# UDAAN

## 2025

Bharat Mata Ki Jai ♡

## METALS AND NON-METALS

## How Reactivity Series Was Built? – Part II

CHEMISTRY | Lecture - 03


BY: SUNIL BHAIYA

# Topics

*to be covered*

(live experiment)

1. Doubt Solving
2. Reaction of Metals with Water
3. Reaction of Metals with Dilute Acid


SUNIL BHAIYA
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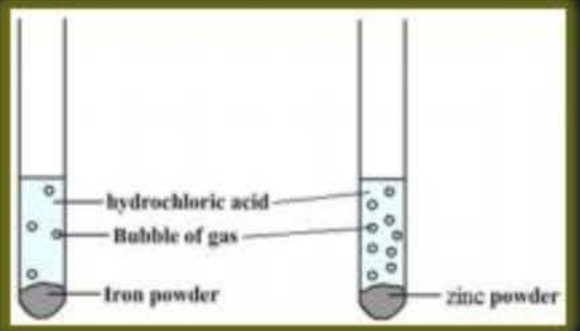
# Knowledge Ride On

Doubt Solving

Knowledge Ride On

Reaction of Metal with Water

# Knowledge Ride On




Reaction of Metal with Dilute Acid

**Knowledge Ride On**

Insaniyat Ka Gyaan

RIDDLE WALLAH

Can you decode the below element?


+ NUM ⟹ Platinum (Pt)

RIDDLE WALLAH

Can you decode the below element?

**NUM** = Platinum (Pt)

*Udaanians be like* ------->

# Doubt Solving

# Concept Clarity

Burning → light energy is released in form of flames / sparkles

I protective oxide layer prevents the metal from further oxidation. Iron does not burn on heating but iron filings burn vigorously when sprinkled in the flame of the burner. Copper does not burn, but the hot metal is

(powdered iron)

II **Toh btao ab last class mein jo cheej burn hui 'Sparkles' ke sath who kya thi?**

A. Solid iron piece

B. Powdered iron

# Give a Thought

All metal oxides/hydroxides are only basic in nature?

A. Yes

B. No

C-I

Metal oxides / hydroxides

(A) BASIC

(B) AMPHOTERIC (दोगला)

(I) 'BOTH'

(II) They can behave as acid as well as base.

Examples on next slide...

C-III EXAMPLE

| Metal oxide | + | Acid | → | Salt | + | Water |
|---|---|---|---|---|---|---|
| Base $Al_2O_3(s)$ (C A) Hasmukhlal | + | 6 dil. $HCl(aq)$ (C A) Simaila | → | $2AlCl_3(aq)$ (Aluminium chloride) | + | $3H_2O(l)$ |

| Metal oxide | + | Base | → | Salt | + | Water |
|---|---|---|---|---|---|---|
| Acid $Al_2O_3(s)$ Hasmukhlal | + | $2NaOH(aq)$ Radhika | → | $2NaAlO_2(aq)$ (Sodium aluminate) | + | $H_2O(l)$ |

(II)

(I) S A B P Z etc. → amphoteric oxides/ hydroxides

S → Sn (Tin)

A → Al (Aluminium)

B → Be (Beryllium)

P → Pb (Lead)

Z → Zn (Zinc)

(II) Our course: $Al_2O_3$ & ZnO → amphoteric oxides

(III)

| | Basic | Amphoteric |
|---|---|---|
| $Na_2O$ | ✓ | × |
| CaO | ✓ | × |
| $Ca(OH)_2$ | ✓ | × |
| $Al_2O_3$ | × | ✓ |
| ZnO | × | ✓ |

# PYQs' Wallah

PW Ka ChemStar!

CBSE 2012

Chose the amphoteric oxide among the following:

$Na_2O$, $ZnO$, $Al_2O_3$, $CO_2$, $H_2O$

$Na_2O$ → Basic

$ZnO$, $Al_2O_3$ → amphoteric

$CO_2$ → acidic

$H_2O$ → neutral

Out - of - syllabus

↓

Bronsted - Lowry Acid Base Theory

↓

Water is amphoteric

CBSE 2015

Give one suitable word for the following:

(i) Metal oxides which show basic as well as acidic behaviour. → amphoteric

(ii) Iodine, a shining non-metal → Lustrous

# KYA BOLTI PUBLIC

# Reaction of Metals with Water

I

II

Cold water → Lowest temp.

↓

Hot water

↓

Steam → Highest temp.

Metal which reacts at low temp. is more reactive than one that doesn't react.

# Reaction of Metals with Water

(I) This rxn also depends on temp. of water

Metal + Water ⟶ Metal oxide + Hydrogen

Na + $H_2O$ ⟶ $Na_2O$ + $H_2$ + heat

(II) Type of metal-nonmetal displacement rxn
[Reactivity of metal > hydrogen of acid]

(III) Displacement reactions are generally exothermic but redox in all cases.

(IV) Evolved $H_2$ gas catches fire & not metal

Dissolves in Water

(V) Metal hydroxide ($NaOH$)

Metal oxides like $Na_2O$, $K_2O$, $CaO$, $MgO$ are soluble in $H_2O$ & forms metal hydroxide.

# Reaction of Metals with Cold Water

(i) (at very low temp.)

reactivity of K > Na

(ii)

| Metal | + | Cold water | → | Metal hydroxide | + | Hydrogen gas |
|---|---|---|---|---|---|---|
| $2Na(s)$ | + | $2H_2O(l)$ | → | $2NaOH(aq)$ | + | $H_2(g)$ + heat |
| $2K(s)$ | + | $2H_2O(l)$ | → | $2KOH(aq)$ | + | $H_2(g)$ + heat |

(1) evolved $H_2$ gas catches fire.

(11) speed of rxn of K with $H_2O$ > Na with $H_2O$
∵ evolved $H_2$ gas immediately catches fire in case of K

(iii)

| Metal | + | Cold water | → | Metal hydroxide | + | Hydrogen gas |
|---|---|---|---|---|---|---|
| $Ca(s)$ | + | $2H_2O(l)$ | → | $Ca(OH)_2(aq)$ | + | $H_2(g)$ + heat |

(i) Evolved hydrogen gas doesn't catch fire. → because evolved heat is not that much.

(ii) The tiny bubbles of hydrogen gas formed stick to the surface of the calcium, and hence it starts floating on the water.

(iv) **Conclusion:** *No other metal except K, Na and Ca reacts with cold water.*

K > Na > Ca

## Reaction of Metals with Hot Water

(I) $K > Na > Ca > Mg$

| Metal | + | Hot water | → | Metal hydroxide | + | Hydrogen gas |
|---|---|---|---|---|---|---|
| (II) $Mg(s)$ | + | $2H_2O(l)$ | → | $Mg(OH)_2(aq)$ | + | $H_2(g)$ + heat |

$MgO + H_2O \rightarrow Mg(OH)_2$

(III)

(i) Evolved hydrogen gas doesn't catch fire.

(ii) The tiny bubbles of hydrogen gas formed stick to the surface of the magnesium, and hence it starts floating on the water.

(IV)

**Conclusion:** *No other metal except K, Na, Ca and Mg reacts with hot water.*

## Reaction of Metals with Steam

Temp. of water is further (↑)

(I) K > Na > Ca > Mg

| Metal | + | Steam | → | Metal oxide | + | Hydrogen gas |
|---|---|---|---|---|---|---|
| $2Al(s)$ | + | $3H_2O(g)$ | → | $Al_2O_3(s)$ | + | $3H_2(g)$ + heat |
| $Zn(s)$ | + | $H_2O(g)$ | → | $ZnO(s)$ | + | $H_2(g)$ + heat |
| $3Fe(s)$ | + | $4H_2O(g)$ | → | $Fe_3O_4(s)$ | + | $4H_2(g)$ + heat |

(II)

(evolved $H_2$ gas doesn't catch fire)

(We can't determine which among these is more reactive)

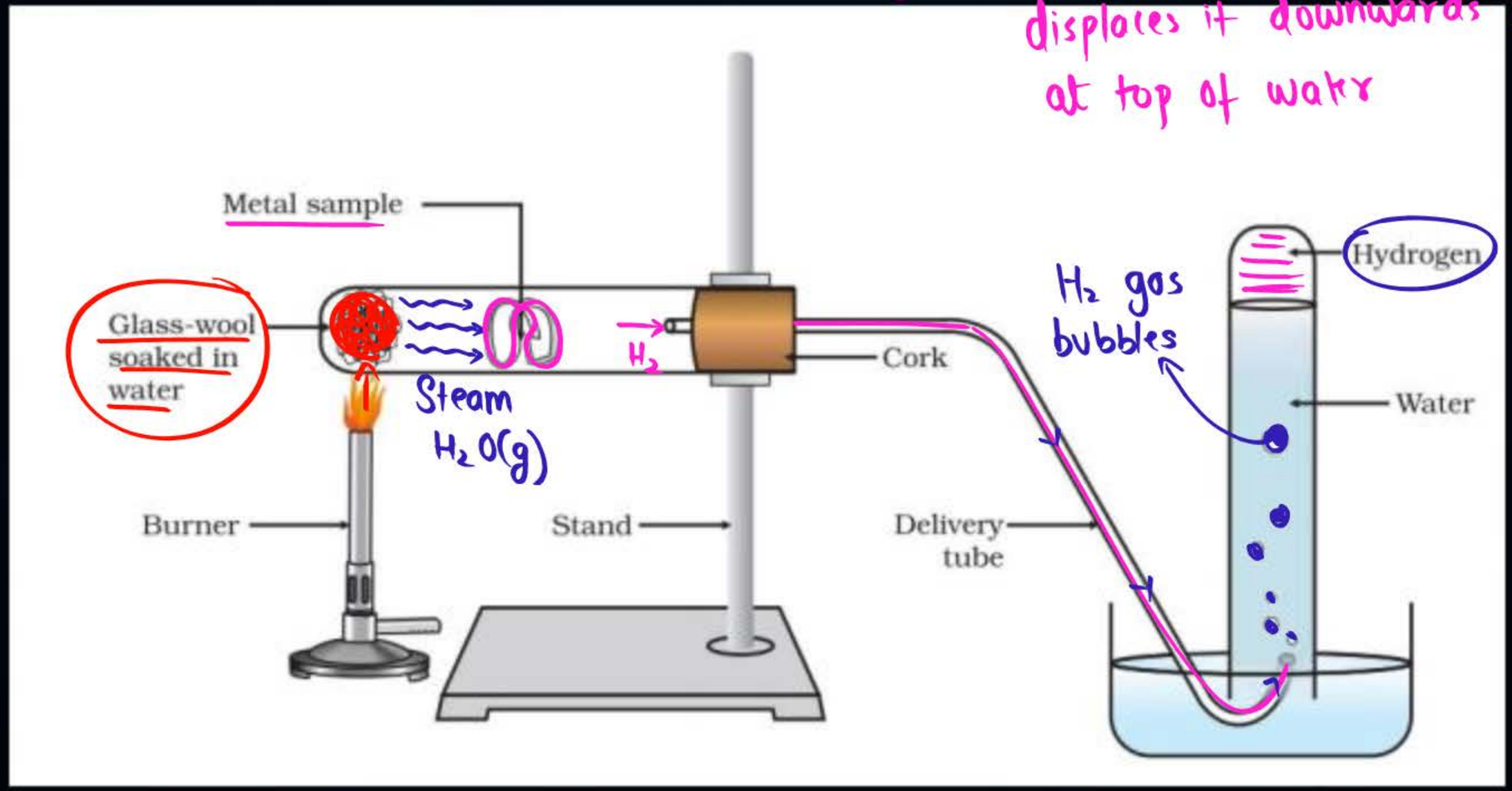
(III) Pb, Cu, Ag and Au (& Pt) don't react with cold water, hot water and steam

**Conclusion:** We can only arrange those metals that react with cold or hot water in decreasing order of their reactivity which is: **K > Na > Ca > Mg**

# Reaction of Metals with Steam

① $H_2$ is sparingly soluble in $H_2O$ (very low solubility in $H_2O$)

② Because $H_2$ is lighter than $H_2O$ it displaces it downwards & collects at top of water



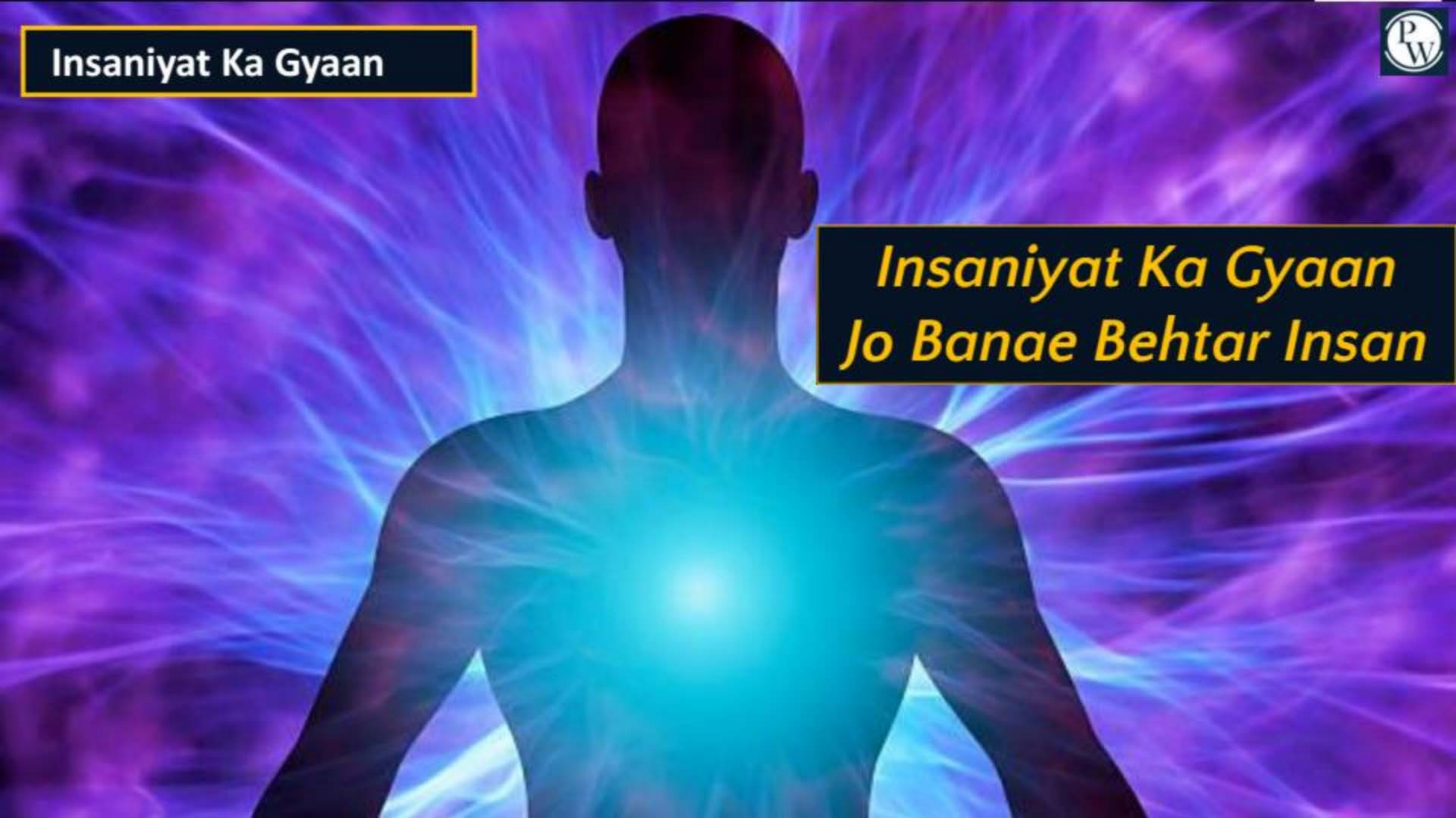
KYA BOLTI PUBLIC

# Concept Polish (गृहकार्य)

## Give a Thought

HW

Why sodium and potassium are stored in kerosene/mineral oil?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Jo Banae Behtar Insan


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#sbsathhai

#pwsathhai

# THANK YOU