

Heat lost or gained can be calculated

$$Q = MC\Delta T$$

m: mass (g)

Q: heat (J)

C: specific heat capacity

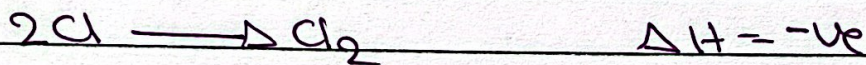
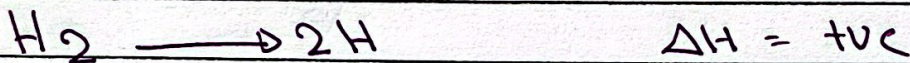
ΔT : difference in temp ($^{\circ}\text{C}$)

Bond energy :- energy needed to break a bond

Breaking: endo

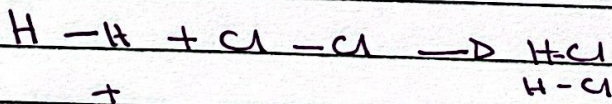
Building: exo

Eg. 1



Step 1 : balance them

step 2 : draw the bonds



$$H-H = 435$$

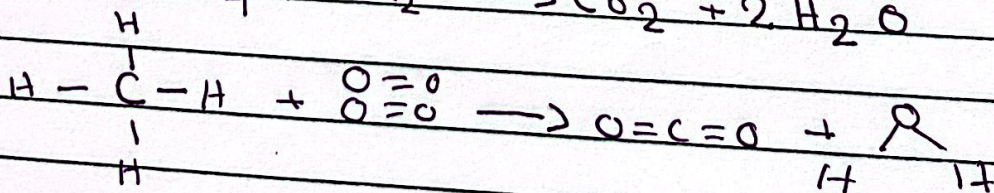
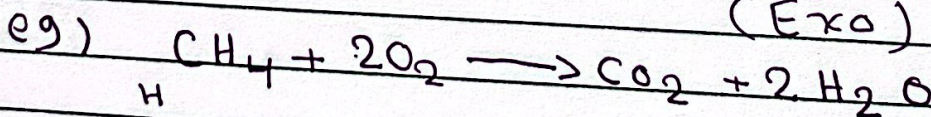
$$Cl-Cl = 243$$

$$H-Cl = 432$$

$$435 + 243 = 678 \text{ KJ/mol}$$

$$2 \times 432 = -864 \text{ KJ/mol}$$

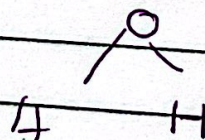
$$\Delta H = -186 \text{ KJ/mol}$$



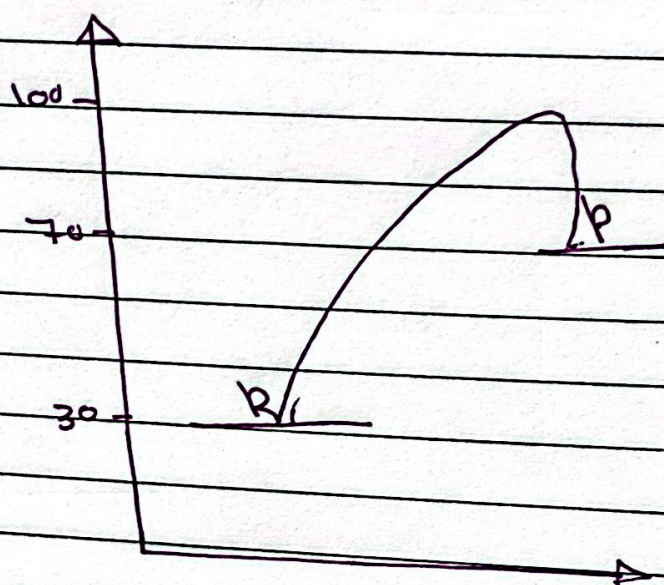
$$413 \times 4 + 2 \times 498 = 2648$$

$$2 \times 805 + 4 \times 464 = -3464$$

$$\Delta H = -816 \text{ KJ/mol}$$



Q



a) What is the enthalpy of reactants
30 kJ

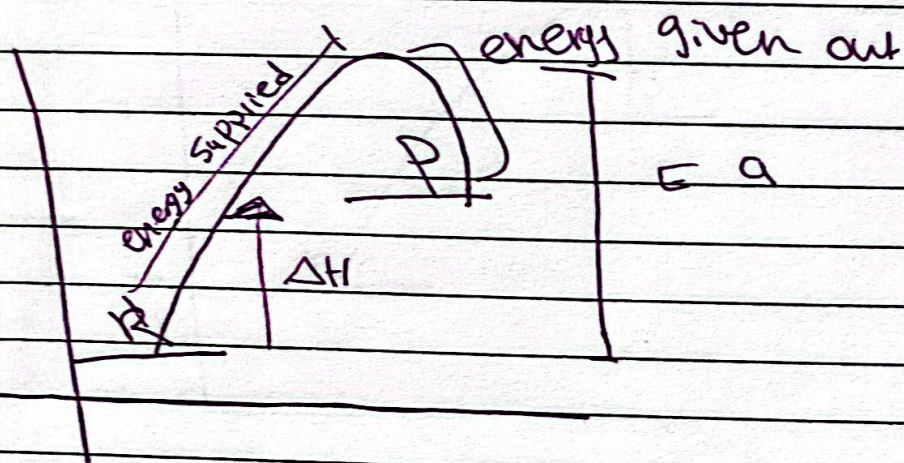
b) enthalpy of products : 70 kJ

c) $\Delta H : 70 - 30 = 40$ kJ (end)

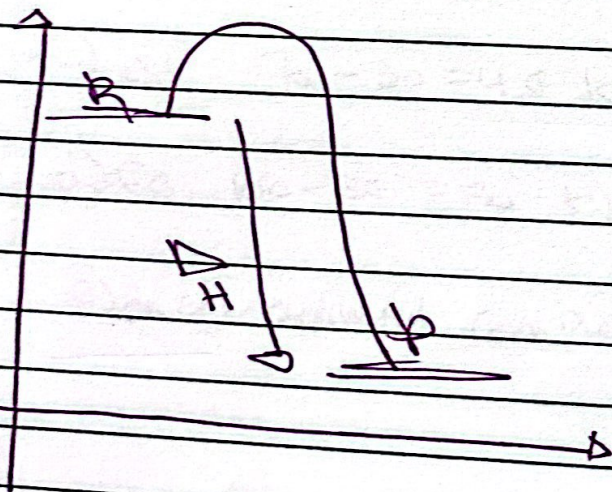
d) $E_a : 100 - 30 = 70$ kJ

e) energy activated completely: 100 kJ

Activation energy : E_a : minimum energy needed to start up a reaction



Endo



Endothermic rxns

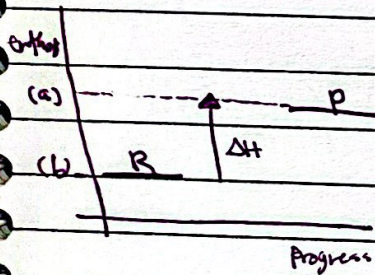
$$\Delta H = +ve$$



Energy supplied is needed to break the bonds of reactants in order to form the products

- Breaking bonds is endo

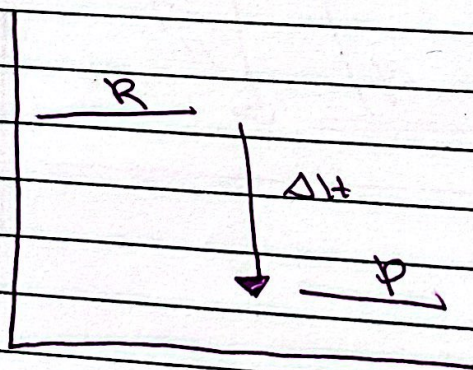
- Building bonds is exo



- a) enthalpy of product
 - b) enthalpy of reactants
- ΔH : enthalpy change
 $= a - b$

exothermic rxns

Energy of product is less than reactants $\Delta H = -ve$



Notes:-

All combustion rxns are exo
(rxns with O_2)

Energetics

Enthalpy (H) : energy stored in a substance

ΔH : enthalpy change.

$$\Delta H : \Delta H_{\text{product}} - \Delta H_{\text{reactants}}$$

\downarrow
+ve

\downarrow
-ve

Endothermic reactions

Exothermic reactions

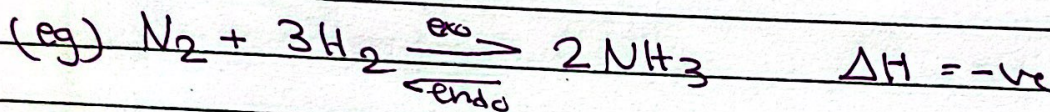
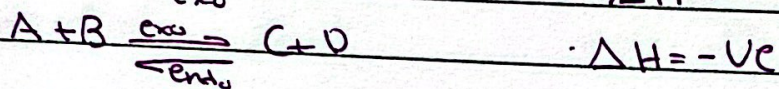
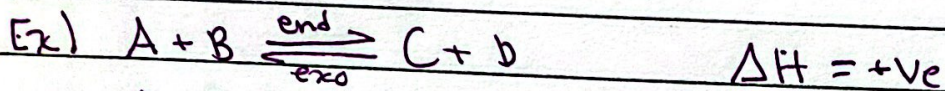
energy level diagrams

diagram that shows the enthalpy of reactants and product

[2] Temperature.

* \uparrow temp favours endo side

* \downarrow Temp favours exo side



Q1) What is the effect of increasing Temp on position of equilibrium

* \uparrow Temp favours endo side (backward)

Q2) What happens to the yield of NH_3 when temp \uparrow
- lower yield

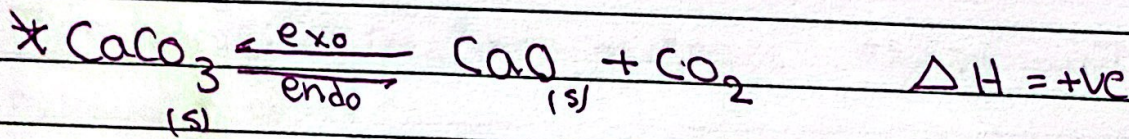
Q3) What should we do to the temp to get more NH_3

- ~~Higher~~

- \downarrow the temp

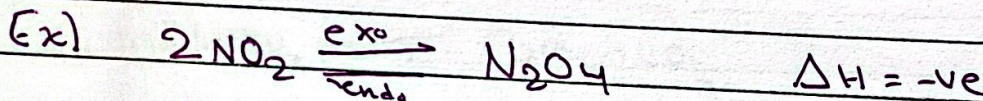
Q4) What happens to the rate of reaction when temp \uparrow

* when temp \uparrow rate or rxn \uparrow because particles gain more KE so they move faster so more chance for successful collisions and more particles can react (EA) so rate increases \Rightarrow Rate of both forward and backward



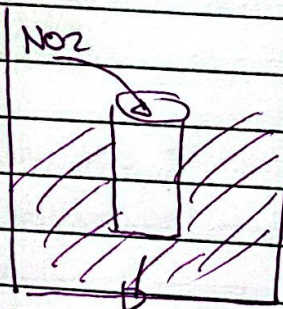
↓ Temp favours exo (backward) so max yield CaCO_3

↓ Temp ↓ rate of reaction



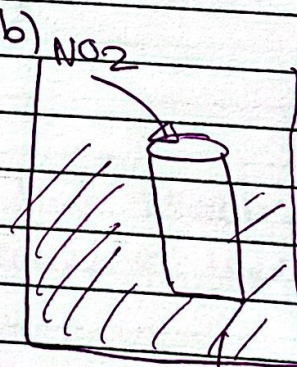
brown colorless

a)



Hot water bath

b)



Cold water bath

* What happens to the colour (a)?

- Brown intensity ↑

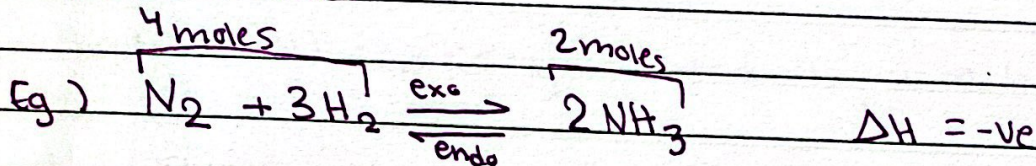
* What happens to the colour (b)?

- Brown intensity ↓

→ ↑ Pressure favours the side having lower # of moles

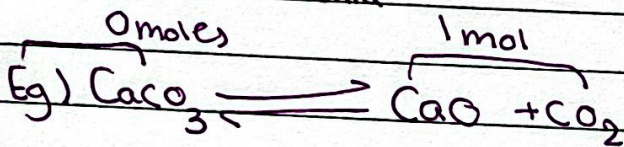
→ ↓ Pressure favours the side having higher # of moles

③ Pressure: for rxns involving gasses, as pressure ↑ no. of molecules ↑ so rate ↑



④ What happens to the yield of ammonia when pressure increases?

↑ Pressure favours side having lower # of moles so forward so more yield of ammonia



↓ Pressure favours the side with higher # of moles so forward

- Catalyst.

a chemical substance that speeds up the rate of a reaction without being affected or used up

* Catalyst has no effect on the position of equilibrium

* Catalyst has no effect on yield

* Catalyst only ↑ rate of rxn.

⑤ sunlight: only for rxns that are affected by light.

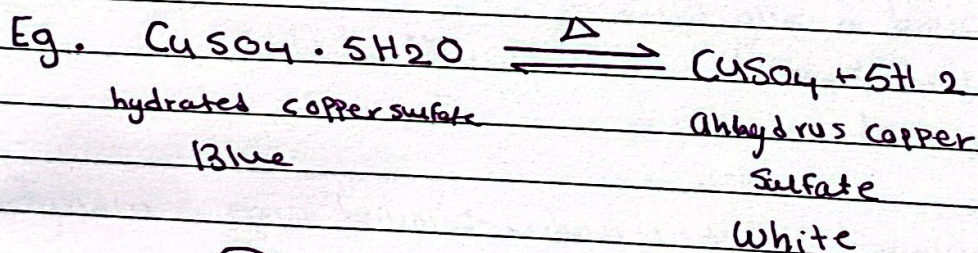
as light \uparrow , K.E of particles \uparrow so more particles move faster, so no. of successful collisions \uparrow so rate \uparrow

⑥ Catalyst: Chemical substance that increase the rate of reaction without being ~~used~~ affected.

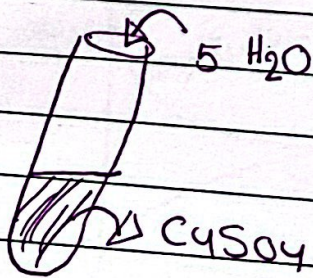
(it increases rate of reaction by lowering the activation energy)

Reversible rxns

* The reaction that goes in both directions (Forward and backward)



$\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$



$5 \text{H}_2\text{O}$

CuSO_4

Write 2 observations

1) water vapour at the mouth

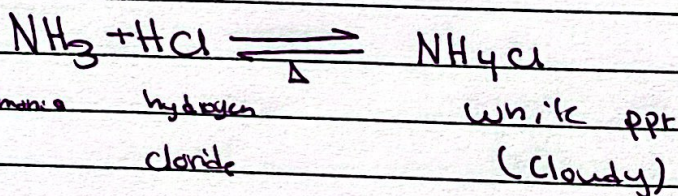
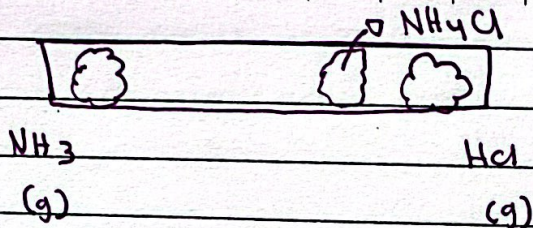
2) colour changes from blue to white.

write down 2 observations

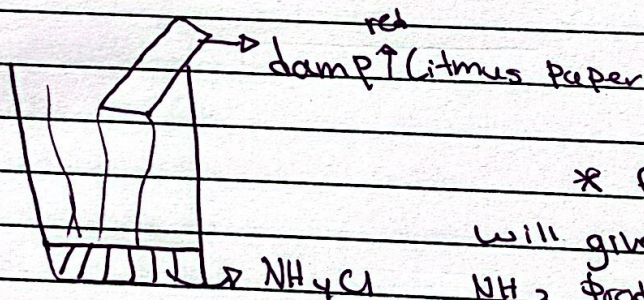
1) colour changes from white to blue

2) test tube gets warmer.

Eg:



* The white cloud is formed far away from NH_3 and close to HCl because NH_3 is lighter than HCl so it moves faster.



* First the litmus paper will give a blue color due to NH_3 produced first, then it will turn red because HCl starts to appear.

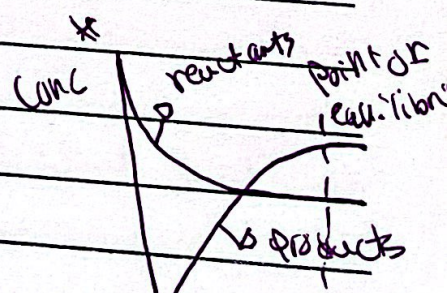
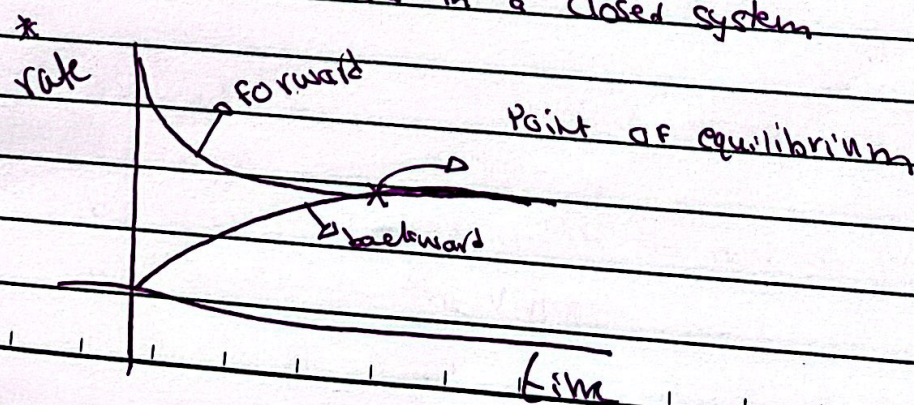
dynamic equilibrium :- When rate of forward is equal rate of backward (happening at the same time) and concentration of reactants and products are constant.

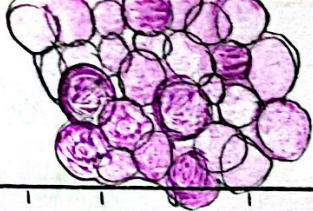
* Features of dynamic equilibrium

1) Rate of reaction forward = backward

2) No observable color change

3) We need to work in a closed system





WIBB 11

* Position of equilibrium:

The proportion of quantity of products to reactants at equilibrium

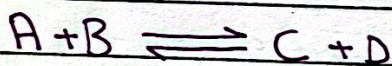
* * factors that affect equilibrium

1) concentration

2) Temperature

3) Pressure: only ~~eff~~ reactants involving gas.

□ Concentration



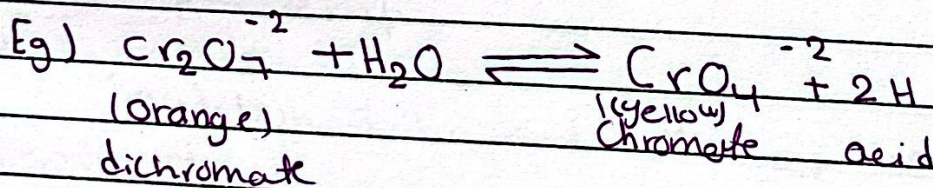
* if $A \uparrow$ Forward will work

faster, The position of the equilibrium will shift to the right

because when concentration of $A \uparrow$ number of particles of $A \uparrow$

so more successful collisions so rate of reaction (forward) will be higher than backwards.

* if $B \downarrow$, position of equilibrium will shift to the left so rate of backward will be higher than forward



Q) What happens if an acid is added to the system

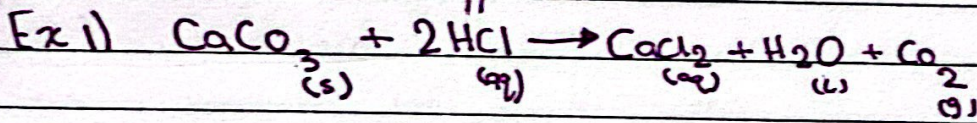
* Yellow \rightarrow Orange because adding acid will shift the position of equilibrium to the left

Q) what happens if a base is added to the system

* Orange \rightarrow Yellow

base will react with the acid so position of equilibrium will shift to the right.

Excess

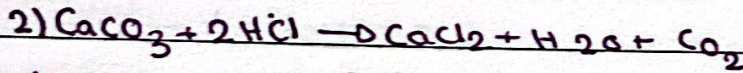


1g chips

$$V = 200 \text{ cm}^3$$

$$C = 0.1 \text{ mol/dm}^3$$

$$\text{Temp} = 25^\circ\text{C}$$

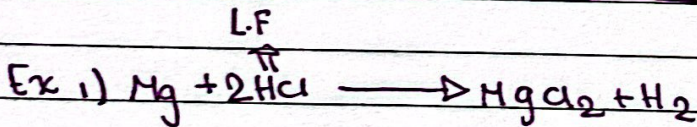
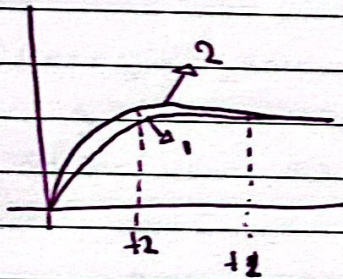


1g chips

$$V = 200 \text{ cm}^3$$

$$C = 0.2 \text{ mol/dm}^3$$

$$\text{Temp} = 25^\circ\text{C}$$

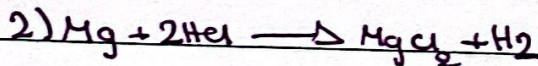


5g

$$V = 200 \text{ cm}^3$$

ribbon

$$C = 0.1 \text{ mol/dm}^3$$

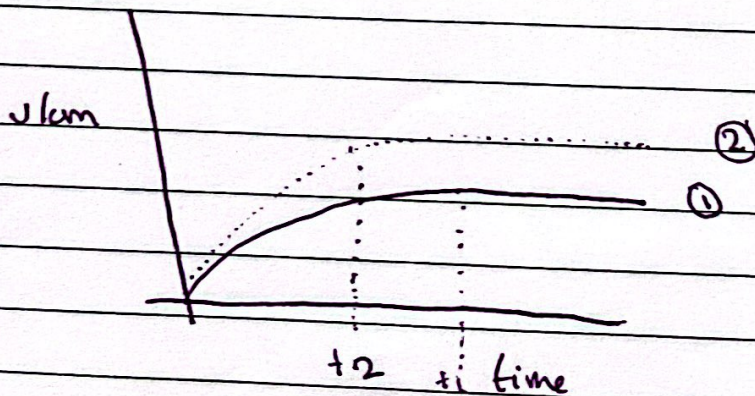


5g

$$V = 200 \text{ cm}^3$$

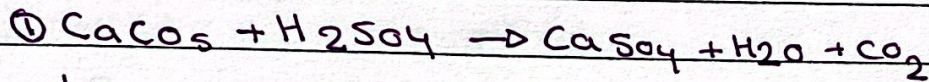
ribbon

$$C = 0.2 \text{ mol/dm}^3$$



2) Surface area

as surface area increases more surface is available for reactants to react so no. of successful collisions increases so rate of reaction increases.



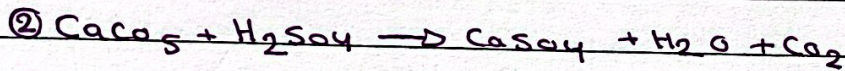
1 g

$$V = 200 \text{ cm}^3$$

Chips

$$C = 0.1 \text{ mol/dm}^3$$

Temp 25°



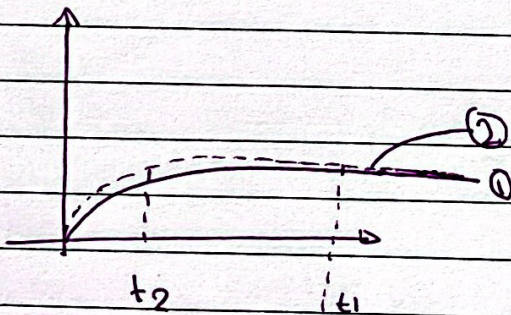
1 g

$$V = 200 \text{ cm}^3$$

powder

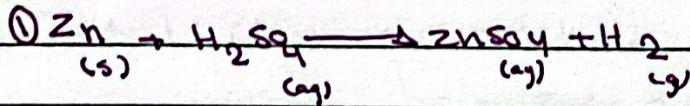
$$C = 0.1 \text{ mol/dm}^3$$

Temp 25°

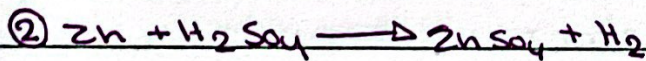


③ Temperature

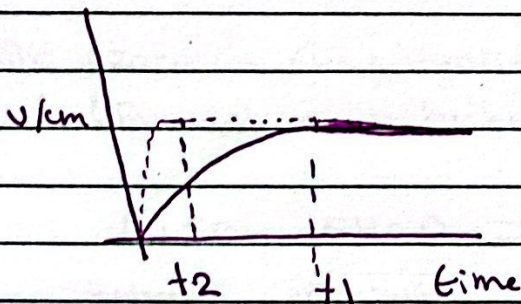
as Temperature \uparrow particles gain more kinetic energy so they move faster so more no. of successful collisions so Rate \uparrow , also more particles reach the activation energy.



2g $V = 400 \text{ cm}^3$ temp: 25°C
 chips $C = 0.1 \text{ mol/dm}^3$

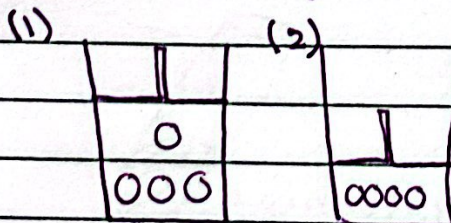


temp: 30°C



④ Pressure

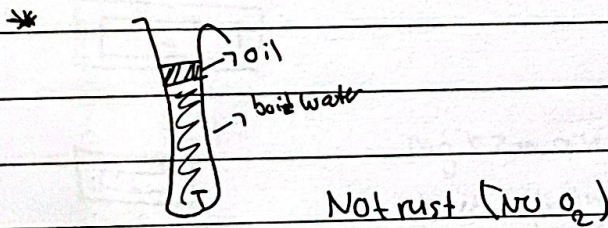
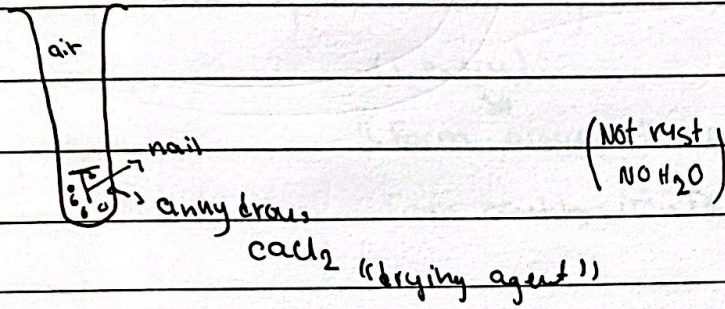
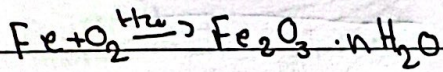
This factor is only ^{considered} ~~affected~~ for rxns involving gas.



(2) has a higher pressure than (1) because volume of (2) is lower than (1) so particles become closer together so no. of

successful collisions in (2) is more than (1) so (2) has a higher rate of reaction.

The reaction of iron with both H_2O and O_2



(post paper)

* A & B are two solutions used to prevent rusting (Plan an experiment to show which solution is the better one. (6 pts))

Take a known mass of iron nail

Apply known quantity of solution A

Put the nail in a known volume of water

For one week measure the mass (Final)

Repeat the experiment using solution B

The solution with the higher mass is worse than the other solution.

Cathodic protection (8)

how to prevent Rusting

(6) Sacrificial protection

(4) Electroplating

(5) Galvanising

(1) Painting

(2) Oiling

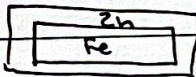
(3) greasing

(7) Cover with plastic

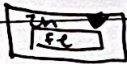
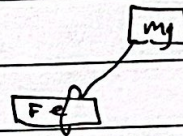
(1, 2, 3, 4)

(Form a layer that prevents O_2 or H_2O from reaching iron Fe)

(5) Coat with zinc



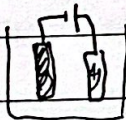
(6)



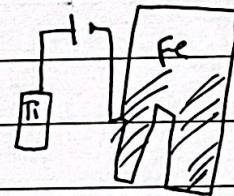
Mg, Zn are both more

reactive than Fe so more likely to lose e⁻s so Fe is less likely to rust

(7)



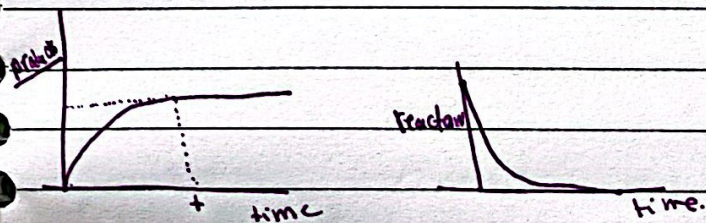
(8)





Rate of Reaction:

* in general reactants ↓ while products ↑



Define rate of reaction:

is the change in the quantity of products or reactants per unit time.

* Methods to follow rate of reaction

- 1) measuring volume of gas produced per min time.
- 2) measuring the mass lost of reactants per min time.

Factors that affect the rate of reaction

- 1) Concentration
- 2) surface area
- 3) Temperature
- 4) Pressure :- gases
- 5) light :- only for reactions that need light.
- 6) catalyst

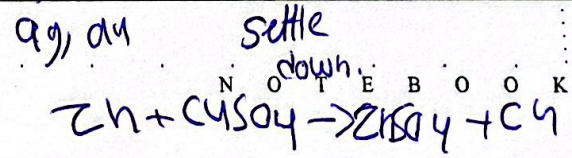
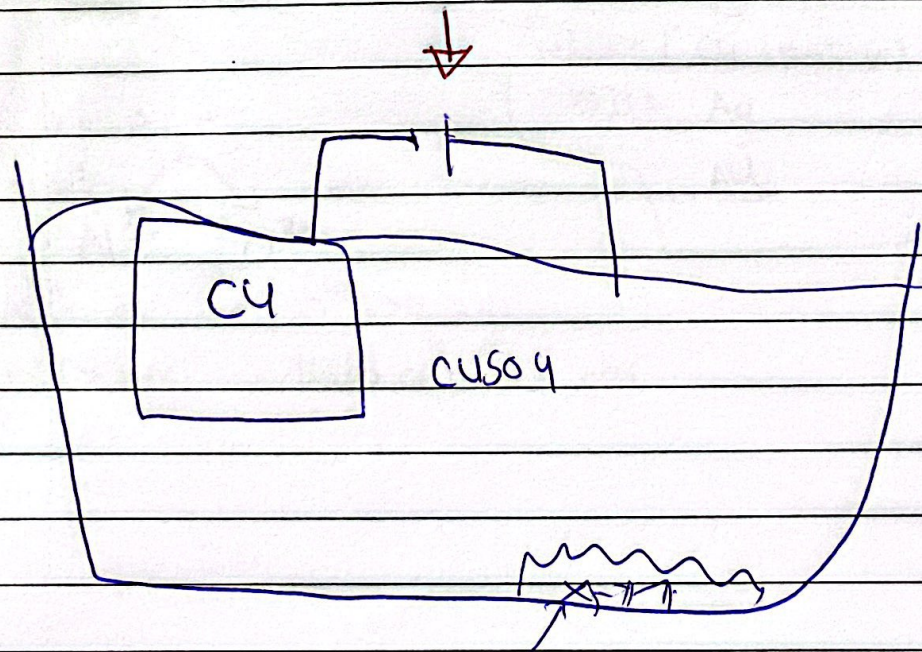
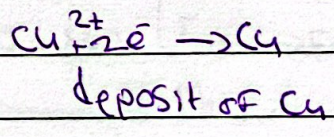
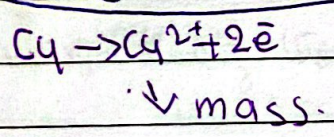
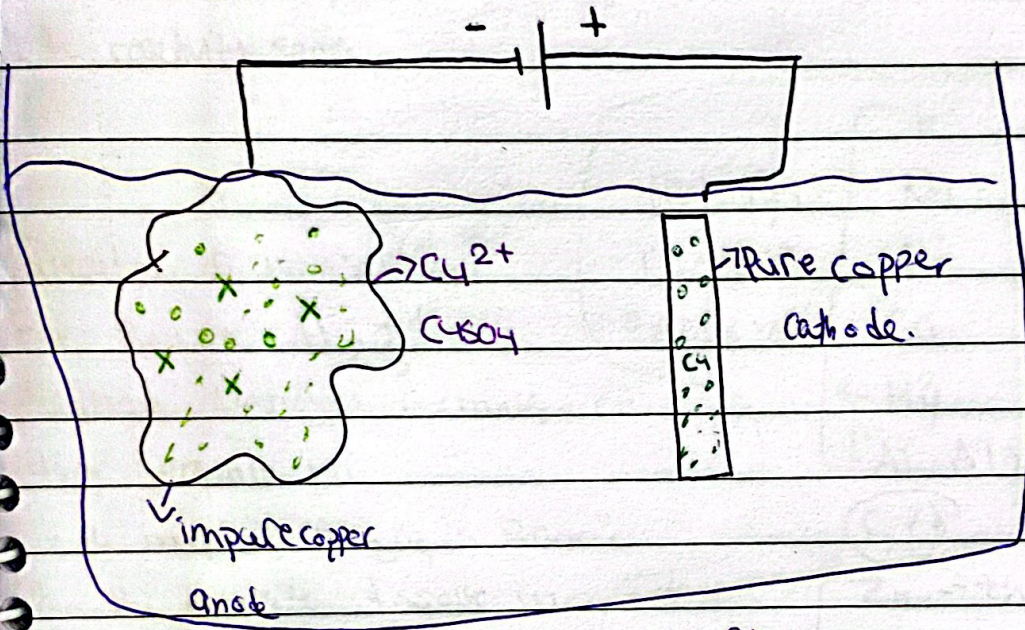
For all reactions:

1) Concentration: amount of soluble that dissolves in solvent:

* as concentration increases, number of particles increase, so more successful collisions, so rate of reaction increases.

* Whenever I want to study a factor, all the other factors must be constant.

Refining metals
Purifying metals.



Extraction of metals

the method of extraction depends on the position of the metal

i.e. the reactivity series

Electrolysis For molten graphite rods	K
	Na
	Li
	Ca
	* Mg
	Al - Al ₂ O ₃ (bauxite)
	(C, Co)
reduction by C & CO	Zn → ZnS (blende)
	Fe → Fe ₂ O ₃ (hematite)
	Pb
	(H)
reduction	Cy (sulfide) CuS
	by H ₂ Ag
	Al.

Extraction of Aluminium

ore - Bauxite Al₂O₃

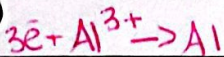
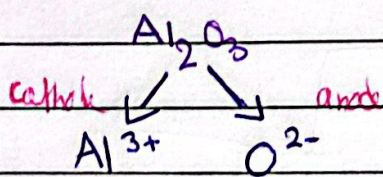
Method: Electrolysis for molten ore
using graphite rods

the m.p of Al₂O₃ is 2000°C

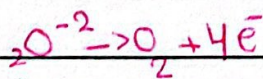
So the bauxite dissolve in molten cryolite Na₃AlF₆

1. lower the m.p to 900°C so less cost

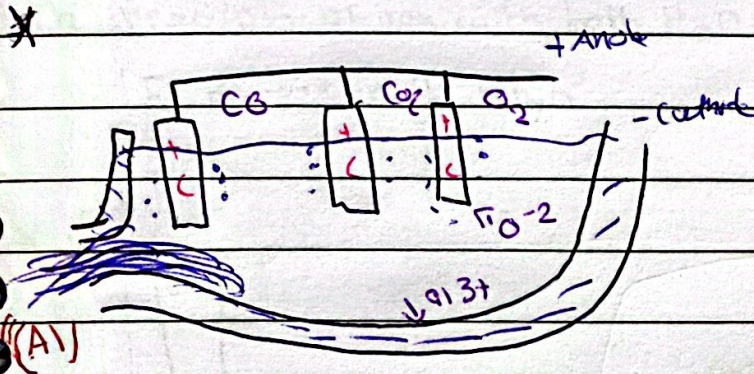
2. increase the electrical conductivity



deposition of metal



bubbles of colorless gas



Gases produced at anode

- 1- O_2
 - 2- CO_2
 - 3- CO
- reaction of carbon rods } gas must
with O_2 } replace them periodically.

Property

uses

- | | |
|--|------------------------------------|
| 1- low density | 1- Air craft bodies |
| 2- conduct electricity | 2- Cables |
| 3- Malleable | 3- Window frame / cooking utensils |
| 4- form a non-toxic ^{oxide} layer | 4- Food cans |
| 5- ductile | 5- electric wires. |

No.

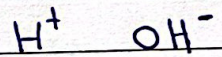
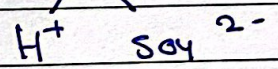
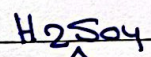
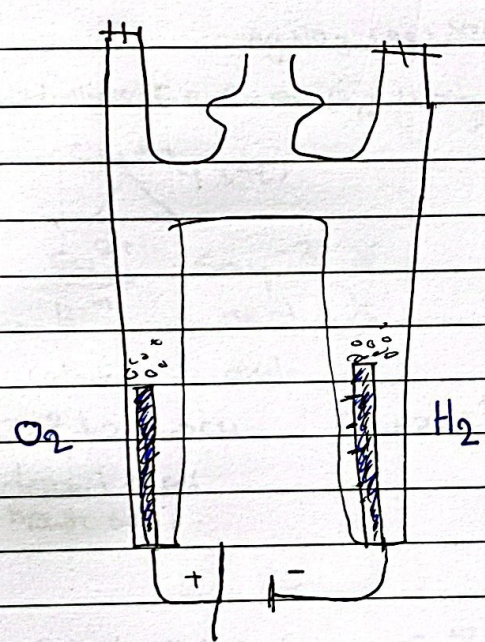
Subject

Date

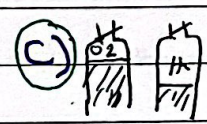
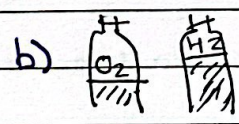
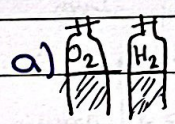
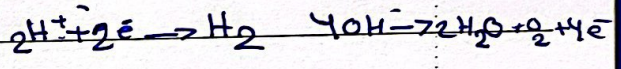
No.

Electrolysis for H_2SO_4 (aq) / graphik rods

Hoff-man



cathode anode



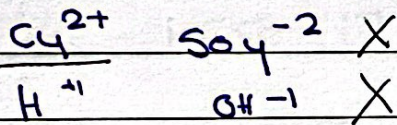
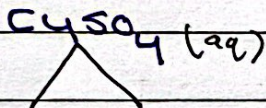
Electrolysis of aqueous electrolyte using active rods

* the rod must be made from the same metal in the electrolyte.

CuSO_4 (aq) $\xrightarrow{\text{using}}$ copper rods

AgNO_3 (aq) $\xrightarrow{\text{using}}$ silver rods

Electrolysis for CuSO_4 (aq) using copper rods.



Cathode

Anode



deposit of red
brown solid

Cathode increase in mass Cu^{2+} gains e^- and deposit of Cu on it
 anode decrease in mass: increase in mass:

Electrolyte stays the same the anode oxidise and replace Cu^{2+} in the electrolyte with the same rate.

molten/graphite

aqueous/graphite

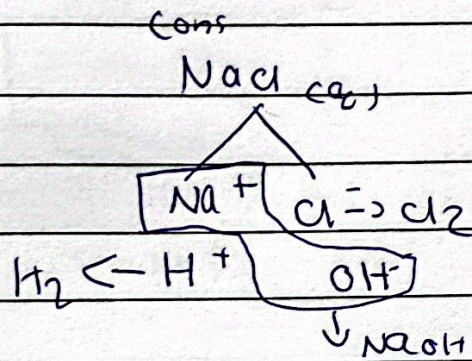
aqueous / active

↓
extraction of metals.

↓
prepare solution

electrolyte

purifying metals (refining)



Electroplating : cover a metal with another metal by using electricity

- why?
- 1) prevent rusting
 - 2) decoration

how to electroplate a metal spoon with Ag (silver)

1- Clean the metal spoon to remove the oxide layer by sand paper. to insure well sticking

2- to make the spoon the cathode (-ve)

3- the anode must be made from silver

4- the electrolyte must contain Ag^+ ex: Ag-NO_3

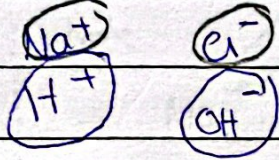
5- turn on the circuit

6- rotate the metal spoon to insure an equal distribution

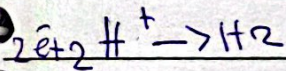
7- rinse with distilled water

8- Dry in oven.

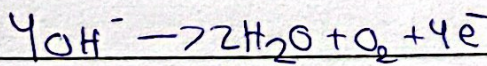
dilute NaCl aq / graphite
 Cathode Anode



electrolyte: NaCl more concentrated



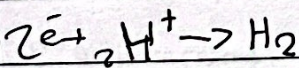
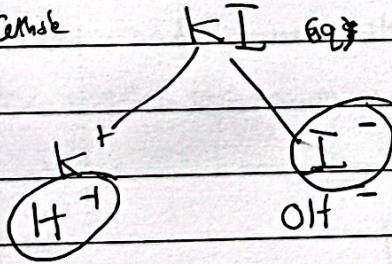
bubbles of colourless gas



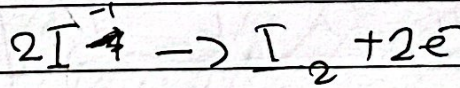
bubbles of colourless gas

concentrated potassium iodide

Cathode Anode



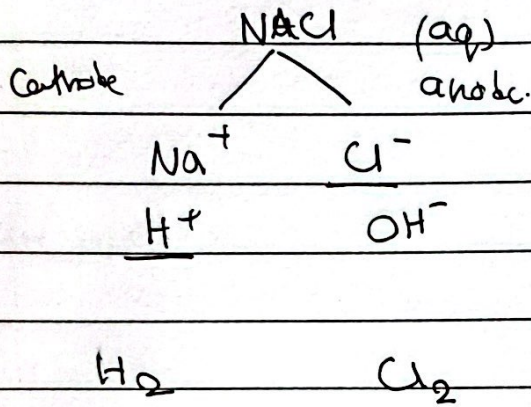
bubbles of colourless gas



purple

electrolyte: ~~KOH~~ KOH

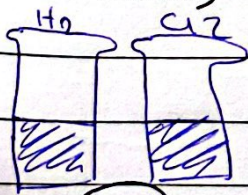
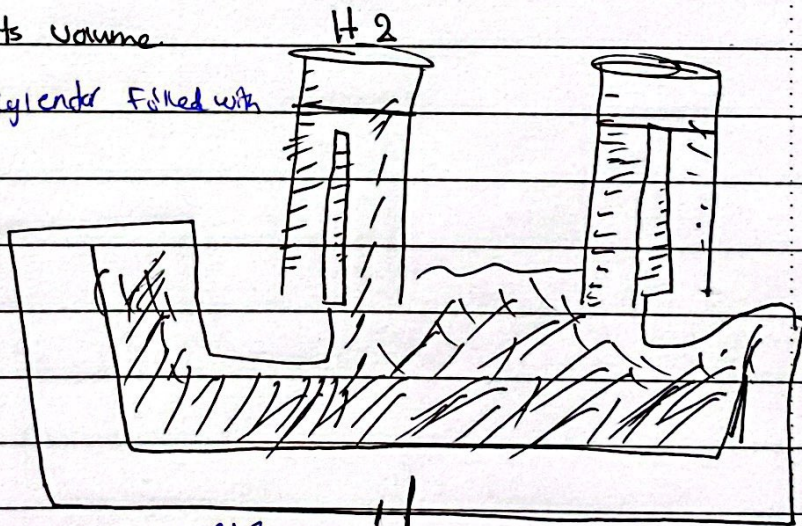
* Concentrated Sodium Chloride solution (Brine)



Q1: plan an experiment to collect the gases at cathode and anode and measure its volume.

Use inverted measuring cylinders filled with brine.

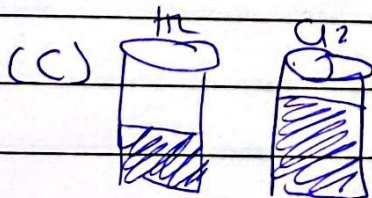
The final appearance of two measuring cylinders



(a)

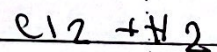
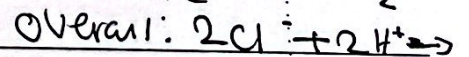
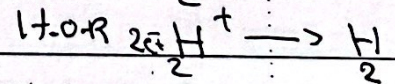
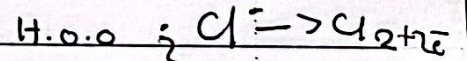


(b)



(c)

Overall reaction



Cathode: the -ve electrode that attracts the +ve ions (cations) where the reduction occurs

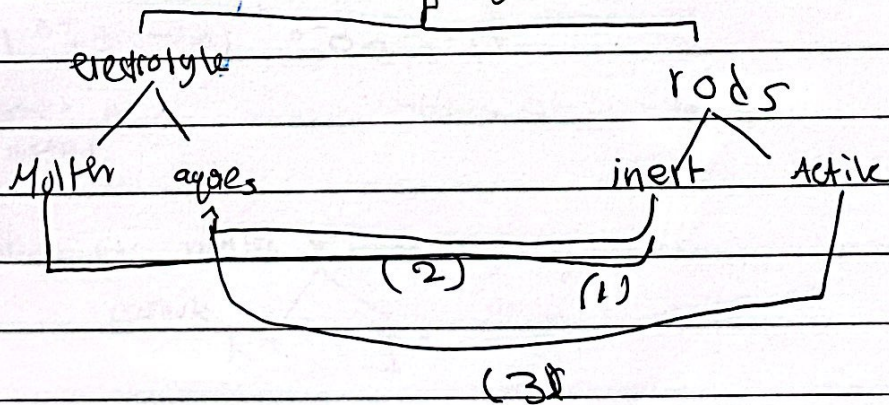
Anode: the +ve electrode that attracts the -ve ions (anions) where the oxidation occurs.

Electrolysis \Rightarrow Discharging

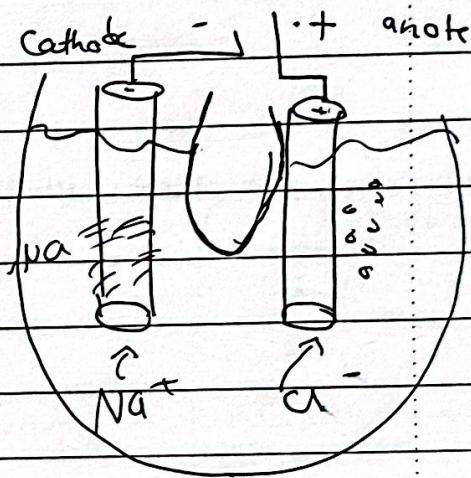
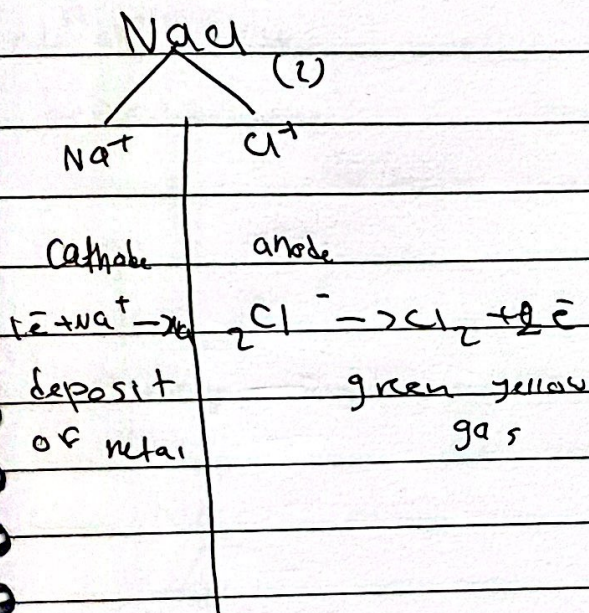
ION \rightarrow element.

Cations			Anions	
$1e^- + Na^+ \rightarrow Na$	} deposit of metal.	}	green gas	$2Cl^- \rightarrow Cl_2 + 2e^-$
$2e^- + Ca^{2+} \rightarrow Ca$			red brown	$2Br^- \rightarrow Br_2 + 2e^-$
$2e^- + Mg^{2+} \rightarrow Mg$			colorless gas	$2O^{2-} \rightarrow O_2 + 4e^-$
$3e^- + Al^{3+} \rightarrow Al$			yellow gas	$2F^- \rightarrow F_2 + 2e^-$
$2e^- + 2H^+ \rightarrow H_2$			colorless gas	$2I^- \rightarrow I_2 + 2e^-$
$3e^- + Fe^{3+} \rightarrow Fe$			(red brown) aq.	

Electrolysis

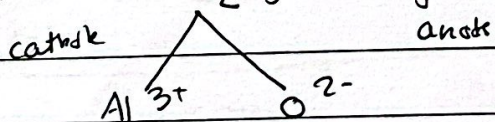


Electrolysis for molten NaCl using graphite

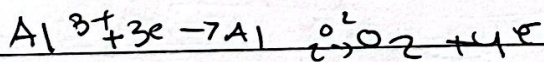


electrolyte: used up

Molten Al_2O_3 using graphite.



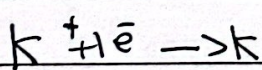
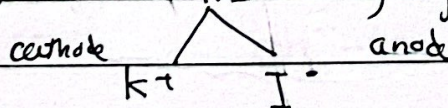
electrolyte: used up



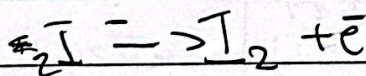
deposit of metal

bubbles of colorless gas

Electrolyte for molten KI using graphite



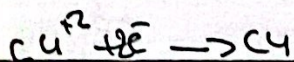
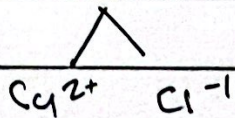
deposit of metal



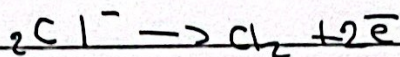
purple gas.

Electrolyte: used up

Molten $CuCl_2$ using graphite



deposit of metal



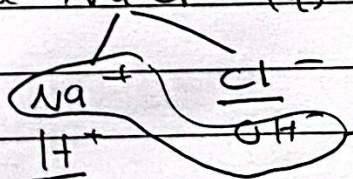
green fumes gas

electrolyte used up.

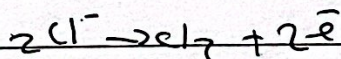
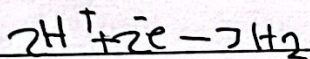
* Electrolysis for aqueous electrolyte using inert rods.

Concentrated

Cathode $NaCl$ (aq) anode



electrolyte: $NaOH$



At anode

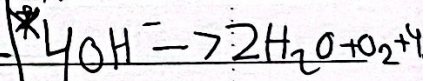
only the concentrated

halide (Cl^{-} , Br^{-} , I^{-})

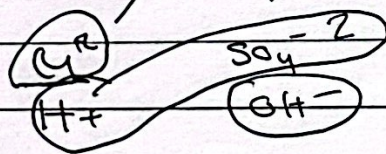
are most likely to oxidise than OH^{-}

(Others with OH^{-})

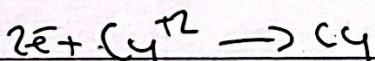
the OH^{-} will oxidise



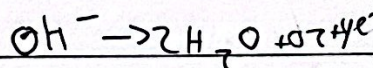
Cathode $CuSO_4$ (aq) Graphite anode



electrolyte



deposit of metal



electrolyte: H_2SO_4

K^{+}

Na^{+}

Li^{+}

Ca^{+2}

Mg^{+2}

Al^{+3}

Zn^{+2}

Fe^{+2}

Pb^{+2}

H^{+}

Cu^{+2}

Ag^{+1}

and $+3$

At Cathode

the less reactive

ion is more likely to reduce

and the more reactive ions

stays in the electrolyte

Subject

Oxidizing agent
or
reducing agent

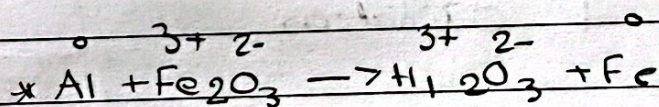
Oxidizing agent ("Oxidant")

The substance that it self reduced and causes the other substance to be oxidise

reducing agent: "Reductant"

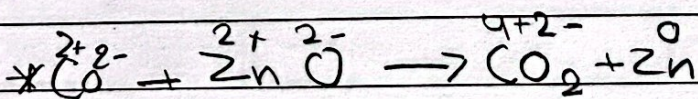
The substance that it self oxidised and causes the other substance to be reduced

if the substance is an ion in the compound
you must write the agent the whole compound



oxidation: Al reducing agent Al

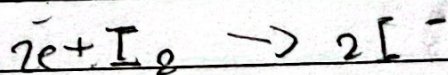
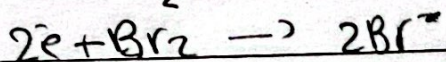
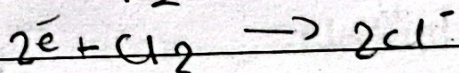
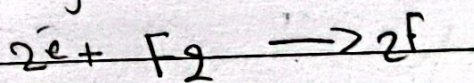
reduction: Fe³⁺ oxidising agent Fe₂O₃



oxidation: C²⁺ reducing agent CO

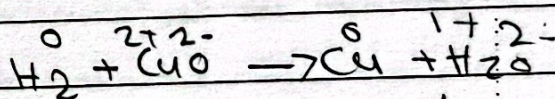
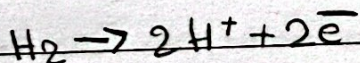
reduction: Zn²⁺ oxidant ZnO

④ Halogens Grp 7



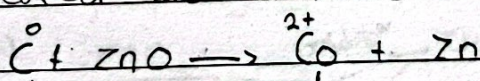
* Most common reducing agent.

① Hydrogen

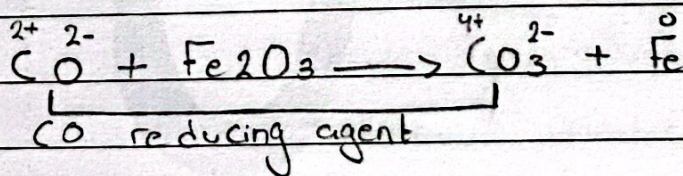


Oxidation / reducing agent

② Carbon and monoxide



oxidation / reducing agent.



CO reducing agent

④ Metals

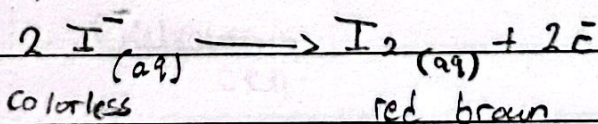
more reactive ↑
K, Na, Li, Ca, Mg,
Al, C, Co, Zn, Fe,
Pb, H, Cu, Ag

More likely to lose e.

More likely to oxidise.

More likely to be
reducing agent.

③ potassium Iodide KI



colorless

red brown



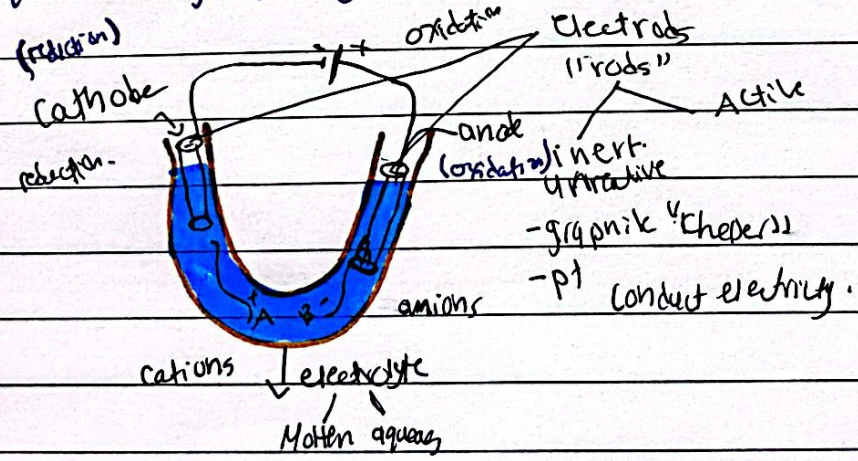
Electrolysis

↓
 electricity Analysis
 Breaking down.

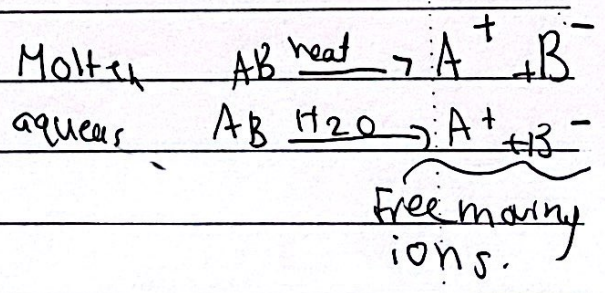
Electrolyte: is a chemical compound that conducts electricity

Q1) Why Ionic compounds don't conduct electricity when solid
 the ions are not free.
 they conduct electricity when molten or dissolved in water.
 the ions are free to move.

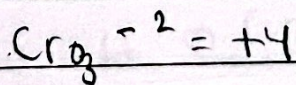
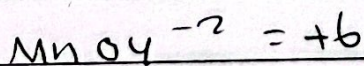
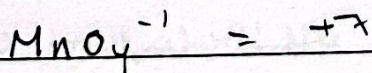
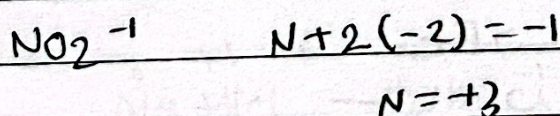
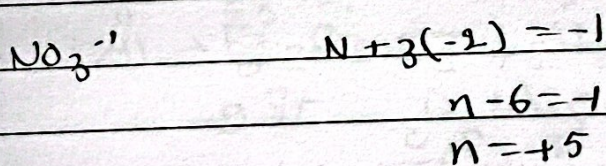
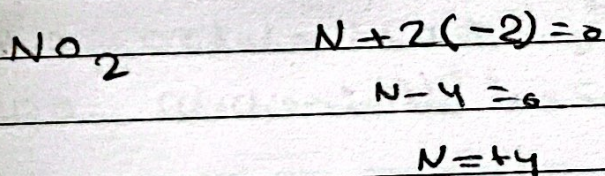
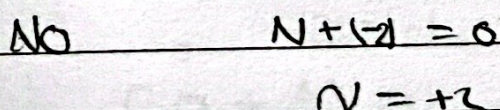
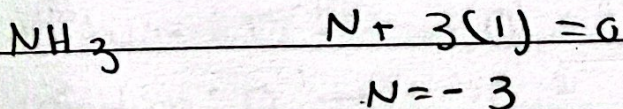
Electrolysis: Breaking down "ionic chemical compounds" Molten or aqueous by passing electricity



Electrolysis cell.



Find the oxidation state of all underlined atoms:

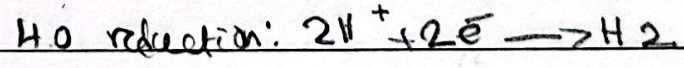
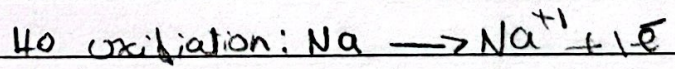
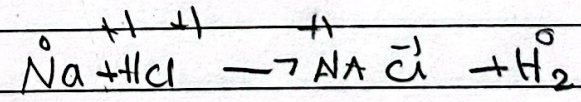
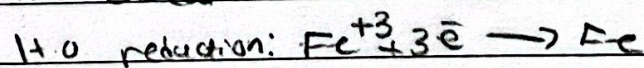
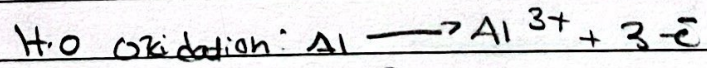
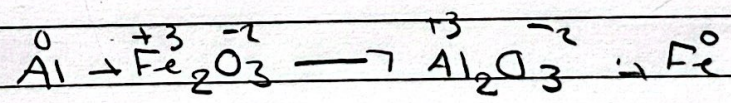
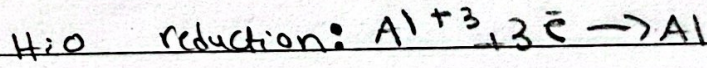
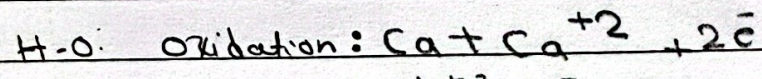
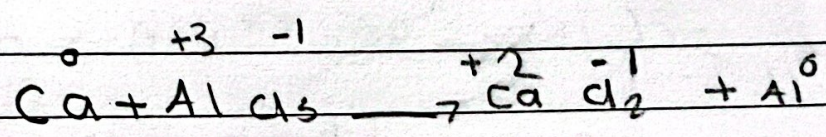
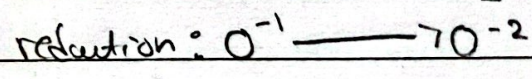
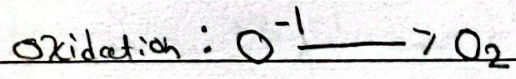
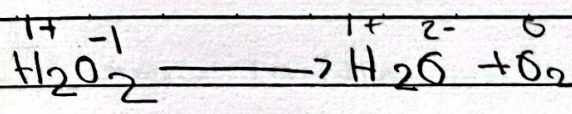


No.

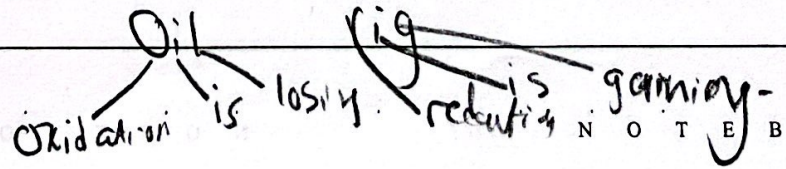
Subject

Oil rig

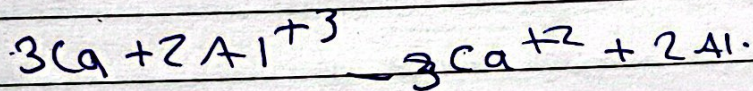
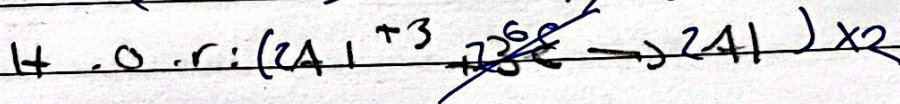
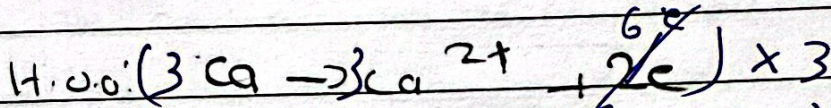
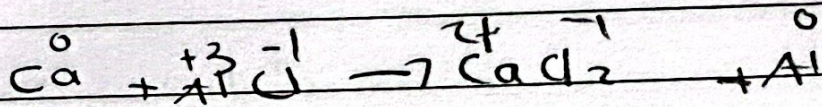
CHEMISTRY



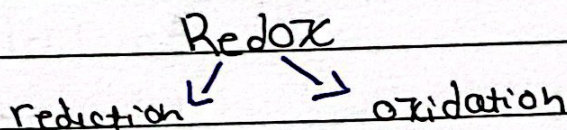
H.O.O \longrightarrow $2\bar{e}$ losing e^- s
 H.O. $\bar{e} \longrightarrow$ gaining e^- s



Overall reaction.



Redox Reaction.



in terms of

① oxygen.

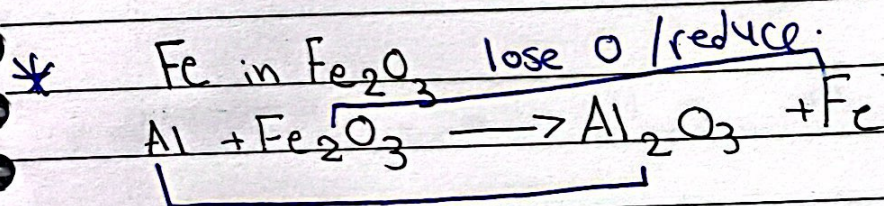
lose oxygen

gain oxygen

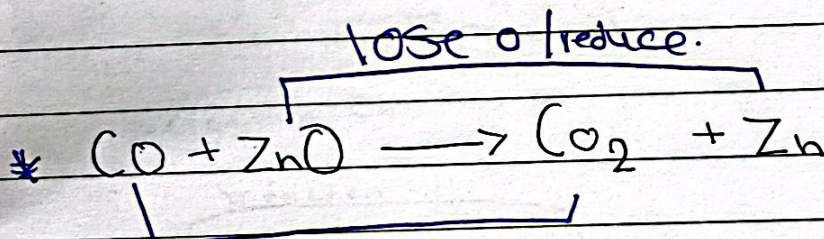
② hydrogen

gain H
(reduced)

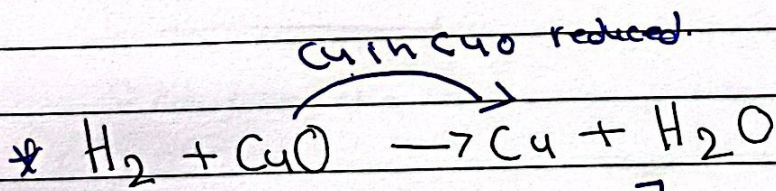
lose H
(oxidize)



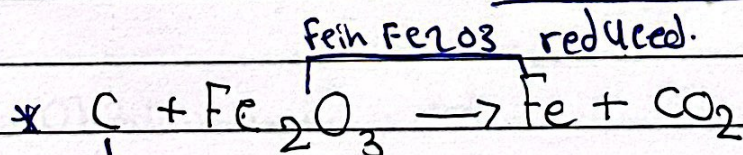
Al: gain O / oxidise



C in CO gain O / oxidise



H₂ gain O / oxidise



C: oxidise

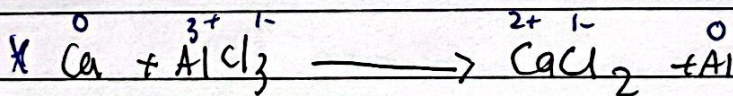
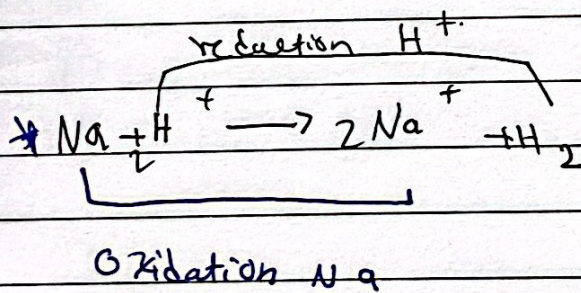
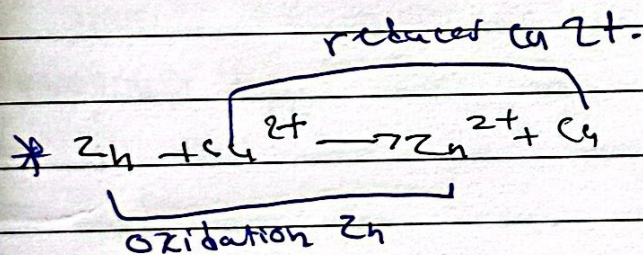
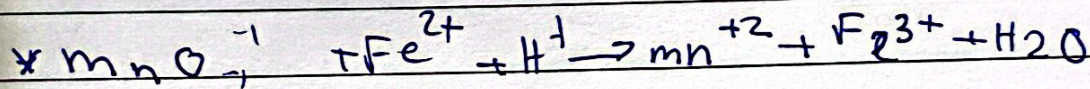
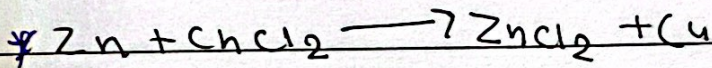
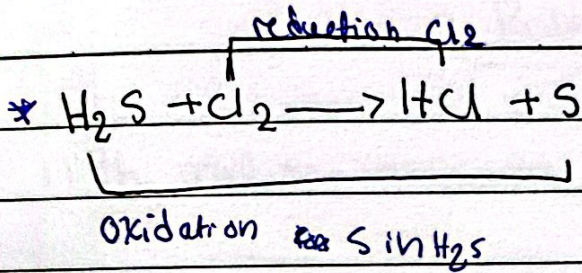
* Oxidation : decrease
State

increase.

Subject _____

Date _____

No. _____

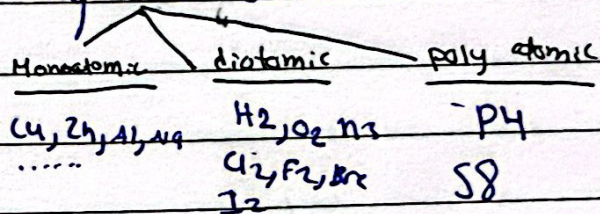


Oxidation: $\text{Ca} \rightarrow \text{Ca}^{2+}$

reduction: $\text{Al}^{3+} \rightarrow \text{Al}$

Rules For oxidation.

1) the oxidation state for any free element = Zero



2) the oxidation state for atoms in a compound from

group I: +1

group II: +2

group III: +3 always only in Al

group VII: -1 always only for F

3) the oxid. state of (H) is (+1) except with metal (-1)

4) the oxidation state of O is -2 except in peroxide (-1) & except in OF₂ (+2)

5) The sum of oxidation state of all atoms in the compound = 0

in the ion = charge of this ion.

