PRAYAS

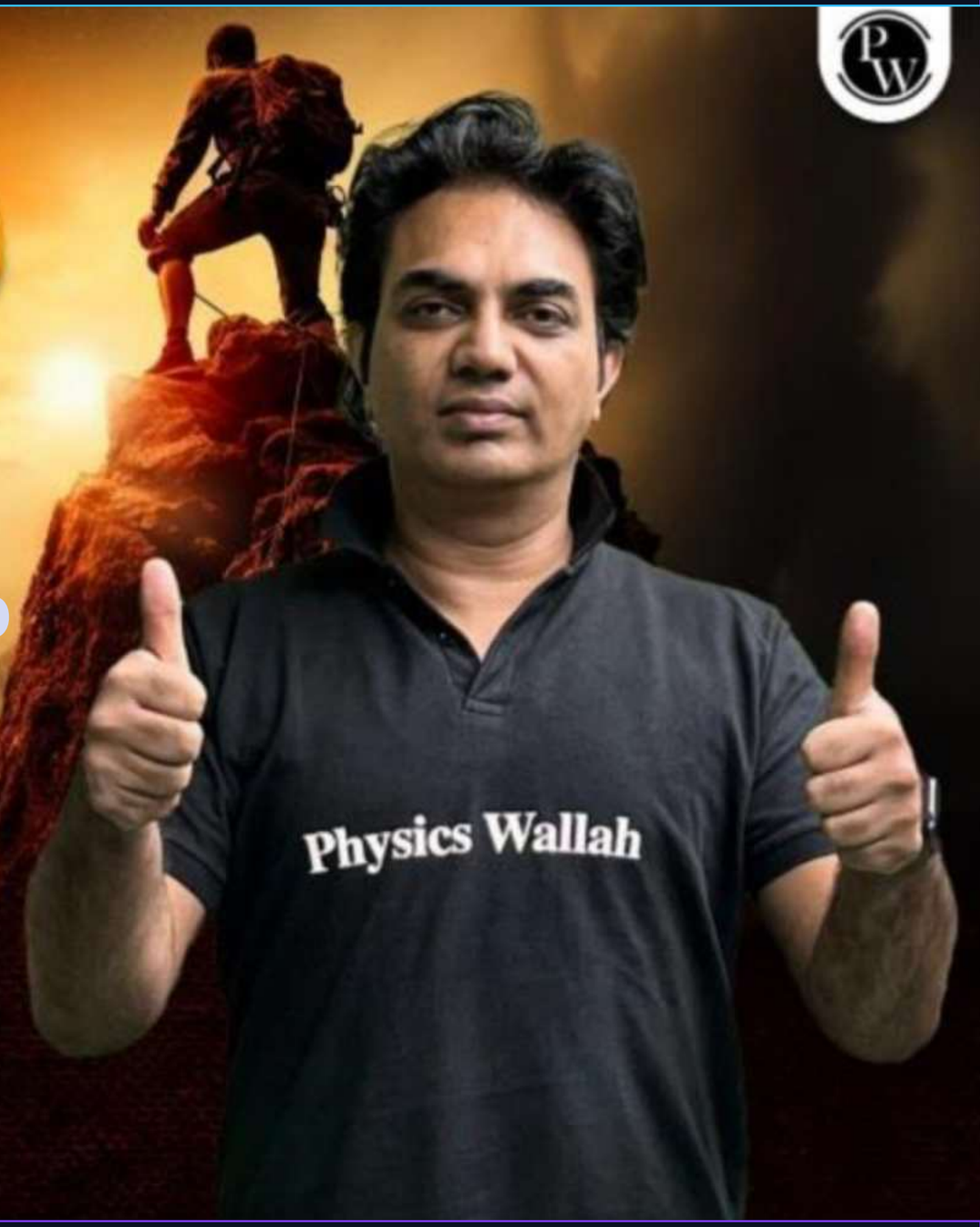
JEE 2026

PHYSICAL CHEMISTRY

REDOX REACTION

Lecture – 01

FAISAL RAZAQ



Topics to be covered

A Concept of Oxidation and Reduction

B Oxidation State

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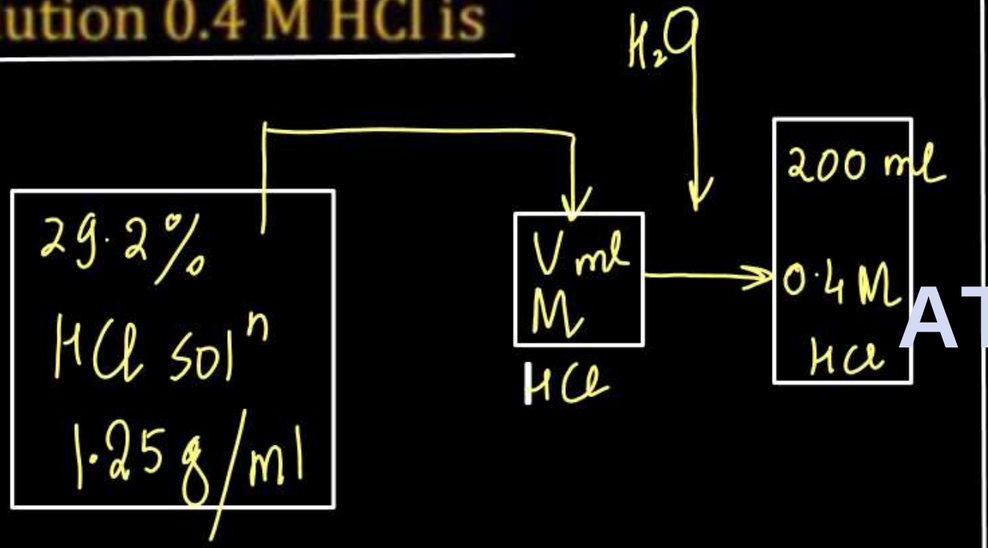
TELEGRAM GROUP BY FAISAL SIR

@FAISALSIRPW

JEE Adv. 2012

$M \times V = 200 \times 0.4$

29.2% (w/W) HCl stock solution has density of 1.25 g mL^{-1}. The molecular weight of HCl is 36.5 g mol^{-1}. The volume (mL) of stock solution required to prepare a 200 mL solution 0.4 M HCl is



29.2 gm HCl in 100 gm solution

wt of solute — wt of solution

$$\text{Molarity} = \frac{(29.2/36.5) \times 1000}{(100/1.25)} = 10\ M$$

$10 \times V = 0.4 \times 200$

$V = 8\ ml$

[Ans : 8]

Question A commercially sold conc. HCl is 35% HCl by mass. If the density of this commercial acid is 1·46 g/ml, the molarity is –

[JEE Main - 2022]

A) 10·2 M

B) 12·5 M

C) 14·0 M

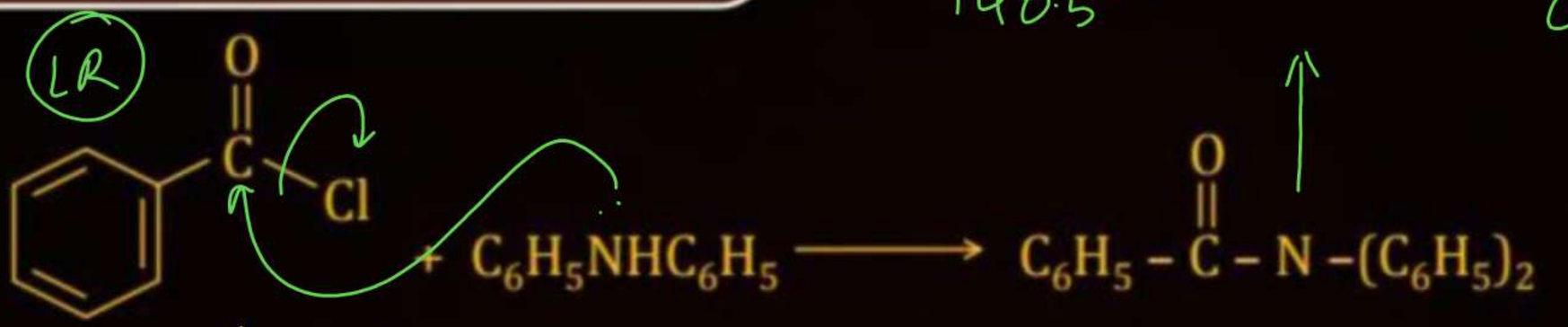
D) 18·2 M

(C)

JEE Main-17 March, 2021 Shift-II

$\frac{0.140}{140.5} \times 273 = 0.272\ g$

12



0.140 g (140.5) 0.388 g (169) 0.210 g (273)

Consider the above reaction. The percentage yield of amide product is _____.
(Round off to the nearest integer).
(Given : Atomic mass : C : 12.0 u, H : 1.0 u, N : 14.0 u, O : 16.0 u, Cl : 35.5 u)

$\%\ yield = \frac{0.210}{0.272} \times 100 \simeq 77\%$

Question

A 6.9 M solution of KOH has in water has 30% by weight of KOH. Calculate the density of solution.

[Ans : 1.288]

JEE Main-07 Jan, 2020 Shift-II

The ammonia (NH_3) released on quantitative reaction of 0.6g urea (NH_2CONH_2) with sodium hydroxide (NaOH) can be neutralized by

(A) 100 mL of 0.1 N HCl

(B) 100 mL of 0.2 N HCl

(C) 200 mL of 0.2 N HCl

(D) 200 mL of 0.4 N HCl

3

JEE Main-17 March, 2021 Shift-I

Complete combustion of 3g of ethane gives $x \times 10^{22}$ molecules of water. The value of x is _____. (Round off to the nearest integer)

[Use : NA = 6.023×10^{23}; Atomic masses in u : C 12.0, O : 16.0 ; H : 1.0]

4

JEE Main-09 Jan, 2020 Shift-II

5g of zinc is treated separately with an excess of

(A) Dilute hydrochloric acid and

(B) Aqueous sodium hydroxide.

The ratio of the volumes of H_2 evolved in these two reactions is :

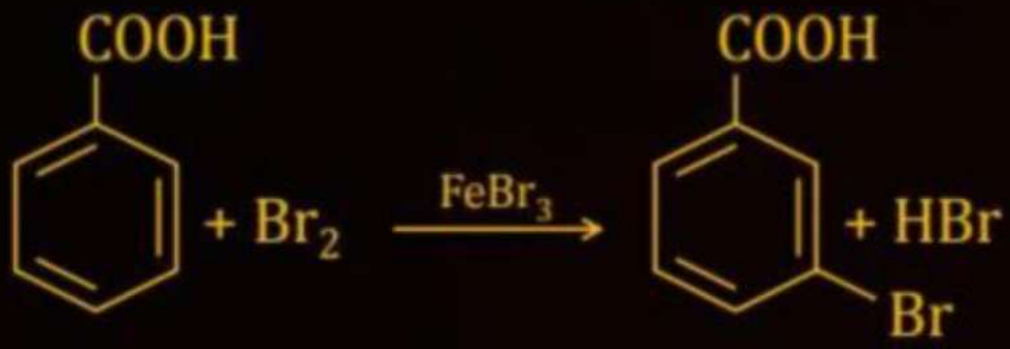
A 1 : 4

B 1 : 1

C 1 : 2

D 2 : 1

JEE Main-18 March, 2021 Shift-II



Consider the above reaction where 6.1 g of Benzoic acid is used to get 7.8 g of m-bromo benzoic acid. The percentage yield of the product is _____. (Round off to the nearest integer).

[Given : Atomic masses : C : 12.0 u, H : 1.0 u, O : 16.0 u, Br : 80.0 u]

JEE Main-09 Jan, 2020 Shift-II

The first and second ionisation enthalpies of a metal are 496 and 4560 kJ mol^{-1}, respectively. How many moles of HCl and H_2SO_4, respectively, will be needed to react completely with 1 mole of the metal hydroxide?

(A) 1 and 1

(B) 1 and 2

(C) 2 and 0.5

(D) 1 and 0.5

JEE Main-18 March, 2021 Shift-I

_____ grams of 3-Hydroxy propanal (MW = 74) must be dehydrated to produce 7.8 g of acrolein (MW = 56) (C_3H_4O) if the percentage yield is 64. (Round off to the nearest integer).

[Given : Atomic masses : C : 12.0 u, H : 1.0 u, O : 16.0 u]

JEE Main-27 August, 2021 Shift-II

10

100 g of propane is completely reacted with 1000 g of oxygen. The mole fraction of carbon dioxide in the resulting mixture is $x \times 10^{-2}$. The value of x is _____. (Nearest integer)

[Atomic weight : H = 1.008; C = 12.00; O = 16.00]

JEE Main-24 Feb, 2021 Shift-II

The formula of a gaseous hydrocarbon which required 6 times of its own volume of O_2 for complete oxidation and produces 4 times its own volume of CO_2 is C_xH_y. The value of y is _____.

OLD CONCEPT OF OXIDATION

(a) Oxidation is a chemical reaction in which oxygen is added

$$2HNO_2 + O_2 \longrightarrow 2HNO_3 ;$$

(b) Hydrogen is removed i.e. hydrogen becomes less

$$Zn + 2HCl \longrightarrow ZnCl_2 + H_2 ;$$

(c) Electronegative element is added

$$2FeCl_2 + Cl_2 \longrightarrow 2FeCl_3 ;$$

(d) Electropositive element is removed

$$2NaI + H_2O_2 \longrightarrow 2NaOH + I_2 ;$$

OLD CONCEPT OF REDUCTION

(a) Hydrogen is added. For example

$H_2 + Cl_2 \longrightarrow 2HCl$ $\quad N_2 + 3H_2 \longrightarrow 2NH_3$

(b) Oxygen is lost. For example

$Fe_2O_3 + 2Al \longrightarrow 2Fe + Al_2O_3$ $\quad Cr_2O_3 + 2Al \longrightarrow 2Cr + Al_2O_3$

(c) Electropositive element is added. For example

$2HgCl_2 + SnCl_2 \longrightarrow Hg_2Cl_2 + SnCl_4$ $\quad CuCl_2 + Cu \longrightarrow Cu_2Cl_2$

(d) Electronegative element is removed. For example

$2FeCl_3 + H_2 \longrightarrow 2FeCl_2 + 2HCl$ $\quad PbS + H_2 \longrightarrow Pb + H_2S$

MODERN CONCEPT OF OXIDATION

electron gain = Reduction
electron loss = Oxidation

(a) **Neutral atom** : When a neutral atom loses electron, it gets converted to a positive ion.

$Na \longrightarrow Na^{+1} + e^-$

$Al \longrightarrow Al^{+3} + 3e^-$

(b) **Cation** : When a cation loses electron, there is an increase in its positive charge.

$Sn^{+2} \longrightarrow Sn^{+4} + 2e^-$

$Hg^{+1} \longrightarrow Hg^{+2} + e^-$

(c) **Anion** : When an anion loses electron equal to its negative charge, it gets converted to a neutral atom.

$2O^{-2} \longrightarrow O_2 + 4e^-$

$2N^{-3} \longrightarrow N_2 + 6e^-$

(d) **Complex Anion :** When a complex anion loses electron, its negative charge decreases.

$$[Fe(CN)_6]^{-4} \longrightarrow [Fe(CN)_6]^{-3} + e^-$$

(e) **Molecule :** When a molecule loses electrons, it breaks up into it constituents.

$$H_2O_2 \longrightarrow 2H^{+1} + O_2 + 2e^-$$

Therefore in oxidation reactions–

(i) Positive charge increases and negative charge decreases

(ii) Oxidation number increases

oxidation.

electron gain = Reduction

MODERN CONCEPT OF REDUCTION

(a) **Neutral Atom :** When a neutral element or atom accepts electrons it gets converted into an anion.

$N + 3e^- \longrightarrow N^{-3}$ $\qquad$ $S + 2e^- \longrightarrow S^{-2}$

(b) **Cation :** When a cation accepts electron equal to its charge, it gets converted into a neutral atom.

$Mg^{+2} + 2e^- \longrightarrow Mg^{o}$ $\qquad$ $Al^{+3} + 3e^- \longrightarrow Al^{o}$

(c) Similarly, when a cation accepts less electrons than its charge, its positive charge decreases. For example

$Cu^{+2} + e^- \longrightarrow Cu^{+1}$ $\qquad$ $Fe^{+3} + e^- \longrightarrow Fe^{+2}$

(d) **Anion :** When an anion accepts electron, its negative charge increases.

$MnO_4^{-1} + e^- \longrightarrow MnO_4^{-2}$

$[Fe(CN)_6]^{-3} + e^- \longrightarrow [Fe(CN)_6]^{-4}$

(e) **Molecule :** When a molecule accepts electron, it is a reduction reaction.

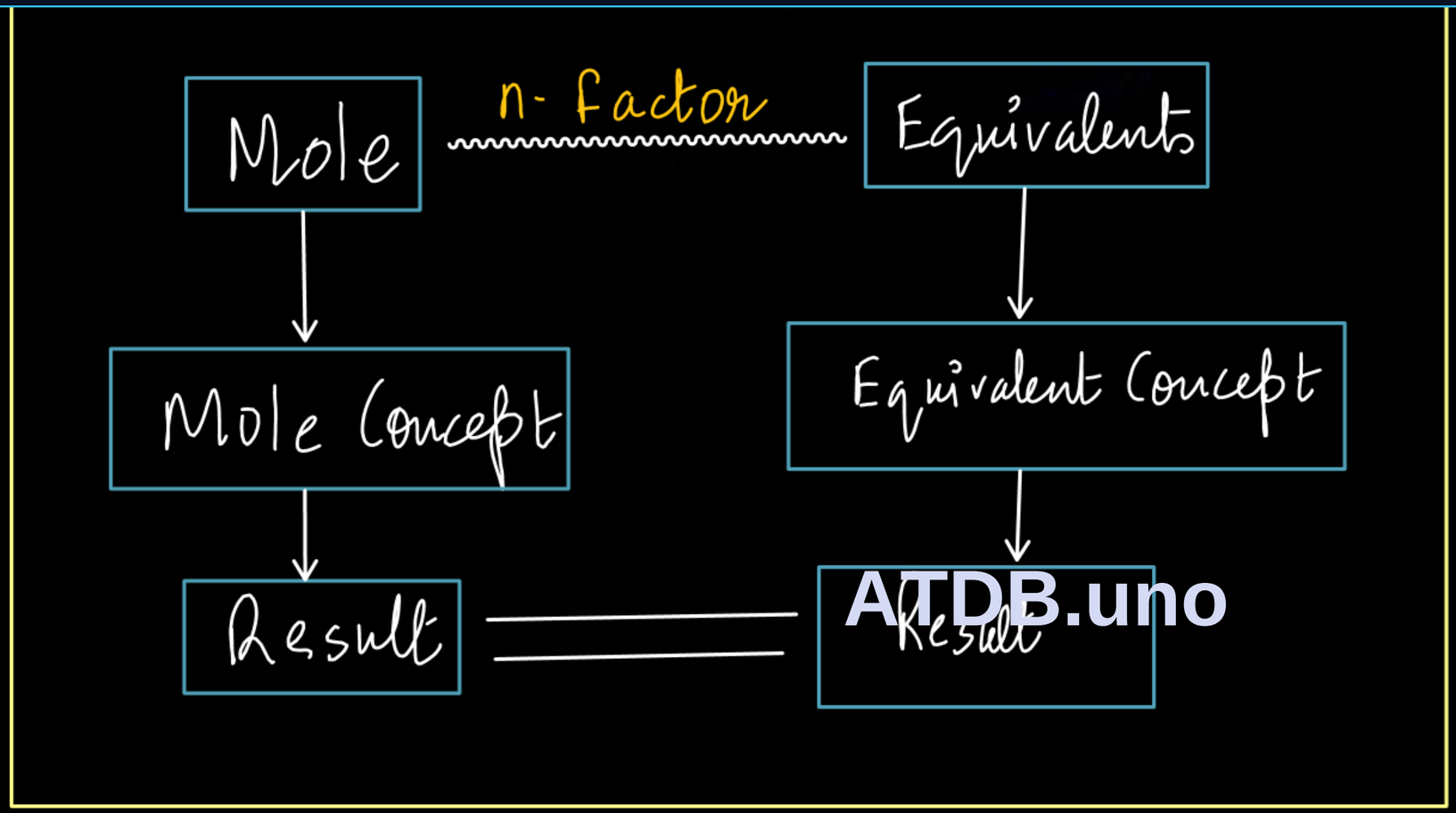
$O_2 + 4e^- \longrightarrow 2O^{-2}$ $\qquad$ $I_2 + 2e^- \longrightarrow 2I^{-1}$

Therefore in reduction reactions–

(i) Positive charge decreases and negative charge increases

(ii) Oxidation number decreases

Red^n



Redox

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n-Factor Calculations for acids

n-factor = replaceable H^+ ions

Maximum replaceable H^+ ions of an acid = Basicity of acid.

Ex. Example Suppose maximum replaceable H^+ ions in an acid are 3.

Basicity = 3

n-factor = 1, 2, 3

Example:

$HCl + NaOH \longrightarrow NaCl + H_2O$
(B = 1, n = 1)

$H_2SO_4 + NaOH \longrightarrow Na_2SO_4 + H_2O$
(B = 2, n = 2)

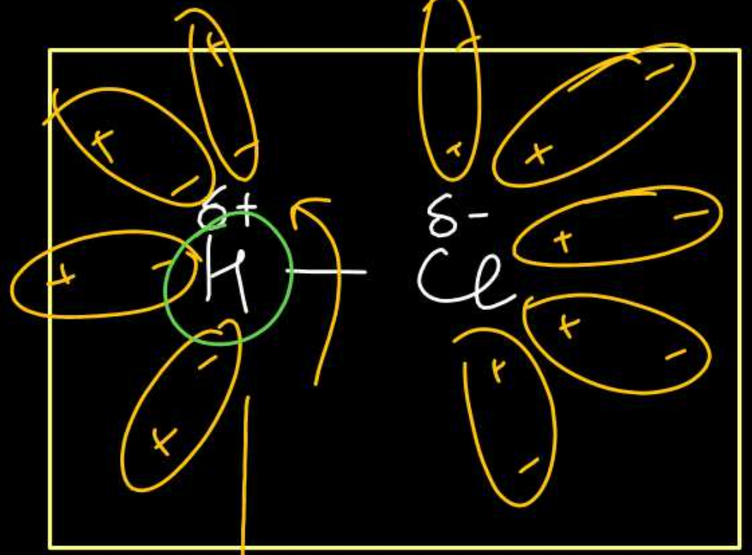
$H_2SO_4 + NaOH \longrightarrow NaHSO_4 + H_2O$
(B = 2, n = 1)

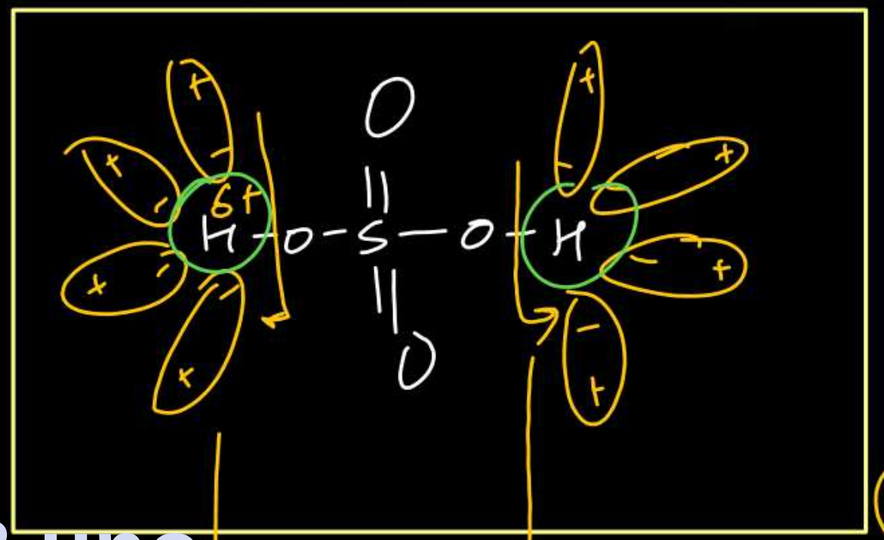
$H_3PO_4 + NaOH \longrightarrow NaH_2PO_4 + H_2O$
(B = 3, n = 1)

$H_3PO_4 + NaOH \longrightarrow Na_2HPO_4 + H_2O$
(B = 3, n = 2)

$H_3PO_4 + NaOH \longrightarrow Na_3PO_4 + H_2O$
(B = 3, n = 3)

$H_2O + H^+ \longrightarrow H_3O$ (Hydronium ion)

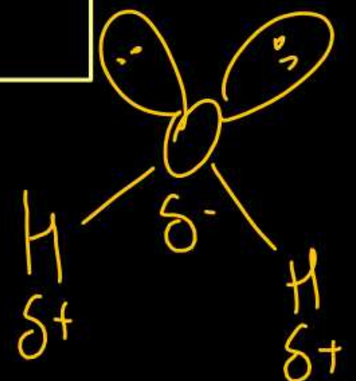




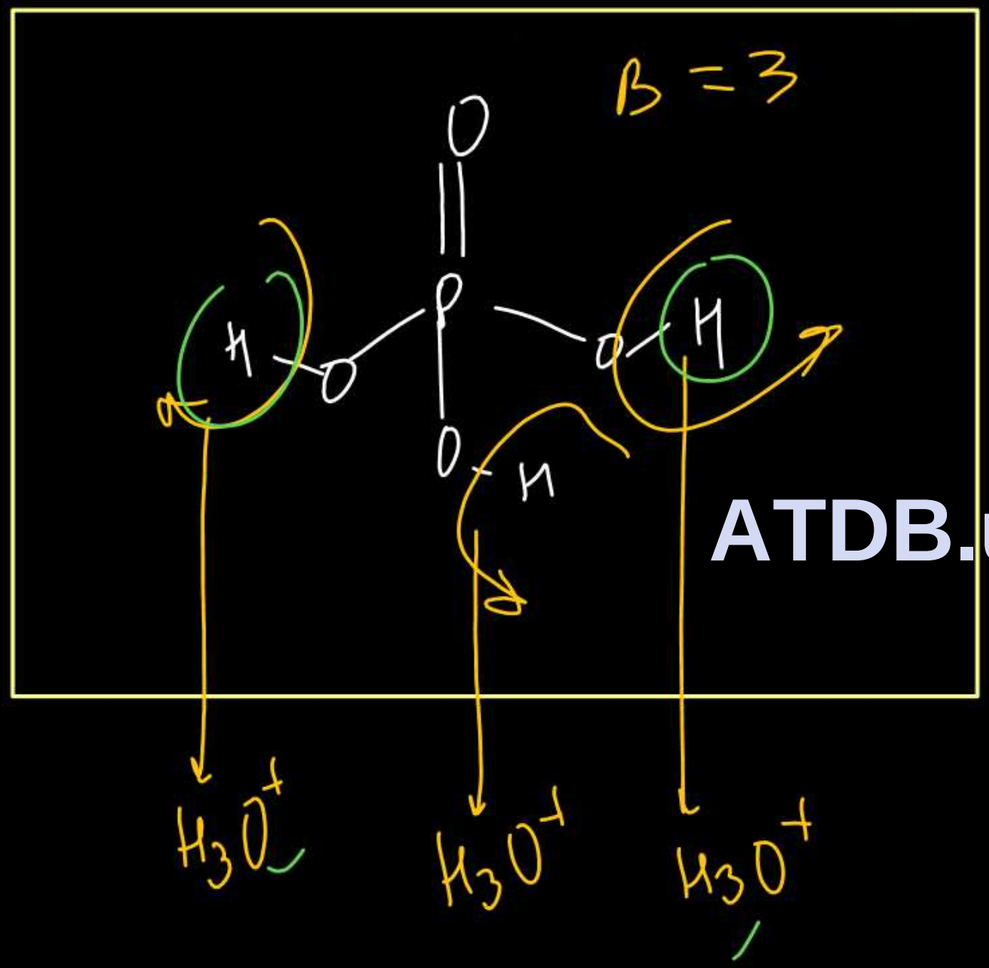
$H_3O^+ = H^+$

H_3O^+

H_3O^+

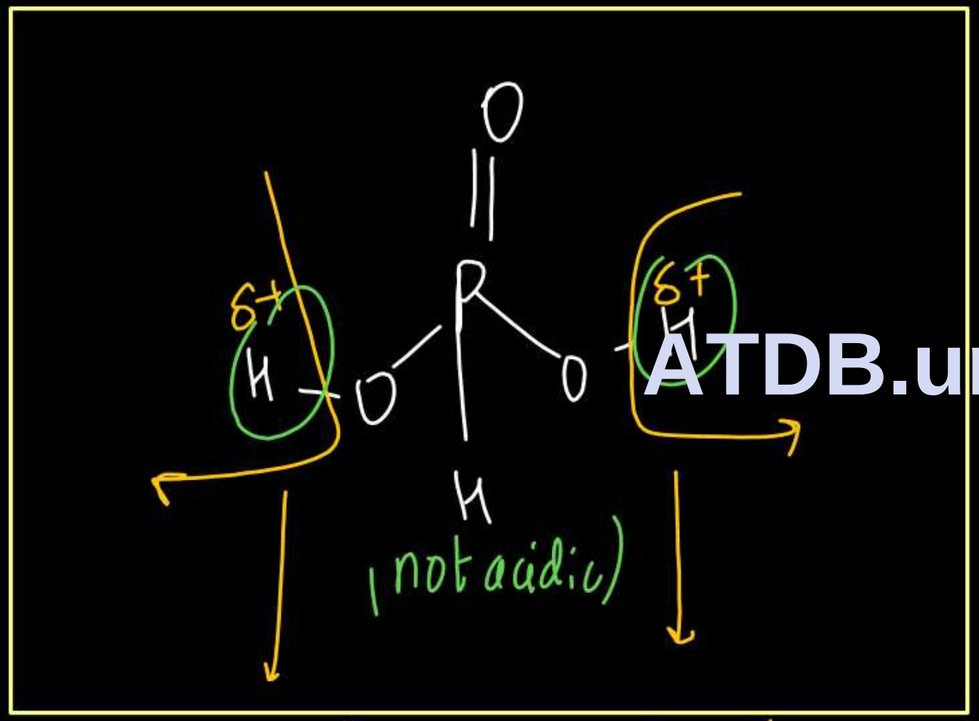


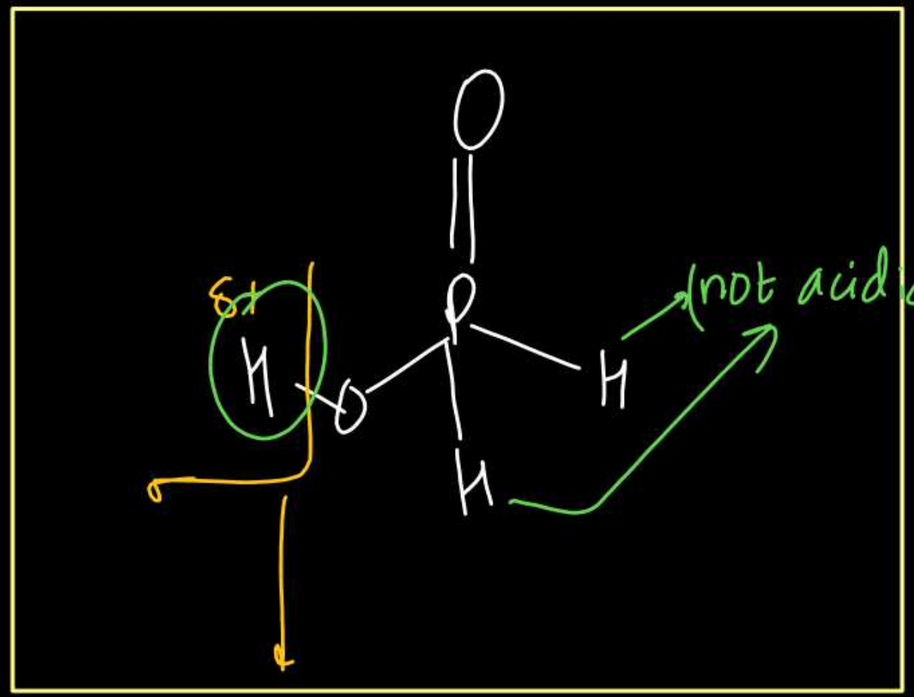
(Polar)



H_3PO_3 (Basicity = 2 (dibasic))

H_3PO_2 (Basicity = 1 (mono))





H_3O^+ H_3O^+ H_3O^+

Question

Which rxn is Possible?

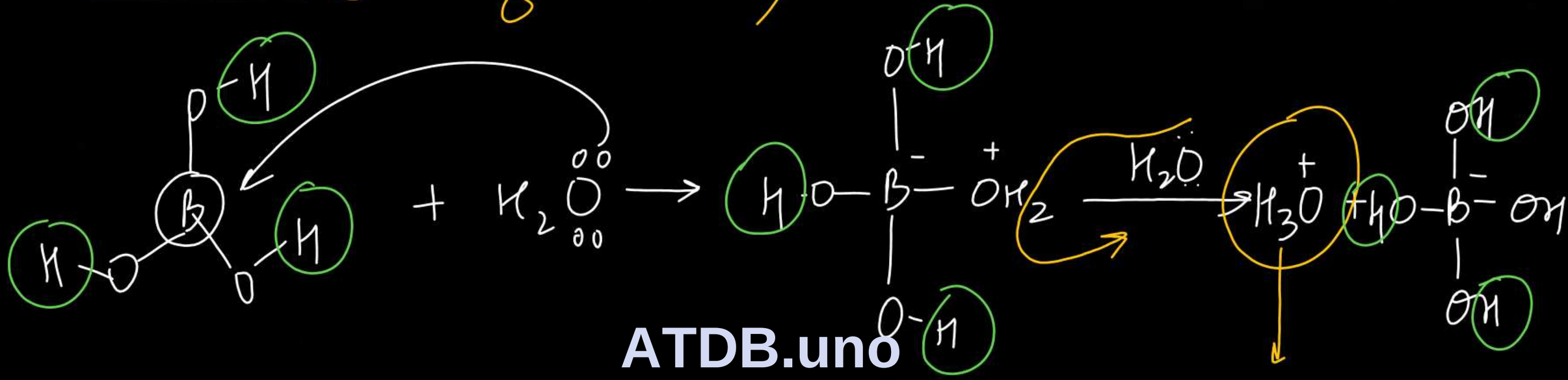
i) $H_3PO_3 + NaOH \longrightarrow NaH_2PO_3$

ii) $H_3PO_3 + NaOH \longrightarrow Na_2HPO_3$

iii) $\overset{H_3PO_3}{Na_2HPO_3} + NaOH \longrightarrow Na_3PO_3$

iv) $NaH_2PO_2 + NaOH \longrightarrow Na_2HPO_2$

H_3BO_3 (Basicity = 1 (mono))



monobasic

Module - 11.W.

Pranumbh and Prabal

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