UDAAN

2025

Bharat Mata Ki Jai ♡

METALS AND NON-METALS

Doubts and How Reactivity Series Was Built? – Part III

CHEMISTRY | Lecture - 04

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Topics

to be covered

1. Doubt Solving
2. Reaction of Metals with Dilute Acid
3. Reaction of Metals with Solutions of Other Metals
4. Reaction of Non-metals with Oxygen and Water


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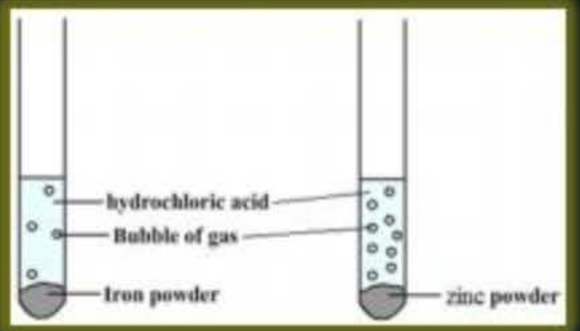
Knowledge Ride On

Doubt Solving

Knowledge Ride On



'Experiment'

Reaction of Metal with Dilute Acid

Knowledge Ride On

Reaction of Metals with Solutions of Other Metals

Knowledge Ride On

Reaction of Non-metals with Oxygen and water

Knowledge Ride On

Insaniyat Ka Gyaan

NEWS WALLAH

DHA 02 and 03 will be solved by watching lectures 02, 03 and 04 of this chapter.

IMPORTANT

RIDDLE WALLAH

Can you decode the below element?

'You'

'Ran'

IUM

= Uranium (U)

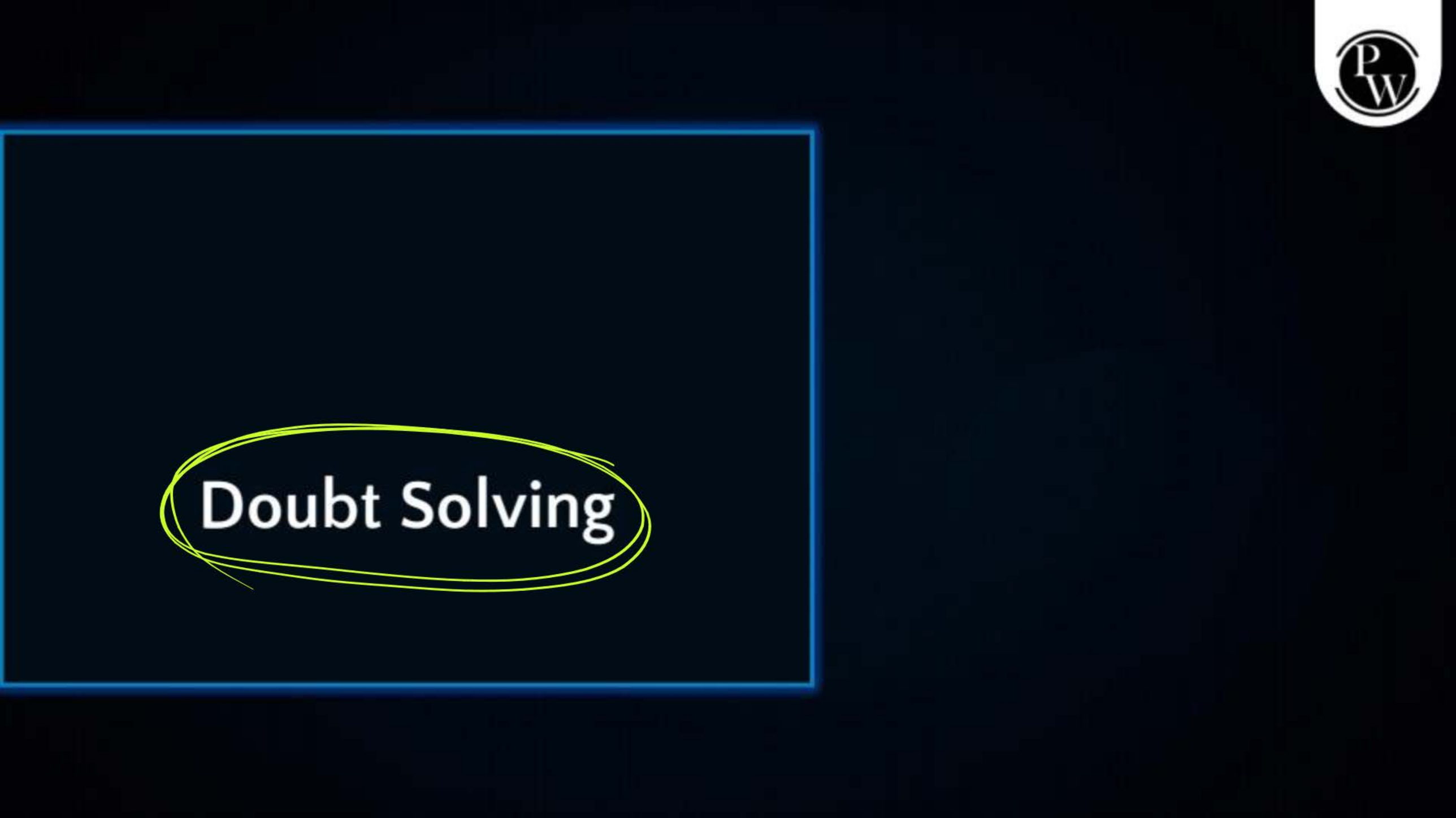
atomic no. = 92

RIDDLE WALLAH

Can you decode the below element?

IUM

Udaanians be like


Doubt Solving

Concept Clarity

catches fire

$K + H_2O \rightarrow K_2O + H_2$ + heat + light (lilac coloured flame)

'Soluble in water'

Overall Rxn $\Longrightarrow$ $2K(s) + 2H_2O(l) \rightarrow 2KOH(aq) + H_2(g)$ + heat + light

Imp

Metal oxides like K_2O, Na_2O, CaO and MgO that are soluble in water dissolve in it to further form metal hydroxide.

ex: $CaO + H_2O \rightarrow Ca(OH)_2$; $K_2O + H_2O \rightarrow 2KOH$

(H_2O: liquid)

Concept Clarity

(Metal which reacts at a lower temp. than another metal which doesn't react is more reactive)

	COLD WATER	HOT WATER	*STEAM
$2K(s) + 2H_2O(l) \rightarrow 2KOH(aq) + H_2(g)$	✓	✓	✓ $H_2O(g)$
$2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$	✓	✓	✓
$Ca(s) + 2H_2O(l) \rightarrow Ca(OH)_2(aq) + H_2(g)$	✓	✓	✓
$Mg(s) + 2H_2O(l) \rightarrow Mg(OH)_2(aq) + H_2(g)$	✗	✓	✓

*In case of steam, metal oxides are formed.

Concept Clarity

	COLD WATER	HOT WATER	*STEAM
$2Al(s) + 3H_2O(l) \rightarrow Al_2O_3(s) + 3H_2(g)$	✗	✗	✓
$Zn(s) + H_2O(l) \rightarrow ZnO(s) + H_2(g)$	✗	✗	✓
$3Fe(s) + 4H_2O(g) \rightarrow Fe_3O_4(s) + 4H_2(g)$	✗	✗	✓

Pb/Cu/Ag/Au/Pt + Cold/Hot Water/Steam → NO REACTION

In case of steam, metal oxides are formed.

Conclusion

- As discussed in the previous class due to the violent reaction of K and Na with cold water they are placed at the top of the reactivity series.
- Speed of reaction of K > Na so K is placed at the top followed by Na.
- Calcium also reacts with cold water after K and Na but not that violently and hence placed at 3rd number. No other metal reacts with cold water except these 3 metals.
- Magnesium reacts with hot water to form metal hydroxide and hydrogen gas. It is placed after calcium and only 4 metals react with hot water, i.e. K, Na, Ca and Mg.
- With steam K, Na, Ca, Mg, Al, Zn and Fe reacts to form metal oxide and hydrogen gas but no other metals react. We aren't able to detect which metal is more active when we are talking about the reaction of Al, Zn and Fe with steam. Hence, only 4 metals are arranged, i.e. K > Na > Ca > Mg on reaction with cold water/hot water/steam.

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Reaction of Metals With Dilute Acids

(Observing these will help us to identify more reactive metal)

CONCEPT

(I) Metal + dil. acid → Metal salt + Hydrogen gas + heat

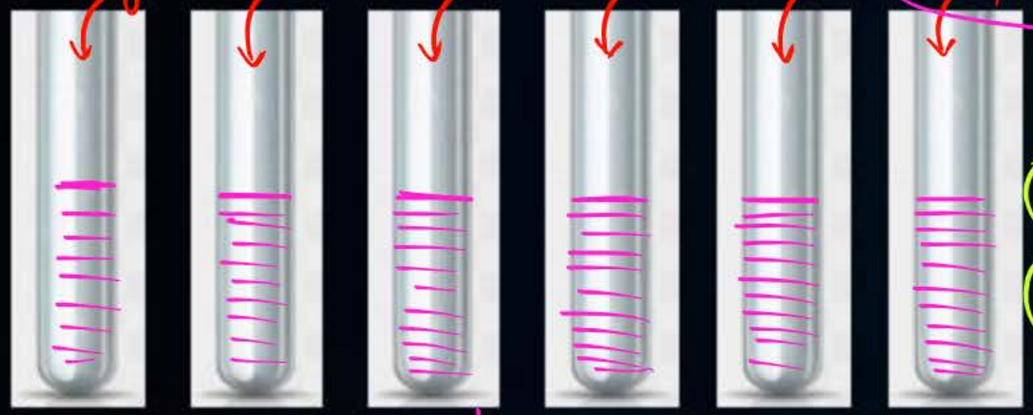
(∵ Reactivity of metal > hydrogen in acid)

(II) Metal - nonmetal displacement rxn

- Redox Rxn
- Generally, exothermic

Reaction of Metals with Dilute Acids

The more reactive metals do not react with the same vigour with acids and it can be understood in terms of the (rate of the effervescence of hydrogen gas.)



Speed of formation of H_2 gas

Way I
(i) more reactive metal produces H_2 bubbles faster

(ii) — " — more heat

Way II

(i) Some amount & Same concentration of acid

(ii) t = 0 s (Drop metal in acid) & Observe till t = 30 s

When magnesium, aluminium, zinc, iron and lead reacts with dilute hydrochloric acid, the rate of formation of hydrogen bubbles follows the order:

Mg > Al > Zn > Fe > Pb

Reaction of Metals with Dilute Acids

Again we can only arrange those metals that react with dilute acids in decreasing order of their reactivity towards dilute acids which is:

K > Na > Ca > Mg > Al > Zn > Fe > Pb > H > Cu/Ag/Au

Way II

We can also identify the most reactive metal by placing a thermometer. The one in which maximum rise in temperature is seen is giving the reaction at a faster rate in the same amount of time. The order of amount of heat released will be:

K > Na > Ca > Mg > Al > Zn > Fe > Pb

Reaction of Metals with Dilute Acids

What happens if the reaction takes place in presence of dilute nitric acid?

Magnesium — Manganese (very)

I. Metal (Mg and Mn) + dilute nitric acid -> Salt (Metal) + Hydrogen gas

$$Mg(s) + 2dil.HNO_3(aq) \rightarrow Mg(NO_3)_2(aq) + H_2(g)$$
$$Mn(s) + 2dil.HNO_3(aq) \rightarrow Mn(NO_3)_2(aq) + H_2(g)$$

II. Other Metals + dilute nitric acid -> Metal Salt + H_2O + $NO/NO_2/N_2O$

Strong oxidising agent

itself reduced to

Oxidises H_2 to H_2O

Aqua-Regia

Indicators are also reagents!

75 mL → conc. HCl
25 mL → conc. HNO_3

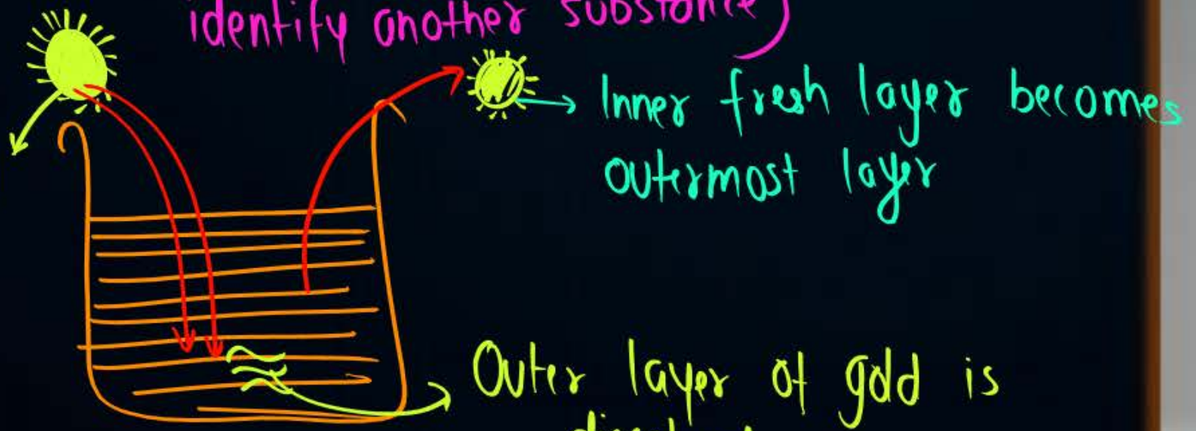
C-I

Aqua regia, which in Latin means 'royal water' is a mixture of C-II ***concentrated nitric acid and hydrochloric acid in the ratio of 1:3*** by volume. It is a highly corrosive and fuming liquid. → fumes → unpleasant smell gases that are harmful It is one of the few reagents that can dissolve gold and platinum.

(शाही जल)

C-III can burn/damage skin if gets in touch

(chemical substance that is used to identify another substance)



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IV

Reaction of Metals With Solutions of Other Metals

Till now after rxn of metal with oxygen, water & dil. acid we have arranged below metals ↓

$K > Na > Ca > Mg > Al > Zn > Fe > Pb > \underset{H}{} > Cu > Hg > Ag > Au$

Reaction of Metals with Solutions of Other Metals

Concept → Metal-metal displacement rxn

Metal A + Salt Solution of Metal B → Salt Solution of Metal A + Metal B

Reactivity of A > B

Reaction of lead with copper chloride solution: When a strip of lead metal is introduced in the blue-green solution of copper chloride, the solution turns colourless due to the formation of lead chloride.

$$Pb(s) + CuCl_2(aq) \rightarrow PbCl_2(aq) + Cu(s)$$

Blue-green soln Colourless

Hence, reactivity of Pb > Cu.

Reaction of Metals with Solutions of Other Metals

(i), (ii) & (iii) Reactivity of Cu > Ag & Au

(i) $Ag\,(s) + Cu(NO_3)_2\,(aq) \rightarrow$ No Reaction

(ii) $Au\,(s) + Cu(NO_3)_2\,(aq) \rightarrow$ No Reaction

Reactivity of (Ag > Au)

Ag: as element & as compound in earth's crust

Au: as element only in earth's crust

(iii) **Reaction of copper with silver nitrate solution:** When a copper wire is introduced in the colourless solution of silver nitrate, the solution starts turning blue due to the formation of copper nitrate.

$$Cu(s) + 2AgNO_3(aq) \rightarrow Cu(NO_3)_2(aq) + 2Ag(s)$$

Colourless Solth — Blue Solth

Hence, reactivity of Cu > Ag.

Reactivity/Activity Series of Metals – Desi Trick

K	Kudi	Potassium
Na	Naal	Sodium
Ca	Car	Calcium
Mg	Maango	Magnesium
Al	Alto	Aluminium
Zn	Zisko	Zinc
Fe	Fir	Iron
Pb	lekar	Lead
H	Hum	**Hydrogen**
Cu	Chale	Copper
Hg	Mathura	Mercury
Ag	Sath	Silver
Au	Ghumne	Gold

Pt Prateek Platinum

Reactivity/Activity Series of Metals – Videsi Trick

K	Please	Potassium
Na	Stop	Sodium
Ca	Calling	Calcium
Mg	Me	Magnesium
Al	A	Aluminium
Zn	Zebra	Zinc
Fe	I	Iron
Pb	Like	Lead
H	her	**Hydrogen**
Cu	Calling	Copper
Hg	Mute	Mercury
Ag	Smart	Silver
Au	Goat	Gold

Cute (C)

Pt Pablo Platinum

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Reaction of Non-metals with Oxygen and Water

Reaction of Non-metals with Oxygen and Water

C-I

Non-metal + **Oxygen** ⟶ **Non-metal oxide**

$C(s) + O_2(g) \longrightarrow CO_2(g)$

$S(s) + O_2(g) \longrightarrow SO_2(g)$

C-II

Non-metal + **Water/Acid** ⟶ **No Reaction**

Generally, no reaction takes place as hydrogen of acid/water can't be displaced by a non-metal.

Give a Thought

C-III

Are non-metal oxides only acidic in nature?

A. Yes

B. No

Non-metal oxides

CO_2

SO_2

SO_3

NO_2

ACIDIC

ACIDIC OXIDE

ACID

$CO_2(g) + H_2O(l) \rightarrow H_2CO_3(aq)$ → Carbonic acid

$SO_2(g) + H_2O(l) \rightarrow H_2SO_3(aq)$ → Sulphurous acid

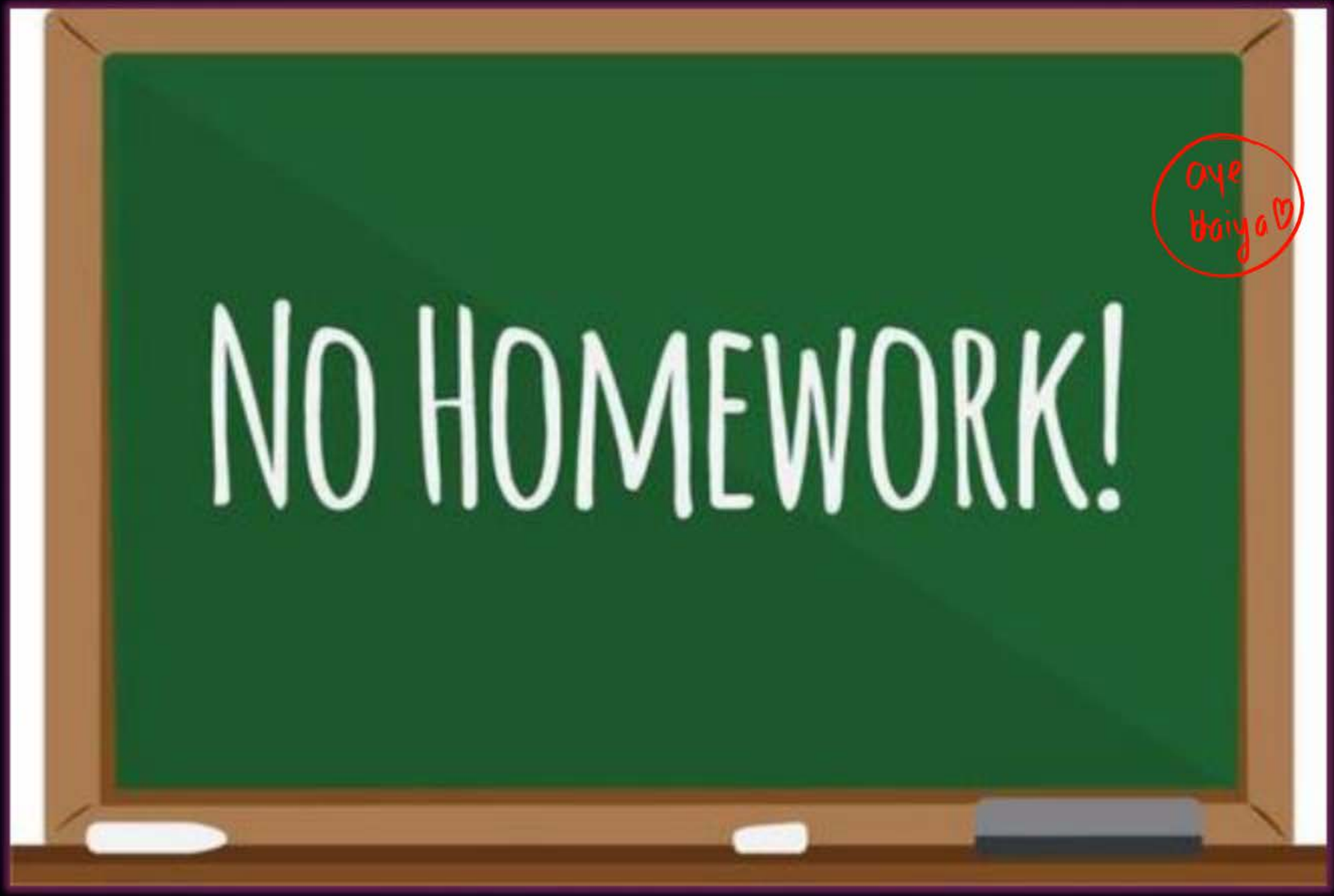
$SO_3(g) + H_2O(l) \rightarrow H_2SO_4(aq)$ → Sulphuric acid

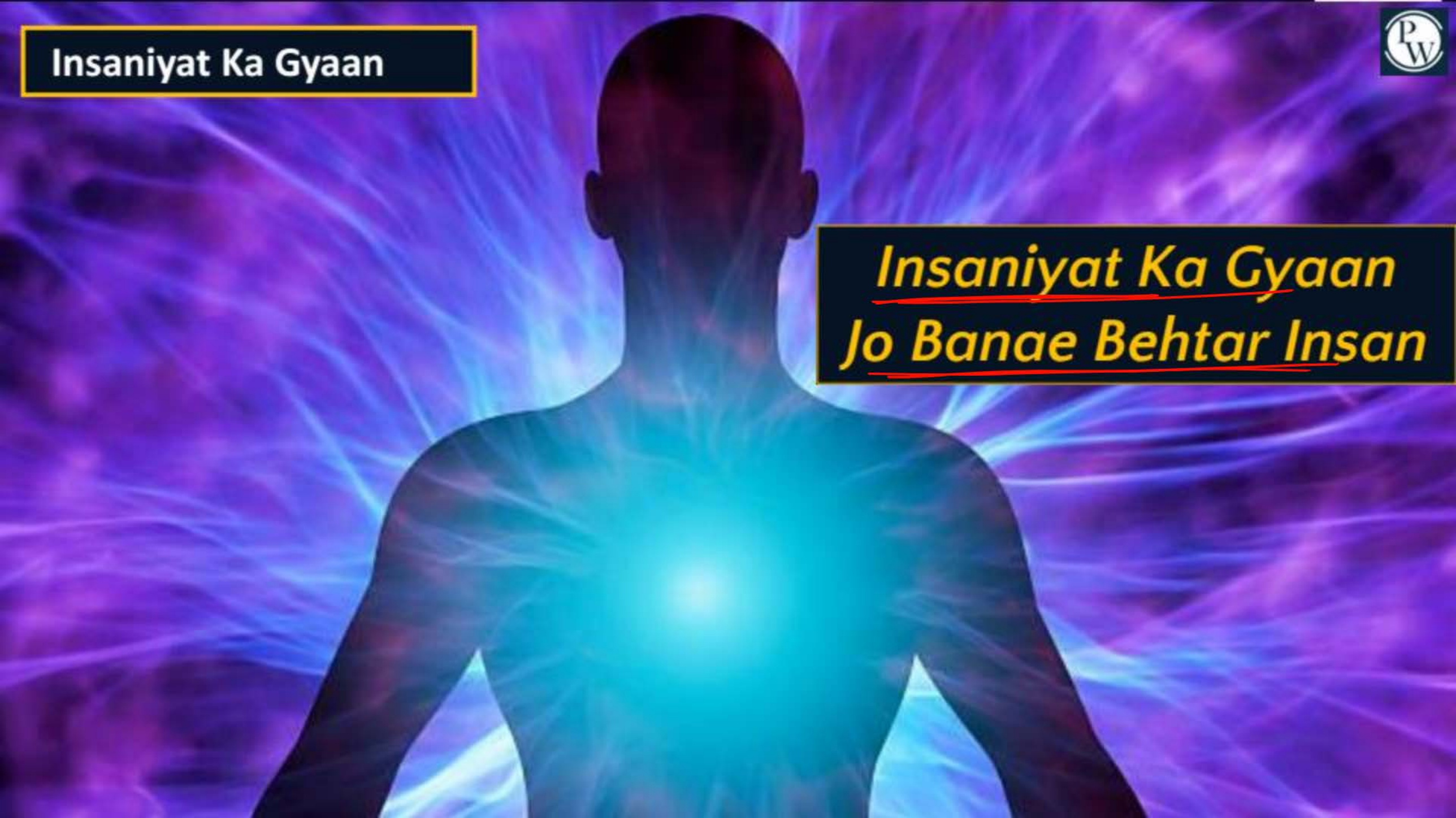
NEUTRAL

NO, N_2O, CO, H_2O etc.

Nitrous oxide (laughing gas)

Concept Polish (गृहकार्य)


NO HOMEWORK!
Oye Hoiya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Jo Banae Behtar Insan


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#sbsathhai

#pwsathhai

THANK YOU