MIDTERM MARATHON

For Class 10th Students

Chemistry

By – Sunil Sir

PHYSICAL CHANGE

- No change in chemical composition.
- Change in physical properties like shape, size, physical state etc.

Example: Melting of ice, Cutting of hair etc.

CHEMICAL CHANGE

- Change in chemical composition.
- Change in physical properties like shape, size, physical state etc.

Example: Rusting of iron, Combustion of charcoal etc.

NO

YES

On basis of change in chemical composition or chemical built-up

CHANGE (परिवर्तन / बदलाव)

CHEMICAL REACTIONS AND EQUATIONS

(I) Barium chloride + Sodium sulphate → Barium sulphate + Sodium chloride

Vinegar + Baking soda → Sodium acetate + Water + Carbon dioxide

Visible
Indicators that tell whether a rxn has occured or not

CHARACTERISTICS OF CHEMICAL REACTION

- Change in colour (in I)
- Formation of precipitate (insoluble solid) (in I)
- Evolution of gas in (II)
- Change in physical state in (I), in (II)
- Change in temperature (तापमान)

Temp. of surroundings → (↑) → EXOTHERMIC (exit)
—"— → (↓) → ENDOTHERMIC (entry)

Skeletal Chemical Equation.png

$Mg + O_2 \rightarrow MgO$

(III) BALANCED CHEMICAL EQUATION: We should balance a chemical equation, i.e. number of at on reactant side should be equal to the produ side.

Hence, it will follow the law of conservation of mass, i.e. mass of reactants is equal to mass o products. (Antoinne L

Balanced Chemical Equation.png

$2Mg\ (s) + 1O_2\ (g) \longrightarrow 2MgO$

(put coefficients to balance eqn)

Representation of a chemical reaction

Process of a chemical change is known as chemical reaction. (रासायनिक प्रतिक्रिया)

Representation of a chemical reaction

I WORD EQUATION: Representing a chemical reaction through words.

Word Equation.png

Magnesium + Oxygen → Magnesium oxide

(Reactants) (अभिकारक) (Product) (उत्पाद)

Undergo chemical change

formed after chemical change

II SKELETAL CHEMICAL EQUATION: In this reactants and products are represented by chemical symbols and formulae. (Number of atoms on reactant side is not equal to product side.) → UNBALANCED CHEMICAL EQn

Skeletal Chemical Equation.png

$$Mg + O_2 \rightarrow MgO$$

III BALANCED CHEMICAL EQUATION: We should balance a chemical equation, i.e. number of atoms on reactant side should be equal to the product side.

Hence, (it will follow the law of conservation of mass, i.e. mass of reactants is equal to mass of products.) → Antoinne Laurent Lavoisier

Balanced Chemical Equation.png

$$2Mg\ (s) + 1O_2\ (g) \longrightarrow 2MgO\ (s)$$

(put coefficients to balance chemical eqn)

IV Limitations of Chemical Equations

- Making Them Informative

Physical State of Reactants & Products

I Physical State of Reactants and Produ...

Physical state	Symbol
Solid →	(s)
Liquid →	(l)
Gas →	(g) or (↑) → gas is evolved
Aqueous solution (Water as solvent) →	(aq)
Precipitate →	(ppt.) or (↓) OR (s)

II Concentration of Acids & Bases

Acid	Symbol
Concentrated →	conc.
Dilute →	dil.

anges / Energy changes

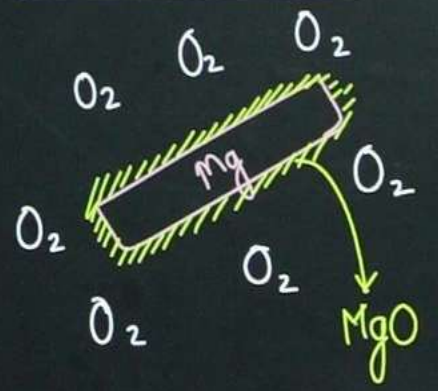
EXOTHERMIC → Reactant(s) ⟶ Product(s) + energy

energy is given/absorbed → ENDOTHERMIC → Reactant(s) $\xrightarrow{\text{Energy}}$ Product(s)

OR

Reactant(s) + energy ⟶ Product(s)

$$2Mg(s) + O_2(g) \rightarrow 2MgO(s)$$



(i) At room temperature (25 °C): Magnesium reacts with oxygen forming a white layer of MgO. *This layer is removed by a sandpaper before burning a magnesium ribbon.*

(ii) Strongly heating a Mg ribbon: Magnesium ribbon burns with a dazzling (bright) white flame forming white powder of magnesium oxide.

eye protection should be used!

dazzling white flame

Burning of Mg Ribbon.png

$$2Mg(s) + O_2(g) \rightarrow 2MgO(s) + \text{Heat energy} + \text{Light energy}$$

(EXOTHERMIC RXN)

(ENERGY IS RELEASED majorly in form of heat)

EXOTHERMIC REACTION: Heat is released and temperature of the immediate surroundings increases.

Example: Burning of any substance, composting, respiration etc.

Burning of natural gas.png

BURNING OF NATURAL GAS → majorly methane (CH_4)

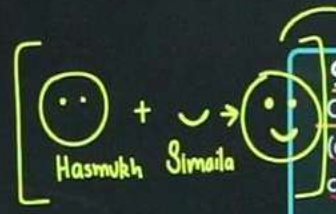
(I) $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$ + heat + light

Respiration

Respiration.jpg

(II) $C_6H_{12}O_6(aq) + 6O_2(aq) \rightarrow 6CO_2(aq) + 6H_2O(l) + \text{energy}$ (Glucose)

(III) Decomposition of vegetable matter → Compost



SYNTHESIS RXN/

COMBINATION REACTION: Multiple reactants (elements or compounds) react to form a single compound.

Representation: A + B --> (AB) Compound

Combination Reaction.png

- $2Mg(s) + O_2(g) \longrightarrow 2MgO(s) + \text{Heat} + \text{light}$
- $CaO(s) + H_2O(l) \longrightarrow Ca(OH)_2(aq) + \text{Heat}$
- $Ca(OH)_2$: (Used for whitewashing)

→ Observations

(I) Vigorous rxn

(II) Exothermic rxn

(III) Water bubbles are formed because water is converted to steam due to heat

$Ca(OH)_2$: Calcium hydroxide
↓
Common Name
Slaked lime
Limewater

(III) Limewash/ Whitewash/ Milk of lime

CaO: Calcium oxide
↓
Common Name
(I) LIME
(II) QUICKLIME
(III) BURNT LIME

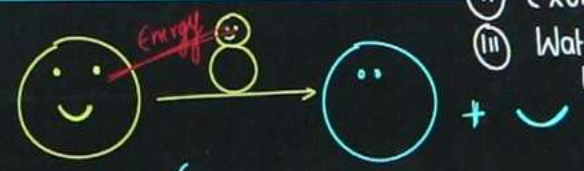
$$Ca(OH)_2(aq) + CO_2(g) \rightarrow CaCO_3(s) + H_2O(l)$$

(Calcium hydroxide) (Calcium carbonate)

from air (0.03%)

↳ evaporate

Calcium carbonate is formed after two to three days of white washing and gives a shiny finish to the walls.



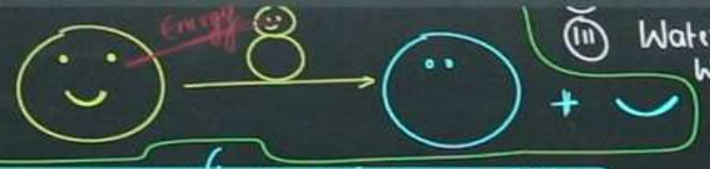
(Inverse of Combination Rxn)

DECOMPOSITION REACTION: One compound (or

(energy is give majorly in form of heat)

ENDOTHERMIC REACTION: Heat is absorbed and temperature of the immediate surroundings decreases.

LIME



(iii) Water bubbles are formed because water is converted to steam due to heat

(energy is give majorly in form of heat)

(Inverse of Combination Rxn)

(I) **DECOMPOSITION REACTION:** One compound (or reactant) breaks into multiple products when energy is supplied in form of heat, light or electricity.

Representation: $\overset{C}{AB} \rightarrow A + B$

→ Decomposition reactions are ~~always~~ generally endothermic.

(A is more reactive metal than B if it loses electron(s) easily than B)

DISPLACEMENT REACTION: More reactive element displaces a less reactive element from its compound.

(These reactions are generally found to occur in the solution.)

Representation: $\underset{\text{metal}}{A} + \underset{\text{metal}}{B}\overset{\text{non-metal}}{C} \rightarrow AC + B$

Displacement reactions are generally exothermic. & all are redox.

$Fe(s) + CuSO_4(aq) \rightarrow FeSO_4(aq) + Cu(s)$

(SILVERY GREY) (Copper sulphate) (BLUE) (Iron sulphate) (PALE GREEN) Reddish-brown deposit on iron nail

Displacement Reaction of Zinc and Copper Sulphate.png

$Zn(s) + CuSO_4(aq) \rightarrow ZnSO_4(aq) + Cu(s)$

(Copper sulphate) (Zinc sulphate)

(SILVERY GREY granules) BLUE COLOURLESS Reddish brown 'Cu'

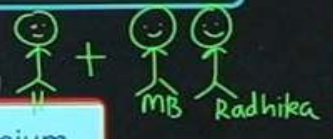
Displacement reaction of lead and copper chloride.p...

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

(Copper chloride) (Lead chloride)

BLUE - GREEN

metal-metal displacement rxn



Reactivity Series of Metals.png

Reactivity (L) K Kudi Potassium

ENDOTHERMIC REACTION: Heat is absorbed and temperature of the immediate surroundings decreases.

Example: Photosynthesis reaction, all decomposition reactions etc.

(energy given in photosynthesis)

Photosynthesis.png

$6CO_2(aq) + 12H_2O(l) \xrightarrow[\text{Chlorophyll}]{\text{Sunlight}} C_6H_{12}O_6(aq) + 6O_2(aq) + 6H_2O(l)$

(Glucose)

(Heat Energy is Given) → Heat → breakdown

THERMOLYTIC DECOMPOSITION/THERMOLYSIS: A single reactant breaks into multiple products on supplying heat energy.

H_2O

FeSO4

$2FeSO_4(s) \xrightarrow[\text{or } \Delta]{\text{Heat}} Fe_2O_3(s) + SO_2(g) + SO_3(g)$

(Ferrous sulphate) (Ferric oxide) Reddish-Brown → further heating

$FeSO_4.7H_2O \xrightarrow[\Delta]{\text{Heat or}} FeSO_4(s) + 7H_2O(g)$

(green crystals) (white)

Thermal decomposition.png

$CaCO_3(s) \xrightarrow{\text{Heat}/\Delta} CaO(s) + CO_2(g)$

(Limestone/Chalk/Marble) (Quick lime) BURNT LIME → used in cement industry

Thermal decomposition of lead nitrate.png

$2Pb(NO_3)_2(s) \xrightarrow[\Delta]{\text{Heat}} 2PbO(s) + 4NO_2(g) + O_2(g)$

(Lead nitrate) WHITE (Lead oxide) yellow (Nitrogen dioxide) Brown fumes (Oxygen)

Observations

(i) Crackling sound is heard on its thermolysis → DECRIPITATION

(ii) Yellow residue is left behind → PbO

(iii) Brown fumes of NO_2 is observed.

electricity → breakdown

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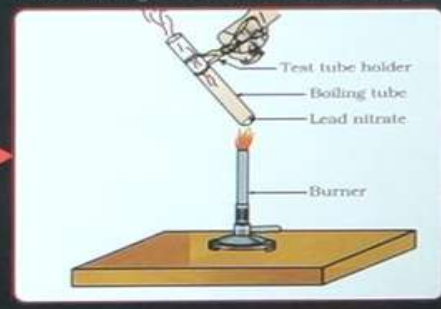

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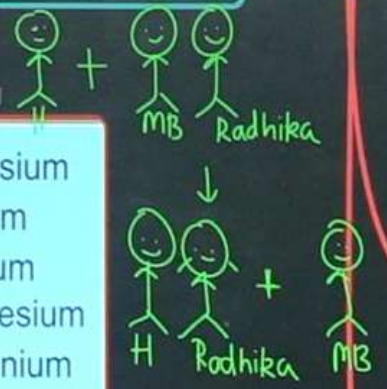
metal-metal displacement rxn

Reactivity (↓) as we move from top to bottom

Reactivity Series of Metals.png

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

↳ it can lose electron like metals



Observations
(i) Crackling sound is heard on its thermolysis → DECRIPITATION
(ii) Yellow residue is left behind → PbO
(iii) Brown fumes of NO_2 is observed.

(II) ELECTROLYTIC DECOMPOSITION/ELECTROLYSIS: A single reactant breaks into multiple products on supplying electrical energy.

electricity → breakdown

$$2H_2O\,(l) \xrightarrow{\text{ICI}} 2H_2\,(g) + O_2\,(g)$$

2 : 1

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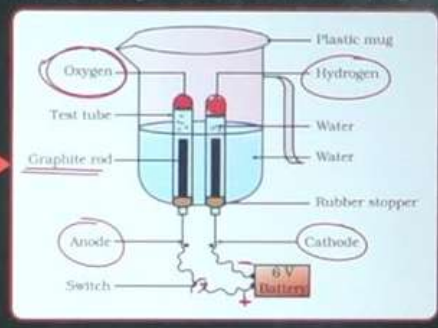


PHOTOLYTIC DECOMPOSITION/PHOTOLYSIS: A single reactant breaks into multiple products on supplying sunlight. /light

Light/Sunlight → breakdown

Photolysis.png

$$2AgCl(s) \xrightarrow[\text{Sunlight } (h\nu)]{\text{Light}} 2Ag(s) + Cl_2(g)$$
(White) (Grey) → (greenish yellow gas)

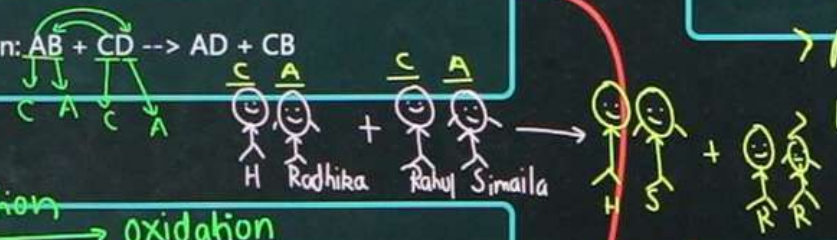
$$2AgBr(s) \xrightarrow[\text{light } (h\nu)]{\text{Light}} 2Ag(s) + Br_2(g)$$
(Yellow) (Grey) → (reddish brown vapour)

→ photosensitive mat is used in photography

Metathesis Rxn

DOUBLE DISPLACEMENT REACTION: Exchange of cations and anions between reactants.

Representation: AB + CD --> AD + CB



(V) REDOX REACTION: Reaction in which both oxidation and reduction takes place simultaneously (एक साथ)

Reduction → oxidation

→ Oxidation: Addition of oxygen or removal of hydrogen or BOTH

PRECIPITATION REACTION: Type of a double displacement reaction in which an insoluble solid, i.e. precipitate is formed.

Double displacement reaction precipitation reaction.png

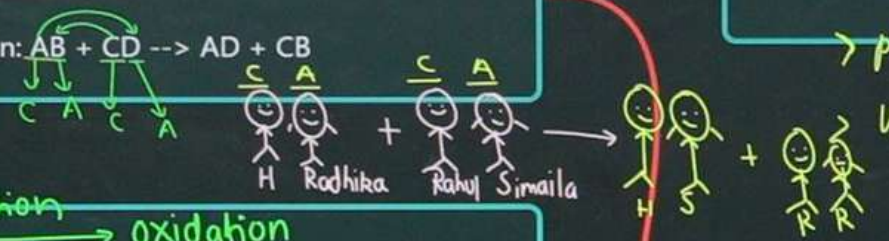
oxless Solid

white insoluble

→ Products)

DOUBLE DISPLACEMENT REACTION: Exchange of cations and anions between reactants.

Representation: AB + CD --> AD + CB



$$2AgBr(s) \xrightarrow{light\ (h\nu)} 2Ag(s) + Br_2(g)$$

(Yellow) (Grey) → (reddish brown vapour)

→ phot 'live mat' is used in photography & wh

V REDOX REACTION: Reaction in which both oxidation and reduction takes place simultaneously (एक साथ)

Reduction → Oxidation

Oxidation: Addition of oxygen or removal of hydrogen or BOTH

Reduction: Addition of hydrogen or removal of oxygen or BOTH

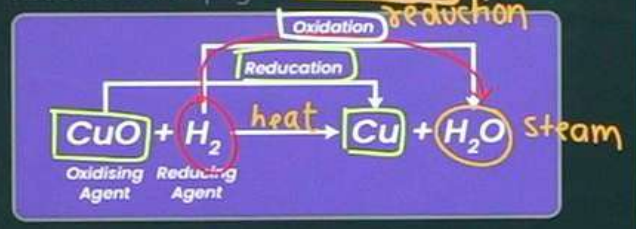
Shiny brown/ reddish brown

$$2Cu + O_2 \xrightarrow{Heat} 2CuO$$

Black

Oxidation reduction

Redox Reaction.png



CuO $\xrightarrow{reduced\ to}$ Cu

H_2 $\xrightarrow{oxidised\ to}$ H_2O

idising gent'

reducing agent

OXIDISING AGENT/OXIDANT: Substance which gives oxygen or gains hydrogen or, that which reduces itself is an oxidising agent. & oxidises others

REDUCING AGENT/REDUCTANT: Substance which gives hydrogen or gains oxygen or , that which oxidises itself is an reducing agent. & reduces others

I PRECIPITATION REACTION: Type of a double displacement reaction in which an insoluble solid, i.e. precipitate is formed.

Double displacement reaction precipitation reaction.png

Colourless Soln

I $Na_2SO_4(aq) + BaCl_2(aq) \rightarrow BaSO_4(s) + 2NaCl(aq)$

(Sodium sulphate) (Barium chloride) (Barium sulphate) (Sodium chloride)

White insoluble solid (ppt.)

Colourless Soln

Double displacement reaction.png

II $Ca(OH)_2(aq) + CO_2(g) \rightarrow CaCO_3(s) + H_2O(l)$

(Calcium hydroxide) (Calcium carbonate)

White insoluble solid

milky / turbid

LIME WATER

Colourless Soln

Precipitate formation.png

III $Pb(NO_3)_2(aq) + 2KI(aq) \rightarrow PbI_2(s) + 2KNO_3(aq)$

C A C A

Yellow Precipitate

Colourless Soln

Colourless Soln

Types of Redox Rxn

Oxidation: Addition of oxygen or removal of hydrogen or BOTH

Reduction: Addition of hydrogen or removal of oxygen or BOTH

shiny brown/ reddish brown

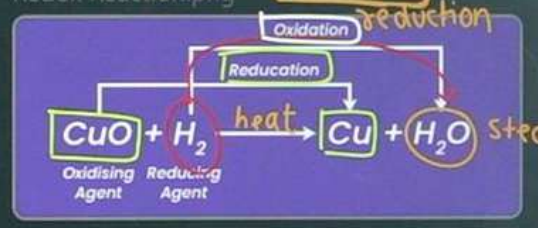
$$2Cu + O_2 \xrightarrow{Heat} 2CuO$$

Black

Oxidation

reduction

Redox Reaction.png



CuO reduced to Cu — 'Oxidising agent'

H_2 oxidised to H_2O — reducing agent

OXIDISING AGENT/OXIDANT:

Substance which gives oxygen or gains hydrogen or, that which reduces itself is an oxidising agent.

& oxidises others

REDUCING AGENT/REDU

Substance which gives h or gains oxygen or , that oxidises itself is an reduc agent. & reduces othe

(II) RANCIDITY/RANCIDIFICATION: 'OXIDATIVE RANCIDITY'

(Oxidation of oils and fats in food resulting in bad smell and taste.)

Rancidity.png

How to prevent

- ✓ Addition of antioxidants (Vitamin C, vitamin E etc.)
- ✓ Filling nitrogen gas/helium gas
- ✓ Refrigeration of food items

Temp(↓), speed of rxn(↓)

(I) CORROSION:

surface degradation

Surface deterioration process of metals where they convert to a more stable form, i.e. (oxides, sulphides, carbonates) and more, due to the attack of atmospheric gases.

Iron: Rusting → name of layer → RUST (Reddish Brown),

Copper, Magnesium, Silver: Tarnishing → name of layer → (PATINA)

atmospheric gases

IRON

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Reddish brown

Copper

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Green

SILVER

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Black

⟹ Patina is a protective layer that sticks on metal & protects inner metal

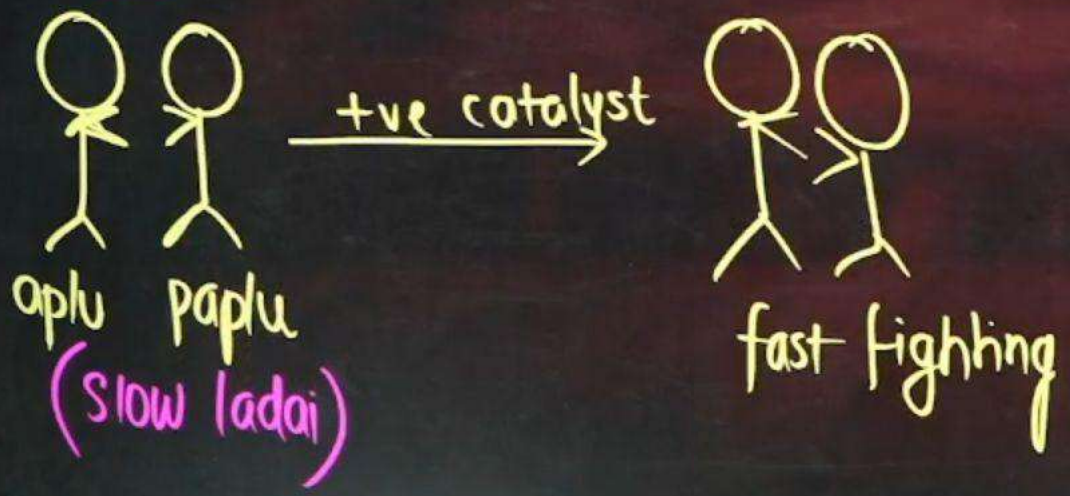
Chapter No. - 01

Chemical Reactions and Equations – Extra Important Gyaan

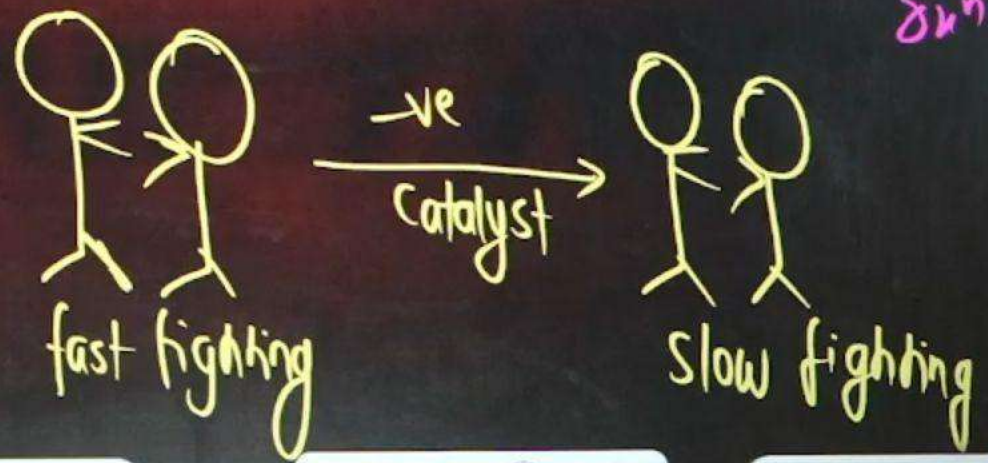
What is a catalyst?

A catalyst is a substance that increases or decreases the rate (speed) of the reaction without itself being consumed in the reaction.

BHUA JI (+ve catalyst) → (↑) speed of rxn



Didi → -ve catalyst
↳ (↓) speed of rxn



Formation of ammonia	Iron +ve catalyst
Decomposition of hydrogen peroxide	Phosphoric Acid -ve catalyst

Give a Thought

Why it is advised to wear eye protection during the burning of magnesium ribbon?

When magnesium ribbon burns in air, dazzling white light is produced which contain *ultraviolet light* that can cause *photokeratitis* or *it can permanently damage the eye*.

(temporary painful condition)

Give a Thought

Are all combination reactions exothermic?

A. Yes

B. No

No! Not all combination reactions are exothermic. They can be endothermic too.

Ex: N_2 (g) + O_2 (g) + Heat → 2NO (g)

The above reaction takes place when heat energy is provided through lightning.

Out-of-NCERT but Important Gyaan

NCERT Class X → $Ca(OH)(aq)$ → slaked lime

- $Ca(OH)_2(s)$: Slaked lime (White powder)
- $Ca(OH)_2(aq)$: Limewater (Saturated aqueous solution) → Colourless Soln
- Suspension of $Ca(OH)_2$ in water: Milk of lime or limewash or whitewash

Class 11th NCERT

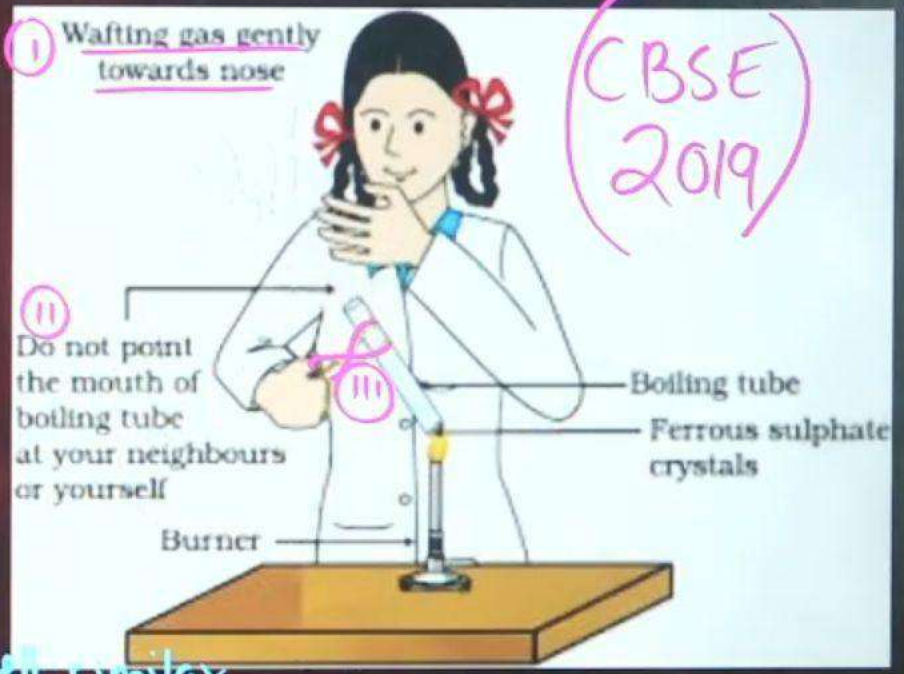
Precautions To Be Followed During Thermolysis of Any Compound

(i) Do not point the mouth of the boiling tube at your neighbours or yourself.

(ii) Waft the gases – Don't sniff them.

This is done to confirm the presence of sulphur dioxide and sulphur trioxide gases released.

(iii) Always use a test tube holder while heating the test tube.



(CBSE 2019)

(Smell similar while burning a matchstick)

Give a Thought

During electrolysis of water

Why acidulated water/water with NaCl is taken?

Water is a poor conductor of electricity. In order to make water a good conductor of electricity, dilute sulphuric acid/NaCl is added to water which are electrolytes (break into ions and conducts electricity) This in turn speed up the electrolysis of water.

Give a Thought

(NCERT activity)

What will happen if burning candle is brought close to the mouth of the test tubes.?

(जलती है पर जलने में मदद नहीं करती)

Hydrogen → Combustible but not a supporter of combustion

When we bring a **glowing candle close** to the mouth of one of the test tubes, the gas in the test tube takes fire and **burns** with a **pop** sound, showing the presence of **hydrogen** in the test tube. (extinguishes candle)

When we bring a burning candle closer to the mouth of another test tube, the candle starts to **burn brightly**, showing that the test tube **contains oxygen**.

तो नहीं पर जलाती है।

not combustible but a supporter of combustion

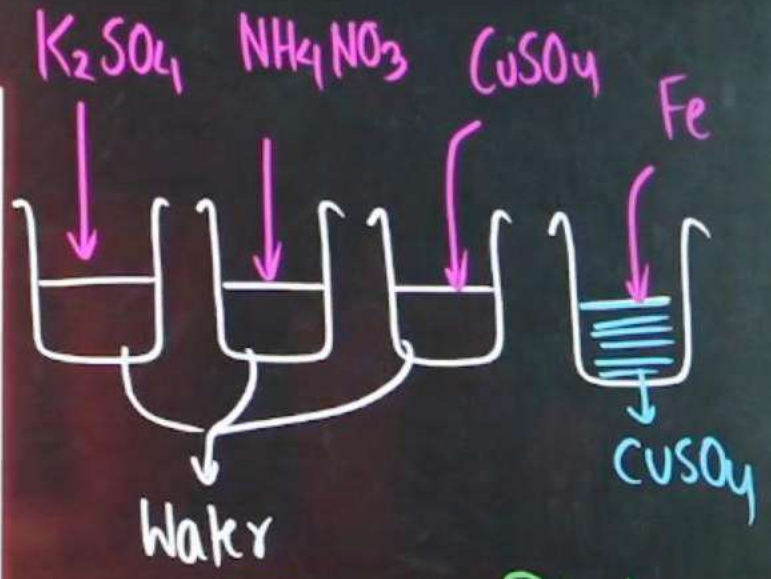
Group Activity Discussion

Group Activity

Perform the following activity.

- Take four beakers and label them as A, B, C and D.
- Put 25 mL of water in A, B and C beakers and copper sulphate solution in beaker D.
- Measure and record the temperature of each liquid contained in the beakers above.
- Add two spatulas of potassium sulphate, ammonium nitrate, anhydrous copper sulphate and fine iron fillings to beakers A, B, C and D respectively and stir.
- Finally measure and record the temperature of each of the mixture above.

Find out which reactions are exothermic and which ones are endothermic in nature.



$$Fe + CuSO_4 \rightarrow FeSO_4 + Cu$$

Displacement rxn are generally exothermic

CONCLUSION

A and B: Endothermic

C: Exothermic

D: Displacement reactions are generally exothermic.

Give a Thought

actual form of rxn

$$Ba(OH)_2 \cdot 8\,H_2O(s) + 2\,NH_4Cl(s) \rightarrow BaCl_2 \cdot 2\,H_2O(s) + 2\,NH_3(aq) + 8\,H_2O(l)$$

Take about 2 g barium hydroxide in a test tube. Add 1 g of ammonium chloride and mix with the help of a glass rod. Touch the bottom of the test tube with your palm. What do you feel? Is this an exothermic or endothermic reaction?

Simple form → $Ba(OH)_2$ (solid) + NH_4Cl (solid) + heat → $BaCl_2$ + NH_4OH → NH_3, H_2O

Video: Water between wooden block and beaker freezes and that's why beaker got stuck with the wooden block. Hence, it is a/an:

- Endothermic reaction
- Solid-solid double displacement reaction

Chapter No. - 01

Chemical Reactions and Equations – Question Practice

QUESTION

Which of the following is a NECESSARY condition for ALL chemical reactions to occur.

(A) The reactants should be in the same state. (X)

(B) Temperature of the reactants should be the same. (X)

(C) The reactants should be in the same amount. (X)

(D) There should be physical contact between the reactants.

QUESTION

In the balanced chemical equation:
(*a*Lead nitrate + *b*Aluminium chloride → *c*Aluminium nitrate + *d*Lead chloride)
Which of the following alternatives is correct?

(A) a = 1, b = 2, c = 2, d = 1

(B) a = 4, b = 3, c = 3, d = 4

(C) a = 2, b = 3, c = 2, d = 3

(D) a = 3, b = 2, c = 2, d = 3

$$3Pb(NO_3)_2 + 2AlCl_3 \longrightarrow 2Al(NO_3)_3 + 3PbCl_2$$

a=3 b=2 c=2 d=3

QUESTION

Which of the following is not an example of an exothermic reaction?

(A) Respiration

(B) Burning of natural gas

(C) Decomposition of vegetable matter into compost

(D) Photosynthesis (Endothermic)

QUESTION

The following reaction is used for the preparation of oxygen gas in the laboratory.

Potassium chlorate

$$2KClO_3\,(s) \xrightarrow[\text{Catalyst}]{\text{Heat}} 2KCl\,(s) + 3O_2\,(g)$$

Thermolysis

Which of the following statement(s) is(are) correct about the reaction?

(A) It is a decomposition reaction and endothermic in nature

(B) It is a combination reaction

(C) It is a decomposition reaction and accompanied by release of heat

(D) It is a photochemical decomposition reaction and exothermic in nature

QUESTION

Electrolysis of water is a decomposition reaction. The mole ratio of hydrogen and oxygen gases liberated during electrolysis of water is:

$$2H_2O(l) \xrightarrow{\text{electricity}} 2H_2(g) + 1O_2(g)$$

(A) 1:1

(B) 2:1 ✓

(C) 4:1

(D) 1:2

CBSE 2024

Select from the following a decomposition reaction in which the source of energy for decomposition is light:

$\Delta \rightarrow$ heat

(a) $2FeSO_4 \xrightarrow{\Delta} Fe_2O_3 + SO_2 + SO_3$

(b) $2H_2O \xrightarrow{\text{electricity}} 2H_2 + O_2$

(c) $2AgBr \xrightarrow[\text{(light)}]{h\nu} 2Ag + Br_2$

(d) $CaCO_3 \xrightarrow{\Delta} CaO + CO_2$

A (a)

B (b)

C (c)

D (d)

CBSE 2020

When hydrogen sulphide gas is passed through a blue solution of copper sulphate, a black precipitate of copper sulphide is obtained and the sulphuric acid so formed remains in the solution. The reaction is an example of a:

(A) Combination reaction

(B) Displacement reaction

(C) Decomposition reaction

(D) Double displacement reaction

$$\underset{C}{H_2}\underset{A}{S} + \underset{C}{Cu}\underset{A}{SO_4} \rightarrow H_2SO_4 + CuS$$

Precipitation Rxn

Black ppt.

CBSE 2024

Identify the correct statement about the following reaction:

$$2H_2S + SO_2 \rightarrow 2H_2O + S$$

Removal of oxygen – Reduction – Oxidising agent

Addition of oxygen – OXIDATION – Reducing agent

(A) H_2S is oxidising agent and SO_2 is reducing agent.

(B) H_2S is reduced to sulphur.

(C) SO_2 is oxidising agent and H_2S is reducing agent.

(D) SO_2 is oxidised to sulphur.

CBSE 2024

Removal of oxygen – Reduction – Oxidising agent

$$MnO_2 + 4HCl \rightarrow MnCl_2 + 2H_2O + Cl_2$$

Removal of hydrogen – OXIDATION – Reducing agent

The reaction given above is a redox reaction because in this case:

(A) MnO_2 is oxidised and HCl is reduced.

(B) HCl is oxidised.

(C) MnO_2 is reduced.

(D) MnO_2 is reduced and HCl is oxidised.

AVOID TASTING/TOUCHING TO IDENTIFY AN ACID OR A BASE

I. Tasting/touching can be disastrous as some acids and bases are highly corrosive.

II. Some acids taste sour while some taste bitter as well as sweet. Hence, tasting is not a relied option.

PHYSICAL PROPERTIES OF ACIDS AND BASES

- Generally, acids are sour in taste. → acids can taste sweet, bitter & sour.
- Bases taste bitter.
- Bases have a soapy texture, i.e. they are slippery to touch.
- Both conduct electricity in aqueous solutions. (when dissolved in H_2O)

ACIDS, BASES AND SALTS

↳ Neutr

Some chemical substances show a sharp change in COLOUR or ODOUR in an acidic or basic medium. Such substances are called acid-base indicators.

INDICATORS THAT SHOW A CHANGE IN COLOUR

INDICATORS THAT SHOW A CHANGE IN COLOUR.png

Indicator	Neutral solution	Acidic solution	Basic solution
(a) Litmus solution	Pale Purple / Mauve	Red	Blue
(b) Turmeric paste	Yellow	Yellow	Brick Red
(c) Hydrangea flowers	Blue	Blue	Pink
(d) Phenolphthalein	Colourless	Colourless	Pink
(e) Methyl orange	Orange	Red / Pinkish red	Yellow

Tells nature of soil

Natural Indicator

Synthetic | Man-made

When reactivity of metal is more H of aci

visually impaired

INDICATORS THAT SHOW A CHANGE IN ODOUR → OLFACTORY INDICATORS

Olfactory Indicator.png

Olfactory indicator	Acidic solution	Basic solution
(a) Onion odoured cloth strips	Smell remains same	Smell vanishes
(b) Vanilla essence	Smell remains same	Smell vanishes
(c) Clove oil	Smell remains same	Smell vanishes

Double di

(Gas fo

BOTH

CHEMICAL PROPERTIES OF ACIDS AND BASES

Reaction of metals with dilute acids.png

[Metal- nonmetal displacement rxn]

Metal	+	Dilute acid	→	Salt	+	Hydrogen
Zn(s)	+	2dil.HCl(aq)	→	$ZnCl_2$(aq)	+	H_2(↑)

heat

effervescence

gas evolved in form of bubbles along with fizzing & foaming

CH_3COOH: Acetic acid

(I) When reactivity of metal is more than H of acid

Reaction of metal carbonates or bicarbonates with acid.png

Metal carbonate/ hydrogen carbonate	+	Acid	→	Salt	+	Water	+	Carbon dioxide
$CaCO_3$(s)	+	CH_3COOH(aq)	→	$Ca(CH_3COO)_2$(aq)	+	H_2O(l)	+	CO_2(↑)

(II)

C A A C

$NaHCO_3$ + CH_3COOH → CH_3COONa + H_2CO_3 → H_2O, CO_2

C A A C

Reaction of metal oxide with acid.png

Metal oxide	+	Acid	→	Salt	+	Water
CuO(s)	+	2HCl(aq)	→	$CuCl_2$(aq)	+	H_2O(l)

(III)

C A (Base) C A

Black — Colourless Soltn — Blue-green soltn

Double displacement rxn [Neutralisation Rxn]

Pasted image 20231 0822 526.png

(Water soluble base)

Metal	+	Alkali	+	Water	→	Salt	+	Hydrogen
Zn(s)	+	2NaOH(aq)	+	$2H_2O$(l)	→	$Na_2Zn(OH)_4$(aq)	+	H_2(↑)
2Al(s)	+	2NaOH(aq)	+	$6H_2O$(l)	→	$2NaAl(OH)_4$(aq)	+	$3H_2$(↑)

(IV)

$Na_2Zn(OH)_4$(aq): Sodium zincate (✓)

$NaAl(OH)_4$(aq): Sodium aluminate (✓)

The chemical reactions in the above cases will form a mixture of different zincate and aluminate anions and not all metals react with bases to show such reactions.

NCERT → [$Zn(s) + 2NaOH(aq) \longrightarrow Na_2ZnO_2(aq) + H_2(↑)$]

Reaction of non-metallic oxide with base.png

Non-metal oxide	+	Base	→	Salt	+	Water
CO_2(g)	+	$Ca(OH)_2$(aq)	→	$CaCO_3$(s)	+	H_2O(l)
SO_3(g)	+	2NaOH(aq)	→	Na_2SO_4(aq)	+	H_2O(l)

(V)

ACID

Neutralisation Rxn

also, a precipitation

OLFACTORY INDICATORS

Double displacement (Gas forming)

BOTH

Amphoteric metals

Sn, Al, Be, Pb, Zn etc.

Confirmation of H_2 gas

Burns with a squeaky pop sound!

Confirmation of CO_2 gas

Test for carbon dioxide gas.png

$Ca(OH)_2$(aq) + CO_2(g) → $CaCO_3$(s) + H_2O(l)

Limewater

Colourless Soltn

Soltn turns milky / turbid due to this

Excess of carbon dioxide gas through limewater.png

$CaCO_3$(s) + H_2O(l) + CO_2(g) → $Ca(HCO_3)_2$(aq)

colourless soltn of calcium bicarbonate

excess of CO_2 or CO_2 is passed for a long time

(I) Some metal oxides, metal hydroxides and ammonium hydroxide are basic in nature.

(II) Some metal oxides / hydroxides: AMPHOTERIC

Sn, Al, Be, Pb, Zn etc.

(act as acid as well as base)

Water-soluble bases are known as alkalis.

	alkali	base
NaOH	✓	✓
$Fe(OH)_3$	×	✓
CuO	×	✓

Burns with a squeaky pop sound!

Some non-metallic oxides are acidic in nature.

CO_2, SO_3, NO_2, SO_2 etc.

Some are neutral as well: CO, N_2O, NO, H_2O etc.

SALTS

$Na^{1+}Cl^{1-}$, $NH_4^{1+}Cl^{1-}$, $MgCl_2 \rightarrow 2Cl^{1-}$ etc. (Mg^{2+})

- Salts are ionic compounds that contain a positively charged ion (cation) and negatively charged ion (anion).
- Salts are electrically neutral as the total positive charge is equal to the total negative charge.
- Salts of weak acid and weak base or strong acid and strong base: NEUTRAL (pH =7)
- Salts of strong acid and weak base: ACIDIC (pH < 7)
- Salts of strong base and weak acid: BASIC (pH > 7)

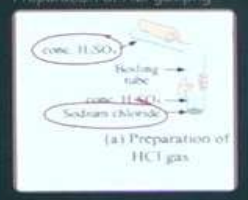
$$\text{ACID} + \text{BASE} \longrightarrow \text{SALT} + \text{WATER}$$

ROLE OF WATER IN DISSOCIATION OF ACIDS

Acids show their acidic character due to the H+(aq) or H3O+ ions that are produced in the aqueous solutions (water is solvent). ($H^+(aq)$ or H_3O^+ (hydronium ions))

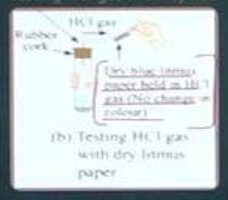
$HCl(g) \xrightarrow{\text{dissolves in } H_2O} HCl(aq)$

Preparation of HCl gas.png



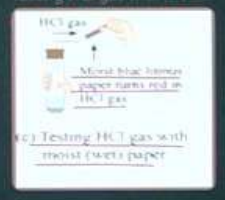
(a) Preparation of HCl gas

Testing HCl gas with dry lit...



(b) Testing HCl gas with dry litmus paper

Testing HCl gas with mois...



(c) Testing HCl gas with moist (wet) paper

Blue litmus paper / solⁿ

neutral & base → REMAINS BLUE

acid → RED

Release of HCl gas.png

$$NaCl(s) + \text{conc. } H_2SO_4(aq) \xrightarrow{T < 200^\circ C} NaHSO_4(aq) + HCl(g)$$

$$2NaCl(s) + \text{conc. } H_2SO_4(aq) \xrightarrow{T > 200^\circ C} Na_2SO_4(aq) + 2HCl(g)$$

DILUTION OF ACIDS

(a) (i) Density of water < acid. Also, reaction of acid with water is exothermic, i.e. a large amount of heat is generated.

(b) So, if water is added to acid, some water converts to water-vapour on the interface and a mixture of acid and water-vapour splash-out and cause burns. (acid dissociates in water which is exothermic)

(ii) The beaker in which the dilution is carried out may also break due to excessive local heating.

HOW TO DO IT?

To slow down the exothermic reaction, dilution of concentrated acid is always done by slowly adding concentrated acid into a sufficient amount of water with gentle stirring.

Acid to water.png

(A)

Water has a good heat holding capacity without (↑) temp.

Water to acid.png

(B) X

$$NaOH(aq) \longrightarrow Na^+(aq) + OH^-(aq)$$
$$HCl(aq) \longrightarrow H^+(aq) + Cl^-(aq)$$
$$CH_3COOH(aq) \rightleftharpoons CH_3COO^-(aq) + H^+(aq)$$

STRONG ACID/STRONG BASE

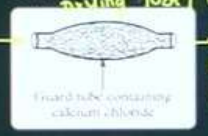
A strong acid or a base is a one that completely dissociates into ions. → in water

WEAK ACID/WEAK BASE

A weak acid or a base is a one that partially dissociates into ions. → in water

During the humid climate, hydrogen chloride gas is first passed through a guard tube containing anhydrous calcium chloride (drying agent) which absorbs the moisture and makes the gas dry.

Guard Tube in Pr... Drying Tube / Guard Tube



moist HCl(g) → dry HCl(g)

List of weak bases.png

WEAK BASES
- (i) NH_4OH
- (ii) $Cu(OH)_2$

List of strong bases.png

STRONG BASES
- (i) NaOH
- (ii) KOH
- (iii) $Ca(OH)_2$
- (iv) $Mg(OH)_2$

(i), (ii) → strong base & strong alkali

(iii), (iv) → strong base but weak alkali

List of strong acids.png

STRONG ACIDS
- (i) H_2SO_4 → Sulphuric acid
- (ii) HNO_3 → Nitric acid
- (iii) HCl → Hydrochloric acid
- (iv) HBr → Hydrobromic acid
- (v) HI → Hydroiodic acid
- (vi) $HClO_4$ → Perchloric acid
- (vii) $HClO_3$ → Chloric acid

except these all are weak acids

- Chemical formula: → $Na_2CO_3.10H_2O$
- Principle of manufacture:

Action of heat on baking soda.png

Thermolysis → $2NaHCO_3(s) \xrightarrow{\Delta} Na_2CO_3(s)$ (SODA ASH)

Crystallisation of soda ash.png

Recrystallisation of Na_2CO_3: $Na_2CO_3(s) + 10H_2O(l) \rightarrow$

PLASTER OF PARIS

- Chemical name: Calcium sulphate hemihydrate
- Chemical formula: $CaSO_4 \cdot \frac{1}{2}H_2O$
- Principle of manufacture

Manufacturing of PoP.png

Formation of PoP: $CaSO_4 \cdot 2H_2O \xrightarrow[\text{or } 100^\circ C]{373\ K} CaSO_4$ (Gypsum → Plaster)

Setting of PoP.png

Setting of PoP: $CaSO_4 \cdot \frac{1}{2}H_2O(s) + 1\frac{1}{2}H_2O(l) \rightarrow$

① Indicator except universal indicator
↓
Change colour to tell whether a substance is an acid | base
[Qualitative Analysis]

⑪ To identify strength of acid or base [Quantitative Analysis]

Meaning of pH

pH stands for "power of hydrogen" where "p" represents the German word for power, potenz and H is the element symbol of hydrogen.

IMPORTANCE OF pH IN DAILY LIFE

ACIDITY AND ALKANITY IN TERMS OF pH

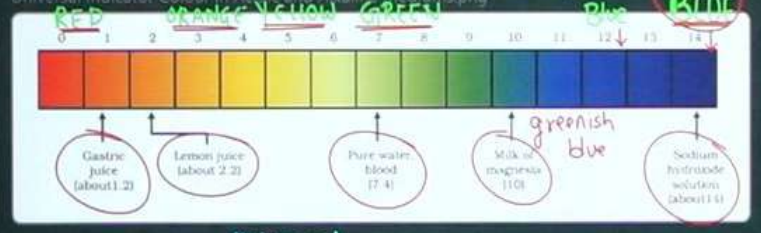
At 25 °C, the solutions may have pH from 0 to 14. For different solutions the pH values will be:

Neutral solutions pH = 7, Concentration of $H^+(aq) = OH^-(aq)$

Acidic solutions pH < 7, Concentration of $H^+(aq) > OH^-(aq)$ → acidic character

Basic solutions pH > 7, Concentration of $H^+(aq) < OH^-(aq)$ → basic character

Universal Indicator Colour in Acidic and Alkaline Mediums.png



Universal indicator → mixture of different indicators like thymol blue, methyl orange etc.

$H^+(aq)$ → Hydronium ions

$OH^-(aq)$ → Hydroxyl / Hydroxide ions

from plants & animals
↓
[ORGANIC ACIDS]
↓

Some Naturally Occurring Acids.png

Natural source	Acid	Natural source	Acid
Citrus fruits	Citric acid	Nettle sting	Formic acid
Tamarind	Tartaric acid	Apple	Malic acid
Tomato	Oxalic acid	Ant sting	Formic acid
Vinegar	Acetic acid	Curd	Lactic acid

Lemon, orange etc. also contains Vitamin C (ascorbic acid)

non-living sources like rocks & minerals
↓
MINERAL | INORGANIC ACIDS
HCl, HNO_3, H_2SO_4 etc.

Natural way
↓
Saliva in mouth
↓
alkaline

Nettle Plant.png

Dock Plant.png

(A) Problem I: When we are stung by a bee or an ant, we feel pain and irritation. This is because ant and bee-sting inject formic acid.

Solution I: To nullify its effect and to provide relief, a solution of mild base like baking soda should be applied.

(B) Problem II: Leaves of nettle plants have stinging hair that injects formic acid when touched accidentally.

Solution II: A traditional remedy is rubbing the area with the leaf of the dock plant (Basic) that grows in the vicinity of the nettle plant.

(C) Problem III: Our tooth enamel is made of calcium hydroxyapatite (a crystalline form of calcium phosphate), which is the hardest substance in the human body. It is insoluble in water but it gets corroded when the pH of the mouth falls below 5.5, i.e. moderately acidic. → (Demineralisation / Cavity of enamel)

Tooth enamel

$Ca_3(PO_4)_2$

Solution III: The best way to prevent tooth decay is to clean the teeth with a basic substance like toothpaste that neutralises the effect of acid produced in the mouth.

Problem IV: Due to overeating (a) or eating too much spicy food (b), the stomach produces more amount of hydrochloric acid than required. This results in the pain and irritation in the lower chest area. This condition is called acidity. / acid reflux (c) caffeinated drinks like tea, coffee etc. ↳ (starts to travel in oesophagus)

Solution IV: It can be cured by taking antacids like Milk of Magnesia, $Mg(OH)_2$ which neutralises the excess acid.

OR 'cold milk can also be taken'

Electrolysis of aqueous NaCl

COMMON SALT / Table salt

- Chemical name: Sodium chloride
- Chemical formula: NaCl
- Occurrence and extraction: (a) Seawater through evaporation (b) Rock salt (solid deposits which are brown due to earthly impurities)
- Uses: (a) It is an essential constituent of our diet. (b) Important raw material for the production of other materials of daily use such as sodium hydroxide, bleaching powder etc.

NaCl ← mining

(maintains blood pressure & responsible for transportation of nutrients)

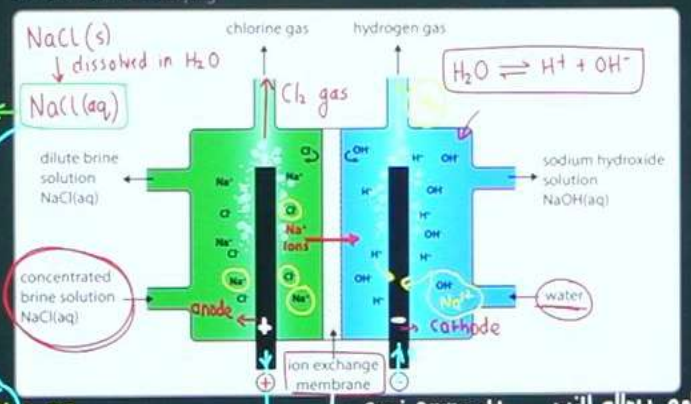
② CAUSTIC SODA / LYE

- Chemical name: Sodium hydroxide
- Chemical formula: NaOH
- Name of manufacturing process: Chlor-alkali process

Chlorine is a by-product

NaOH is the main product

Chlor-Alkali Process.png



NaCl(s) ↓ dissolved in H_2O → NaCl(aq) ← BRINE SOLT^n

Na^{1+} & Cl^{1-}

e^- → semi-permeable membrane - will allow only Na^+ to move through

Nascent Cl

$Cl^{1-} \rightarrow Cl + e^-$

$Cl^{1-} \rightarrow Cl + e^-$

$2Cl^{1-} \rightarrow Cl_2 + 2e^-$

Oxidation [Loss of electron(s)] → Anode

Reaction at cathode and anode.png

At cathode: $2H^+ + 2e^- \rightarrow H_2$

At anode: $2Cl^- \rightarrow Cl_2 + 2e^-$

$H^+ + e^- \rightarrow H$ (Nascent H)

$H^+ + e^- \rightarrow H$

$2H^+ + 2e^- \rightarrow H_2$

Gain of electrons [Reduction] → CATHODE

Overall reaction.png

The complete reaction of the process will be:

$$2NaCl(aq) + 2H_2O(l) \xrightarrow{\text{Electricity}} 2NaOH(aq) + H_2(g) + Cl_2(g)$$

By-product

main product ← near cathode | at cathode | at anode

(i) Uses of caustic soda

(a) It is used to manufacture soaps and detergents.

(b) It is used for degreasing metals. → removing oil, dirt, grease etc from metals

(c) It is used as a drain cleaner to open clogged drains.

(ii) Uses of hydrogen gas (Liberated at cathode)

(a) Liquid hydrogen is used as rocket fuel.

(b) It is used to manufacture ammonia for fertilisers.

(c) It is used in the hydrogenation of vegetable oil to vegetable ghee. → margarine (bread spread)

(iii) Uses of chlorine gas (Liberated at anode)

(a) It is used to manufacture pesticides and PVC. → polyvinyl chloride

(b) It is used to manufacture CFCs for refrigerators. → chlorofluorocarbons (used as a refrigerant for cooling)

(c) It is used as a disinfectant in the swimming pools. → kills germs on non-living surfaces

BLEACHING POWDER

- Chemical name: Calcium oxychloride
- Chemical formula: $CaOCl_2$ (Actual composition is quite complex)
- Principle of manufacture: The chlorine gas obtained as a by-product from the chlor-alkali process when reacts with dry slaked lime produces bleaching powder.

Preparation of bleaching powder.png

$$Ca(OH)_2(s) + Cl_2(g) \rightarrow CaOCl_2(s) + H_2O(g)$$

dry slaked lime

In Hesenclever Plant or Beckmann Plant

Uses of bleaching powder

(a) It is used in the textile industry for bleaching cotton and linen. (decolourising)
(b) It is used as an oxidising agent in chemical industries.
(c) It is used for disinfecting drinking water by killing germs.

because of Cl gas

BAKING SODA

- Chemical name: Sodium hydrogen carbonate
- Chemical formula: $NaHCO_3$
- Principle of manufacture:

Ammonia Soda Process / Solvay's process → Intermediate Product → $NaHCO_3$

Preparation of baking soda.png

$$NaCl(aq) + H_2O(l) + CO_2(g) + NH_3(g) \rightarrow NaHCO_3(s) + NH_4Cl(aq)$$

(II) Carbonating Tower

(I) Brine Soln → (III) Ammonia Tower

filter out

Uses of baking soda

(a) It is used to make baking powder (mixture of baking soda and mild edible acid such as tartaric acid). When it is heated or mixed with water, baking soda reacts with acid to form sodium salt of acid, water vapour and carbon dioxide.
(b) It is used in soda-acid fire extinguishers.
(c) It is used as an ingredient of antacid medicines.

BAKING POWDER

It is a mixture of baking soda, a dry acid such as tartaric acid and cornstarch

to prevent unintentional rxn btw. soda & dry acid by absorbing moisture

Light Green	Blue	White	White
$FeSO_4.7H_2O$,	$CuSO_4.5H_2O$,	$Na_2CO_3.10H_2O$,	$CaSO_4.2H_2O$

WASHING SODA

- Chemical name: Sodium carbonate decahydrate
- Chemical formula: $Na_2CO_3.10H_2O$
- Principle of manufacture:

Action of heat on baking soda.png

Thermolysis

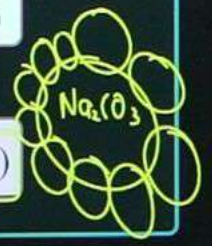
$$2NaHCO_3(s) \xrightarrow{\Delta} Na_2CO_3(s) + H_2O(g) + CO_2(g)$$

(SODA ASH) → main product of Solvay's process

Crystallisation of soda ash.png

Recrystallisation of Na_2CO_3

$$Na_2CO_3(s) + 10H_2O(l) \rightarrow Na_2CO_3.10H_2O(s)$$



WATER OF CRYSTALLISATION

(a) The fixed number of water molecules that are attached to one formula unit salt and makes the salt crystalline (fixed geometrical shape) is called water of crystallisation.

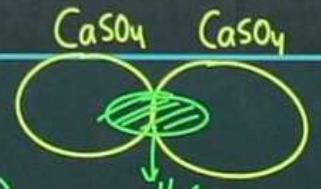
(b) In some cases it give colour as well.

Uses of washing soda

(a) It is used to remove permanent hardness of water. (chlorides & sulphate of Ca & Mg)
(b) It is used to manufacture sodium compounds such as borax.
(c) It is used as a cleaning agent to remove stubborn stains from clothes.

→ glass and paper industries

PLASTER OF PARIS



- Chemical name: Calcium sulphate hemihydrate
- Chemical formula: $CaSO_4 \cdot \frac{1}{2}H_2O$ or $(CaSO_4)_2 \cdot H_2O$
- Principle of manufacture

Formation of PoP

Manufacturing of PoP.png

$$\underset{\text{Gypsum}}{CaSO_4 \cdot 2H_2O} \xrightarrow[\text{or } 100\,^\circ C]{373\ K} \underset{\text{Plaster of Paris}}{\overset{25\%}{CaSO_4 \cdot \frac{1}{2}H_2O}} + \overset{75\%}{\frac{3}{2}H_2O}$$

Setting of PoP

Setting of PoP.png

$$CaSO_4 \cdot \frac{1}{2}H_2O(s) + 1\frac{1}{2}H_2O\ (l) \rightarrow CaSO_4.2H_2O(s)$$

Hard mass (Gypsum)

Uses of plaster of Paris

(a) It is used for setting fractured bones in the right position.

(b) It is used for making toys, decorative items, statues and more.

(c) It is used to make the surface of walls and ceilings smooth.

rong base & strong alkali

strong base but weak alkali

lphuric acid

tric acid

drochloric acid

Chapter No. - 02

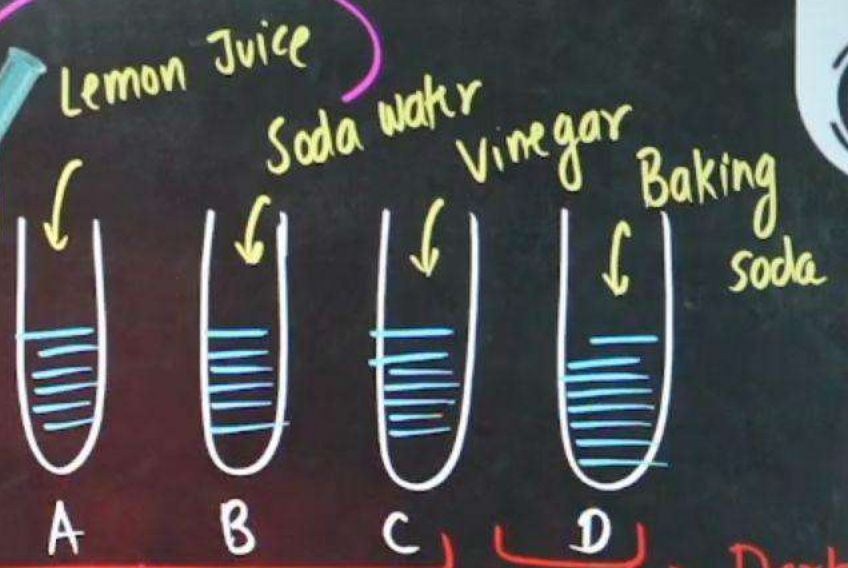
Acids, Bases and Salts - – Extra Important Gyaan

Group Activity Discussion

(I) Prepare your own indicator

- Crush beetroot in a mortar.
- Add sufficient water to obtain the extract.
- Filter the extract by the procedure learnt by you in earlier classes.
- Collect the filtrate to test the substances you may have tasted earlier.
- Arrange four test tubes in a test tube stand and label them as A,B,C and D. Pour 2 mL each of lemon juice solution, soda-water, vinegar and baking soda solution in them respectively.
- Put 2-3 drops of the beetroot extract in each test tube and note the colour change if any. Write your observation in a Table.

$H_2O + CO_2 \rightarrow H_2CO_3$



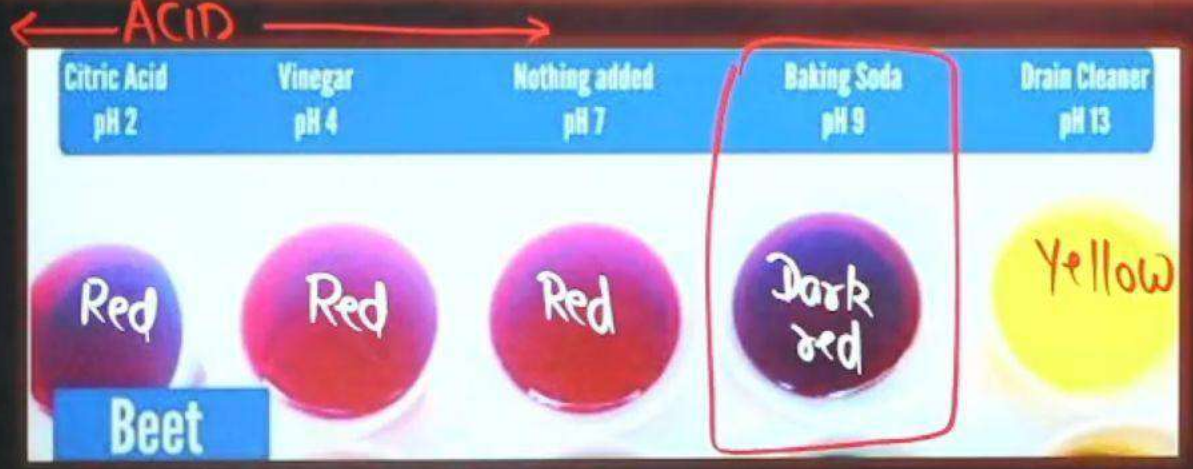
Red

Dark red

Beetroot Indicator (Natural Indicator)

ACID & NEUTRAL → RED

BASIC
- mild base (dark red)
- strong base (yellow)



Group Activity Discussion

$C_6H_{12}O_6$

You are given aqueous solutions of four hydrogen-containing compounds, i.e. glucose, alcohol, sulphuric acid and hydrochloric acid. Which of the given solutions will glow a bulb when connected to an electric circuit and why?

→ Glucose, Alcohol → don't dissociate into ions in H_2O & hence, can't conduct electricity.

→ HCl, H_2SO_4 → dissociate into ions in water & conducts electricity.

Thus, we conclude that all hydrogen-containing compounds are not acids as they don't ionise to produce $H^+(aq)$ and aqueous solutions of all acids conduct electricity.

pH Shifting of Fresh Milk by Milkman

Fresh /Raw Milk

↓

Lactic Acid Forming Bacteria

↓

Acidic Character Increases

↓

Souring of Milk

To decrease souring of milk, milkman adds baking soda (basic in nature).

↓

This milk takes time to set as curd because lactic acid will first neutralise baking soda and then curdling will start.

- *Natural sweet taste and smell of milk turns to SOUR TASTE AND SOUR SMELL*
- *Colour turns from white to LIGHT YELLOW.*

Give a Thought

NaCl will be a salt of strong base and strong acid.

A. Yes

B. No

(-I) $HCl + NaOH \longrightarrow NaCl + H_2O$

(-II) Strong acid + Strong base $\longrightarrow$ Neutral salt (pH=7) + Water

Give a Thought

$CaCO_3$ will be a salt of strong base and weak acid.

A. Yes

B. No

C-I

Acid	Base	Salt	Water

$$H_2CO_3 + Ca(OH)_2 \longrightarrow CaCO_3 + H_2O$$

C-II

Weak acid + Strong base $\longrightarrow$ Basic salt (pH>7) + Water

Give a Thought

NH_4Cl will be a salt of weak base and strong acid.

A. Yes

B. No

C-I

ACID BASE SALT WATER

$HCL + NH_4OH \longrightarrow NH_4Cl + H_2O$

C-II

Strong acid + Weak base ⟶ Acidic salt (pH<7) + WATER

Chapter No. - 02

Acids, Bases and Salts – Question Practice

CBSE 2024

Juice of tamarind turns blue litmus to red. It is because of the presence of an acid called:

(A) Methanoic acid

(B) Acetic acid

(C) Tartaric acid

(D) Oxalic acid

CBSE 2024

Four solutions, namely glucose, alcohol, hydrochloric acid and sulphuric acid filled in four separate beakers are connected one by one in an electric circuit with a bulb. The solutions in which the bulb will glow when current is passed are :

(A) Glucose and alcohol

(B) Alcohol and hydrochloric acid

(C) Glucose and sulphuric acid

(D) Hydrochloric acid and sulphuric acid

$HCl(aq) \longrightarrow H^+(aq) + Cl^-(aq)$

$H_2SO_4(aq) \longrightarrow 2H^+(aq) + SO_4^{2-}(aq)$

Question

(A): $Mg(s) + 2\,dil.\,HCl(aq) \longrightarrow MgCl_2(aq) + H_2(\uparrow)$

(B): $Na_2CO_3 + HCl \longrightarrow NaCl + H_2O + CO_2$

Two test tubes A and B contain equal amounts of dilute hydrochloric acid. On adding magnesium to test tube A and sodium carbonate to test tube B, which of the following observations will be observed: (H_2 & CO_2 are not supporter of)

A. The gases evolved in both the test tubes are supporters of combustion. (×)

B. The gas evolved in test tube B will extinguish a burning splinter with a squeaky pop sound. (×)

C. The gas evolved in test tube A will turn limewater milky. (×)

D. The gas evolved in test tube A will extinguish the burning splinter with a squeaky pop sound while the gas evolved in test tube B will directly extinguish the burning splinter.

CBSE 2024

When 2 mL of sodium hydroxide solution is added to few pieces of granulated zinc in a test tube and then warmed, the reaction that occurs can be written in the form of a balanced chemical equation as:

$2NaOH + Zn \rightarrow Na_2ZnO_2 + H_2$

(A) $NaOH + Zn \rightarrow NaZnO_2 + H_2O$

(B) $2NaOH + Zn \rightarrow Na_2ZnO_2 + H_2$

(C) $2NaOH + Zn \rightarrow NaZnO_2 + H_2$

(D) $2NaOH + Zn \rightarrow Na_2ZnO_2 + H_2O$

Question

strong acid

strong base

Equal volumes of hydrochloric acid and sodium hydroxide solutions of same concentration are mixed and the pH of the resulting solution is checked with a pH paper. What would be the colour obtained?

pH = 7

(A) Red ✗

(B) Yellow ✗

(C) Yellowish-green ✓

(D) Blue ✗

Question

(Strong acid) HNO_3 + (weak base) NH_4OH → NH_4NO_3 + H_2O

Assertion (A): pH of ammonium nitrate solution is acidic in nature.

Reason (R): Ammonium nitrate is a salt of weak base and strong acid

A. Both (A) and (R) are true and (R) is the correct explanation of (A)

B. Both (A) and (R) are true but (R) is not the correct explanation of (A)

C. (A) is true but (R) is false

D. (A) is false but (R) is true

Question

Match the chemical substances given in Column (A) with their appropriate application given in Column (B)

Column (A)	Column (B)
(A) Bleaching powder	(i) Preparation of glass
(B) Baking soda	(ii) Production of H_2 and Cl_2
(C) Washing soda	(iii) Decolourisation
(D) Sodium chloride	(iv) Antacid

A (a)– (ii), (b) – (i), (c) – (iv), (d) – (iii)

B (a)– (i), (b) – (ii), (c) – (iv), (d) – (iii)

C (a)– (iv), (b) – (ii), (c) – (i), (d) – (iii)

D (a)– (iii), (b) – (iv), (c) – (i), (d) – (ii)

Question

Match the important chemicals given in Column (A) with the chemical formulae given in Column (B)

Column (A)	Column (B)
(a) Plaster of Paris	(i) $Ca(OH)_2$
(b) Gypsum	(ii) $CaSO_4.1/2\ H_2O$
(c) Bleaching Powder	(iii) $CaSO_4.2H_2O$
(d) Slaked Lime	(iv) $CaOCl_2$

A (a)– (ii), (b) – (iii), (c) – (i), (d) – (iv)

B (a)– (iii), (b) – (ii), (c) – (i), (d) – (iv)

C (a)– (ii), (b) – (iii), (c) – (iv), (d) – (i)

D (a)– (iii), (b) – (ii), (c) – (iv), (d) – (i)

CBSE 2024

Consider the following compounds: $FeSO_4$; $CuSO_4$; $CaSO_4$; Na_2CO_3
The compound having maximum number of water of crystallisation in its crystalline form in one molecule is :

(A) $FeSO_4$

(B) $CuSO_4$

(C) $CaSO_4$

(D) Na_2CO_3

→ $FeSO_4 \cdot 7H_2O$
→ $CuSO_4 \cdot 5H_2O$
→ $CaSO_4 \cdot 2H_2O$
→ $Na_2CO_3 \cdot 10H_2O$

PHYSICAL PROPERTIES OF METALS AND NON-METALS

Table - Physical Properties of Metals and Non-metals.png

Property	Metals	Non-metals
Hardness (कठोरता)	Generally, hard Exception: Lithium, Sodium and Potassium (Hg)	Generally, soft Exception: Diamond
Lustre (चमक)	Lustrous	Generally, non-lustrous / dull Exception: Iodine and Graphite
Malleability	Generally, malleable Exception: Mercury	Non-malleable
Ductility	Generally, ductile Exception: Mercury	Generally, non-ductile Exception: Carbon fibre
Sonority	Sonorous	Non-sonorous
Electrical conductivity (free e⁻ / delocalised e⁻)	Good electrical conductors	Generally poor electrical conductors Exception: Graphite
Thermal conductivity / heat conduction	Generally, good thermal conductors Exception: Lead and Mercury	Generally, poor thermal conductors Exception: Diamond
Melting point	High melting point Exception: Gallium and Caesium	Generally, low melting point Exception: Diamond, Graphite

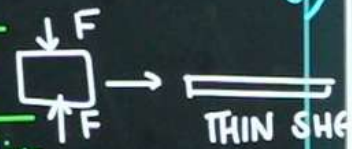
(ability of substance to resist cutting or scratching)

cut with a knife

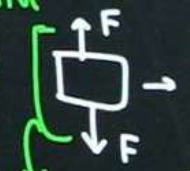
(form of C) hardest naturally occurring substance

form of C

Best conductor of heat



Compressive force



Thin wire

Tensile force

(ringing sound when struck hard)

Take place because of atomic vibrations

Na & K are more reactive than H of H_2O

Ga	M.P.	State at room temp. (25 °C)
Ga	29.7 °C	SOLID
Cs	28.4 °C	

Cs → melts on human palm (37 °C)

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or source
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REACTION OF METALS WITH WATE

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Metal	+	Cold wate
$2Na(s)$	+	$2H_2O(l)$
$2K(s)$	+	$2H_2O(l)$

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Metal	+	Cold wat
$Ca(s)$	+	$2H_2O(l)$

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Metal	+	Hot water
$Mg(s)$	+	$2H_2O(l)$

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Metal	+	Stea
$2Al(s)$	+	$3H_2O$
$Zn(s)$	+	H_2O
$3Fe(s)$	+	$4H_2O$

"Reaction of metals with oxygen"

(A metal is more reactive if it reacts at a low temp)

A metal that releases more energy is more reactive

REACTION OF METAL WITH OXYGEN

REACTION OF METALS WITH OXYGEN.png

Metal + Oxygen → Metal oxide

(Room Temp. or Low Heating)

AT ROOM TEMPERATURE OR LOW HEATING.png

Metal	Product formed	Colour of product	Colour of flame
Potassium →	K_2O	Yellow	Lilac / Pale Purple
Sodium →	Na_2O	White	Orange / Golden Yellow
Calcium →	CaO	–"–	
Magnesium →	MgO	–"–	
Aluminium →	Al_2O_3	–"–	NO FLAME
Zinc →	ZnO	–"–	
Iron →	Fe_3O_4 ($FeO.Fe_2O_3$)	Black	
Lead →	PbO	Yellow	
Copper → (low heating)	CuO	Black	
Silver, Gold And Platinum	← NO RXⁿ →		

(STRONG HEATING)

STONGLY HEATING IN PRESENCE OF OXYGEN.png

Metal	Product formed	Colour of product	Colour of flame
Potassium →	K_2O	Yellow	Lilac / Pale purple
Sodium →	Na_2O	White	Orange / Golden yellow
Calcium →	CaO	–"–	're tip' ← White
Magnesium →	MgO	–"–	–"–
Aluminium →	Al_2O_3	–"–	–"–
Zinc →	ZnO	–"–	Light Blue

Highly vigorous ←

Vigorous ←

moderate

Some metal oxides are basic while some are amphoteric in nature.

metal hydroxides

Na, K, Ca, Mg etc.

Sn, Al, Be, Pb, Zn etc

Neutralisation Rxⁿ

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Metal oxide	+	Acid	→	Salt	+	Water
$Al_2O_3(s)$ (BASE)	+	6 dil. HCl(aq) (Strong acid)	→	$2AlCl_3(aq)$ (Aluminium chloride)	+	$3H_2O(l)$

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Metal oxide	+	Base	→	Salt	+	Water
$Al_2O_3(s)$ (acid)	+	2NaOH(aq) (STRONG BASE)	→	$2NaAlO_2(aq)$ (Sodium aluminate)	+	$H_2O(l)$

CONCLUSION

(i) K and Na are most reactive but which is more reactive between both of them.

(ii) Ag, Au and Pt are least reactive but which is more reactive amongst all of them.

(iii) Ca, Al and Mg are reactive metals but which is more reactive → less reactive than K & Na but more

STONGLY HEATING IN PRESENCE OF OXYGEN.png (STRONG HEATING)

Metal	Product formed	Colour of product	Colour of flame
Potassium →	K_2O	Yellow	Lilac / Pale purple
Sodium →	Na_2O	White	Orange / Golden yellow
Calcium →	CaO	—"—	White
Magnesium →	MgO	—"—	—"—
Aluminium →	Al_2O_3	—"—	—"—
Zinc →	ZnO	—"—	Light Blue
Iron →	Fe_3O_4	Black	Sparkles (No flame)
Lead →	PbO	Yellow	No flame
Copper →	CuO	Black	
Silver, Gold And Platinum	← NO REACTION →		

're tip'

Highly vigorous

Vigorous

moderate

Speed of rxn further (↓)

Na_2O & K_2O → NaOH & KOH (soluble in H_2O)

CONCLUSION

(i) K and Na are most reactive but which is more reactive between both of them.

(ii) Ag, Au and Pt are least reactive but which is more reactive amongst all of them.

(iii) Ca, Al and Mg are reactive metals but which is more reactive amongst all of them. → less reactive than K & Na but more reactive than Zn & other metals.

(iv) Zn is more reactive than iron, lead and copper but less reactive than K, Na, Ca, Mg and Al but but which is more reactive amongst all of them.

(v) Iron is less reactive than K, Na, Ca, Mg, Al & Zn but more reactive than other metals.

Sodium and potassium are highly reactive metals and react with air (oxygen/moisture) and catches fire. To prevent the supply of air they are kept in kerosene/mineral oil.

REACTION OF METALS WITH WATER (Temp. dependent rxn)

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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

Catches fire

Na & K are more reactive than H of H_2O

(i) Metal oxides of sodium, potassium, calcium and magnesium are soluble in water forming metal hydroxides.

(ii) The evolved hydrogen gas catches fire in case of sodium and potasssium due to the heat of reaction.

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

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

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

Na_2O & K_2O $\xrightarrow{\text{soluble in } H_2O}$ NaOH & KOH

Na & K are more reactive than H of H_2O

Sodium and potassium are highly reactive metals and react with air (oxygen/moisture) and catches fire. To prevent the supply of air they are kept in kerosene/mineral oil.

REACTION OF METALS WITH WATER (Temp. dependent rxn)

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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

Catches fire

(i) Metal oxides of sodium, potassium, calcium and magnesium are soluble in water forming metal hydroxides.
(ii) The evolved hydrogen gas catches fire in case of sodium and potasssium due to the heat of reaction.

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

(i) Evolved hydrogen gas doesn't catch fire.
(ii) The tiny bubbles of hydrogen gas formed stick to the surface of the calcium, and hence it starts floating on the water.

→ no other metal reacts with cold water

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

(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.

→ no other metals except K, Na, Ca & Mg reacts with hot water.

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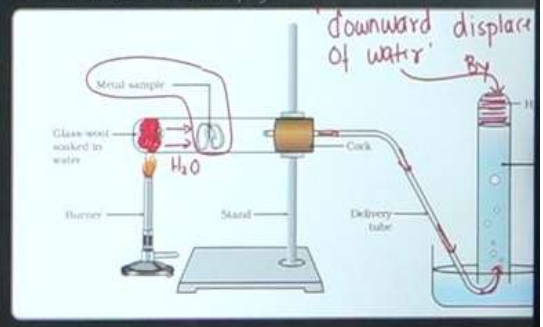
Metal	+	Steam	→	Metal oxide	+	Hydrogen gas
$2Al(s)$	+	$3H_2O(g)$	→	$Al_2O_3(s)$	+	$3H_2(g)$
$Zn(s)$	+	$H_2O(g)$	→	$ZnO(s)$	+	$H_2(g)$
$3Fe(s)$	+	$4H_2O(g)$	→	$Fe_3O_4(s)$	+	$4H_2(g)$

(i) Evolve hydrogen gas doesn't catch fire. Also, we are unable to identify the reactivity order between Al, Zn and Fe.
(ii) Metals like Pb, Cu, Ag and Au (Pt) don't even react with cold water/hot water or even with steam It is impossible to determine their order of reactivity.

EXTRA
Al + Steam → Rxn
Hot Zn + Steam → —"—
Red Hot Fe + Steam → —"—
→ ICSE

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 metal with steam.png



metal - nonmetal displacement, Exothermic, Redox

REACTION OF METALS WITH DILUTE ACIDS

REACTION OF METALS WITH DILUTE ACID.png

Metal + dil. acid → Salt + Hydrogen gas + heat

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

I Mg > Al > Zn > Fe > Pb

II

This means that the amount of heat evolved also decreases.

(Metals like Cu, Ag, Au & Pt don't react with dil. acids)

CONCLUSION

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)

In case of nitric acid (HNO_3), only magnesium and manganese react with very dilute nitric acid to form salt and hydrogen gas.

When other metals react with nitric acid, hydrogen gas is not evolved. Nitric acid being a strong oxidising agent oxidises the hydrogen gas to water (H_2O) and itself gets reduced to oxides of nitrogen like NO/NO_2/N_2O

$Mg + 2\,dil.HNO_3 \longrightarrow Mg(NO_3)_2 + H_2$

$Mn + 2\,dil.HNO_3 \longrightarrow Mn(NO_3)_2 + H_2$

Aqua regia, which in Latin means 'royal water' is a mixture of concentrated nitric acid and hydrochloric acid in the ratio of 1:3 by volume. It is a highly corrosive and fuming liquid.

It is one of the few reagents that can dissolve gold and platinum.

25 mL conc. HNO_3 + 75 mL conc. HCl → AQUA REGIA

REACTION OF METALS WITH SOLUTIONS OF OTHER METALS

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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; Reddish brown

Hence, reactivity of Pb > Cu.

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REACTIVITY/ACTIVITY SERIES OF METALS

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K	Kudi →	Potassium
Na	Naal →	Sodium
Ca	Car →	Calcium
Mg	Maango →	Magnesium
Al	Alto →	Aluminium
Zn	Zisko →	Zinc

→ Carbon (C)

→ Temporary Solⁿ

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 → Reddish brown

Hence, reactivity of Pb > Cu.

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(a) **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.

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

Reddish brown → colourless solⁿ → Blue solⁿ

Hence, reactivity of Cu > Ag.

(b) $Ag + Cu(NO_3)_2 \longrightarrow$ No Rxⁿ

(c) $Au + Cu(NO_3)_2 \longrightarrow$ No Rxⁿ

Reactivity of Cu > Ag & Au

Ag: Free as well as combined form

Au: Free state/ elemental state

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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	Chalk →	Copper
Hg	Mathura →	Mercury
Ag	Sath →	Silver
Au	Ghumne →	Gold

→ Carbon (C)

(Pt) Prateek Platinum

AQUA REGIA

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(I) Non-metal + Oxygen → Non-metal oxide

$C + O_2 \longrightarrow CO_2$

$S + O_2 \longrightarrow SO_2$

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(II) Non-metal Oxide + Water → Acid

$CO_2 + H_2O \longrightarrow H_2CO_3$

$SO_2 + H_2O \longrightarrow H_2SO_3$

(III) Non-metals generally don't react with water/acid because they can't displace their hydrogen.

(IV) Non-metallic oxides

- Neutral → CO, NO, N_2O, H_2O etc.
- Acidic → NO_2, SO_2, SO_3, CO_2 etc.

Electrovalent Compounds/

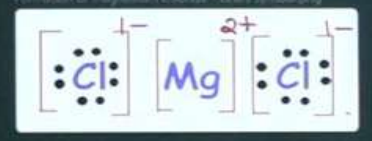
IONIC COMPOUNDS

FORMATION OF MAGNESIUM CHLORIDE

Mg → 2,8,2 CL → 2,8,7

Formation of magnesium chloride.png

Formation of magnesium chloride - Lewis Symbol.png



FORMATION OF SODIUM CHLORIDE

'Cation'

Sodium cation.png

$$Na\ (2,8,1) \rightarrow Na^+\ (2,8) + e^-$$

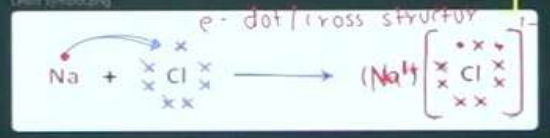
'Anion'

Chloride ion.png

$$Cl\ (2,8,7) + e^- \rightarrow Cl^-\ (2,8,8)$$

Lewis symbol.png

e- dot / cross structure



Valence / outermost shell e⁻ → represent through (•) or (x)

PROPERTIES OF IONIC COMPPOUNDS

Properties of ionic compounds.png

I	Physical nature	Generally, brittle solids and breaks into pieces when pressure is applied.
II	Melting and boiling points	High melting and boiling points as a sufficient amount of energy is required to break the strong electrovalent bonds.
III	Solubility	Generally, Soluble in water and insoluble in solvents like kerosene, petrol and more.
IV	Electrical conductivity	Conducts electricity in molten and aqueous form. It does not conduct electricity in solid form as the ions are immobile in the solid state.

→ molten/ fused form
NaCl (l)

→ aqueous form
NaCl (aq)

Strong electrostatic force of attraction

ions are free to move & hence it conducts electricity

$$NaCl(s) \xrightarrow{800^\circ C} NaCl(l)$$

$$NaCl \xrightarrow{\text{dissolve in } H_2O} NaCl(aq)$$

CORROSION AND ITS TYPES

Rusting of iron.png

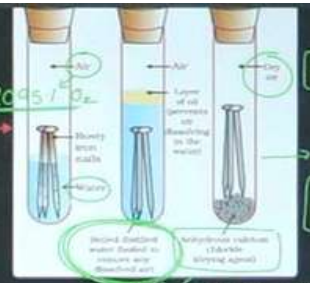
Type of corrosion	Colour of layer and chemical equation
Rusting of iron Iron reacts with moist air to form hydrated ferric oxide (RUST)	RUST Reddish-brown $4Fe(s) + 3O_2(g) + xH_2O(g) \rightarrow 2Fe_2O_3.xH_2O(s)$

Tarnishing of copper.png

Tarnishing of copper Copper reacts with moist carbon dioxide gas in the air to form copper carbonate	Patina Basic copper carbonate/ Copper carbonate hydroxide Green $2Cu(s) + CO_2(g) + O_2(g) + H_2O(g) \rightarrow CuCO_3.Cu(OH)_2(s)$

Tarnishing of silver.png

Tarnishing of silver Silver reacts with hydrogen sulphide gas present in the air to form silver sulphide	PATINA Black $4Ag(s) + 2H_2S(g) + O_2(g) \rightarrow 2Ag_2S(s) + 2H_2O(g)$



2005 / O_2

[Cont

NO

[Only

Only water

WAYS TO PREVENT RUSTING

Temporary So

I. Barrier Protection: In this a layer is introduced betwe rusting, i.e. oxygen and water vapour. Some of the w oil or grease.

II. Sacrificial Protection: In this a layer of more reactive reactive metal. The more reactive metal prevents or contact with iron and gets corroded in place of iron. in which a layer of zinc is applied on iron.

III. Alloying: Alloying is a very good method of improvi Pure iron is very soft, stretches easily when hot and If it is mixed with a small amount of carbon (about 0 strong. This is known as Steel. → Still it

Also, if iron is mixed with nickel and chromium, we g hard and does not rust.

hardness

- Some other alloys are:

Alloys.png

Alloy	Constituent elements
Stainless steel	Iron + Nickel + Chromium
Brass	Copper + Zinc
Bronze	Copper + Tin
Solder	Lead + Tin

reduced

Aluminothermy

METALS OF LOW REACTIVITY

Zn, Fe, Pb → medium reactivity metals

Cu, Hg, Ag ← low reactivity metals

Au, Pt ← least reactivity metals

High reactivity metals

Pasted image 20

K
Na
Ca
Mg
Al
Zn
Fe
Pb
Cu
Hg
Ag
Au
Pt

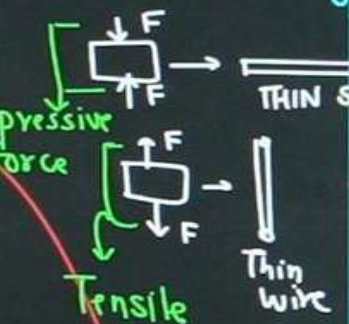
Combined form ←

Combined form ←

Free as well as combined form ←

always free state

(ability of substance to resist cutting or scratching)



Compressive force

Tensile force

(ringing sound when struck hard)

Ta of a

ORES OF SOME COMMON METALS

ORES OF SOME COMMON METALS.png

Metal	Name of the ore	Chemical formula of ore
(a) Sodium (Na)	Rock salt	NaCl
(b) Aluminium (Al)	Bauxite	$Al_2O_3.2H_2O$
(c) Zinc (Zn)	(i) Zinc blende (ii) Calamine	(i) ZnS (ii) $ZnCO_3$
(d) Iron (Fe)	(i) Haemetite (ii) Magnetite (iii) Iron pyrite (iv) Siderite	(i) Fe_2O_3 (ii) Fe_3O_4 (iii) FeS_2 (iv) $FeCO_3$
(e) Copper (Cu)	(i) Copper glance (ii) Cuprite (iii) Copper pyrite	(i) Cu_2S (ii) Cu_2O (iii) $CuFeS_2$
(f) Mercury (Hg)	Cinnabar	HgS
(g) Lead (Pb)	Galena	PbS

IMPORTANT TERMS — Metallurgy

Branch of science that deals with extraction of metals.

free state · Combined form · major source · minor source

- Metals occur naturally in the form of elements or compounds in the earth's crust or seawater and are called minerals.
- The minerals from which metals can be extracted economically and conveniently are called ores. Thus, all ores are minerals but all minerals are not ores.
- The earthly and rocky impurities that are associated with the mineral are called gangue or matrix.

Common Steps

- Crushing and grinding of ore: This involves converting the ore to powdered form. / pulverised form
- Concentration/Dressing/Enrichment of ore: This involves removing gangue or matrix from ore due to their differences in physical or chemical properties.
- Roasting: Sulphide ores are heated in excess of oxygen below melting point of metal to convert to metal oxide. Sulphur dioxide gas is evolved.
- Calcination: Carbonate ores are heated in absence of oxygen below melting point of metal to convert to metal oxide. Carbon dioxide gas is evolved.

sed for welding the broken
y, railway tracks etc.
type of displacement,
reaction.

$2Fe(l) + Al_2O_3(s) + Heat$
Molten

powder

[Exothermic + Redox Rxn]

de to manganese.png

$3Mn(l) + 2Al_2O_3(s) + heat$

'ING'

Cu_2S: Copper glance

HgS: Cinnabar

Copper from copper glance.png

$$2Cu_2S(s) + 3O_2(g) \xrightarrow[heat]{\Delta} 2Cu_2O(s) + 2SO_2(g)$$

(auto-reduction)

$$2Cu_2O(s) + Cu_2S(s) \xrightarrow{\Delta} 6Cu(s) + SO_2(g)$$

Extraction of mercury from cinnabar.png

$$2HgS(s) + 3O_2(g) \xrightarrow{\Delta} 2HgO(s) + 2SO_2(g)$$

$$HgS(s) + 2HgO(s) \xrightarrow{\Delta} 3Hg(l) + SO_2(g)$$

$$2HgO(s) \xrightarrow{\Delta} 2Hg(l) + O_2(g)$$

→ auto-reduction

Steps involved in extraction of low reactivity metals.png

Step I
Crushing and Grinding of Ore

Powdered Ore

Step II
Concentration of Ore

Concentrated Ore

Step III
Roasting (Sulphide Ore)

Step IV
Auto-reduction
(Conversion of metal oxide to metal)

Step V
Refining

Step IV
Reduction to metal oxide to metal (Using reducing agent)

Using coke (C)

Using aluminium (Al)

Step V
Refining/Purification of metal

below ~
ore reduced
C

Aluminothermy

FUN FACT ABOUT PHYSICAL PROPERTIE
- Only metal found in liquid state at roo
- Only non-metal found in liquid state a
- Gold is the most malleable and ductile
- Diamond is the best conductor of heat
- Silver is the best conductor of heat in
- Order of electricity conduction among

NCERT

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K
Na

High reactivity metals

(ability of

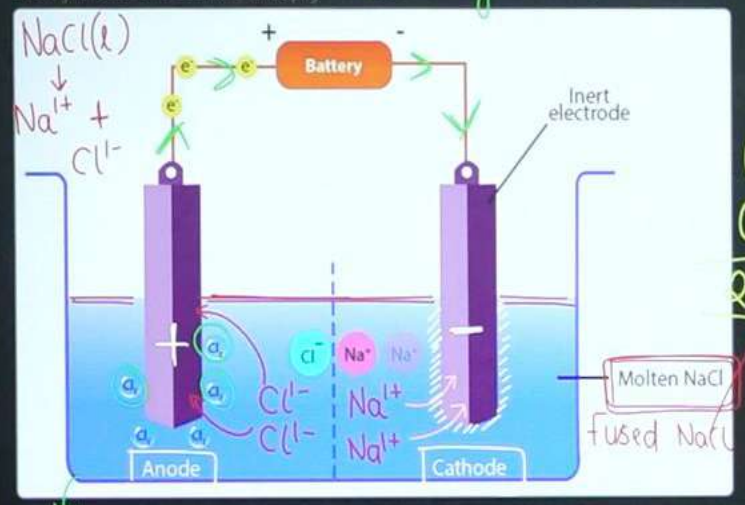
PHYSICAL PROPERTIES OF METALS AND
Table - Physical Properties of Metals and

Property	Me

Electrolytic reduction of molten NaCl

or Electrolysis of molten NaCl

Electrolytic reduction of sodium chloride.png



$NaCl(l) \rightarrow Na^{1+} + Cl^{1-}$

fused NaCl

Electrolytic Tank

Anode

$Cl^{1-} \rightarrow Cl + e^-$ (Nascent Cl)

$Cl^{1-} \rightarrow Cl + e^-$

$2Cl^{1-} \rightarrow Cl_2 + 2e^-$

Cathode

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

ZnS: Zinc blende $ZnCO_3$: Calamine

Roasting of zinc blende.png

$$2ZnS(s) + 3O_2(g) \xrightarrow{\Delta} 2ZnO(s) + 2SO_2(g)$$

Roasting

Calcination of calamine.png

$$ZnCO_3(s) \xrightarrow{\Delta} ZnO(s) + CO_2(g)$$

Calcination

Smelting of zinc oxide to zinc.png

$$ZnO(s) + C(s) \rightarrow Zn(s) + CO(g)$$

But, Zn(l) → This process is called 'SMELTING'

REDUCTION OF METAL OXIDE TO METAL - ALUMINOTHERMY (because excessive heat is released)

- Thermite reaction is used for welding the broken parts of iron machinery, railway tracks etc.
- Thermite reaction is a type of displacement, exothermic and redox reaction.

metal oxide powder

$$Fe_2O_3(s) + 2Al(s) \xrightarrow{\text{ignited by Mg ribbon}} 2Fe(l) + Al_2O_3(s) + \text{Heat}$$

Molten

metal powder

Displacement Rxn [Exothermic + Redox Rxn]

Reduction of manganese dioxide to manganese.png

$$3MnO_2(s) + 4Al(s) \longrightarrow 3Mn(l) + 2Al_2O_3(s) + \text{heat}$$

$Cu^{2+} + 2e$

Cu_2S

Copper from copper glance.p

$2Cu_2S(s) +$

(auto

$2Cu_2O(s) +$

Steps involved in extraction of high reactivity metals.png

Step I
Crushing and Grinding of Ore

Step II
Concentration of Ore

Step III
Electrolytic Reduction (Pure metal)

Oxides or Chlorides

Steps involved in extraction of medium reactivity metals.png

Step I
Crushing and Grinding of Ore

Step II
Concentration of Ore

Step III
Roasting (Sulphide Ore)

(Oxide Ore)

Step III
Calcination (Carbonate Ore)

Metal oxide

Step IV
Reduction to metal oxide to metal (Using reducing agent)

Using coke (C)

Using aluminium (Al)

Smelting

Step V
Refining/Purification of metal

metal below → Carbon ore reduced by C

Aluminothermy

Steps involved in extraction

Crushing a

Concel

Roastin

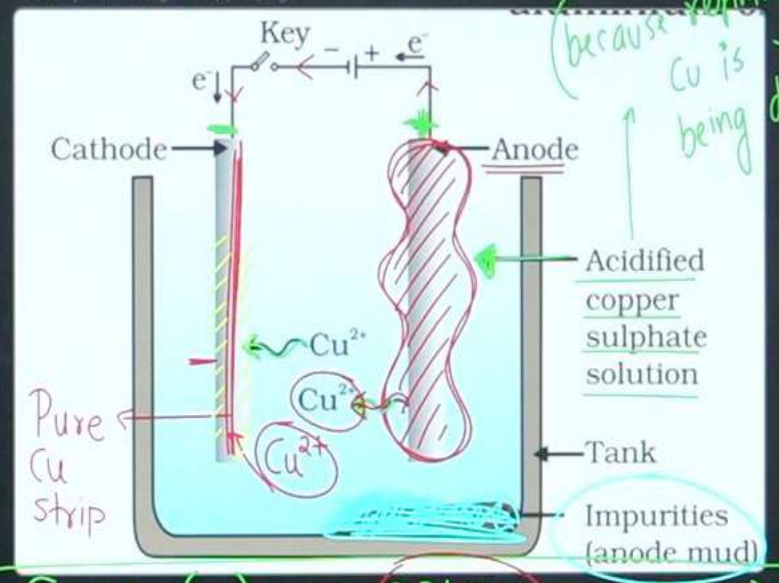
METALS OF MEDIUM REACTIVITY

or metals of medium, low & least reactivity

ELECTROLYTIC REFINING/PURIFICATION OF METALS

- Done for metals such as copper, zinc, tin, nickel etc.
- In this process, the impure metal is made the anode and a thin strip of pure metal is made the cathode.
- A solution of the metal salt is used as an electrolyte.
- On passing the current through the electrolyte, the pure metal from the anode dissolves into the electrolyte.
- An equivalent amount of pure metal from the electrolyte is deposited on the cathode.
- The soluble impurities go into the solution, whereas, the insoluble impurities settle down at the bottom of the anode and are known as anode mud.

Electrolytic refining of copper.png



(because refining of Cu is being done)

with time
anode → THINNER
cathode → THICKER

(i) electrolyte → $CuSO_4(aq) \longrightarrow Cu^{2+}(aq) + SO_4^{2-}(aq)$

(ii) at anode - Loss of electron(s) - OXIDATION

$Cu \longrightarrow Cu^{2+} + 2e^-$

(iii) at cathode - gain of electron(s) - REDUCTION

$Cu^{2+} + 2e^- \rightarrow Cu(s)$

ZnS: Zinc blende $ZnCO_3$: Calamine

REDUCTION OF METAL OXIDE TO METAL - ALUMINOTHERMY

(because excessive heat is released)

- Thermite reaction is used for welding the broken parts of iron machinery, railway tracks etc.
- Thermite reaction is a type of displacement, exothermic and redox reaction.

Roasting of zinc blende.png

$$2ZnS(s) + 3O_2(g) \xrightarrow{\Delta} 2ZnO(s) + 2SO_2(g)$$

metal oxide powder

$$Fe_2O_3(s) + 2Al(s) \xrightarrow{\text{ignited by Mg ribbon}} 2Fe(l) + Al_2O_3(s) + \text{Heat}$$

Molten

metal powder

Cu_2S: Copper glance

HgS: Cinn

Copper from copper glance.png

Extraction of mercury from cinnabar.png

mpounds/

CORROSION AND ITS TYPES

Rusting of iron.png

Type of corrosion	Colour of layer and chemical equation
Rusting of iron Iron reacts with moist air to form hydrated ferric oxide. (RUST)	 RUST Reddish-brown $4Fe(s) + 3O_2(g) + xH_2O(g) \rightarrow 2Fe_2O_3 \cdot xH_2O(s)$

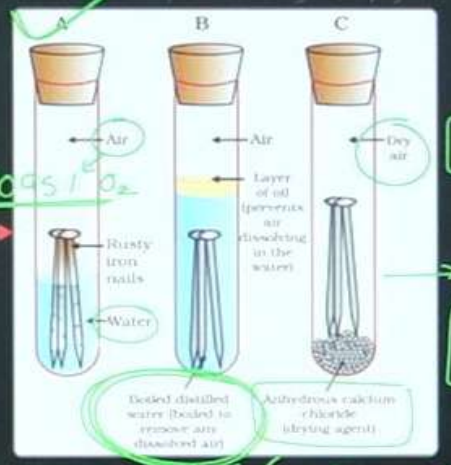
Tarnishing of copper.png

Tarnishing of copper Copper reacts with moist carbon dioxide gas in the air to form copper carbonate.	Patina Basic copper carbonate / Copper carbonate hydroxide Green $2Cu(s) + CO_2(g) + O_2(g) + H_2O(g) \rightarrow CuCO_3 \cdot Cu(OH)_2(s)$

Tarnishing of silver.png

Tarnishing of silver Silver reacts with hydrogen sulphide gas present in the air to form silver sulphide.	PATINA Black $4Ag(s) + 2H_2S(g) + O_2(g) \rightarrow 2Ag_2S(s) + 2H_2O(g)$

Factors that are required for rusting of iron.png



20.95% O_2

[Contains 20.95% O_2]

→ NO RUSTING

[Only O_2 no H_2O]

No RUSTING

(Only water & no oxygen)

WAYS TO PREVENT RUSTING

Temporary Solⁿ

(I) • **Barrier Protection:** In this a layer is introduced between iron and factors that cause rusting, i.e. oxygen and water vapour. Some of the ways are painting and applying oil or grease.

(II) • **Sacrificial Protection:** In this a layer of more reactive metal is placed on a less reactive metal. The more reactive metal prevents oxygen and water to come in contact with iron and gets corroded in place of iron. One such way is galvanisation in which a layer of zinc is applied on iron. → Temporary Solⁿ

(III) • **Alloying:** Alloying is a very good method of improving the properties of a metal. Pure iron is very soft, stretches easily when hot and prone to rust. If it is mixed with a small amount of carbon (about 0.05 %), it becomes hard and strong. This is known as Steel. → Still it is prone to rust.
Also, if iron is mixed with nickel and chromium, we get stainless steel, which is hard and does not rust.
• Some other alloys are:

hardness → resistance to corrosion → make it stainless

Alloys.png

Alloy	Constituent elements	Change in properties (Compare to constituent elements)
Stainless steel	Iron + Nickel + Chromium	- Hard - Does not rust
Brass (पीतल)	Copper + Zinc 80% 20%	- Poor conductor of electricity
Bronze (कांस्य)	Copper + Tin 90% 10%	- Poor conductor of electricity
Solder	Lead + Tin 50% 50%	- Low melting point

REACTION OF METALS WITH DILUTE ACIDS

metal - nonm

Metal + a

REACTION OF METALS WITH DILUTE ACID.png

When magnesium, aluminium, zinc, iron and l hydrochloric acid, the rate of formation of hydrog order:

(I) Mg > Al > Zn > Fe > Pb

(II)

This means that the amount of heat evolved also c

(Metals like Cu, Ag react wi

REACTION OF METALS WITH SOLUTIONS OF OTHER METALS

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Reaction of lead with copper chloride solution
is introduced in the blue-green solution of copper colourless due to the formation of lead chloride.

$Pb(s) + CuCl_2(aq) \rightarrow PbCl$

Blue-green solⁿ

Hence, reactivity of Pb > Cu.

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(a) **Reaction of copper with silver nitrate soluti**
introduced in the colourless solution of silver turning blue due to the formation of copper nitrat

$Cu(s) + 2AgNO_3(aq) \rightarrow C$

Reddish brown → colour sol

Hence, reactivity of Cu > Ag.

(b) $Ag + Cu(NO_3)_2 \rightarrow$

(c) $Au + Cu(NO_3)_2 \rightarrow$

aye bhaiya

Chapter No. - 03

Metals and Non-metals - -
Question Practice

15 min.

CBSE 2024

A metal and a non-metal that exists in liquid state at the room temperature are respectively:

(25°c)

(A) Bromine and Mercury

(B) Mercury and Iodine

(C) Mercury and Bromine

(D) Iodine and Mercury

Question

Which of the following oxide(s) of iron would be obtained on prolonged reaction of iron with steam?

$$3Fe + 4H_2O \longrightarrow Fe_3O_4 + H_2$$

$(FeO.Fe_2O_3)$

(A) FeO

(B) Fe_2O_3

(C) Fe_3O_4

(D) Fe_2O_3 and Fe_3O_4

Question

Which among the following is the correct order of rate of reaction of metals with same quantity and concentration of dilute hydrochloric acid?

(A) Fe > Al > Zn > Pb

(B) Mg < Al < Zn < Fe

(C) Mg > Al > Zn > Fe

(D) Al > Mg > Zn > Fe

Question

The composition of aqua-regia is:

(A) Conc. HCl : Dil. HNO_3, 1 : 3

(B) Conc. HCl : Dil. HNO_3, 3 : 1

(C) Conc. HCl : Conc. HNO_3, 3 : 1

(D) Dil. HCl : Dil. HNO_3, 3 : 1

Question

Statement I: All non-metals are poor conductors of heat and electricity.

Statement II: Oxides of non-metals are neutral as well as acidic while that of metals are basic as well as amphoteric in nature.

(A) Statement I is true while Statement II is false.

(B) Both statements are true.

(C) Statement I is false while Statement II is true.

(D) Both statements are false.

Question

Metals are refined by using different methods. Which of the following metals are refined by electrolytic refining?

(i) Au (ii) Cu (iii) Na (iv) K

electrolytic reduction

(A) (i) and (ii)

(B) (i) and (iii)

(C) (ii) and (iii)

(D) (iii) and (iv)

CBSE 2024

Which of the following is an alloy of copper and tin?

Cu (90%) Sn (10%)

(A) Nichrome

(B) Brass

(C) Constantan

(D) Bronze

Question

Stainless steel is very useful material for our life. In stainless steel, iron is mixed with

(A) Ni and Cr

(B) Cu and Cr

(C) Ni and Cu

(D) Cu and Au

CBSE 2024

poor conductors of electricity

Assertion (A): The metals and alloys are good conductors of electricity.

Reason (R): Bronze is an alloy of copper and tin and it is not a good conductor of electricity.

(A) Both (A) and (R) are true and (R) is the correct explanation of (A)

(B) Both (A) and (R) are true but (R) is not the correct explanation of (A)

(C) (A) is true but (R) is false

(D) (A) is false but (R) is true

Aye Bhaiya ♡

THANK YOU