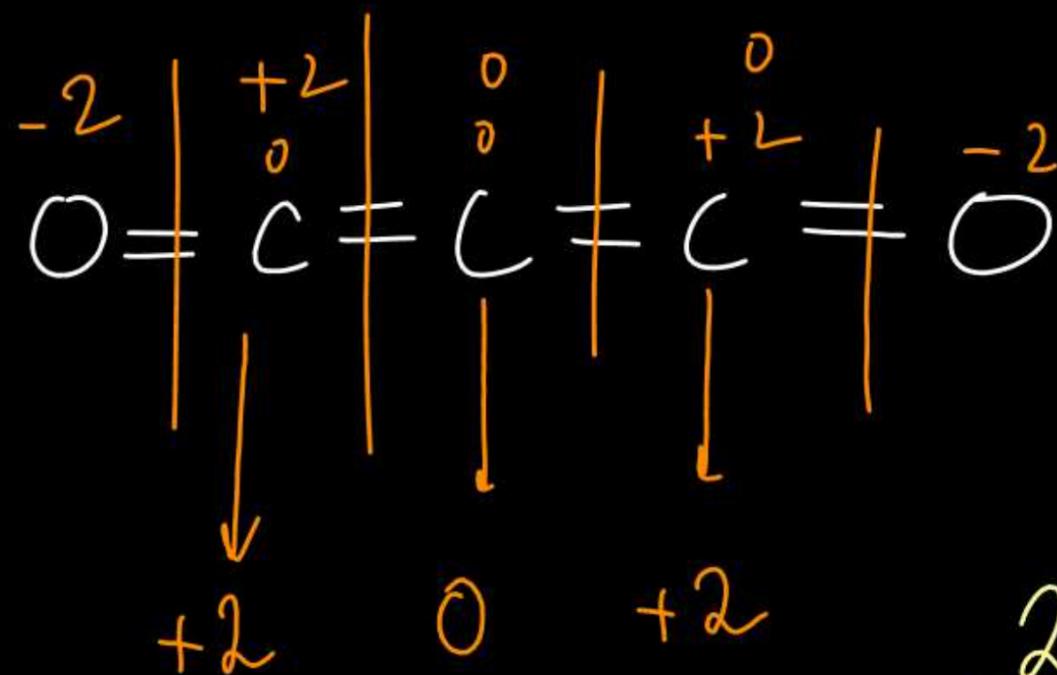
among 3-carbons $\begin{cases} 2C = +2 \\ 1C = 0 \end{cases}$

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

CrO_5 (Butterfly str)

O·S of $Cr = +6$

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

ATDB.uno
ATDB.uno | Studyprayas à FOR PERSONAL STUDY USE ONLY. DO NOT SHARE OR REDISTRIBUTE.
ATDB PDFZ
https://ATDB.uno | Unauthorised redistribution is strictly prohibited
ATDB.uno
ATDB.uno

Caro's Acid (H_2SO_5)

Marshal's Acid ($H_2S_2O_8$)
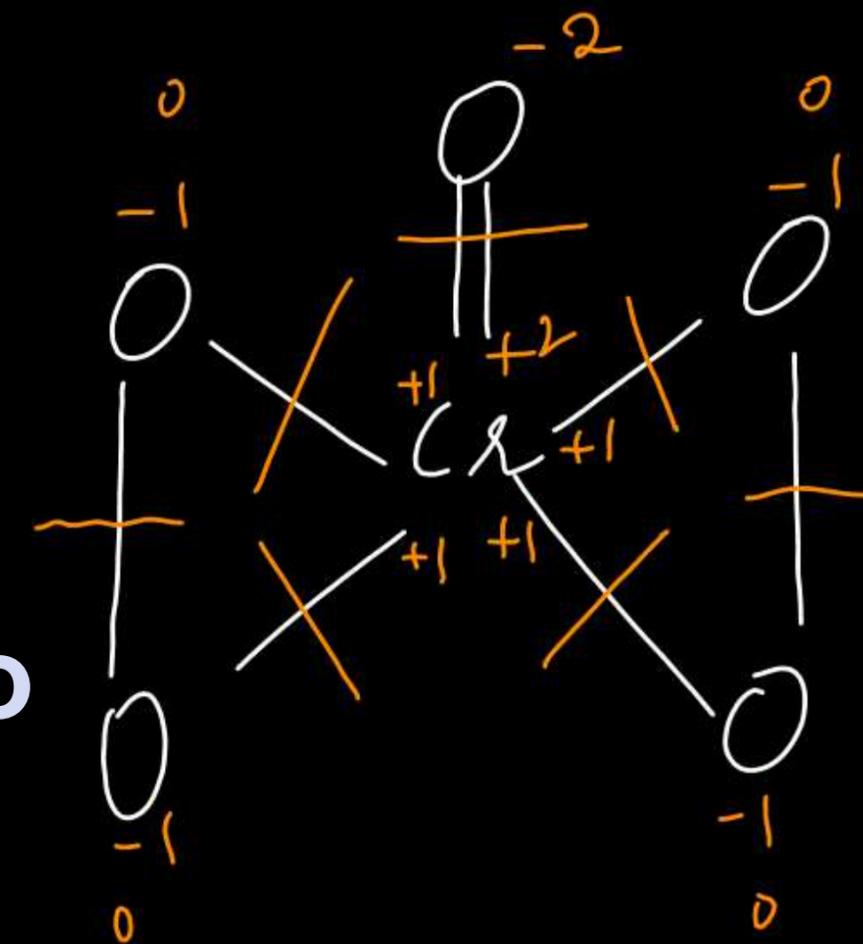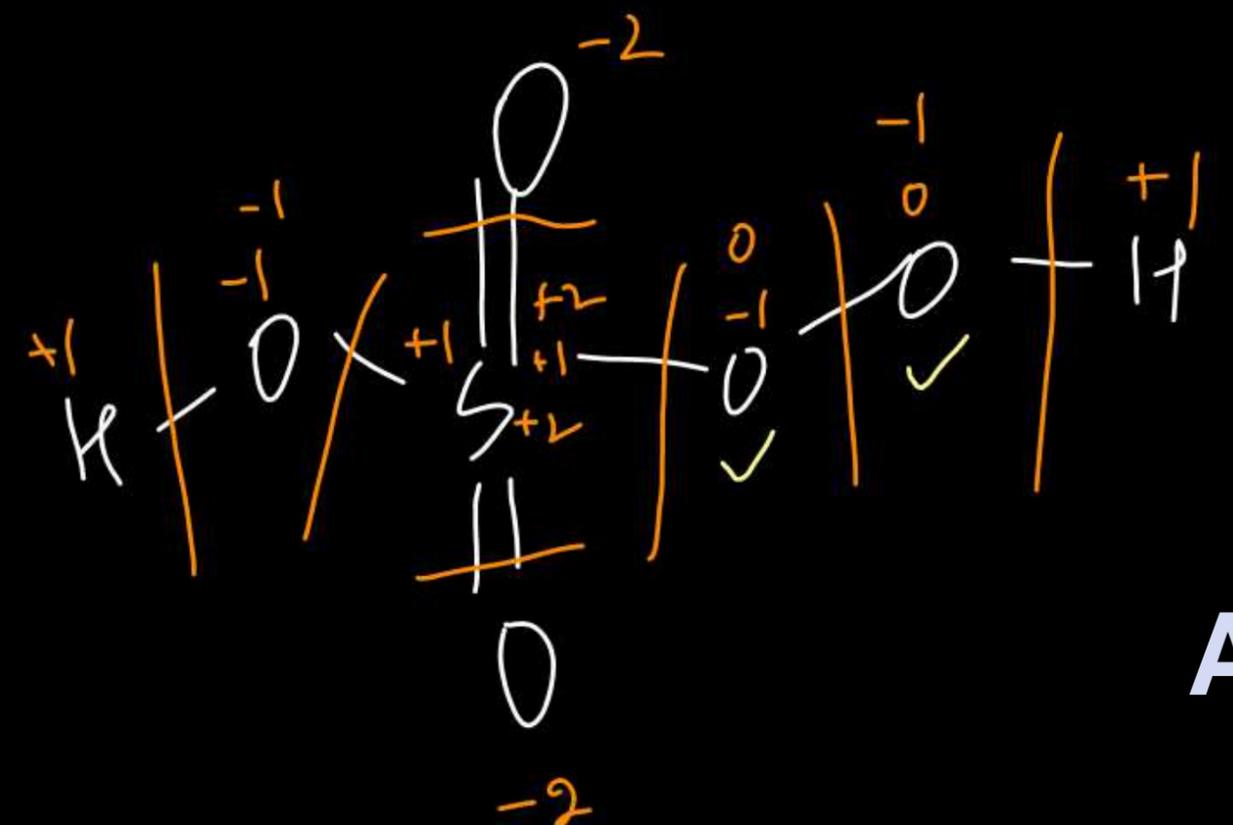
O.S of S atom $= +6$

Among 5·O-atoms $\begin{cases} 3O = -2 \\ 2O = -1 \end{cases}$
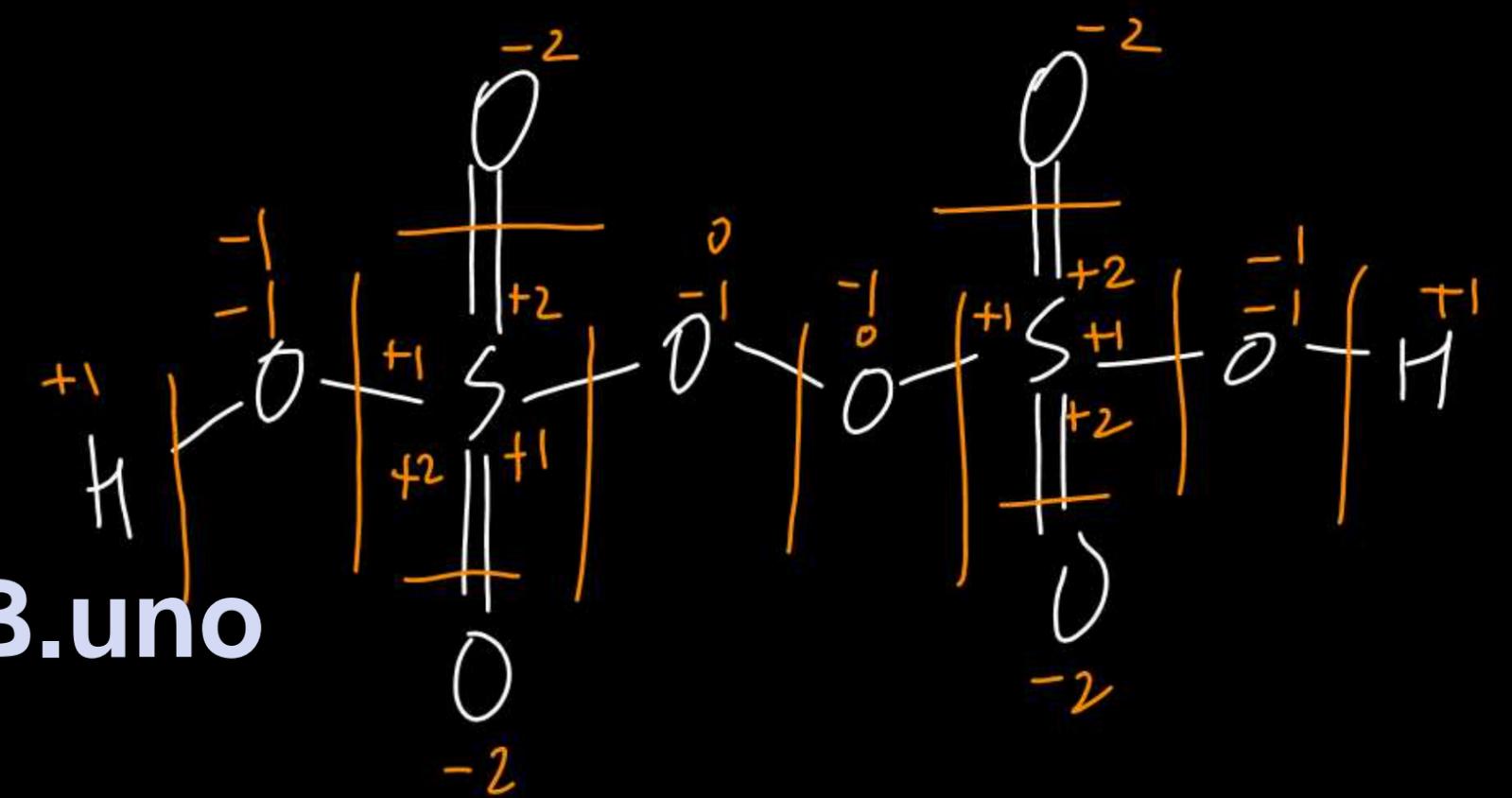
Among 2 S atoms both are $+6$

$Avg = \dfrac{+6+6}{2} = +6$

Among 8 O-atoms $\begin{cases} 6O = -2 \\ 2O = -1 \end{cases}$

Tribromooctaoxide (Br_3O_8)

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

$+6 \quad +4 \qquad +6$

Tetrathionate ion ($S_4O_6^-$)

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

$+5 \qquad 0 \qquad 0 \qquad +5$

ATDB.uno

ATDB.uno | Studyprayas à FOR PERSONAL STUDY USE ONLY. DO NOT SHARE OR REDISTRIBUTE.

ATDB PDFZ
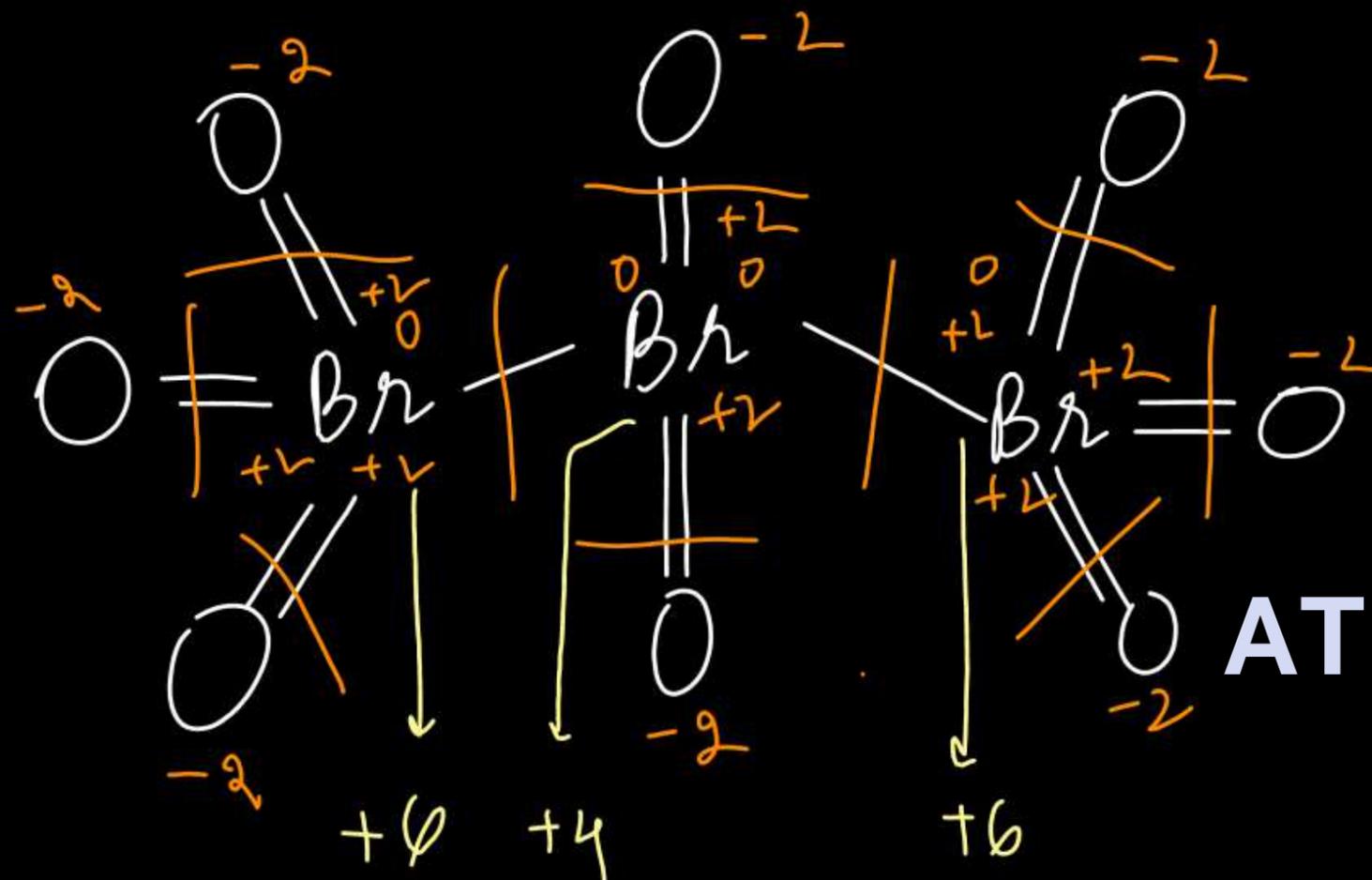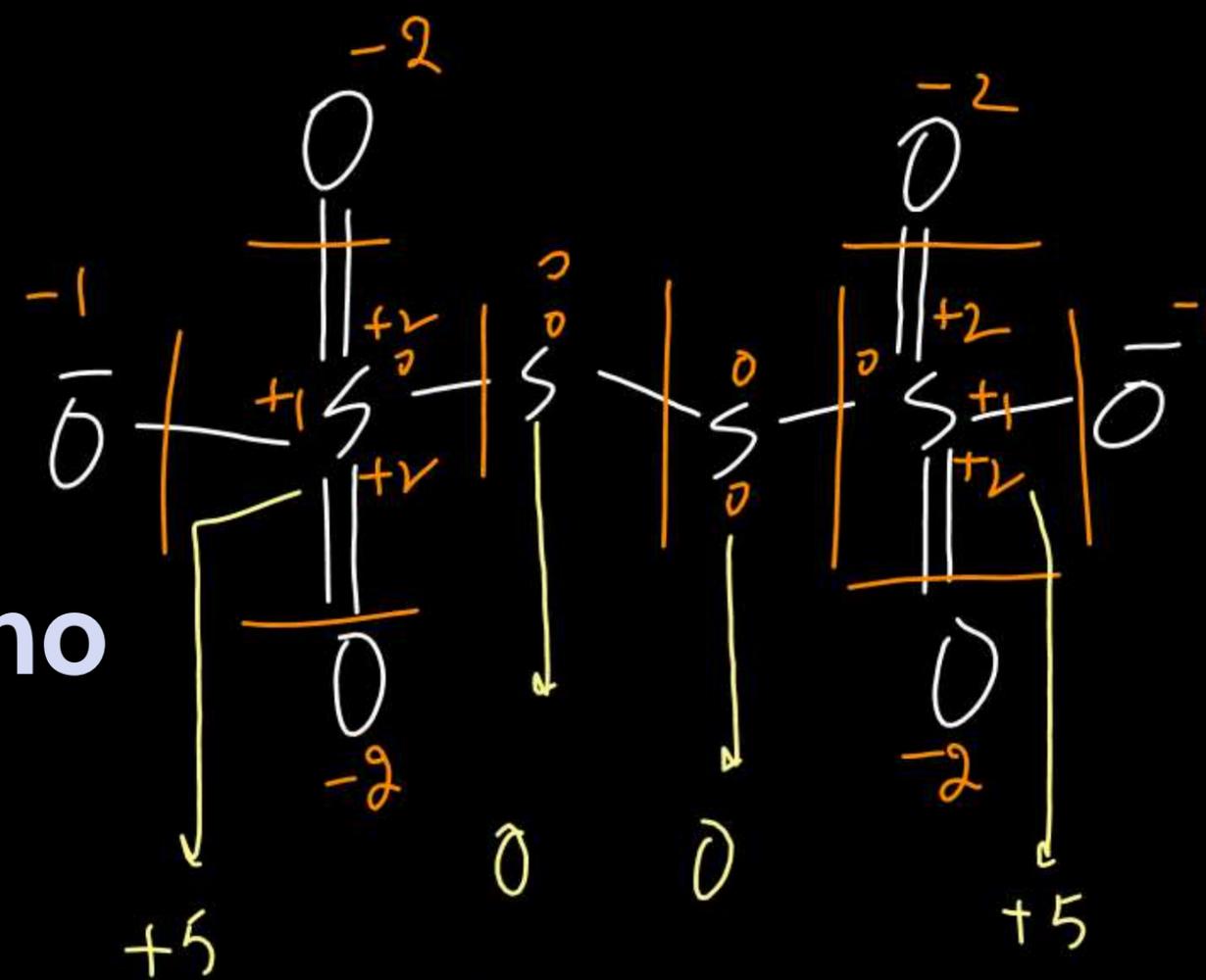
ATDB.uno

JEE Adv. 2011 Paper 1

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

$$(\ast - \ast) = 5$$
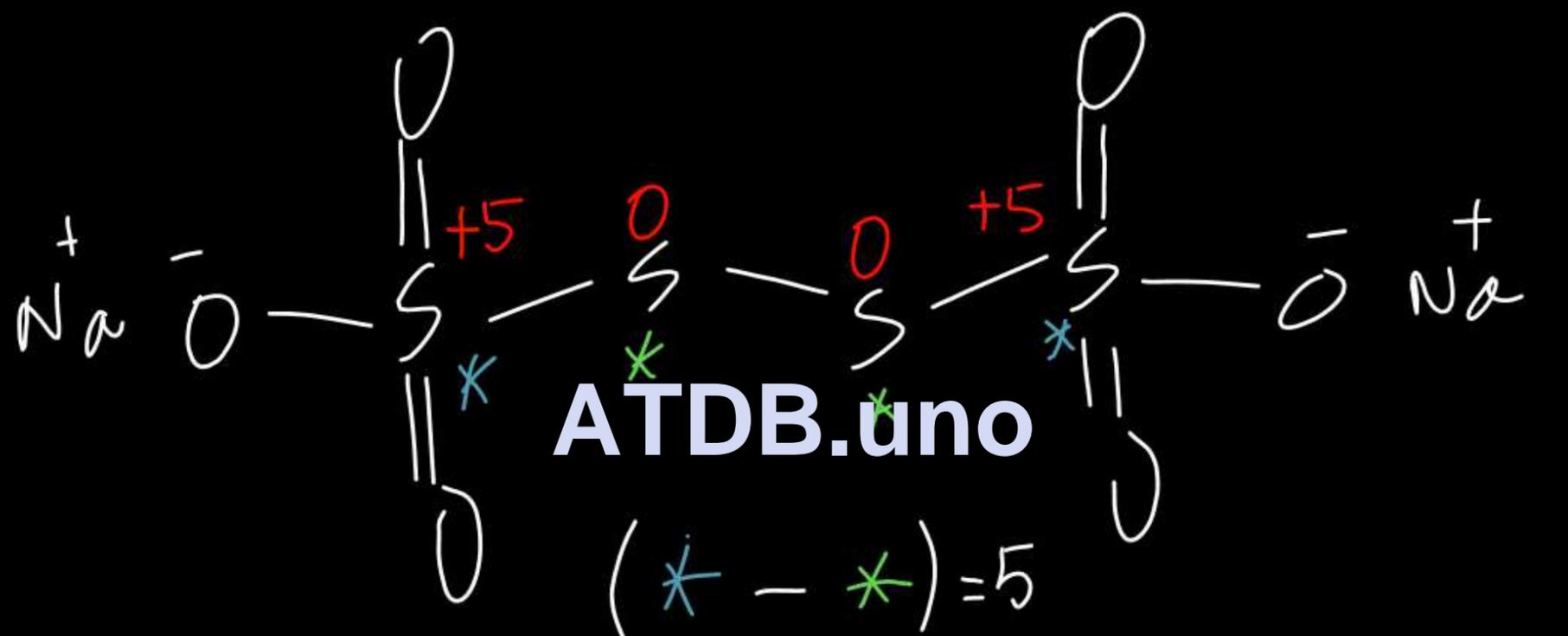
Rules governing Oxidation state

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.

$$\overset{0}{F} - \overset{0}{F}$$

ATDB.uno FZ
ATDB.uno | Studyprayas â FOR PERSONAL STUDY USE ONLY. DO NOT SHARE OR REDISTRIBUTE.
ATDB PDFZ
https://ATDB.uno | Unauthorised redistribution is strictly prohibited
ATDB.uno
ATDB.uno

ii) Oxygen Atom

$$O = O$$

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

H—H

* 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 $H = 0$

ATDB.uno PDFZ

ATDB.uno | Studyprayas â FOR PERSONAL STUDY USE ONLY. DO NOT SHARE OR REDISTRIBUTE.

ATDB PDFZ

IV) 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.

$$\overset{+5}{K}ClO_3 \qquad \overset{+5}{} \qquad \overset{+5}{K}BrO_3 \qquad \overset{+7}{H}ClO_4$$
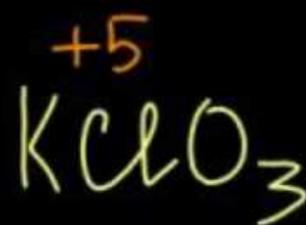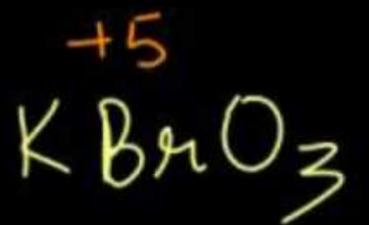
V) Metals

* 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 , $Fe_{(s)}$, $Na_{(s)}$

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

ATDB.uno

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

LIST OF IONS

H.W₀

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

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

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

ATDB.uno

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

ATDB.uno

ATDB.uno | Studyprayas å FOR PERSONAL STUDY USE ONLY. DO NOT SHARE OR REDISTRIBUTE.

ATDB PDFZ

Question

Oxidation number of Sulphur in Na_2SO_4 is

A –2

B +6

C +2

D –6

ATDB.uno

ATDB.uno

ATDB PDFZ

ATDB.uno | Studyprayas FOR PERSONAL STUDY USE ONLY. DO NOT SHARE OR REDISTRIBUTE.

ATDB PDFZ

https://ATDB.uno | Unauthorised redistribution is strictly prohibited

ATDB.uno

ATDB.uno

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

ATDB.uno

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

ATDB.uno

ATDB.uno PDFZ

ATDB.uno | Studyprayas â FOR PERSONAL STUDY USE ONLY. DO NOT SHARE OR REDISTRIBUTE.

ATDB PDFZ

Question

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

A ICl

B ClO_3

C ClF_3

D $HClO_4$

ATDB.uno

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

ATDB.uno

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

ATDB.uno PDFZ

ATDB.uno | Studyprayas â FOR PERSONAL STUDY USE ONLY. DO NOT SHARE OR REDISTRIBUTE.

ATDB PDFZ

Question

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

A +3

B –3

C +6

D –6

ATDB.uno

ATDB.uno | Studyprayas à FOR PERSONAL STUDY USE ONLY. DO NOT SHARE OR REDISTRIBUTE.

ATDB PDFZ

Question

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

A −2

B +1

C +6

D 0

ATDB.uno

ATDB.uno | Studyprayas â FOR PERSONAL STUDY USE ONLY. DO NOT SHARE OR REDISTRIBUTE.

ATDB PDFZ

ATDB PDFZ

ATDB.uno

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 $FePO_4$

ATDB.uno

ATDB.uno

ATDB.uno | Studyprayas å FOR PERSONAL STUDY USE ONLY. DO NOT SHARE OR REDISTRIBUTE.

ATDB PDFZ

ATDB PDFZ

https://ATDB.uno | Unauthorised redistribution is strictly prohibited

ATDB.uno

ATDB.uno

Question

Oxidation number of Sulphur in H_2SO_5 is

A +2

B +4

C +8

D +6

ATDB.uno

ATDB.uno

ATDB.uno | Studyprayas â FOR PERSONAL STUDY USE ONLY. DO NOT SHARE OR REDISTRIBUTE.

ATDB PDFZ

Question

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

A +2

B +3

C +1

D +4

ATDB.uno

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

ATDB.uno

H.W Module

Probal + Prarambh

Mole Concept.

ATDB.uno PDFZ

ATDB.uno | Studyprayas â FOR PERSONAL STUDY USE ONLY. DO NOT SHARE OR REDISTRIBUTE.

ATDB PDFZ