

Saturday

20/8/2022

Redox

reduction

oxidation

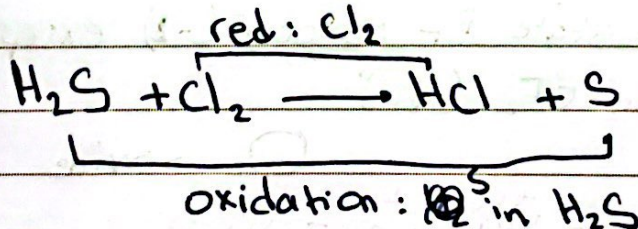
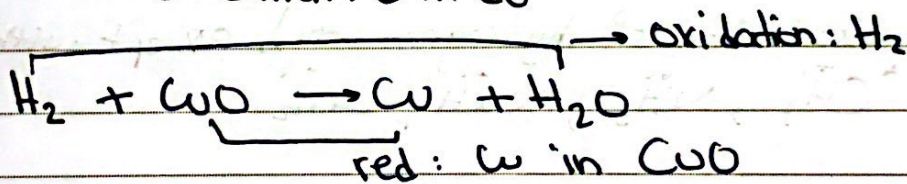
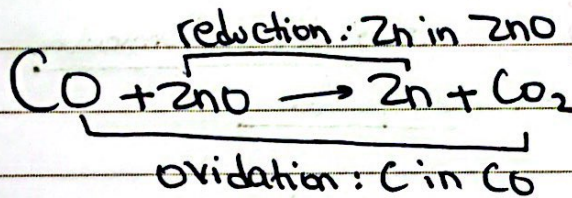
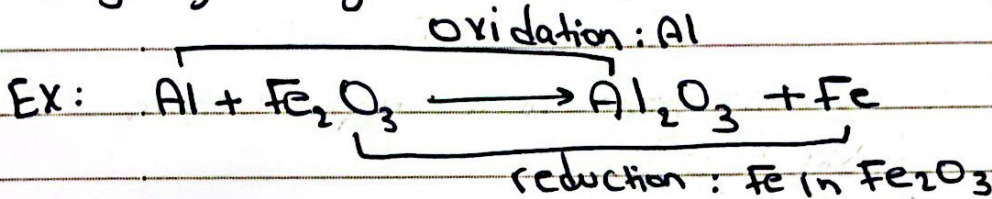
in terms of

1) oxygen lose O

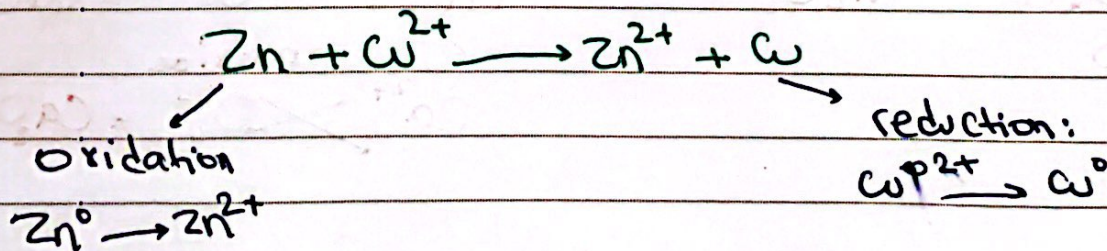
gain O

2) hydrogen gain H

lose H₂



⇒ Oxidation State : decrease → reduction
increase → oxidation.



rules for oxidation state:-

1) the oxidation state for any free element = zero

monatomic diatomic polyatomic
Na, K, Li... H₂, O₂, P₄
N₂, F₂ S₈

2) the oxidation no of any atom in a compound from

group 1 = +1 (Na, K, Li)

group 2 = +2 (Mg, Ca, Sr)

group 3 = +3 always 3 only for aluminium

group 7 = -1 always -1 only for F

3) the oxidation of hydrogen (+1) except with metal hydride (-1) CH₄, NH₃, NaH, CaH₂

4) the oxidation state for oxygen (-2) except in peroxide (-1) except in OF₂ (+2)

O₂ → oxide O₂²⁻ → peroxide

sodium oxide = ~~Na⁺¹XO₂⁻²~~ = Na₂O

sodium peroxide = ~~Na⁺¹XO₂⁻²~~ = Na₂O₂

~~H⁺¹XO₂⁻²~~
H₂O

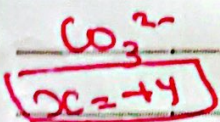
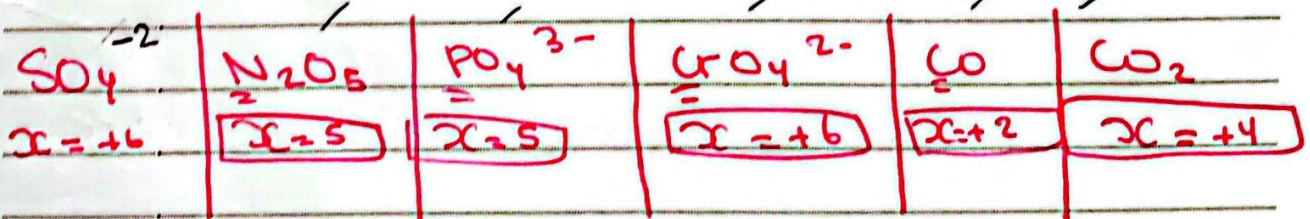
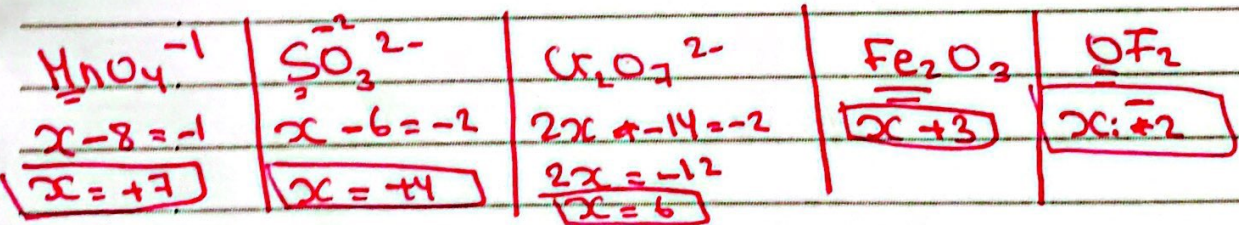
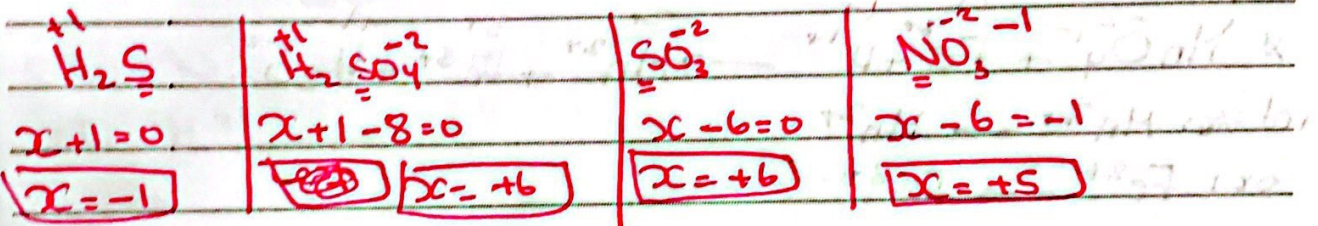
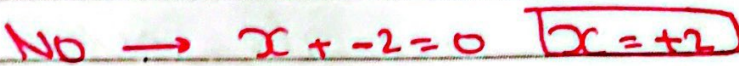
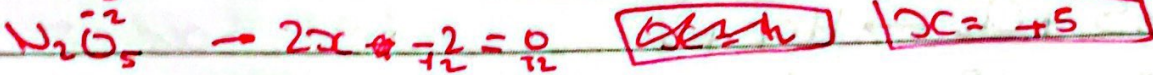
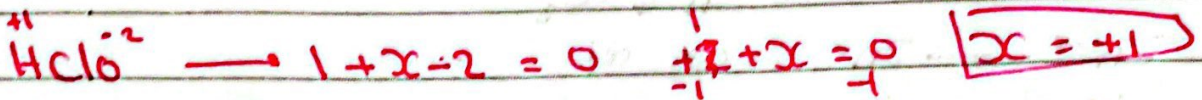
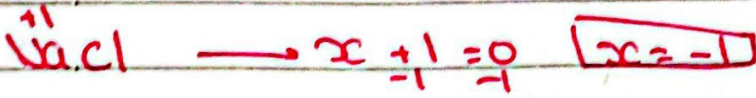
~~H⁺¹XO₂⁻²~~
H₂O₂

Calcium oxide

Ca²⁺ O²⁻ = CaO

peroxide
~~Ca²⁺XO₂⁻²~~ = CaO₂

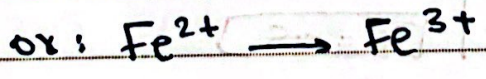
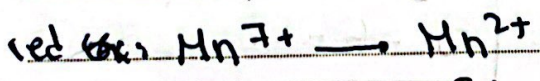
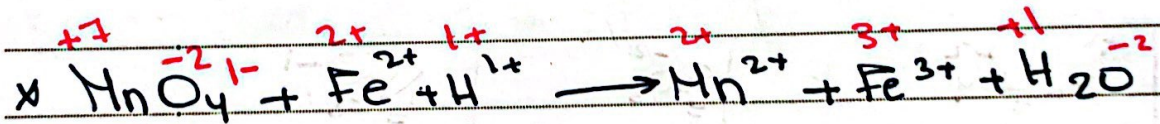
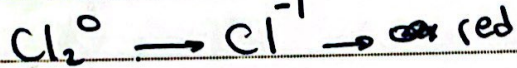
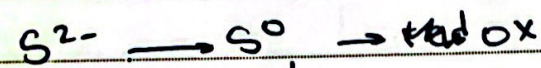
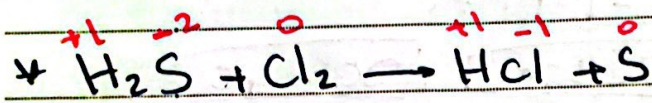
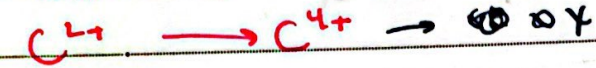
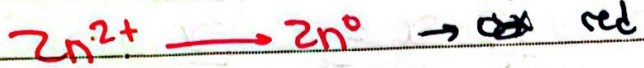
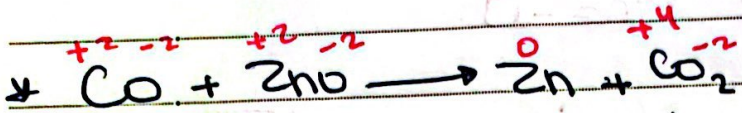
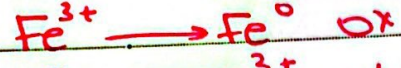
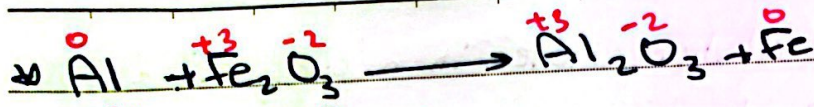
5) the sum of all oxidation state in a compound = 0
 In an ion = charge of this ion

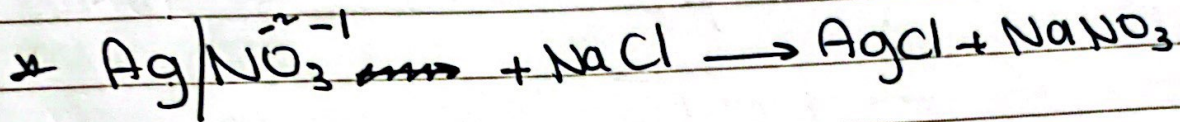
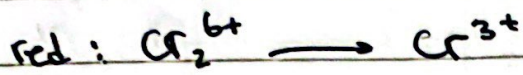
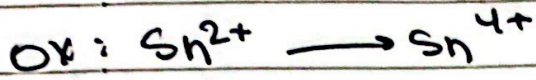
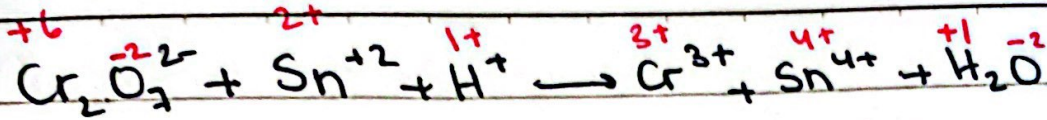


$$2x - 2 = 0 \Rightarrow x = 1$$

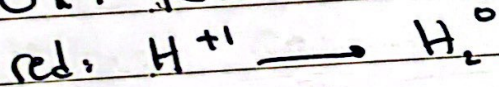
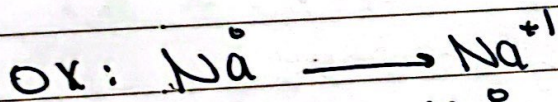
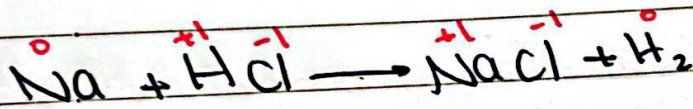
$$x = 1$$

$$x + (-8) = 0 \Rightarrow x = +8$$



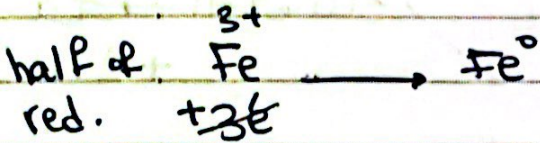
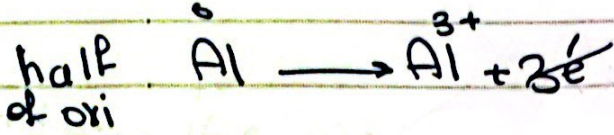
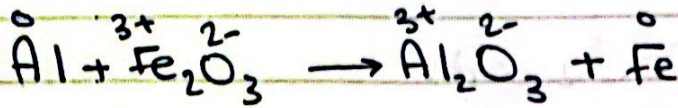


= Not redox.



Saturday

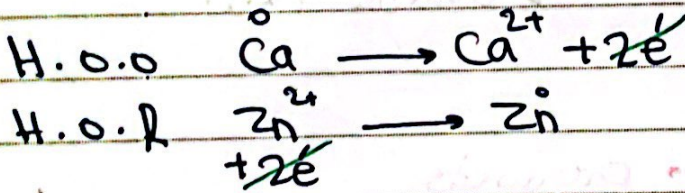
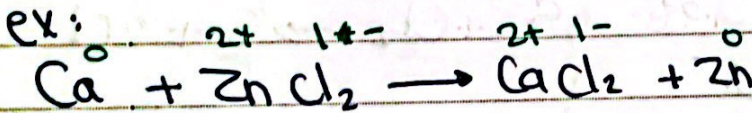
3/9/2022.



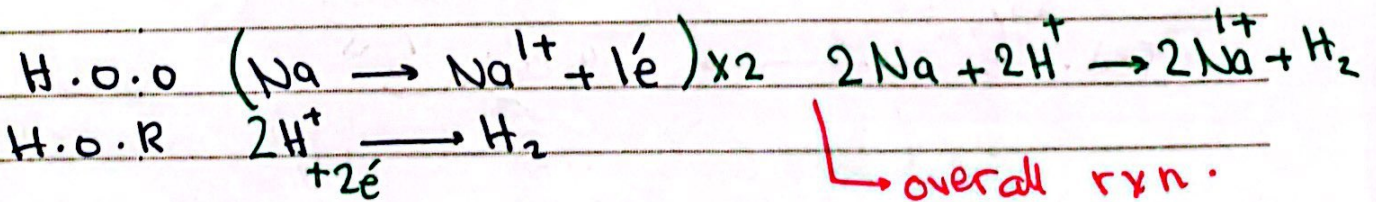
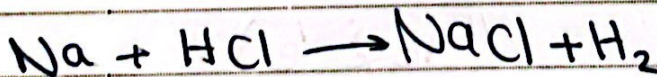
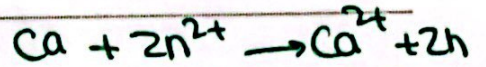
writing a balanced half ionic equation.

1) atoms

2) the charge by adding e^- to the side with the greater charge by the difference



Overall rxn:



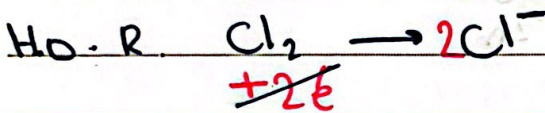
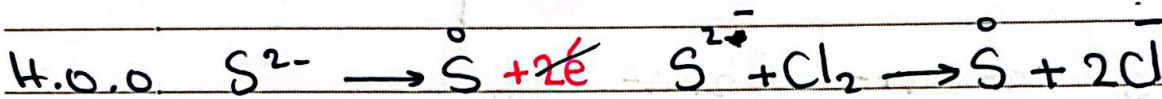
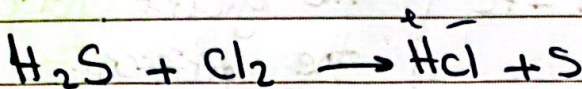
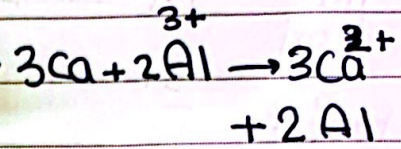
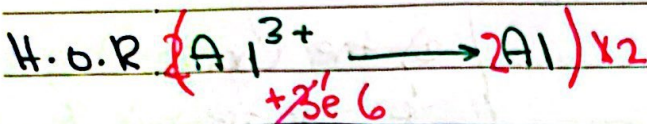
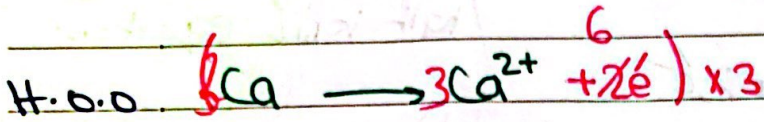
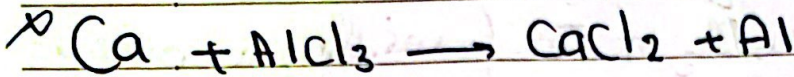
Overall rxn.

Saturday

$$2x + 1 = 1$$

$$\begin{array}{r} 3x + 3 = 0 \\ -3 = -3 \\ \hline 3x = -3 \\ \hline x = -1 \end{array}$$

3/9/2022

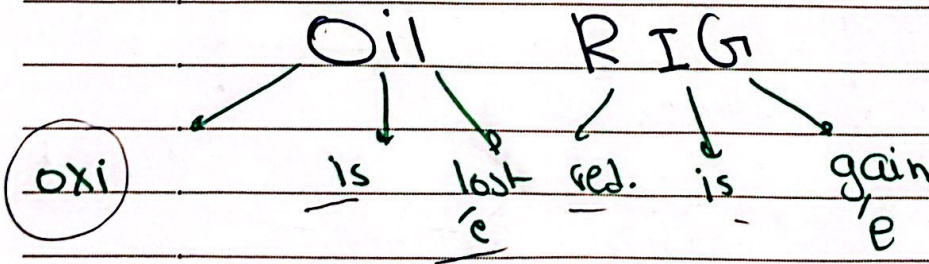


overall rxn.

Reactants \rightarrow products

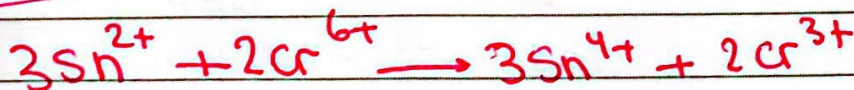
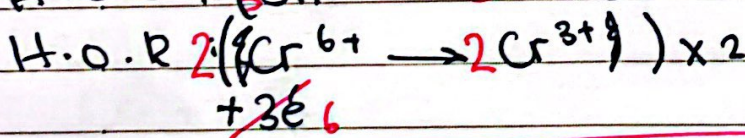
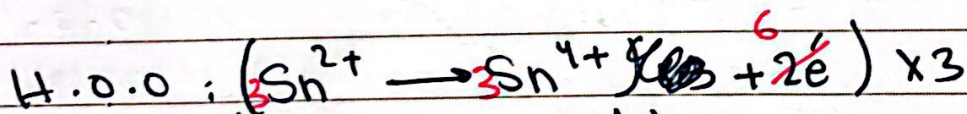
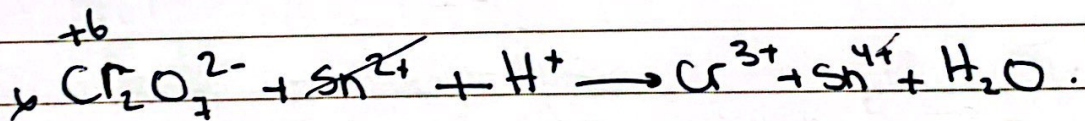
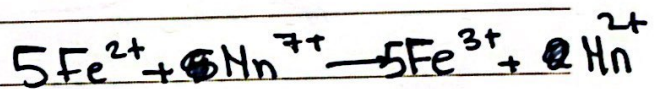
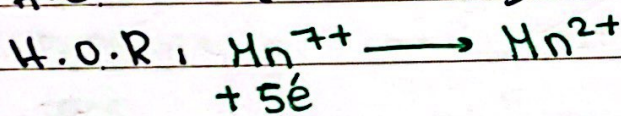
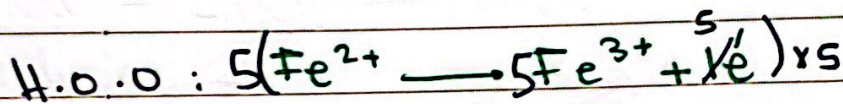
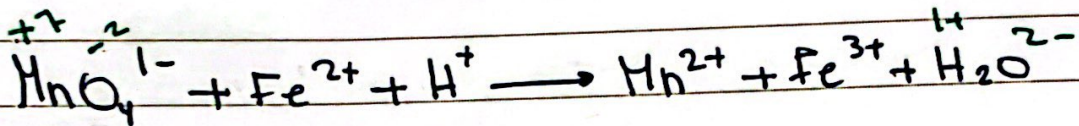
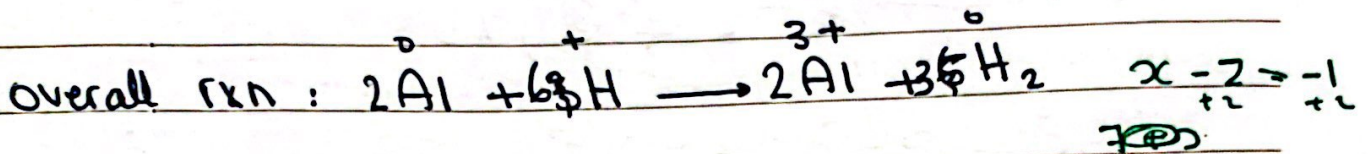
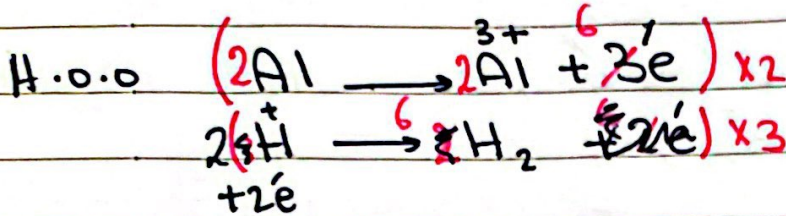
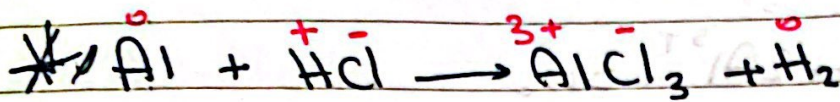
oxi \rightarrow e "lose e"

red. e \rightarrow "gain e"



Saturday

3/19/2022



Oxidising + reducing agent.

Oxidising agent: the substance that itself reduced and causes the other substance to be oxidise.

reducing agent: the substance that itself oxidise and causes the other substance to reduce.

⇒ if substance is an Ion in a compound the agent is the compound itself

reducing agent

oxidation

O gain O

H lose H

↓
lose e⁻

in terms of e⁻

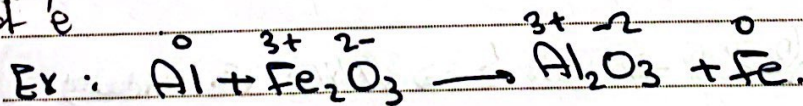
oxidising agent

reduction

lose O

gain H

↓
gain e⁻

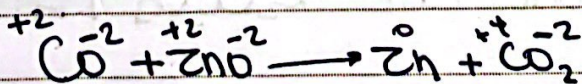


oxi: Al

red: Fe³⁺

reducing agent: Al

oxidising agent: Fe₂O₃



ox: C²⁺

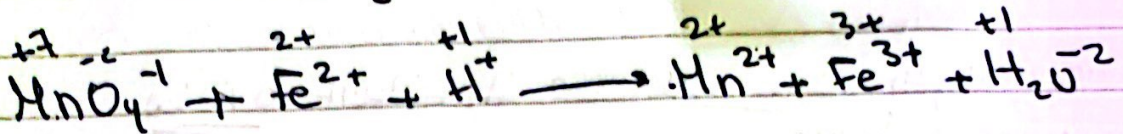
red: Zn²⁺

reducing agent: CO

oxidising agent: ZnO



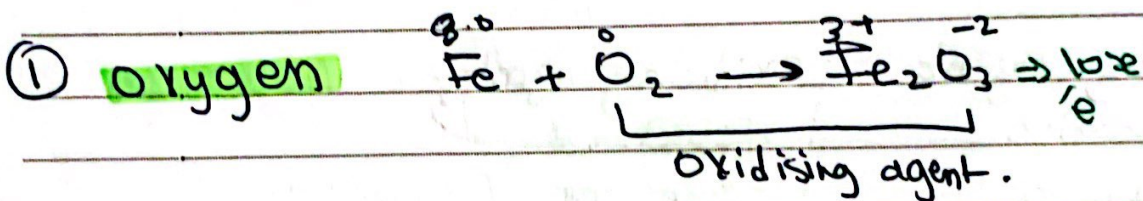
ox: S^{2-} reducing: H_2S
 red: Cl_2 oxidising: Cl_2



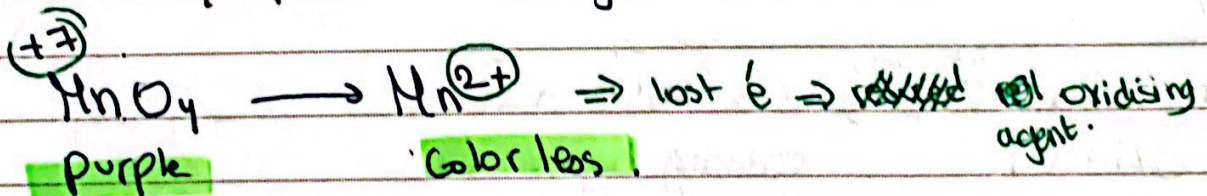
ox: Fe^{2+} oxidising: MnO_4
 red: Mn^{7+} reducing: Fe^{2+}

→ themselves reducing.

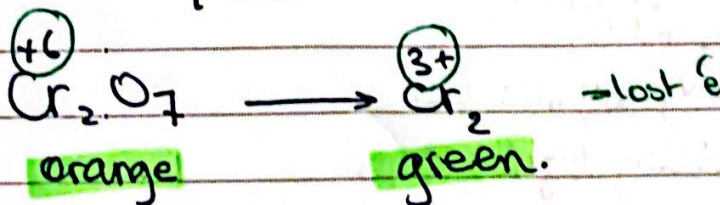
* most common **oxidising agent.**



② Acidify **potassium manganate KMnO_4** / H^+



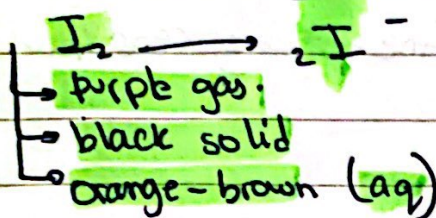
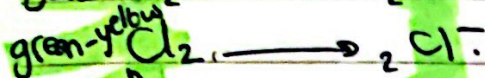
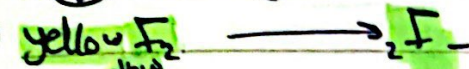
③ Acidify **potassium dichromate $\text{K}_2\text{Cr}_2\text{O}_7$** / H^+



Tues day

6/9/22

④ halogens:

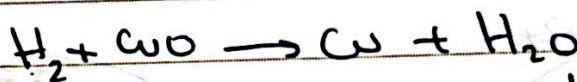


colorless.

losing/gaining of oxygen \Rightarrow losing/gaining of electrons \Rightarrow oxidized/reduced \Rightarrow oxidising agents.

most common reducing agents. themselves oxidise

① hydrogen.

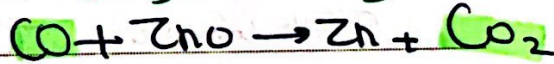


gaining \rightarrow loss of electrons \rightarrow oxidation.
of O_2 reducing agent

reducing agent.

gaining $O_2 \rightarrow$ losing electrons.

② carbon and carbon monoxide



reducing agent.

③ Iodide $2I^- \rightarrow I_2 + 2e^- \Rightarrow$ oxidized (reducing agent)

red-brown color.

④ Metals.

- K
- Na
- Li
- Ca
- Mg
- Al
- C, Co
- Zn
- Fe
- Pb
- H
- Co
- Ag

* more reactive
more likely to lose e
more likely to be oxidized
more likely to be a reducing agent

K \rightarrow strongest reductant
K⁺ \rightarrow weakest oxidant.
Ag \rightarrow weakest reductant
Ag⁺ \rightarrow strongest oxidant.

Wednesday.

7/9/2022

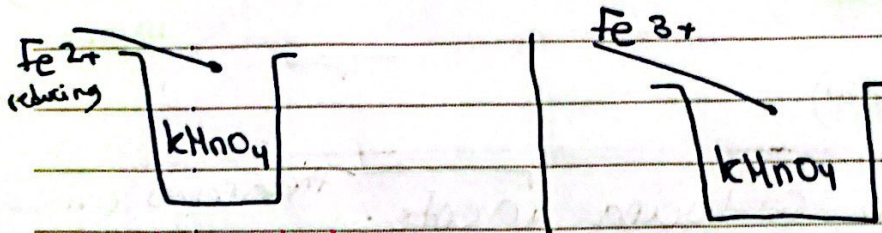
*check-point

redox

Q: Fe^{2+} is a reducing agent

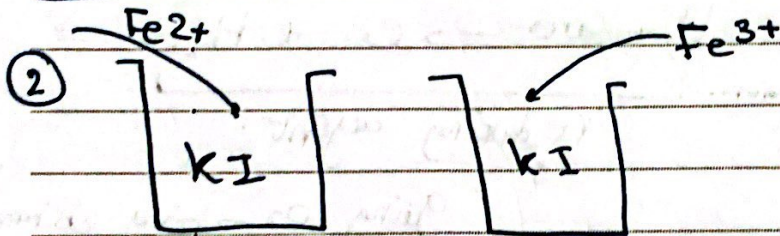
Fe^{3+} is an oxidising agent.

record the observation in each of the following reactions.

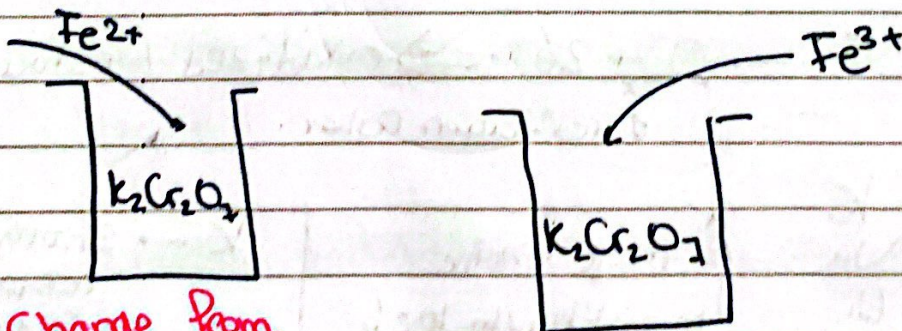
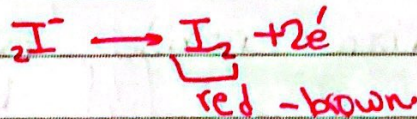


purple \rightarrow colorless

Stays purple. / No Change.



Stays colorless



Change from orange to green

No Change.

Wednesday.

7/19/2022.

Electrolysis

Electrolysis: the breaking down chemical compound (Ionic) when molten or aqueous by passing electricity.

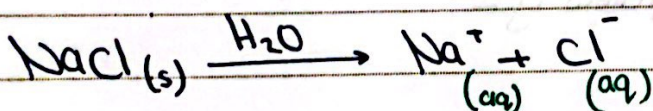
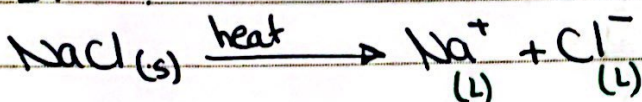
* why the ionic compounds don't conduct electricity when solid?

the ions are not free to move.

* why the ionic compound conduct electricity when molten?

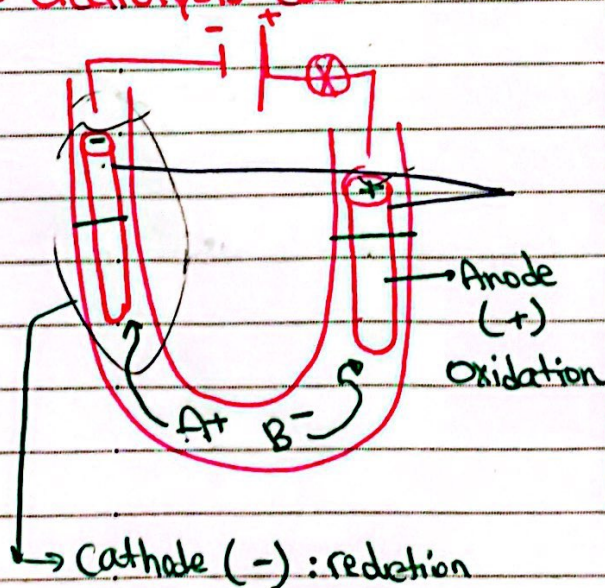
the ions are free to move.

EX:



* Electrolyte: Chemical compound that conducts electricity when molten or aqueous.

* electrolysis cell.



⊖ Cathode: the -ve rod that attracts the +ve ions (cation) where reduction occurs.

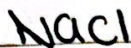
Anode: the +ve rod that the -ve ions (anions) attract where oxidation occurs.

Saturday

10/9/2022.

electrolysis

* electrolysis for molten electrolyte.



Total ions: Na⁺ Cl⁻

Cathode

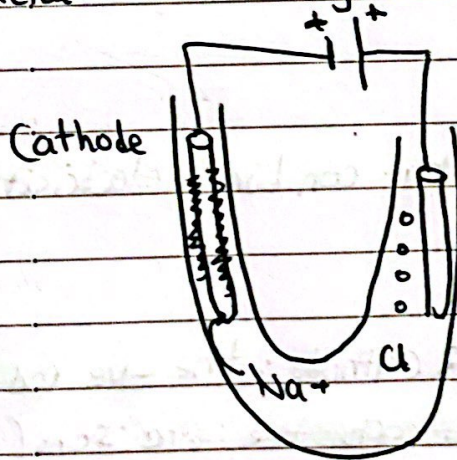
anode.



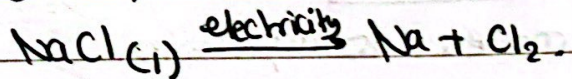
deposits
of metal

bubbles of

green-yellow gas.



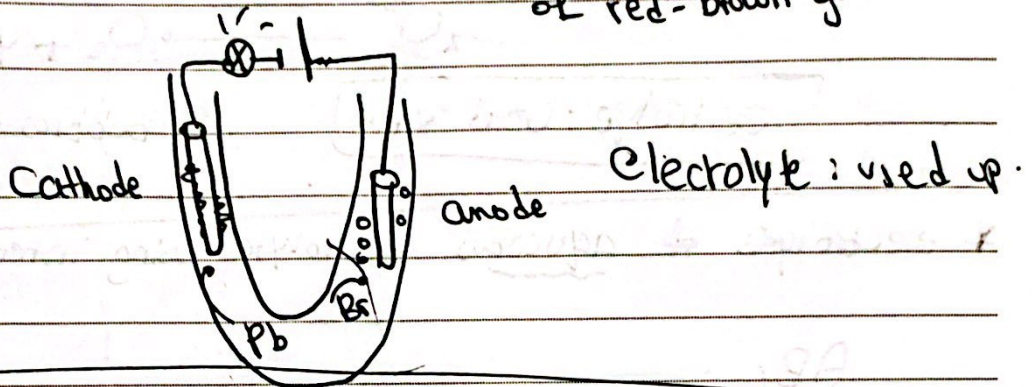
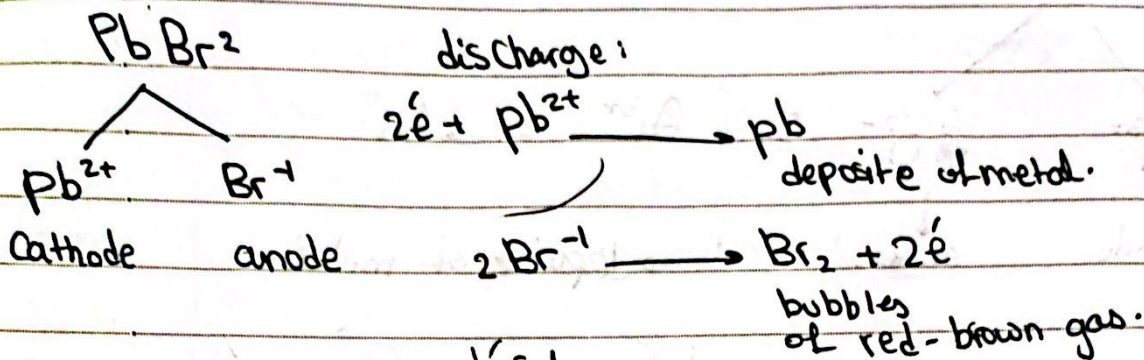
electrolyte is used up.



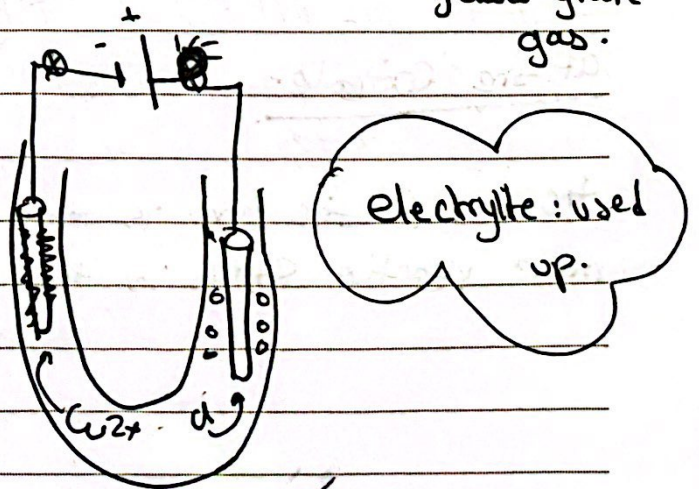
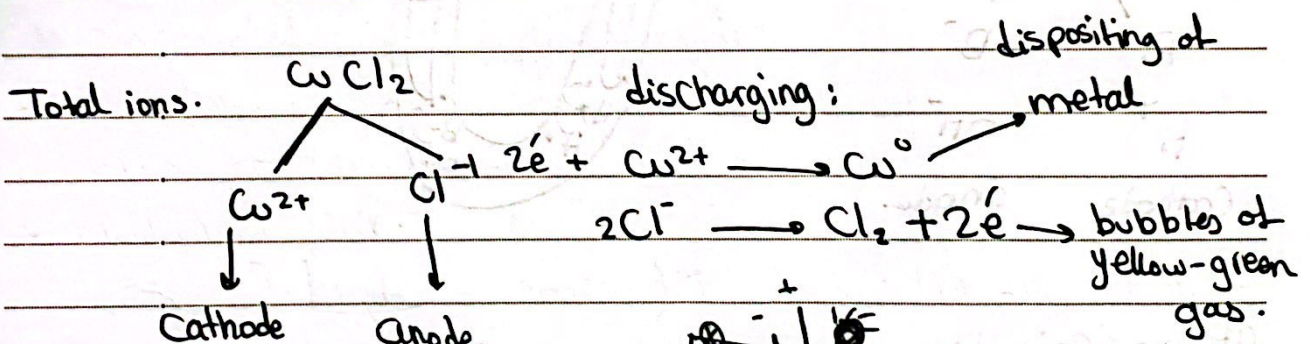
Saturday.

10/9/2022.

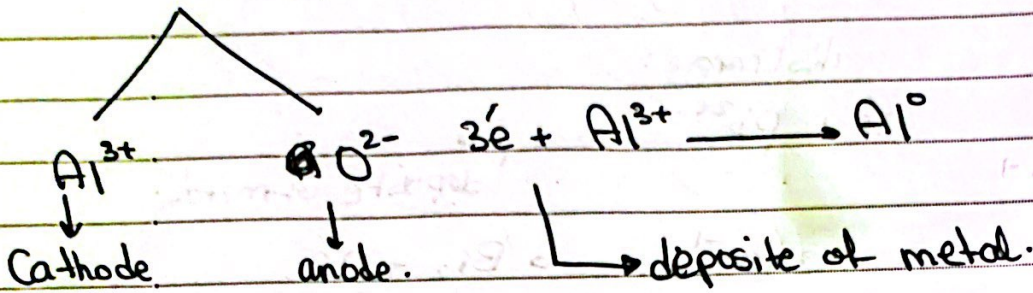
molten lead(II) bromide



$CuCl_2$ / graphite.



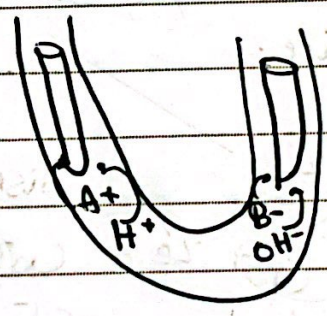
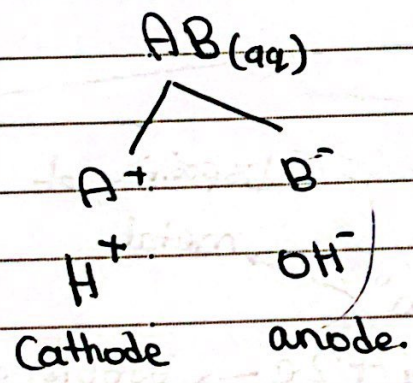
$Al_2O_3(l)$ / graphite.



electrolyte: used up.

bubbles of colorless

* electrolysis of aqueous electrolyte using inert electrodes.



at the Cathode:

the less reactive ion is more likely to reduce and the more reactive stays in the electrolyte.

- K^+
- Na^+
- Li^+
- Ca^{+2}
- Mg^{+2}
- Al^{+3}
- Zn^{+2}
- $Fe^{+2/+3}$
- Pb^{+2}
- $H^+ \Rightarrow H_2$
- $Cu^{+1/+2}$
- Ag^{+1}
- Au^{+3}

*At the anode.

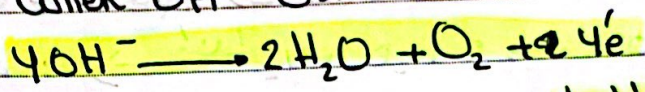
always OH^- except concentrated halide

Cl^-, Br^-, I^-

When the halide oxidise.



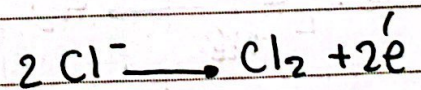
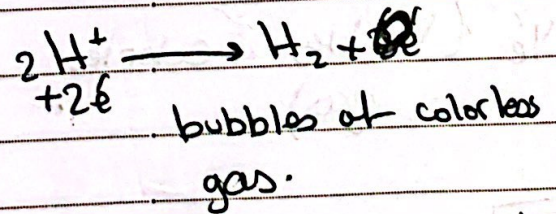
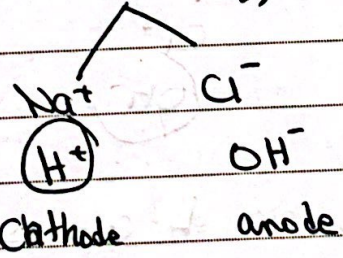
When OH^- oxidise



bubbles of colorless

gas.

* Concentrated $NaCl(aq)$ / graphite

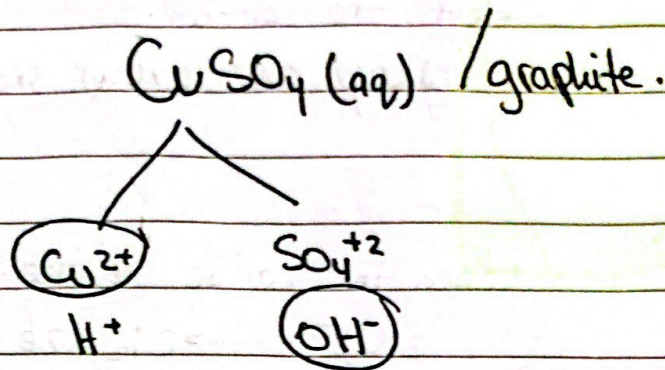


bubbles of green-yellow gas.

electrolyte : $NaOH$.

Tuesday

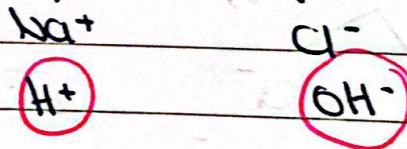
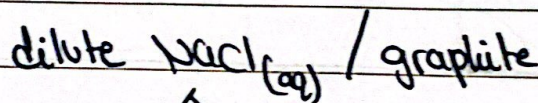
13/9/2022.



Cathode: $2e^- + \text{Cu}^{2+} \rightarrow \text{Cu} \Rightarrow$ deposits of red-brown solid

Anode: $4\text{OH}^- \rightarrow 2\text{H}_2\text{O} + \text{O}_2 + 4e^- \Rightarrow$ bubbles of colorless gas.

electrolyte: H_2SO_4 .



Cathode: $2\text{H}^+ + 2e^- \rightarrow \text{H}_2$ (bubbles of colorless gas)

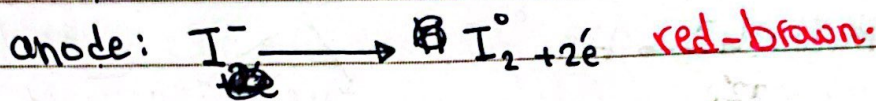
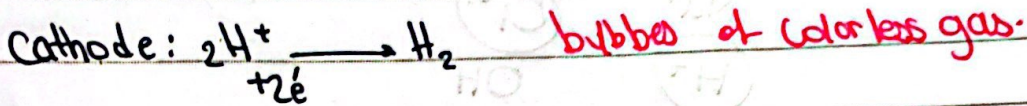
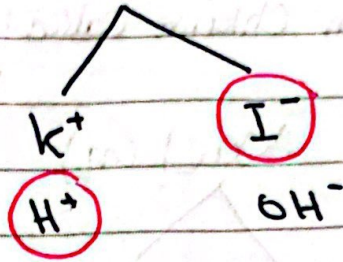
Anode: $4\text{OH}^- \rightarrow 2\text{H}_2\text{O} + \text{O}_2 + 4e^-$ (bubbles of colorless gas).

electrolyte: NaCl

Tuesday

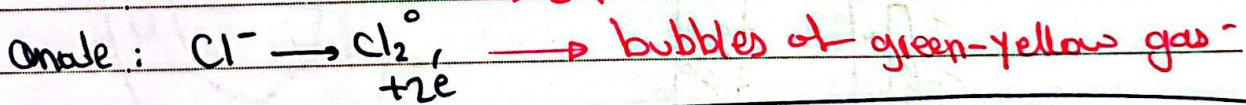
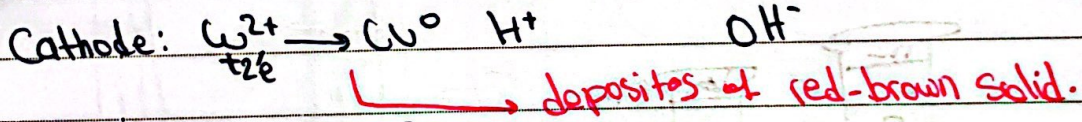
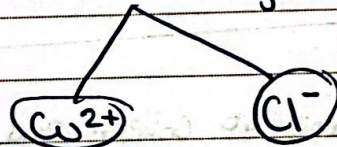
13/9/22.

Conc. KI(aq) / graphite

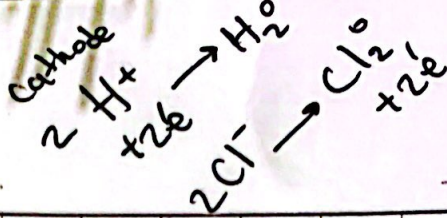
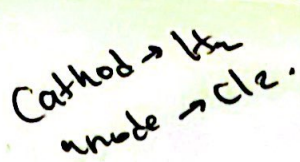


Electrolyte: KOH

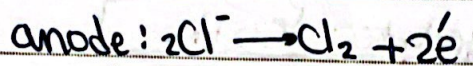
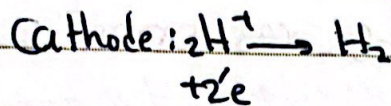
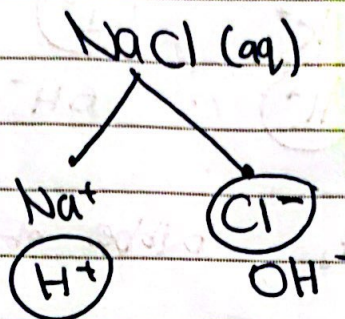
Conc. CuCl₂ / graphite



Electrolyte: ~~KOH~~ less concentrated CuCl₂

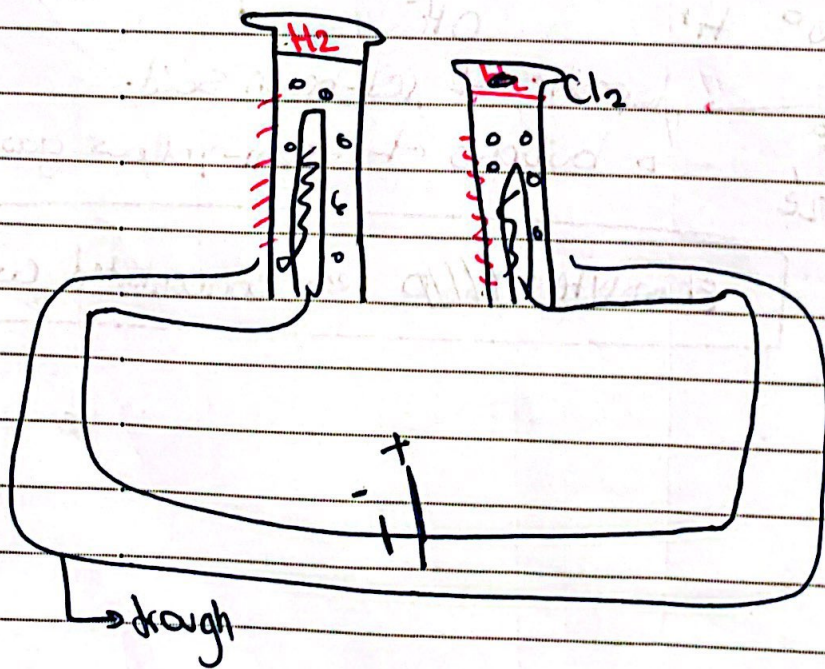


* concentrated sodium chloride called Brine solution.

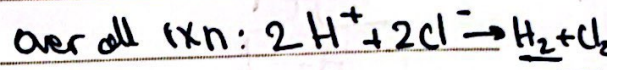
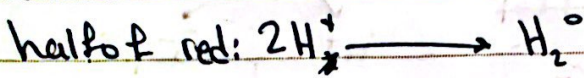
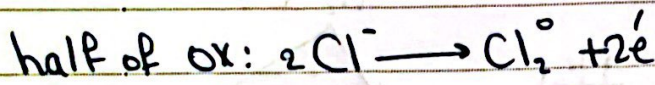
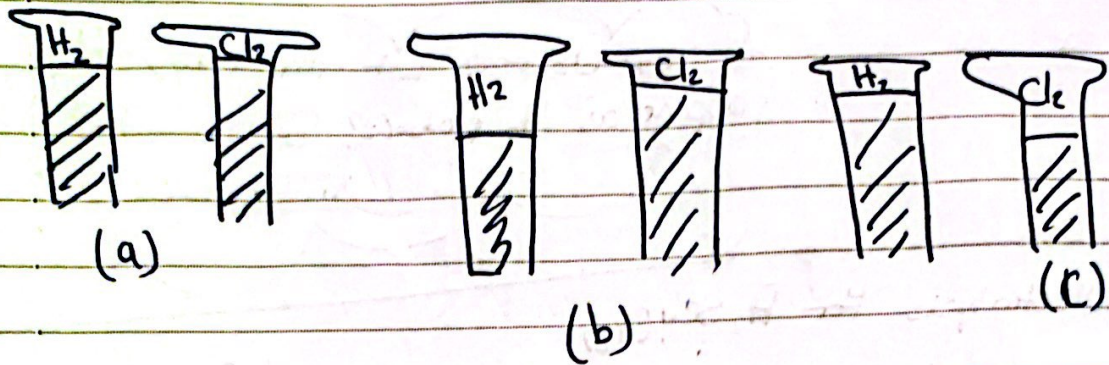


electrolyte: NaOH

Q1: plan an experiment to collect and measure the volume

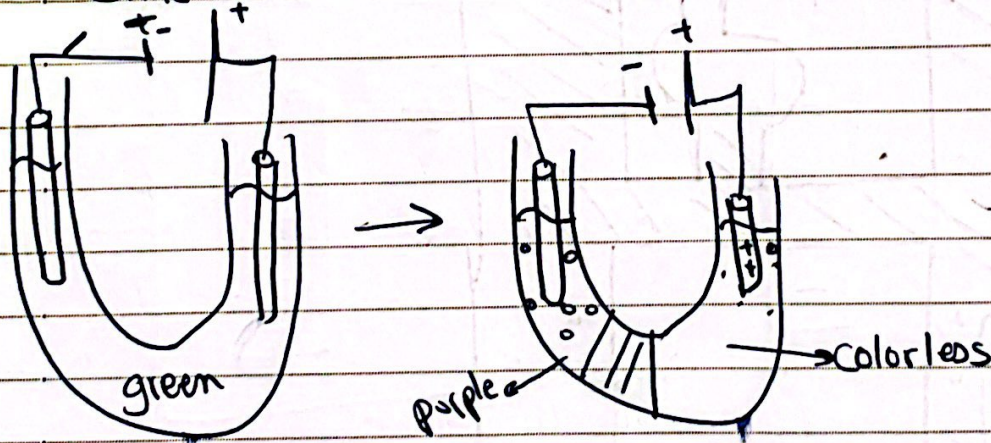


Q2:- the final appearance of two measuring cylinders are?



ratio = 1 : 1

Q3: Brine with universal indicator.



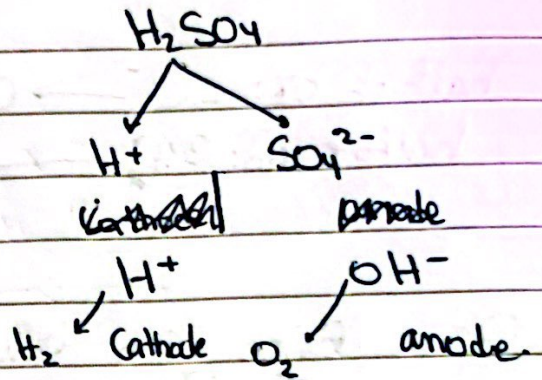
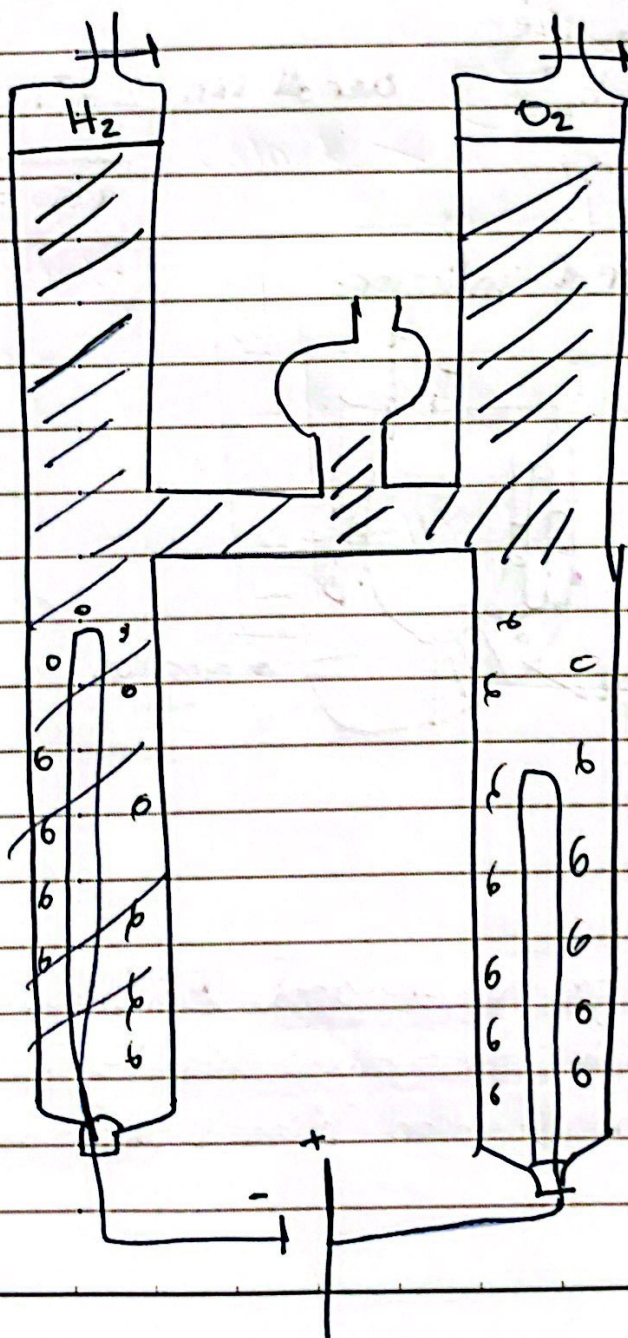
observation:

- 1) the bulb lights up.
- 2) bubbles of green-yellow gas on the anode (oxidation of Cl^-)
- 3) bubbles of colorless gas on the cathode (reduction of H^+)
- 4) around the cathode the solution becomes purple because NaOH is an alkali

5) around the anode the solution becomes colorless since Cl_2 bleaches the color.

the Cl_2 does not immediately appear as H_2 produce? Cl_2 dissolved in solution.

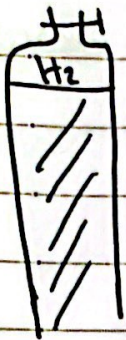
* electrolysis for $\text{H}_2\text{SO}_4(\text{aq})$



Tuesday

13/9/2022

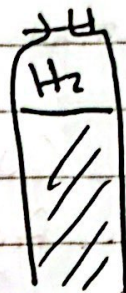
Q2: the final appearance: ~~a~~



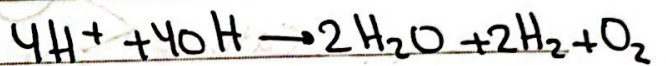
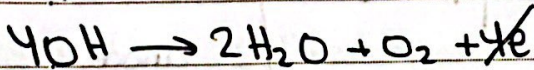
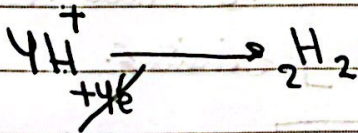
(a)



(b)



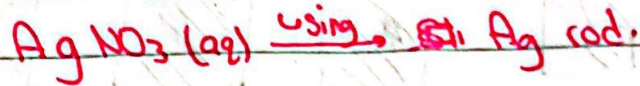
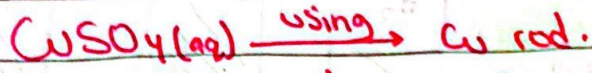
(c)



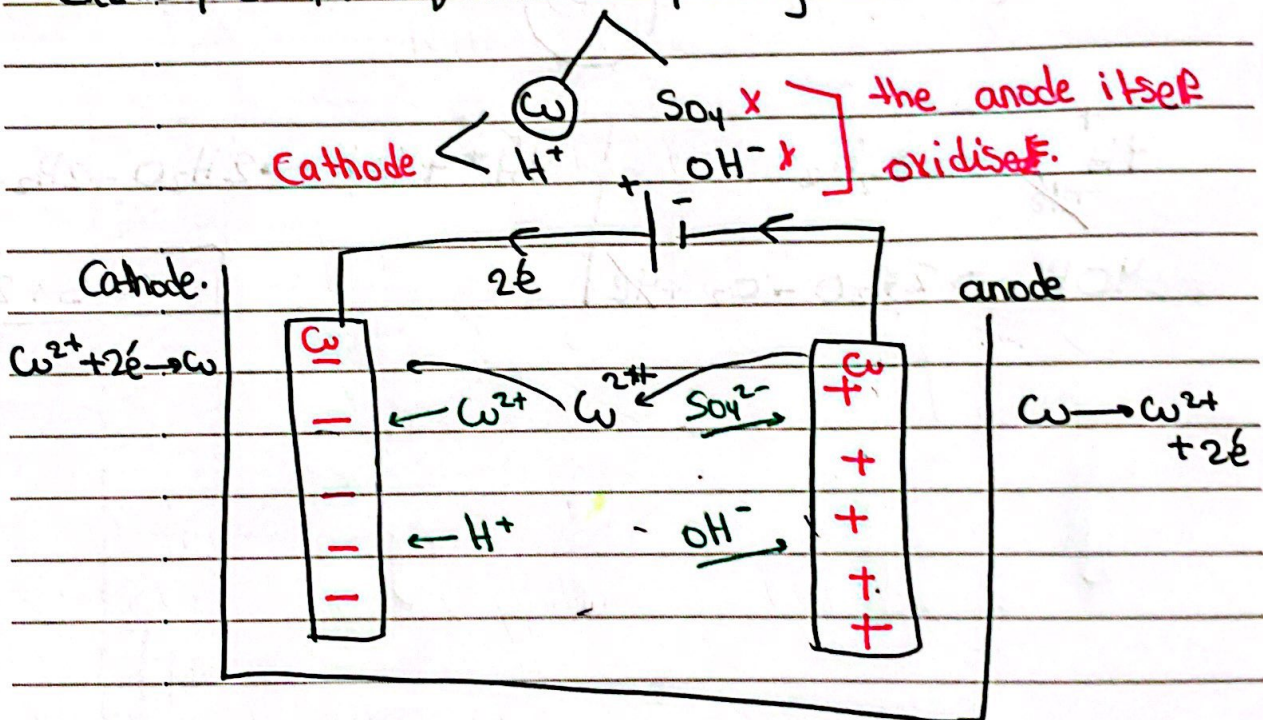
ratio: 2:1

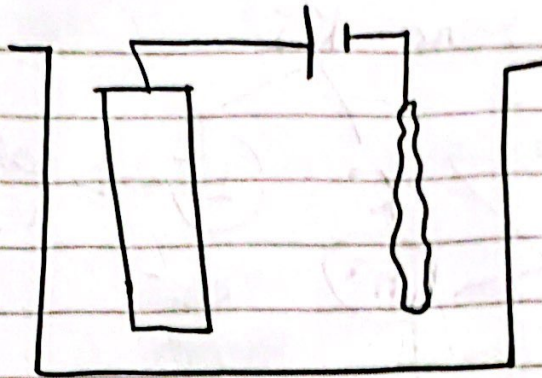
↓ Electrolysis for aqueous electrolyte using Active rod.

↳ the rod must be the same metal ion in the electrolyte.



electrolysis for aqueous CuSO_4 using Cu rod.





Cathode

↑ mass

Cu deposits

anode

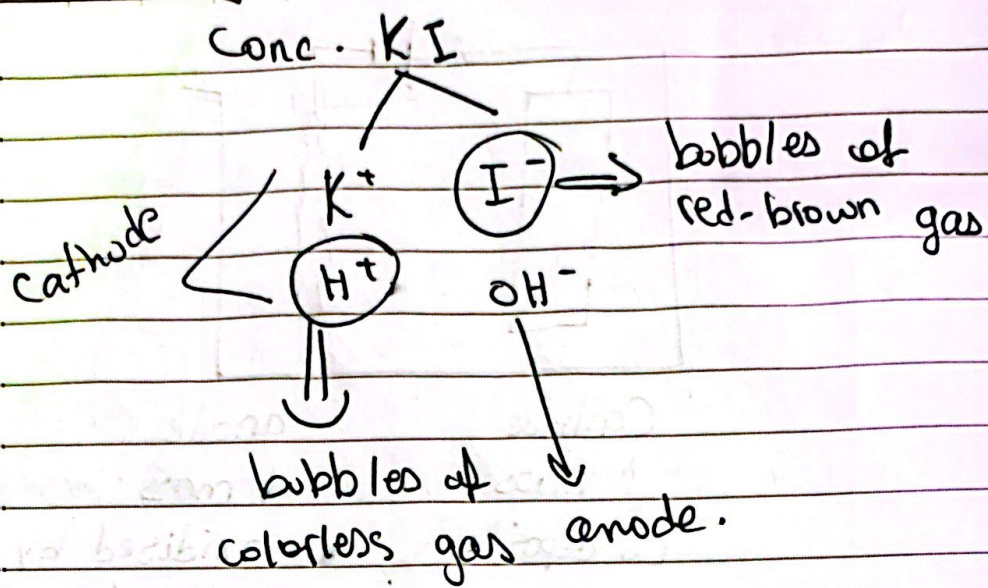
↓ mass

oxidised by
lose e^-

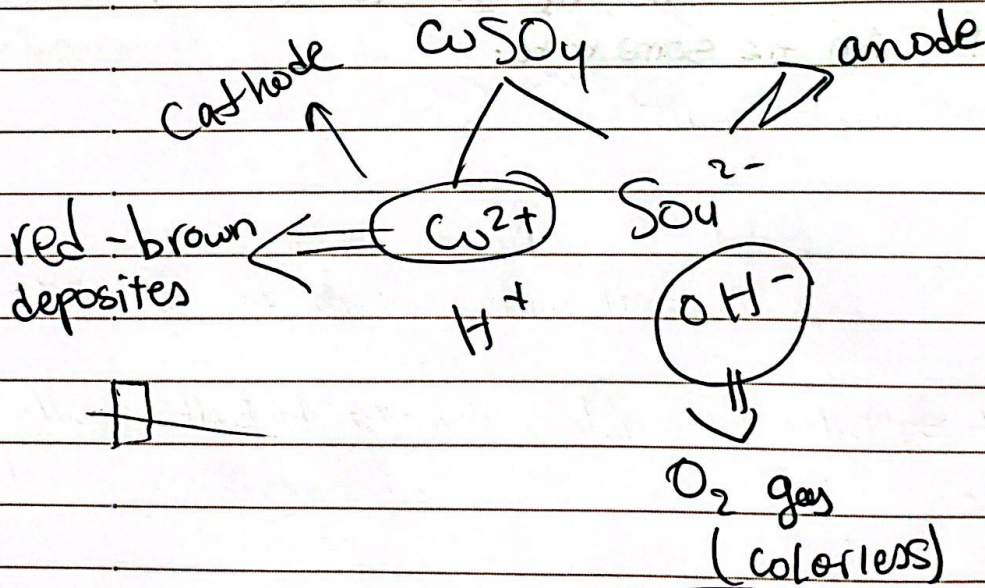
↓ electrolyte: Stays the same, same concentration

* the anode oxidised and replaces the Cu^{2+} in the electrolyte with the same rate.

lab session



electrolyte = Kolt



electrolyte : H_2SO_4

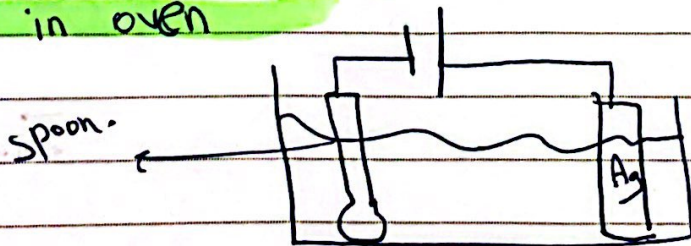
electroplating :-

Coating a metal with another metal using electrolysis:

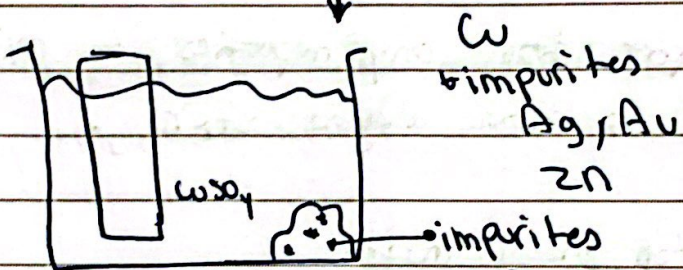
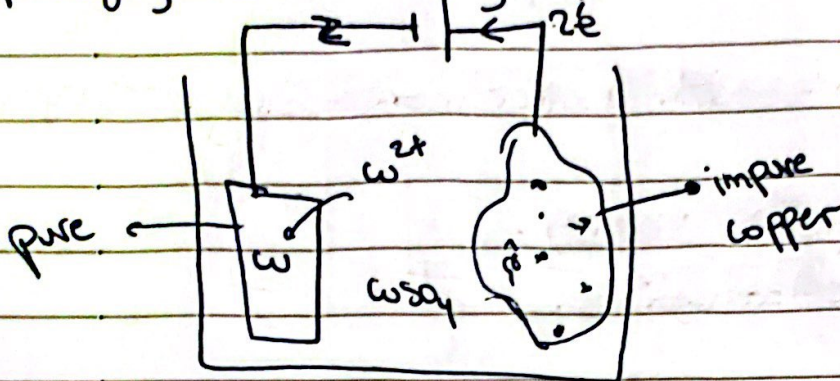
- Why :
- 1) to prevent rusting.
 - 2) more attractive.

* how to electroplate a metal spoon with silver?

- 1) Clean the spoon from any impurities or oxide layer using sand paper to ensure a good sticking.
- 2) make the spoon the cathode.
- 3) the anode must be Ag.
- 4) the electrolyte must contain Ag^+ eg. $AgNO_3$.
- 5) turn on the circuit be sure that the spoon is fully immersed in the electrolyte.
- 6) rotate the spoon to ensure an equal distribution.
- 7) rinse in distilled water.
- 8) dry in oven



② purifying metals / refining copper.



Au, Ag settle down (less reactive)
 $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$

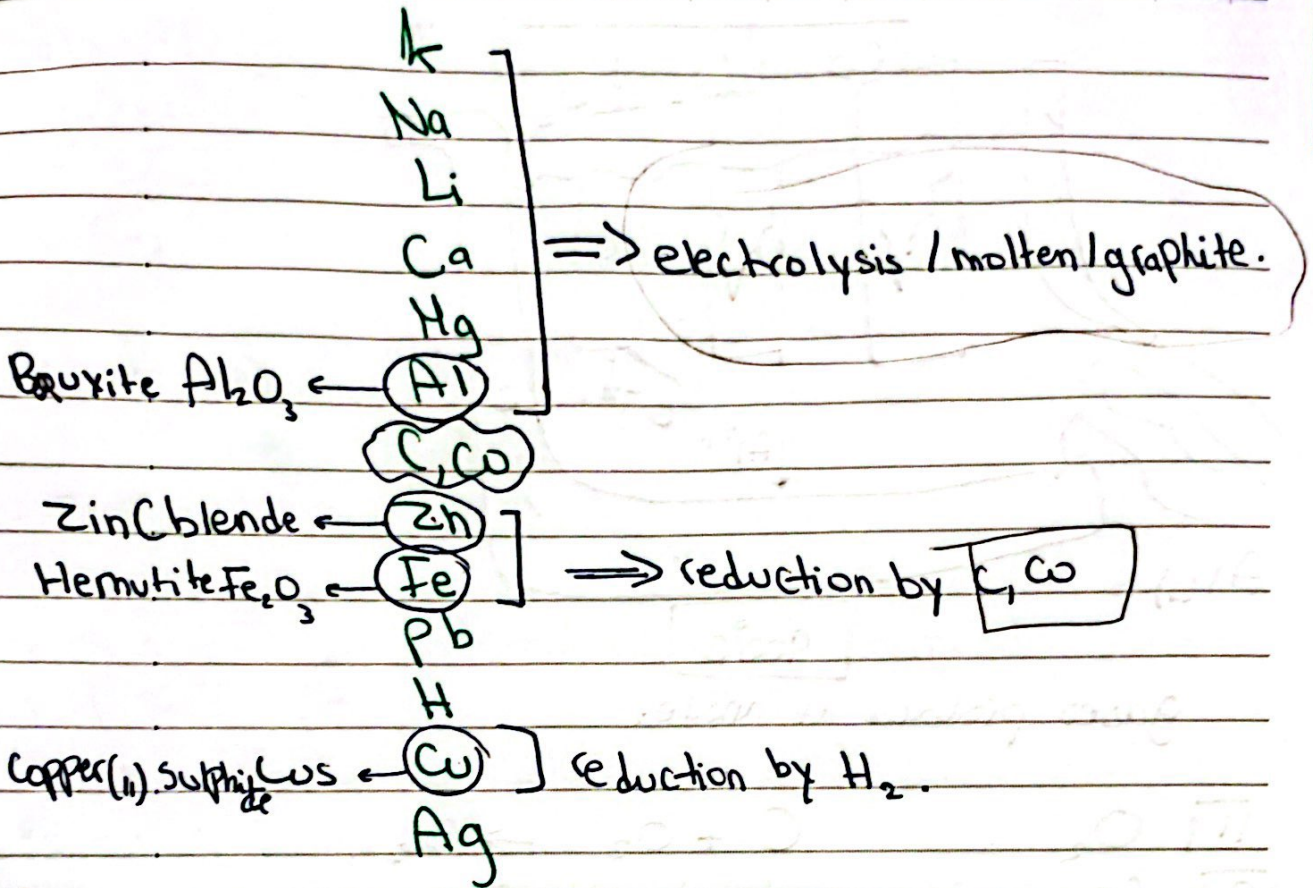
* extraction of metals from their ores

* the method of extraction depends on the position of metal in reactivity series.

Pip.

Tuesday.

20/9/2022.



extraction of aluminium

ore :- Al_2O_3 Bauxite

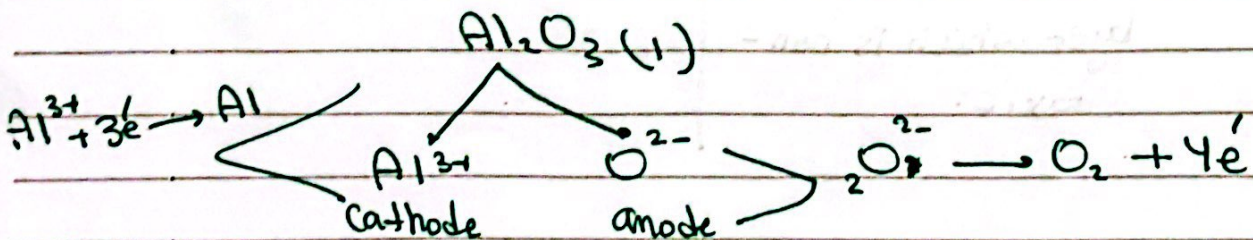
method :- electrolysis for molten Al_2O_3 / graphite.

* m.p. of Al_2O_3 is about $2000^\circ C$

So we dissolve Al_2O_3 in a molten cryolite Na_3AlF_6

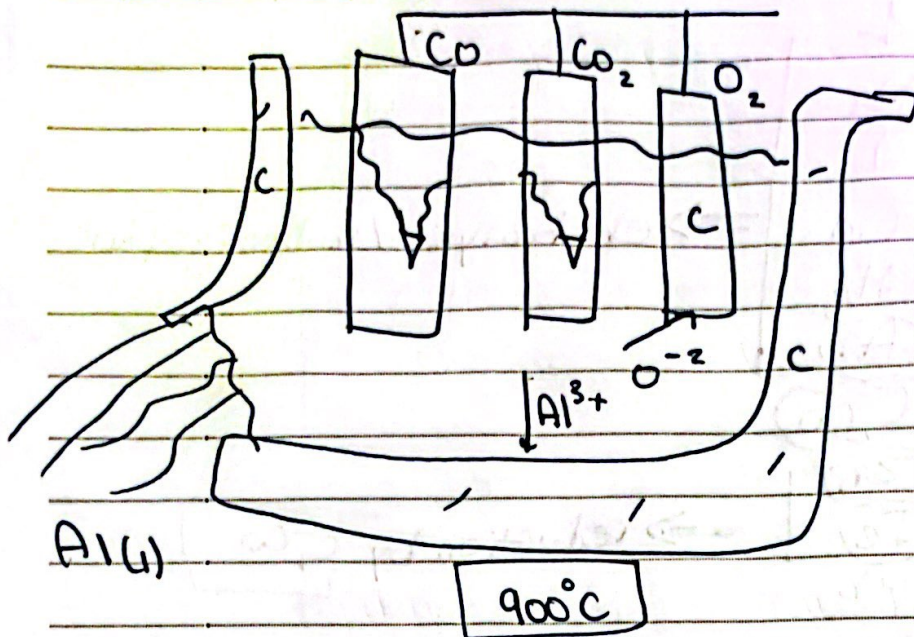
↳ to lower the m.p. to $900^\circ C$ so less cost.

↳ to increase the electrical conductivity.



Tuesday

20/9/2022



gases produced at anode:

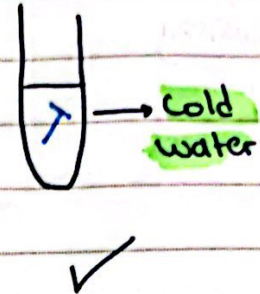
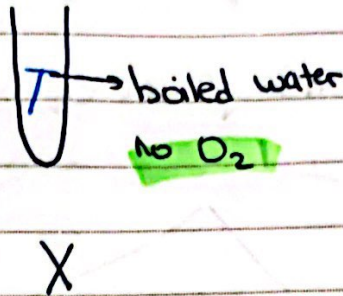
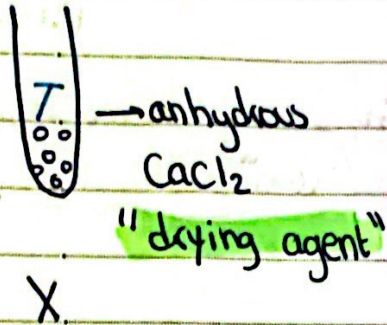
- [1] O_2 $C + O_2 \rightarrow CO_2$
- [2] CO_2 } reaction of rods with O_2
- [3] CO } So we must replace them periodically.

property	use
- low density	- aircraft bodies
- ductile	- wires (electrical)
- malleable	- window frame / cooking utensils
- Form an oxide layer which is non-toxic.	- Food Cans.

Wednesday.

21/9/2022.

* Rust: reaction of iron with both O_2 and H_2O
 \Rightarrow 6-7 days.



* plan an exp to show which rust prevention solution is better.

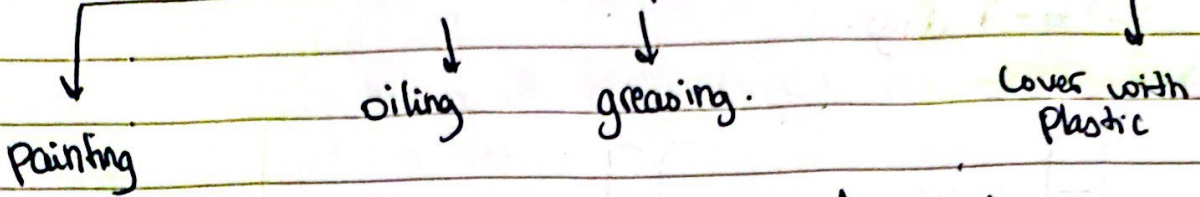
- \rightarrow take a known mass of iron nail & apply a known volume of the first solution.
- \rightarrow put them in a known volume of water for a week.
- \rightarrow dry them and measure the mass again. Repeat the exp with 2 solutions.

Conclusion: the exp which causes more increase in mass \rightarrow worse solution.

Wednesday

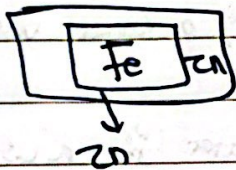
21/9/2022.

how to prevent rusting

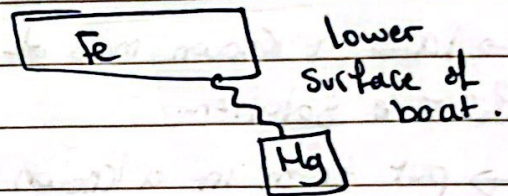


|| to prevent O_2 and H_2O from reacting the "iron"

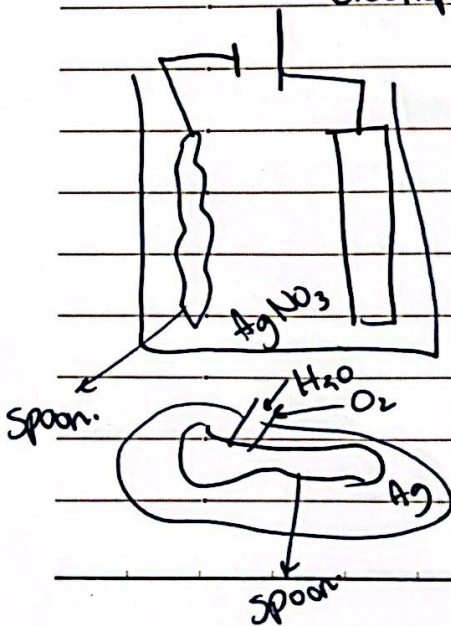
galvanizing / coating



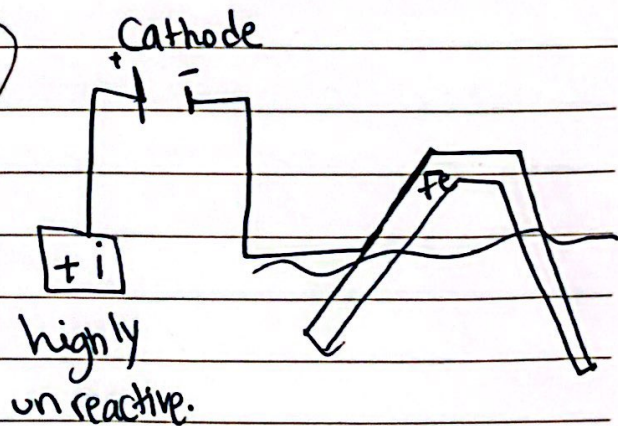
Sacrificial protection.



electroplating



* Cathodic protection

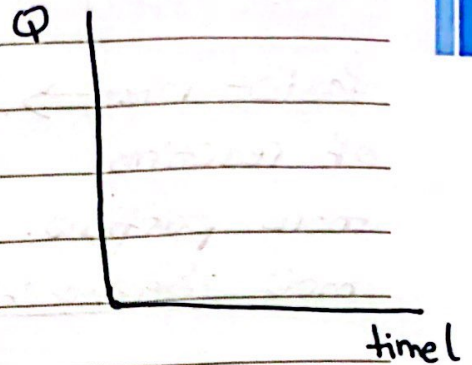


Wednesday.

28/9/2022.

rate of reaction:-

$$\text{Rate} = \frac{\text{Change in quantity}}{\text{Change in time}} = \frac{\Delta Q}{\Delta t}$$

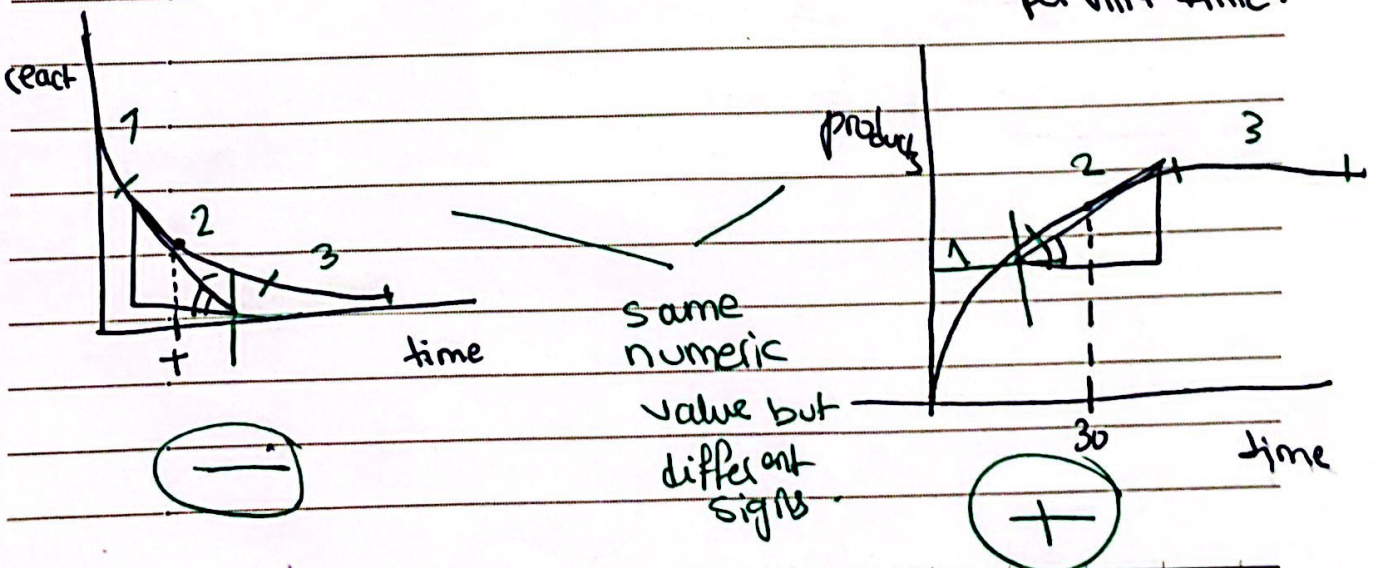


- $\frac{\Delta \text{mass}}{\Delta \text{time}}$, $\frac{\Delta \text{Conc.}}{\Delta \text{time}}$, $\frac{\Delta \text{pH}}{\Delta \text{time}}$, $\frac{\Delta \text{volume}}{\Delta \text{time}}$, $\frac{\Delta \text{temp.}}{\Delta \text{time}}$, $\frac{\Delta \text{light intensity}}{\Delta \text{time}}$
 $\frac{\Delta \text{height of ppt}}{\Delta \text{time}}$

measure the rate of reaction

how fast the reactants consumed per unit time.

how fast the products produced per unit time.



Wednesday

28/9/2022.

region (1)

fastest rate \Rightarrow from the graph. Steepest, more amount of reactions.

more particles.

more effective collisions per unit time.

region (2)

slower rate \Rightarrow from the ~~graph~~ graph. less steep

less number of particles.

so less no. of effective collisions per unit time.

region (3)

reaction is over \Rightarrow gradient = 0 (horizontal)

no more limiting factor.

no more effective collisions

Wednesday.

28/9/2022.

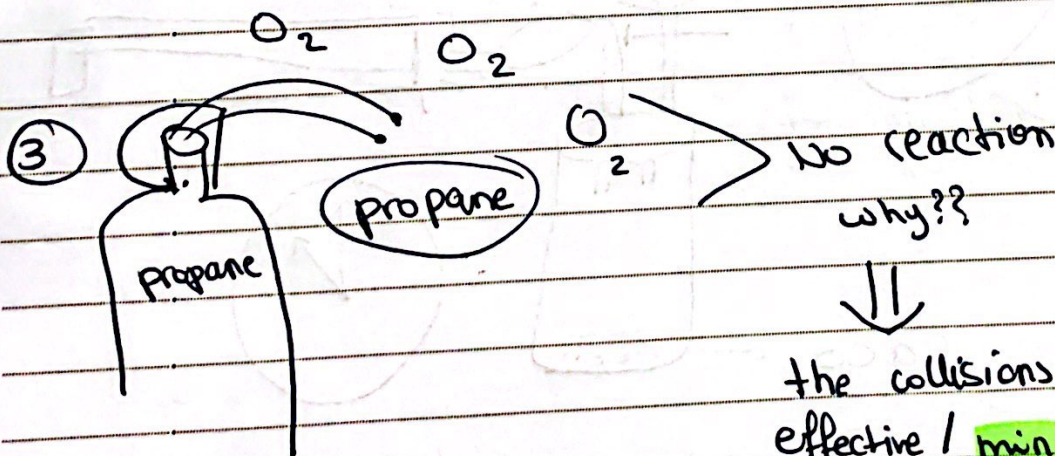
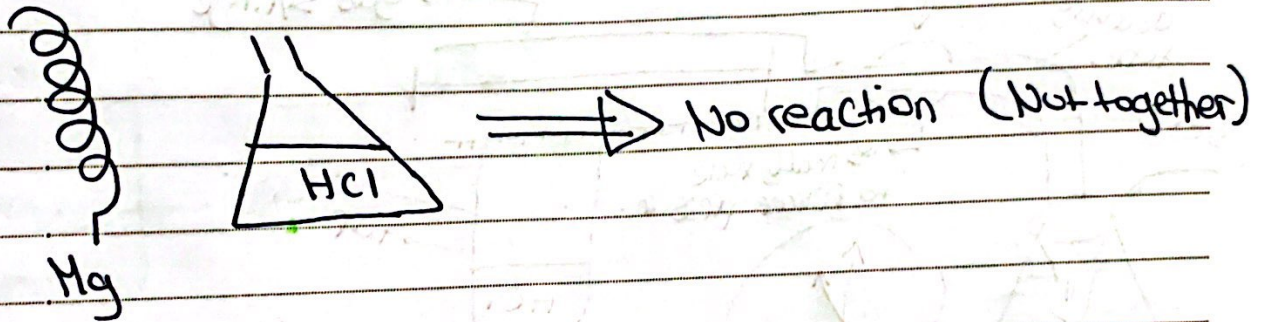
* For any chemical reaction there are three main conditions:-

3 rules

① the reactants must be suitable



② the reactants must collide.

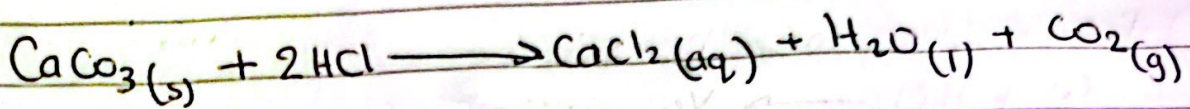


the collisions must be effective / min amount of energy to start rxn
Activation energy E_a

Saturday.

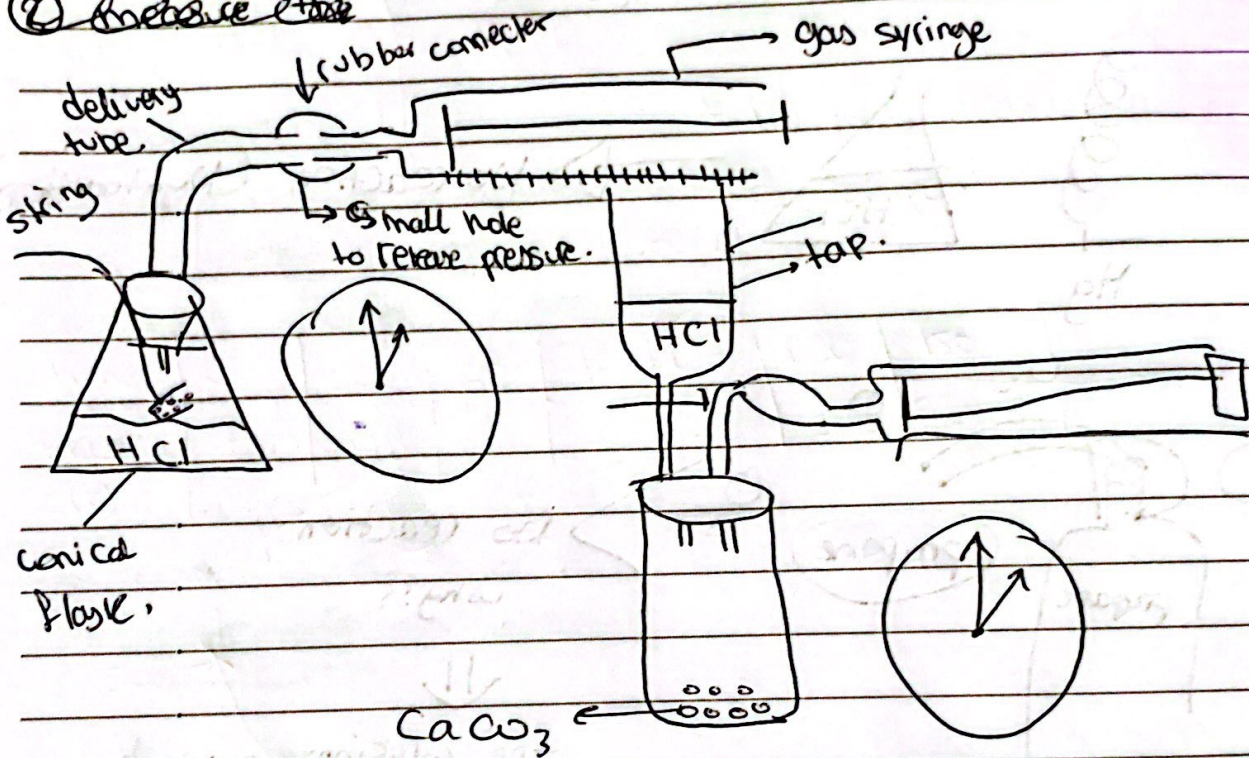
1/10/2022

measuring the rate of reaction:



① measuring the volume of gas per unit time.

② Pressure etc

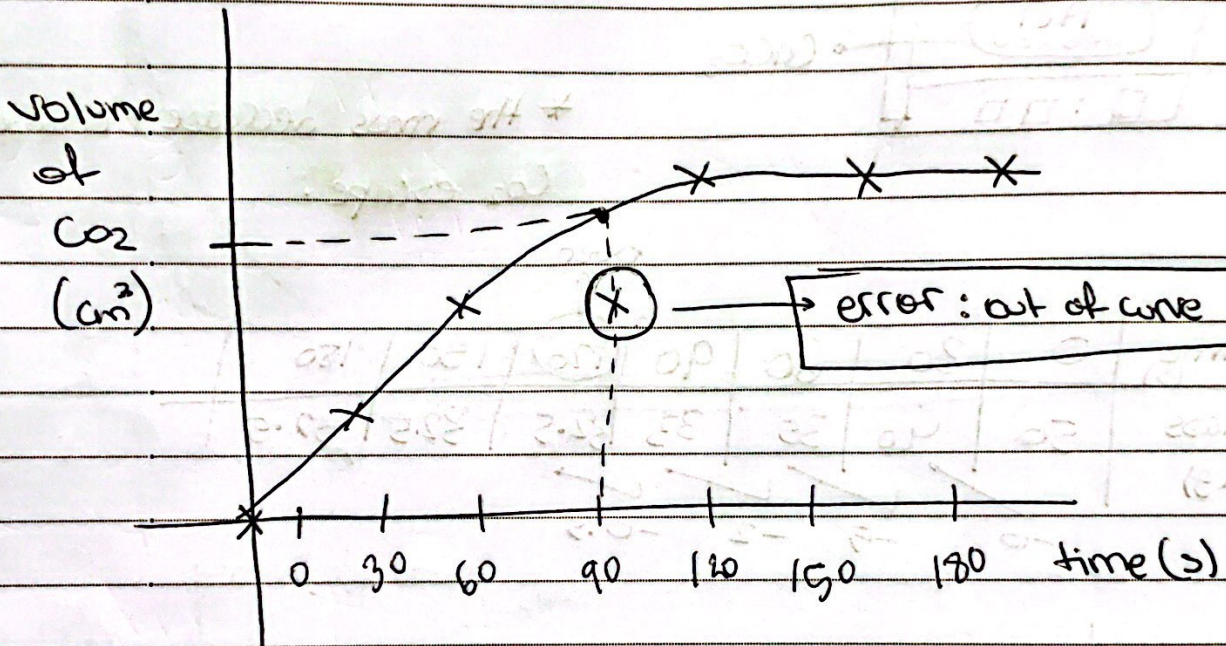


Saturday.

1/10/22

Time (s)	0	30	60	90	120	150	180
Volume of CO ₂	0	10	15	17	17.5	17.5	17.5

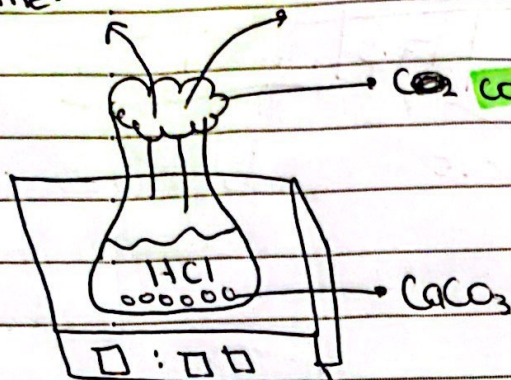
Annotations:
 - Above 120: ↓ over
 - Below 0-30: +10
 - Below 30-60: +5
 - Below 60-90: +2
 - Below 90-120: 0.5
 - Below 120-180: Constant



Saturday

1/10/22

② ~~was~~ measure the mass of Conical Flask + contents per unit time.



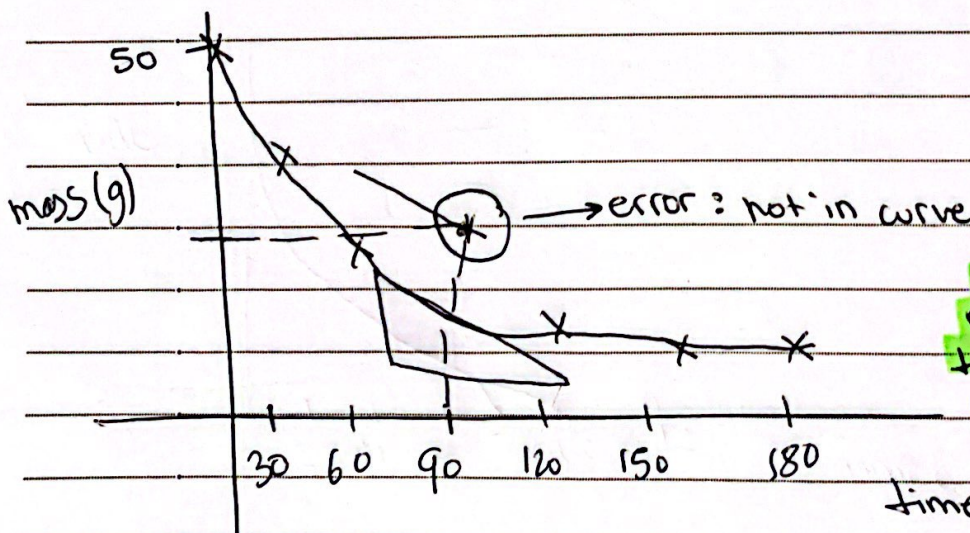
to allow CO_2 to escape and prevent Splashing

* the mass decrease because CO_2 escape.

time (s)	0	30	60	90	120	150	180
mass (g)	50	40	35	33	32.5	32.5	32.5

Mass change values: -10, -5, -2, -0.5

over ↑



to find the rate at specific time at $t = 80$

draw tangent.

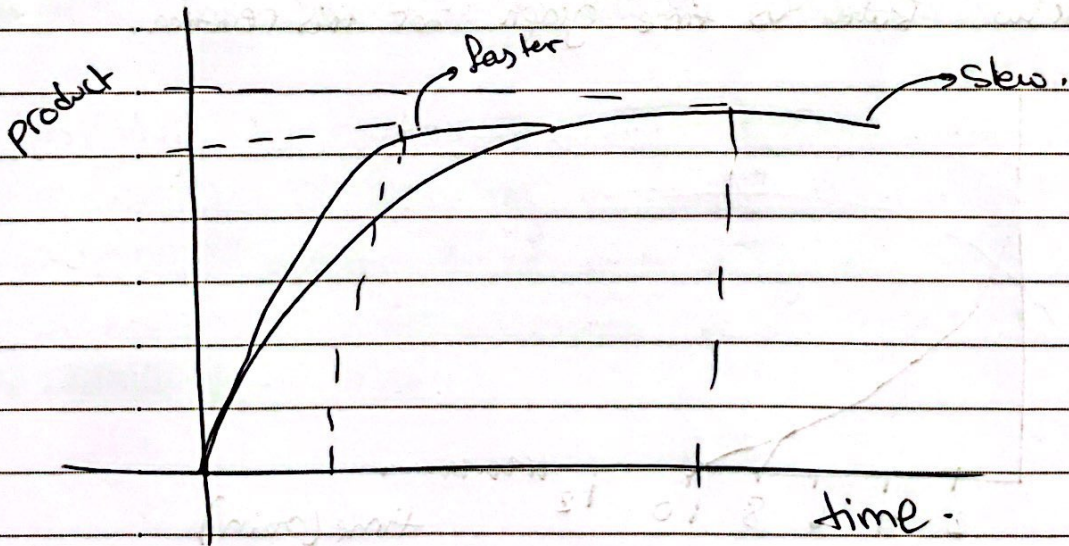
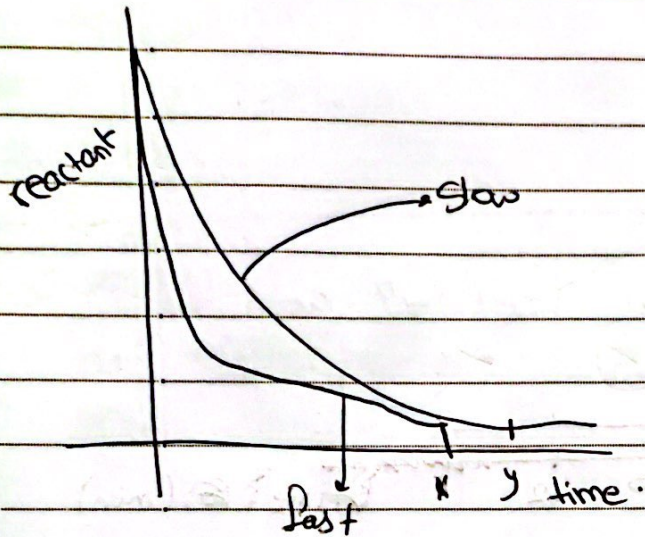
time (s)

Saturday

1/10/22

Increasing the rate of reaction.

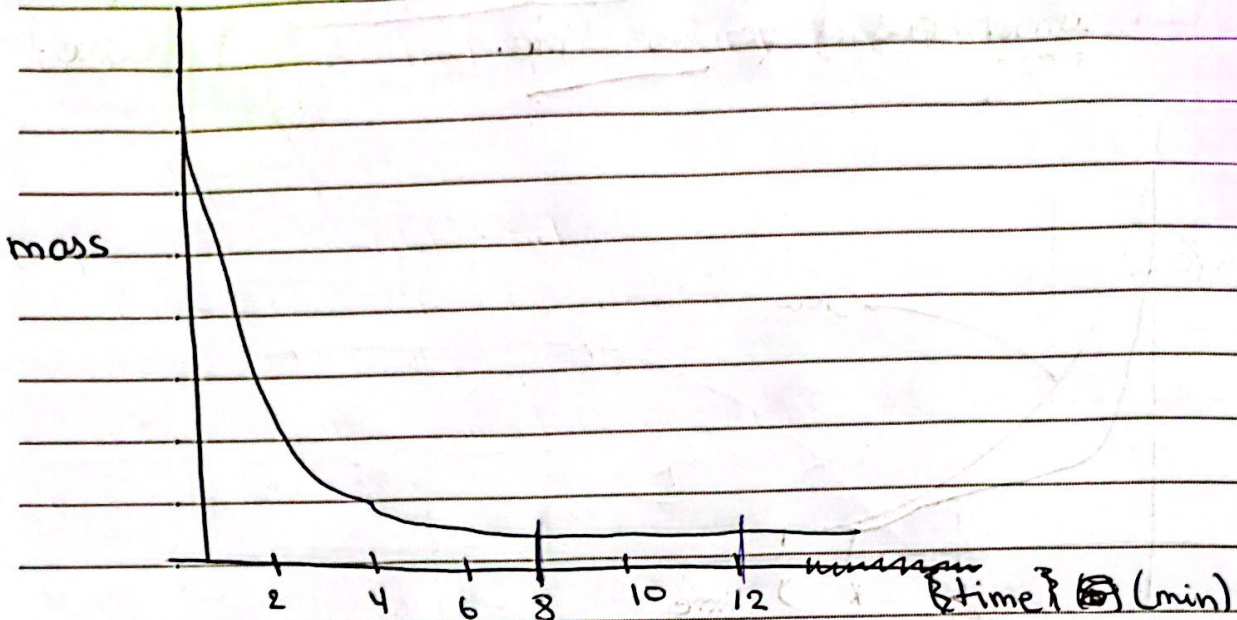
more product per same period of time
same product per less time. } Steeper curve.



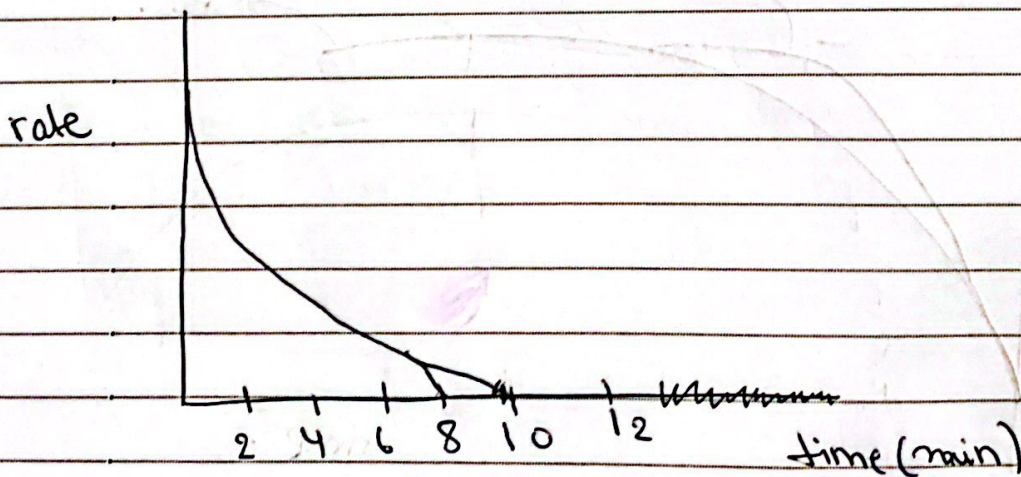
Saturday

1/10/22

Q: the graph shows how the amount of reactant changes with time.



draw Rate vs time graph for this reaction.



Saturday.

1/10/22

Factors that affect the rate of reaction:

- ① temperature.
- ② Surface area.
- ③ concentration / amount
- ④ pressure
- ⑤ light intensity.
- ⑥ Catalyst.

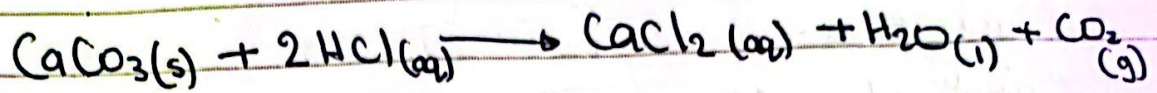
Temp.:-

* **State** how the temp. affect the rate of reaction.
as the temperature increases the rate of rxn. increases.

* **Explain** how the temperature affect the rate of reaction

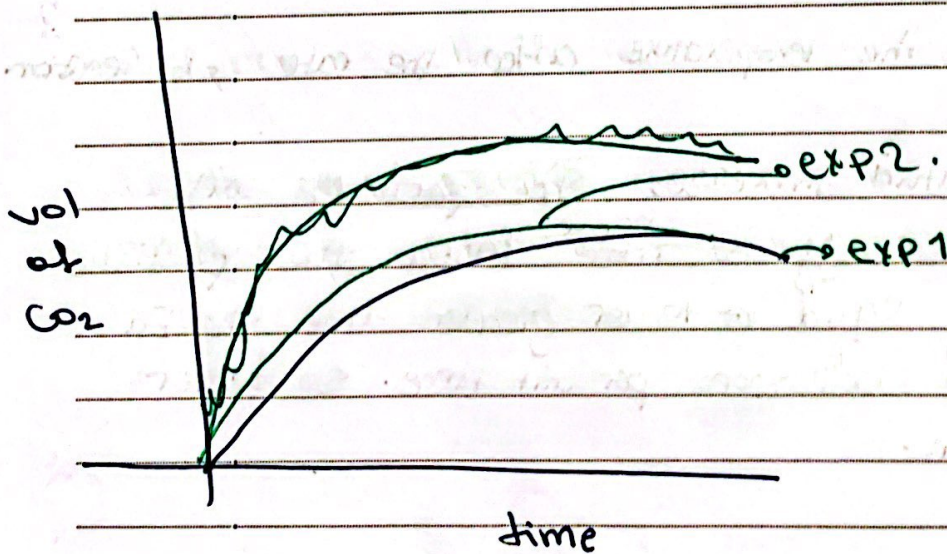
as the temperature increases the particles will gain kinetic energy so ^{move} faster the particles will have energy equal to or greater than the E_a so more effective collisions per unit time. so faster rate of reaction.

Plan an exp to show how the temp. affect the rate of reaction.



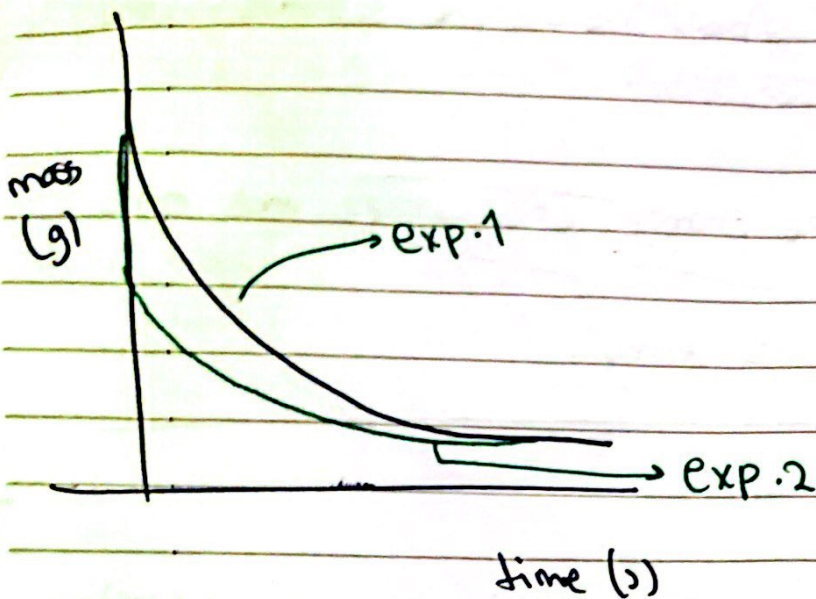
exp1: 2.0g lump
 $V_{\text{HCl}} = 0.1 \text{ dm}^3$
 $M = 1 \text{ mol/dm}^3$
Temp 25°C

exp2: 2.0g lump
 $V_{\text{HCl}} = 0.1 \text{ dm}^3$
 $M = 1 \text{ mol/dm}^3$
Temp: 55°C



Tuesday.

4/10/2022.



↓ take a known mass of lumps CaCO_3 add them to a known volume of known conc. of HCl at 25°C measure the volume of CO_2 produced using gas syringe per unit time

⊗ Repeat the exp at 50°C

the exp. at 50°C produce CO_2 with less time → put a Collision*

* **State** how the surface area affect the rate of reaction

as the surface area increases the rate of reaction increase.

* **explain** how the surface area affect the rate of reaction?

as the surface area increases, the rate of reaction increases (decrease the particle size by crushing using mortar and pestle.

more particles exposed to the reaction, more effective collisions per unit time so increase the rate of reaction.

Plan an exp to show how the surface area affect the rate of reaction.

keep everything constant change **one lumps** and one **powder** everything same as temp.

③ Concentration

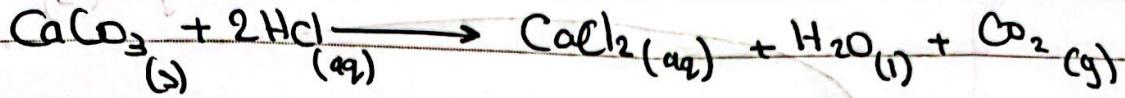
★ **State** how the concentration affect the rate of reaction
Conc. ↑

rate of reaction ↑

★ **explain** how the conc. affect the rate of reaction.

as the conc increases, more particles so more effective collisions per unit time so faster rate of reaction.

* Plan an exp



exp 1: mass
 $\text{CaCO}_3 = 2g$
 lumps

$V = 0.10 \text{ dm}^3$
 HCl

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

temp = 25°C

exp 2: mass
 $\text{CaCO}_3 = 2g$
 lumps

$V = 0.10 \text{ dm}^3$

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

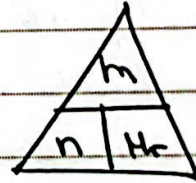
temp = 25°C

exp 3: mass
 $\text{CaCO}_3 = 4g$
 lumps

$V = 0.1 \text{ dm}^3$

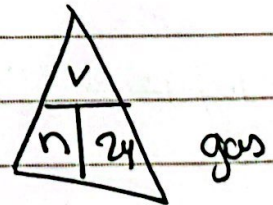
$M = 0.1 \text{ mol/dm}^3$

temp = 25°C



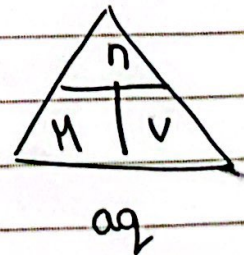
need 0.005

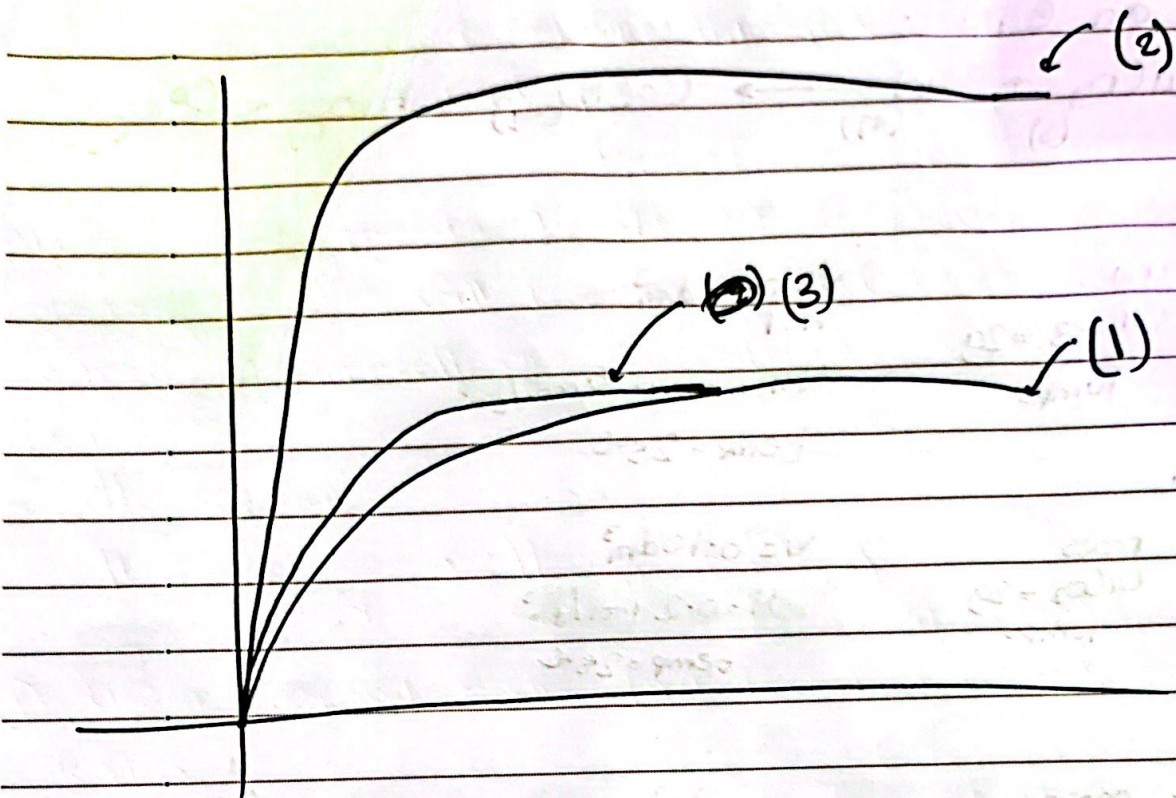
0.04



added 0.02

0.01 → limiting





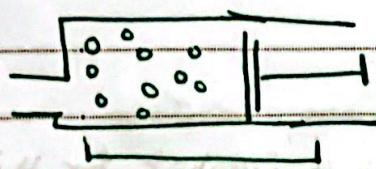
~~Wed~~ Wednesday :

12/10/22.

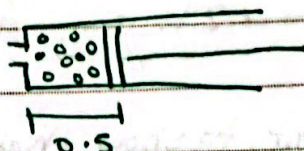
4) pressure only affects the gas.

explain how the pressure affect the rate of reaction?

as the pressure increases (by reducing the volume) so more particles per unit volume so more effective collisions per unit time so faster rate of reaction.



$$\frac{10 \text{ particles}}{1 \text{ litre}} = \underline{\underline{10}}$$

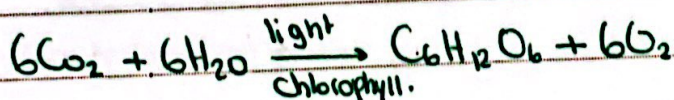


$$\frac{10 \text{ particles}}{0.5} = \underline{\underline{20}}$$

↳ This is to show that more particles per unit volume

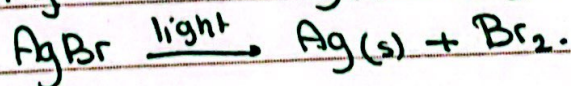
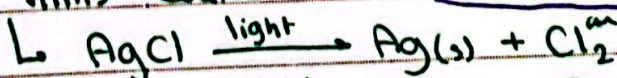
5) light. "only for photochemical reactions."

↳ reactions that need light to occur.
e.g: photosynthesis.



photographic films :- (out of 2023 syllabus)

films coated with silver chloride or silver bromide.



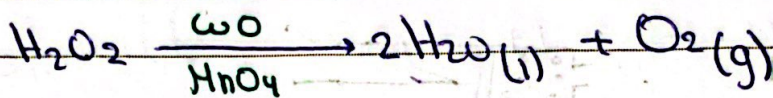
Wednesday.

12/10/22.

6) Catalyst: chemical substance that speeds up the reaction without being used up.

how? : it provides an alternative way with lower E_a
So more particles will have energy equal to or more than E_a
So more effective collisions per unit time, so faster rate of rxn.

the reaction:



① plan an experiment to show that CuO is a catalyst for this reaction.

take a known volume with a known conc. of H_2O_2 .
measure the volume of O_2 produced per unit time. repeat the exp. using CuO, the exp. using CuO will produce more O_2 per the same unit time.

Wednesday

12/10/22.

② plan an experiment to show which of catalyst is better. CuO or MnO_2 .

Same as Q1.

+ same mass of catalyst.

the exp. which produce more O_2 per the same unit time is the better catalyst.

③ plan an exp. to show that CuO is not used up during the reaction

measure the mass of copper oxide add to H_2O_2 until no more fizzes filter the mixture.

dry solid in oven

remeasure the mass.

same initial and final mass.

$$V_{\text{mass}} = U_{\text{mass}}$$

↳ substance is a catalyst

Tuesday

16/10/2022

Reversible reaction.

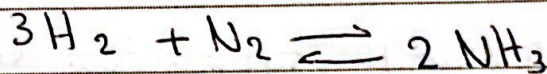
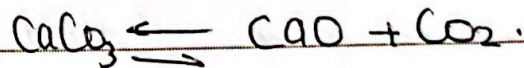
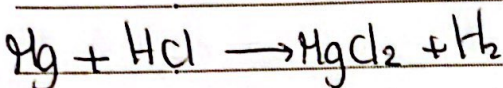
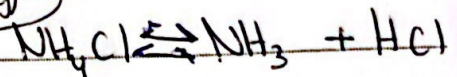
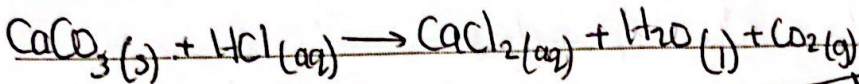
types of chemical rxn

one way

reactants $\xrightarrow{\text{forward}}$ products

both ways

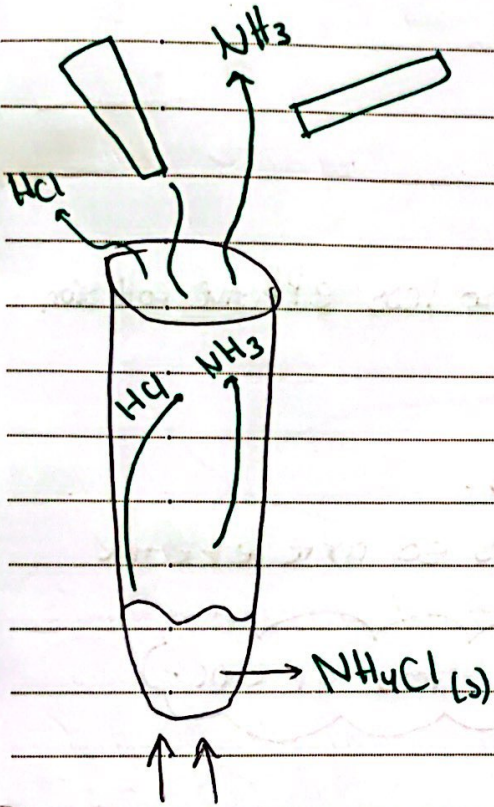
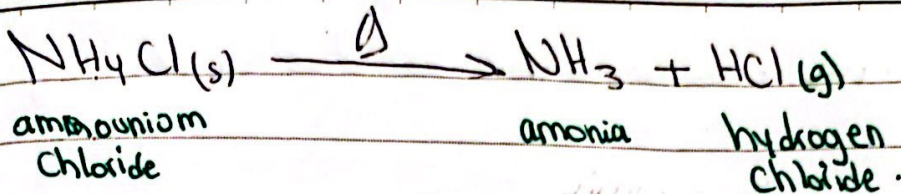
reactants $\xrightleftharpoons[\text{backwards}]{\text{forward}}$ products



*dynamic equilibrium: when the rate of products and reactants are equal, when the concentration of reactants and products are ~~equal~~ constant.

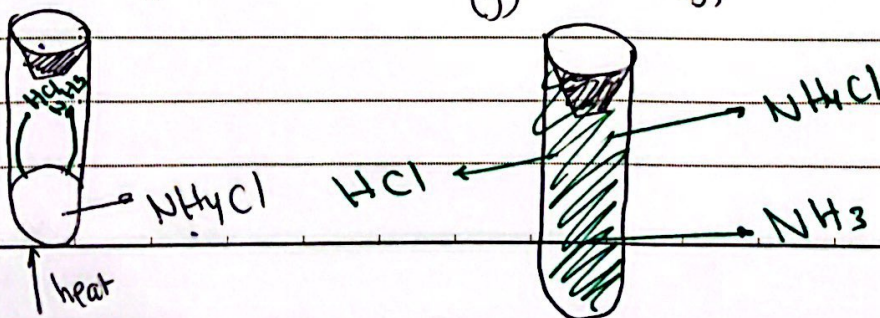
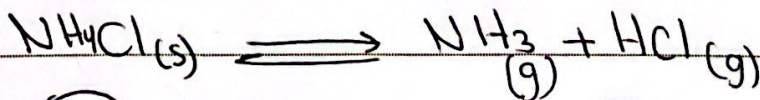
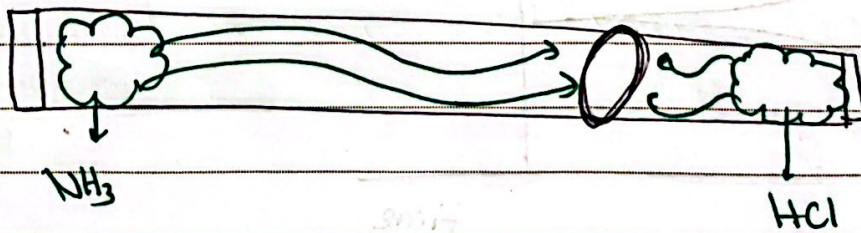
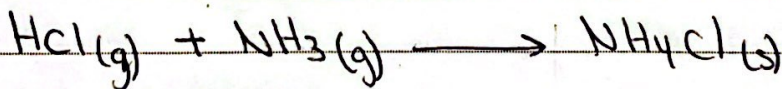
Tuesday

16/10/2022



Q:- which damp litmus paper will change color first, why [3]

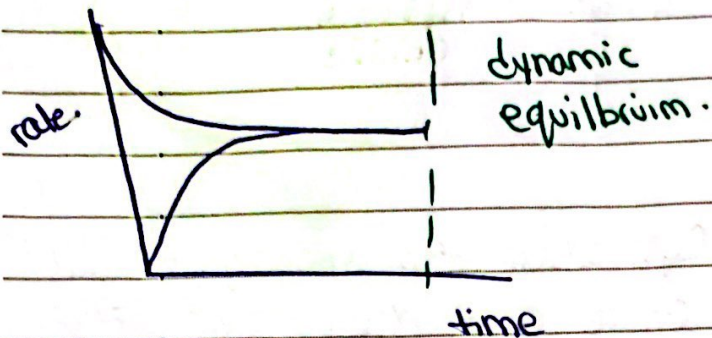
the damp red litmus paper changes to blue first because $\text{NH}_3(aq)$ is an alkali and lighter than $\text{HCl}(aq)$ which is acidic.



Tuesday.

25/10/2022.

in terms of rate:-



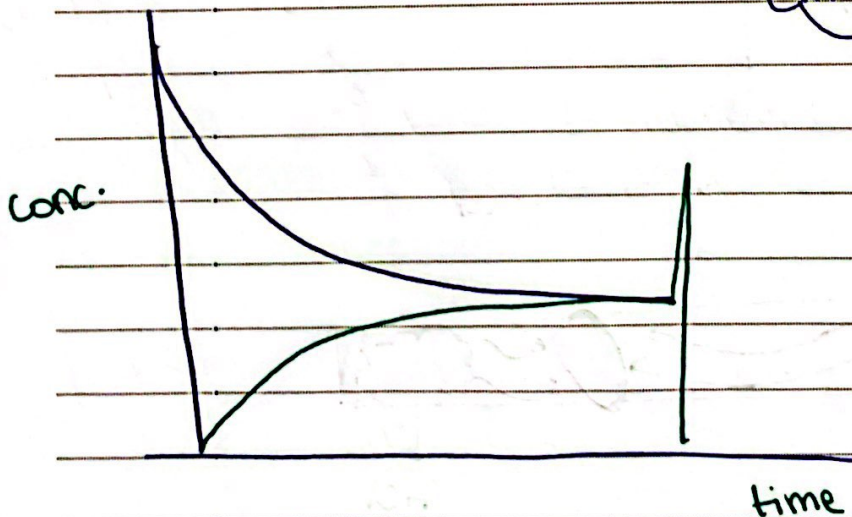
→ rate of forward decrease.

→ less reactants so less particles so less effective collision per unit time.

→ the rate of backward increases.

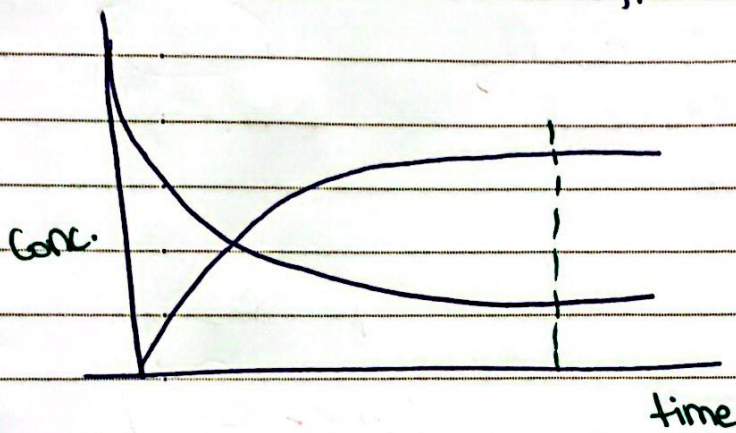
→ more products, so more particles so more effective collisions per unit time.

in terms of conc.



Tuesday.

25/10/22.



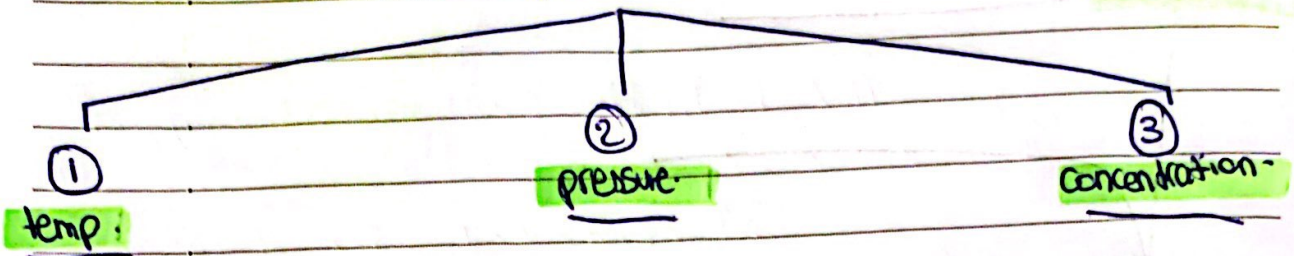
* Le Chatelier principle:-

- if the system is at equilibrium \rightleftharpoons and any external factor disturbs the equil.
- the equil can shift itself to the forward \rightleftharpoons or to the backward \leftarrow to return back to the equil.

Tuesday

25/10/22

Factors affect the position of equilibrium.



👁 -- endo

↑ temp shift
to endo.

↓ temp. shift
to exo.

① temperature:-

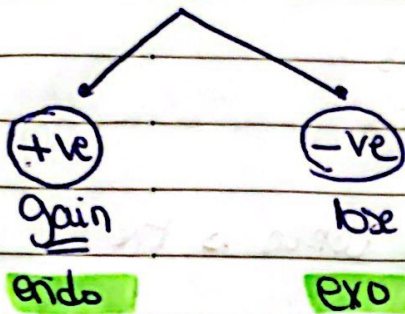
↑ temp. ↑ rate of endothermic.
 ↑ rate of exothermic.

Shift to
endo

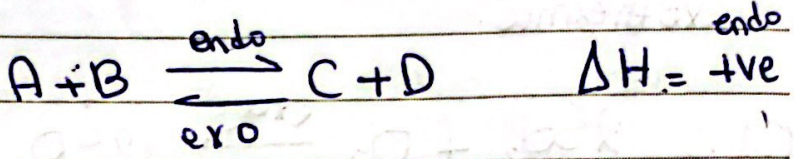
↓ temp. ↓ rate of endo.
 ↓ rate of exo.

Shift to
exo

$\Delta H =$
enthalpy change.



The sign of ΔH is always represent to forward reaction

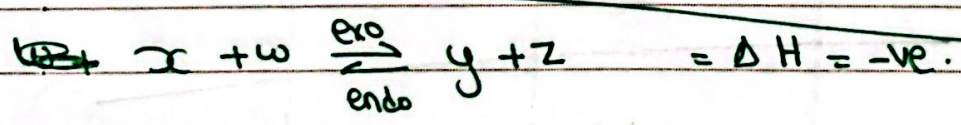


↑ temp ↑ rate of forward
 ↑ rate of backward.

A ↓ B ↓ C ↑ D ↑

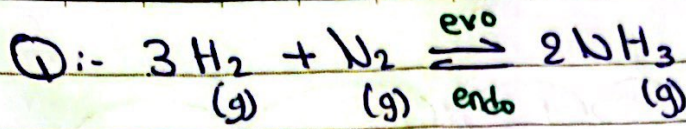
↓ temp ↓ forward
 ↓ backward.

A ↑ B ↑ C ↓ D ↓



↑ temp ↑ rate of forward
 ↑↑ rate of backward } shift to endo.

↑ x ↑ w , ↓ y , z ↓



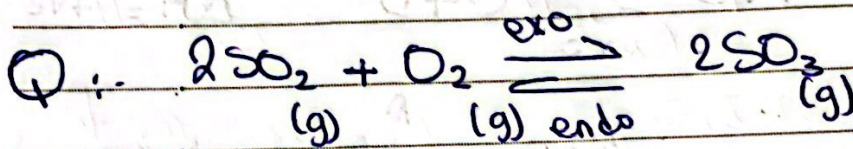
$$\Delta H = -ve$$

exo

to produce more more yield of NH_3 .

We must use low temperature.

to favour the forward reaction when is the exothermic.



$$\Delta H = -ve$$

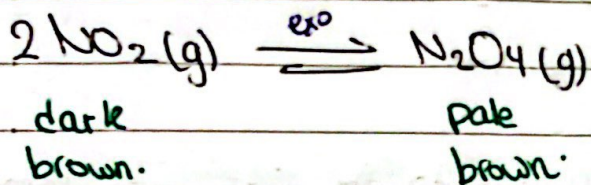
exo

	rate of forward	rate of backward.	% SO_3
\uparrow temp.	increase	increase.	decrease
\downarrow temp.	decrease	decrease.	increase.

Wednesday.

26/10/22

→ mixture of NO_2 and N_2O_4 at equil. in a sealed tube.



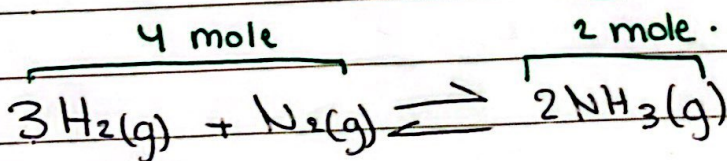
↓
if we put this sealed tube in a cold water bath the mixture becomes paler, why?

~~because the reaction is exothermic~~ because the forward reaction is exothermic endothermic by cooling.

② pressure.

as the pressure increases the equil. shift to the side with less pressure.
with less gas mole.

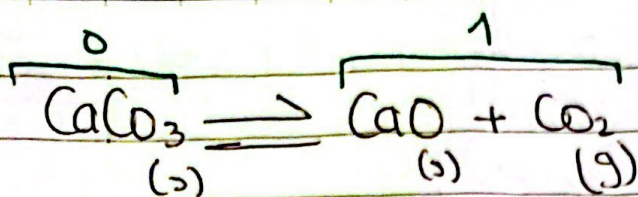
as the pressure decreases
⇌ ⇌ ⇌ ⇌ ⇌ more pressure.
with more gas mole.



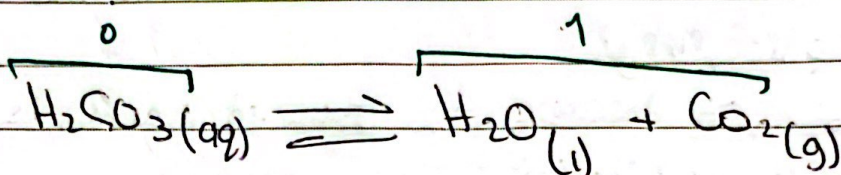
↑ pressure shift to forward to the side with less gas moles. ↑ % of NH_3 .

Wednesday.

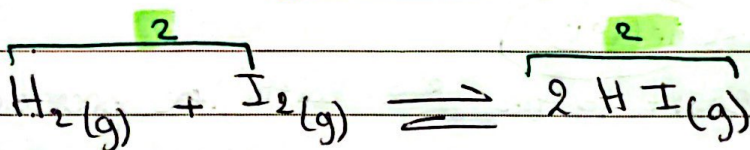
26/10/22.



↓ pressure shift forward to the side with more gas moles.



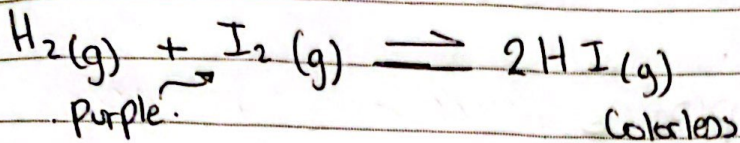
↓ pressure shift forward to the side with more gas moles.



Changing the pressure has no effect were on the position of equil. since both sides has the same number of gas moles.

Wednesday.

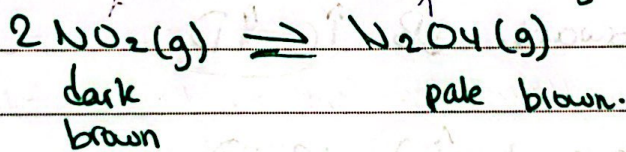
26/10/22



the equil. doesn't affect by increasing the pressure why by increasing the pressure the mixture becomes more purple?

the I_2 molecules become closer to each other so the color seems to be darker.

Sealed tube contains mixture of $\text{NO}_2(\text{g})$ and $\text{N}_2\text{O}_4(\text{g})$



by increasing the pressure the color of the mixture

(a) becomes paler, then goes darker.

(b) \nearrow darker and stays paler

(c) \nearrow paler and stays paler.

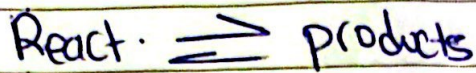
(d) \nearrow darker $\nearrow \nearrow$ darker.

As question

Saturday.

29/10/2022

③ Concentration :-



\uparrow reactant }
 \downarrow product } Shift forward.

\downarrow reactant }
 \uparrow product } Shift backward.



$\uparrow [A]$ Shift forward. $\downarrow B$ $\uparrow C$ $\uparrow D$

$\downarrow [B]$ Shift backward $\uparrow A$ $\downarrow C$ $\downarrow D$

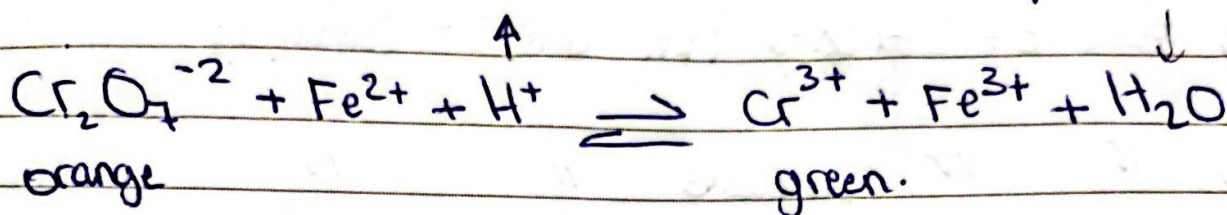
$\uparrow [C]$ Shift backward $\uparrow A$ $\uparrow B$ $\downarrow D$

$\uparrow [D]$ Shift backward. $\uparrow A$ $\uparrow B$ $\downarrow C$

Saturday.

29/10/22.

Q the reversible reaction be (on) at equilibrium



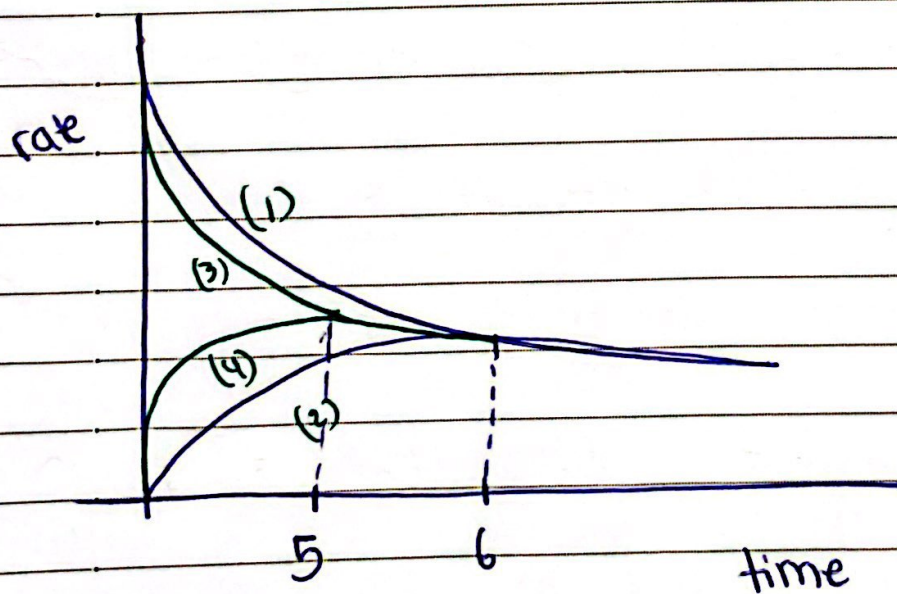
explain why by adding HCl to the rxn mixture the color of the mixture becomes green?

HCl is an acid. (proton donor)

more H^+ , shift forward so more Cr^{3+} more green.

less $\text{Cr}_2\text{O}_7^{2-}$ less orange.

† Catalyst: has no effect on the position of equilibrium since it speeds up the rate of forward + backward.



Saturday -

29/10/2022

1) Rate of Forward rxn without Catalyst.

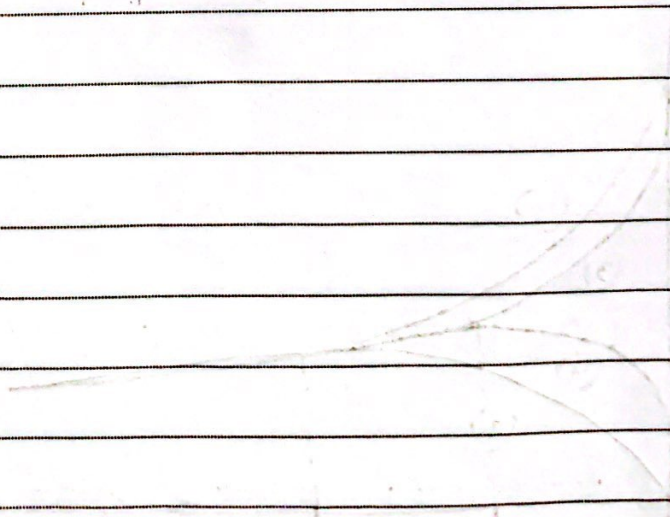
2) " " backward " "

3) rate of Forward " with "

4) " " backward " "

5) time taken to reach equil. with catalyst.

6) " " " " without "



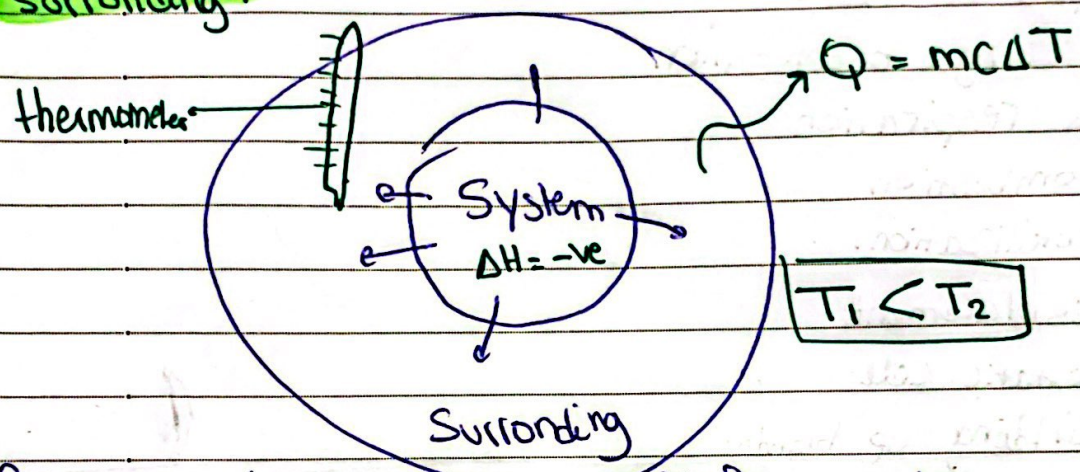
Wednesday.

2/11/22.

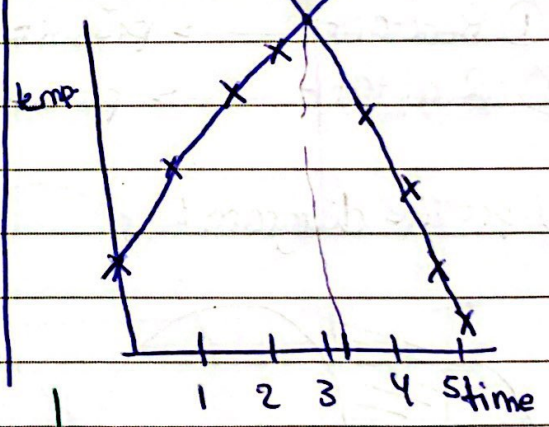
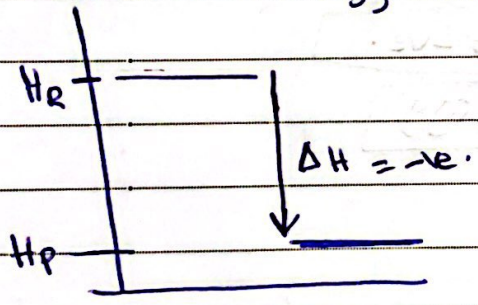
Energetics

exothermic:-

Reactions that gives out (release) energy to the surrounding.



For System: (energy level diagram) For Surrounding:



enthalpy: heat contents stored energy

H_r enthalpy of reactants

H_p enthalpy of products.

Reaction is over between min 3 and 4

$Q = mc\Delta T$

energy transfer = J

mass specific heat capacity

change in temp.

Thursday 08

3/11/20

↑ ΔH → more exothermic
↑ Δt

Examples on EXO:-

① Freezing, Condensation.

② Respiration.

③ Combustion

④ neutralization.

⑤ displacement.

⑥ - voltaic cell.

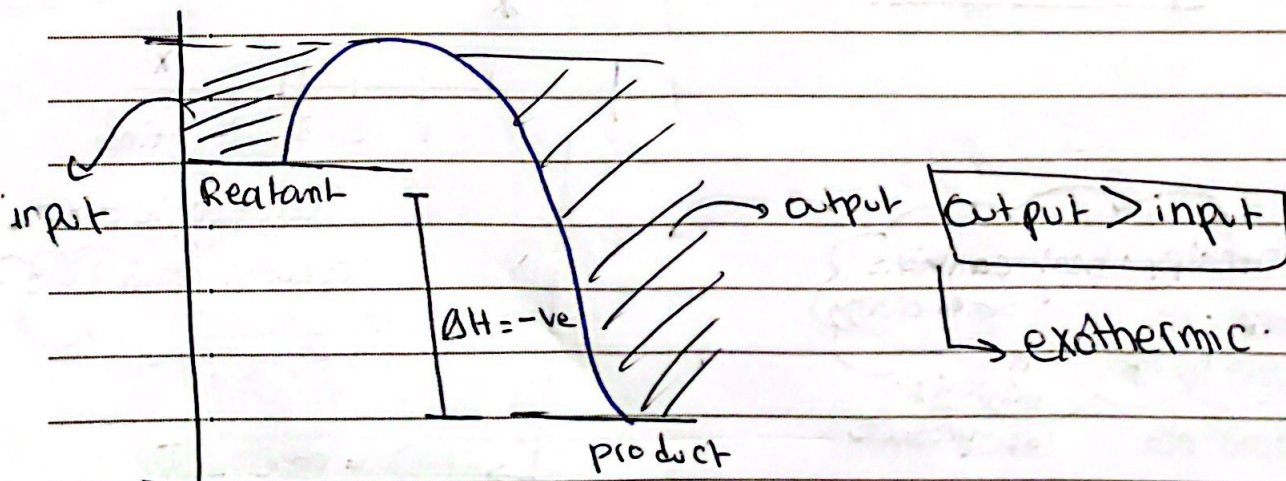
⑦ = building up bonds.

how to express exo. rxn.

① Reactant → products $\Delta H = -ve.$

② Reactant → products + energy

③ profile diagram:



In exo:-

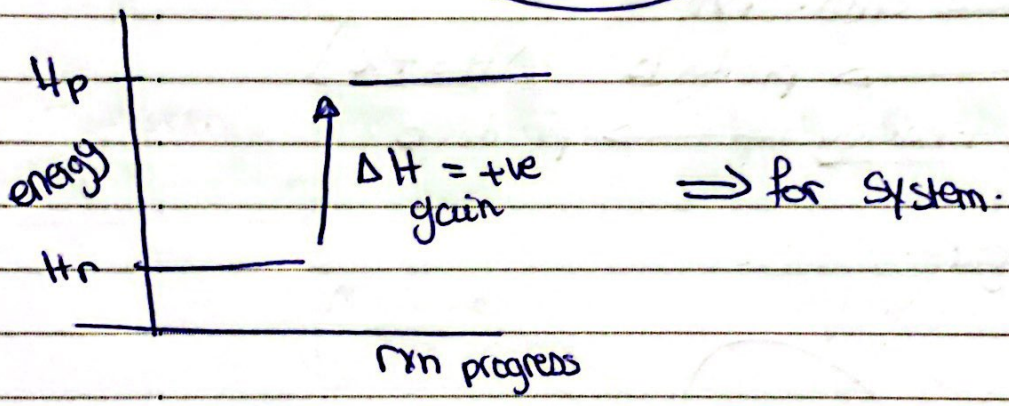
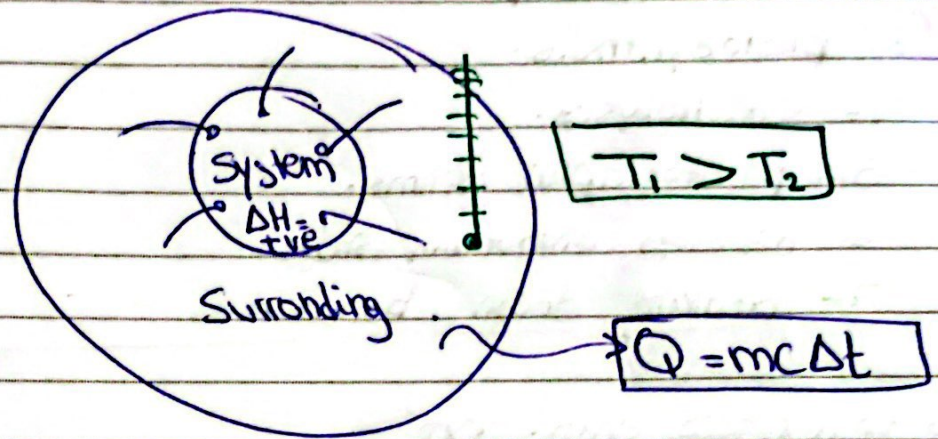
energy released to build up bonds is greater than the energy absorbed to break down bonds.

Thursday:

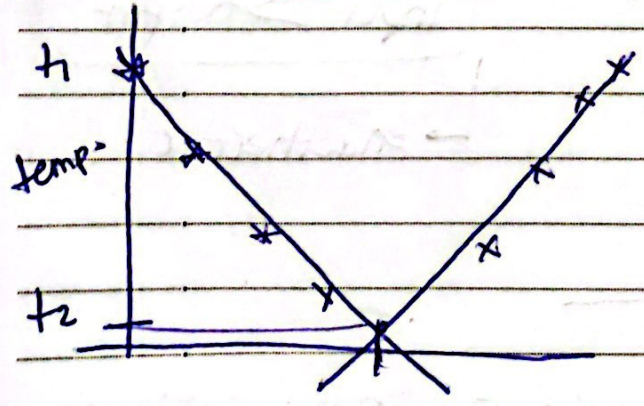
3/11/22.

endothermic

Reactions that absorb (take in) energy from the surrounding.



→ for Surrounding (temp diagram)



$Q = mc \Delta t$

↑ Q ↑ Δt
more endothermic

Thursday.

3/11/22.

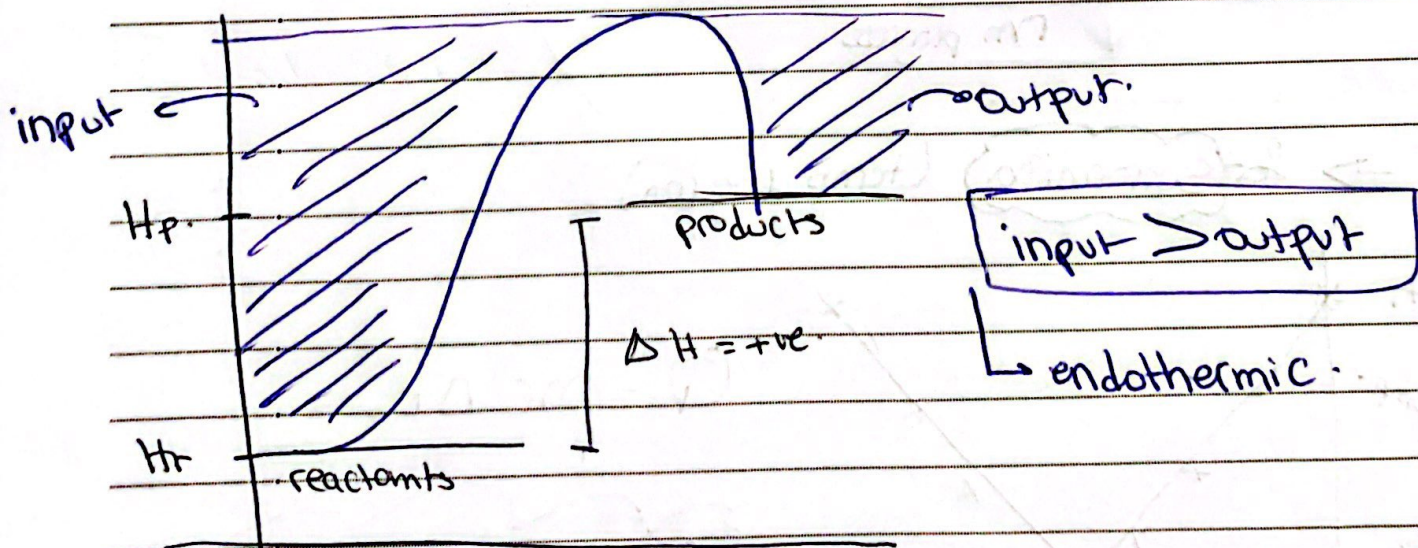
examples on endothermic.

- 1- boiling and melting.
- 2- thermal decomposition.
- 3- photosynthesis.
- 4- electrolysis.
- 5- photographic films.
- 6- dissolved ammonium salts.
- 7- breaking down bonds.

how to express endo. rxn?

- ① Reactant \longrightarrow products $\Delta H = +ve$
- ② Reactants + energy \longrightarrow products.

③ profile diagram:



in endo

the energy absorbed to break down bonds is greater than the energy released when building up bonds.

Tuesday

8/11/22

measuring ΔH reaction.

theoretical

experimental

combustion

neutralization

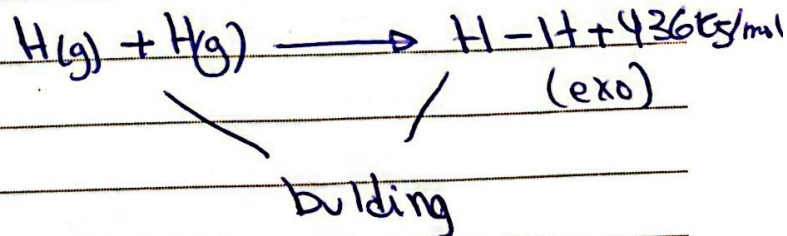
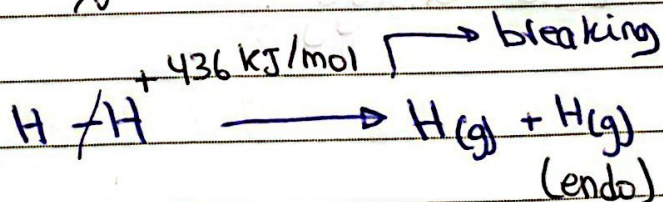
displacement

ΔH reaction using Bond energy :-

Bond energy : the amount of energy needed to break 1 mol of a bond in gaseous state

~ ~ ~ ~ released to build ~ ~
~ ~ ~

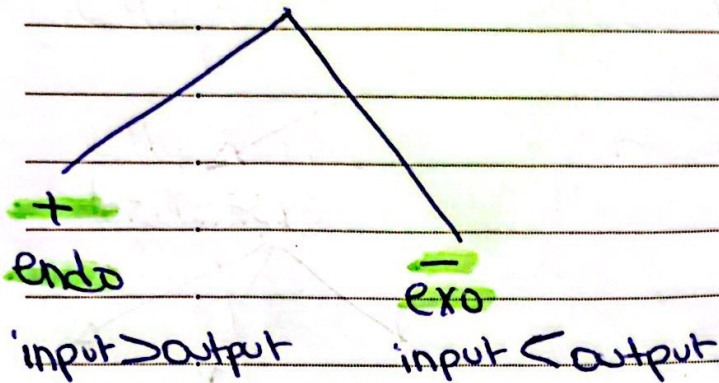
Bond	Bond energy kJ/mol
H - H	436



Tuesday

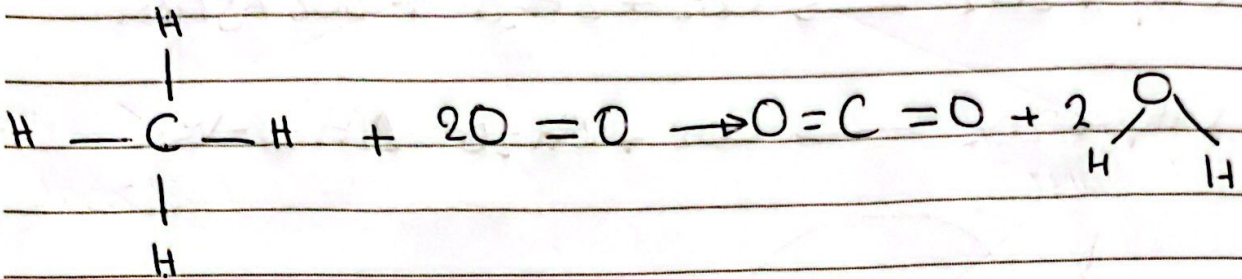
8/11/22

$$\Delta H_{\text{reaction}} = \sum^{\text{sum}} \text{input} - \sum \text{output}$$



to use this equation:-

- ① **balanced** equation.
- ② **Covalent** structure.
- ③ **bond energy**.



bond	bond energy
C-H	413
O=O	495
C=O	799
O-H	463
C-O	358

bond broken

bond formed

$$4 \times \text{C-H} = 4 \times 413$$

+

$$2 \times \text{O=O} = 2 \times 495$$

$$\boxed{2642 \text{ kJ}}$$

$$2 \times \text{C=O} = 2 \times 799$$

$$4 \times \text{O-H} = 4 \times 463$$

$$\boxed{3450 \text{ kJ}}$$

$$\Delta H = \Sigma \text{input} - \Sigma \text{output}$$

$$2642 - 3450 =$$

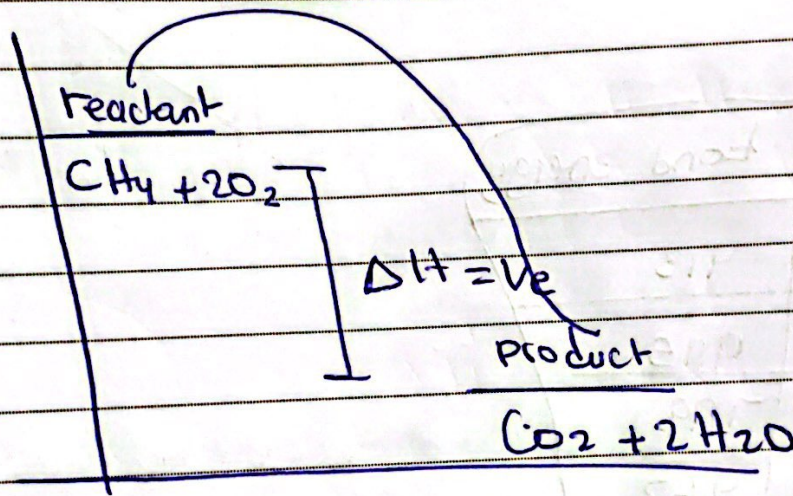
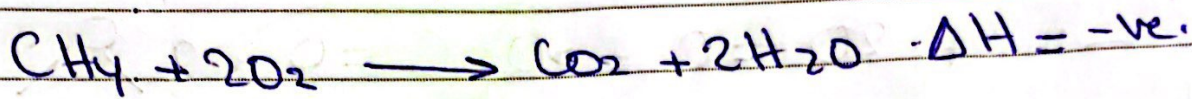
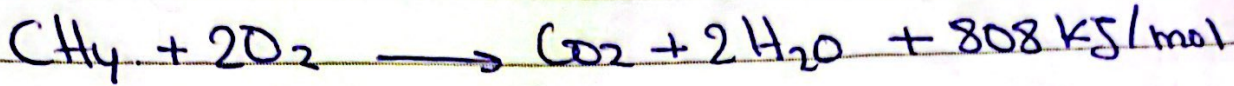
$$\boxed{-808} \Rightarrow \text{exo}$$

input < output

Tuesday

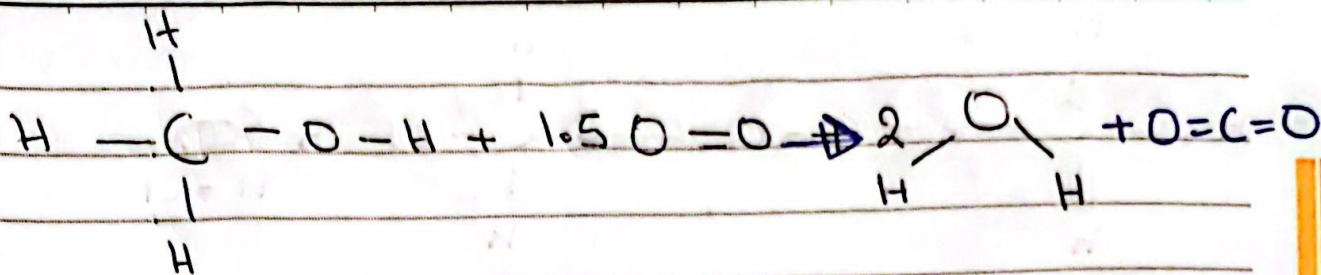
8/11/2022

ways to express the rxn.



Tuesday

8/11/22.



bonds broken

Bonds Formed

$$\begin{array}{l}
 3 \times \text{C-H} \quad 3 \times 413 \\
 1 \times \text{C-O} \quad 1 \times 358 \\
 1 \times \text{O-H} \quad 1 \times 463 + \\
 1.5 \times \text{O} = \text{O} \quad \underline{1.5 \times 495} \\
 \quad \quad \quad 2802.5 \text{ kJ}
 \end{array}$$

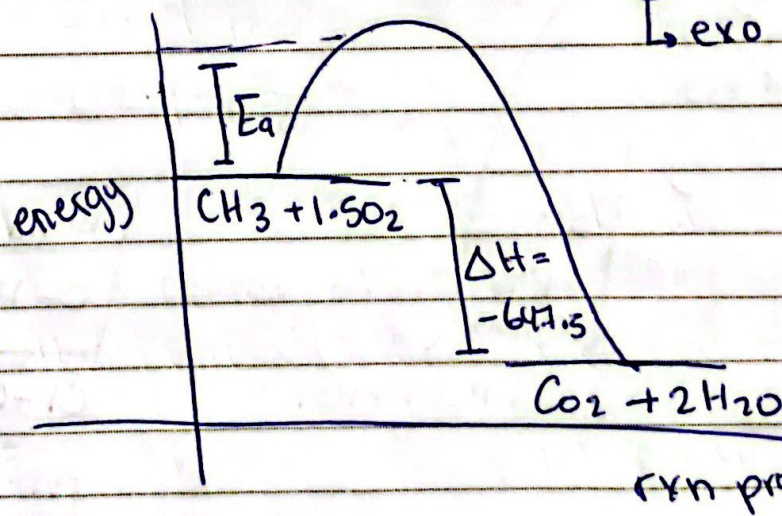
$$\begin{array}{l}
 2 \times \text{C=O} \quad 2 \times 799 \\
 4 \times \text{O-H} \quad \underline{4 \times 463} \\
 \quad \quad \quad 3450 \text{ kJ}
 \end{array}$$

$$\Delta H = \sum \text{input} - \sum \text{output}$$

$$2802.5 - 3450$$

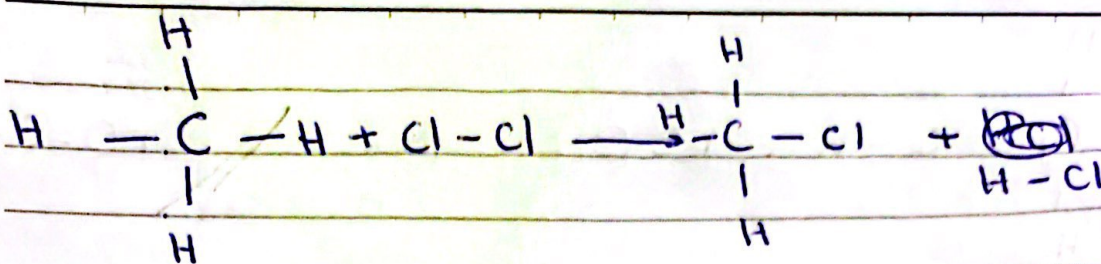
$$= -647.5 \text{ kJ/mol}$$

exo



Tuesday

9/11/22



bonds broken:

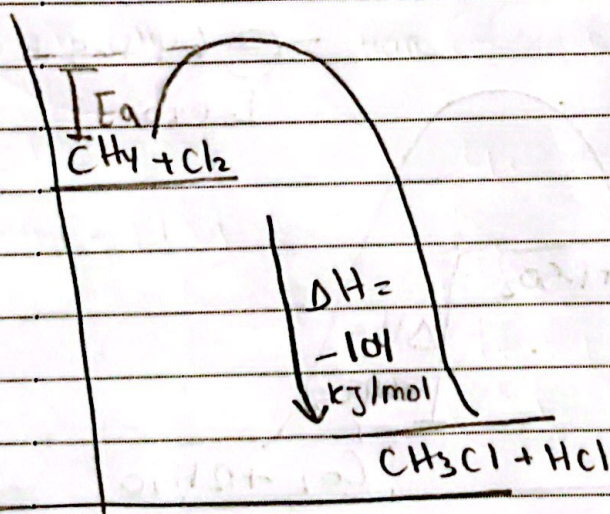
bonds formed:

$$\begin{array}{l} 3 \times \text{C} - \text{H} \quad 413 \\ 1 \times \text{Cl} - \text{Cl} \quad 242 \\ \hline 655 \text{ kJ} \end{array}$$

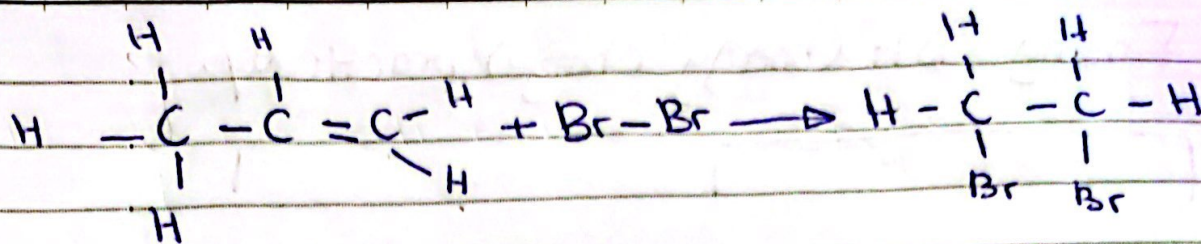
$$\begin{array}{l} \text{C} - \text{Cl} \quad 328 \\ \text{H} - \text{Cl} \quad 431 \\ \hline 759 \end{array}$$

$$\Delta H = 655 - 759 = -104 \text{ kJ/mol}$$

exo



bond	bond energy
C-H	413
Cl-Cl	242
H-Cl	431
C-Cl	328



bonds broken

$$\begin{array}{l} 2 \text{ Br}-\text{Br} \quad 193 \\ 1 \times \text{C}=\text{C} \quad 614 \\ \hline 807 \text{ kJ} \end{array}$$

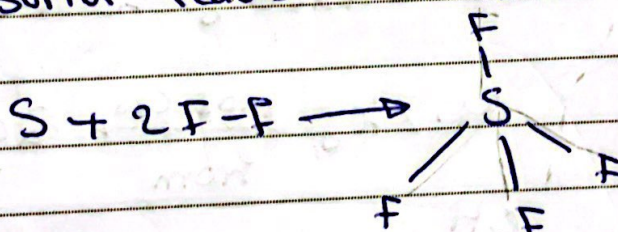
bonds formed

$$\begin{array}{l} 2 \times 76 \\ 2 \times \text{C}-\text{Br} \\ \text{C}-\text{C} \quad 348 \\ \hline 900 \text{ kJ} \end{array}$$

Bond	bond energy
C-H	413
C-C	348
C=C	614
Br-Br	193
C-Br	276

$$\Delta H = 807 - 900 = -93 \text{ kJ/mol}$$

When sulfur reacts with fluorine the rxn gives -780 kJ/mol



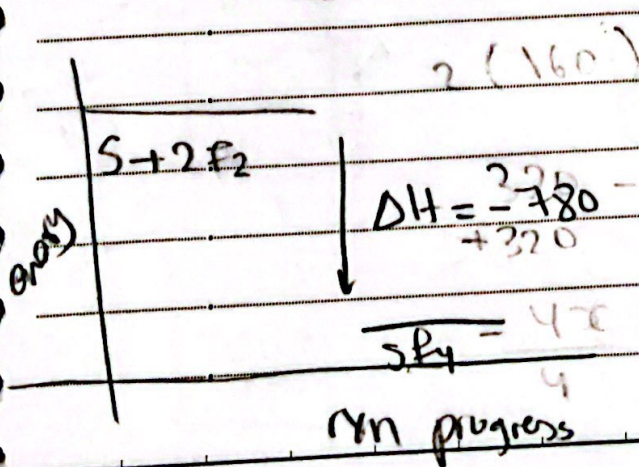
if the bond energy of F-F is 160 kJ/mol find the bond energy of S-F?

bonds broken

$$2 \times \text{F}-\text{F}$$

bonds formed

$$4 \times \text{S}-\text{F}$$



$$\begin{aligned} \Delta H &= \text{input} - \text{output} \\ -780 &= (2 \times 160) - 4x \\ -1100 &= -4x \\ \frac{-1100}{-4} &= \frac{-4x}{-4} \\ x &= 275 \text{ kJ/mol} \end{aligned}$$

Wednesday

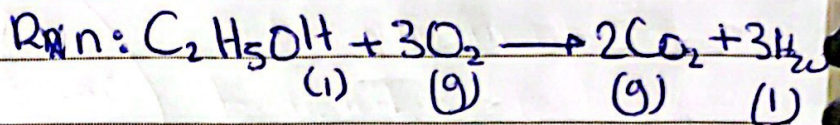
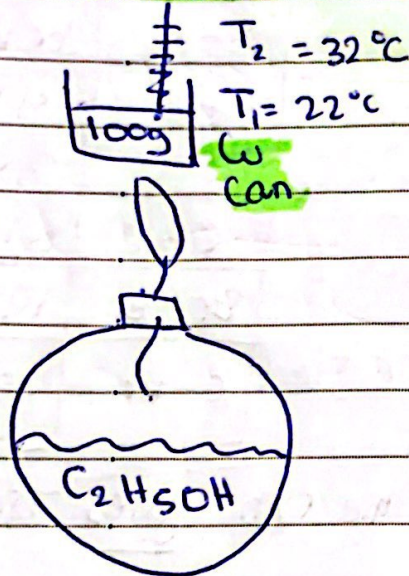
9/11/22

→ Finding ΔH (energy change) practically.

Combustion

displacement

neutralization



$$\Delta T = \frac{Q}{mc}$$

$$Q = mc\Delta T$$

$$\text{energy} = 100 \times 4.2 \times 10$$

$$\text{transfer} = 4200 \text{ J} \approx 4.2 \text{ kJ}$$

$$m_i = 200 \text{ g}$$

$$m_f = 198 \text{ g}$$

4.2 kJ produced from 2g C₂H₅OH

ΔH

1 mole

96.6
kJ

= 46g

C₂H₅OH

$$\Delta H = -96.6 \text{ kJ}$$

Thursday =

10/11/22

two fuels A and B

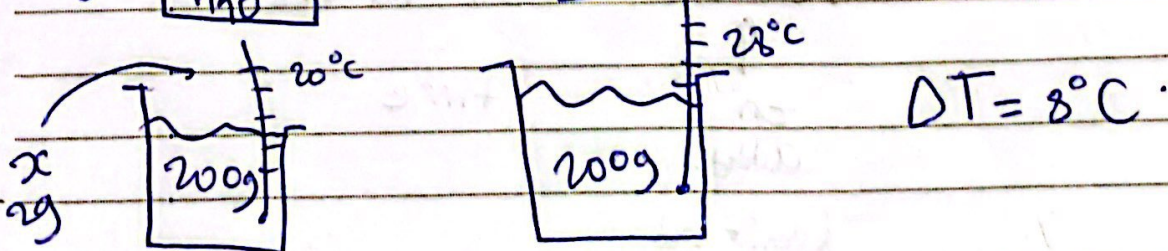
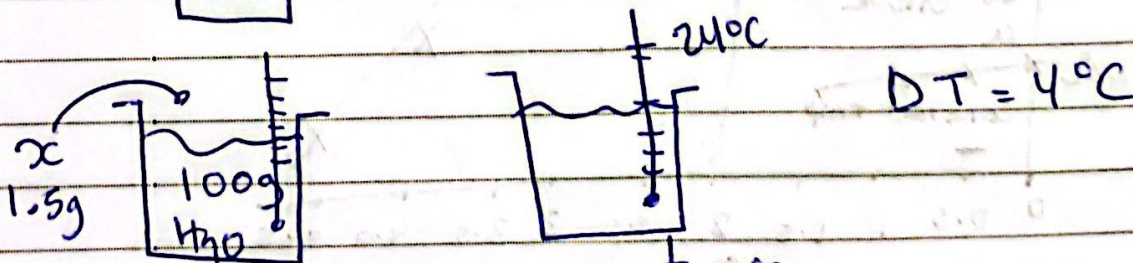
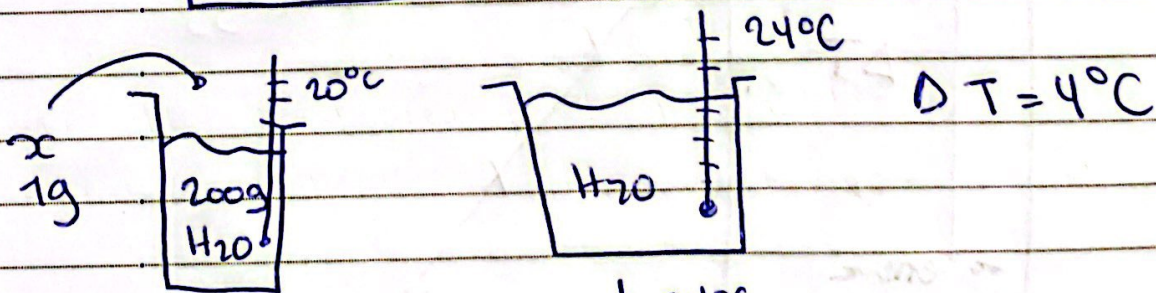
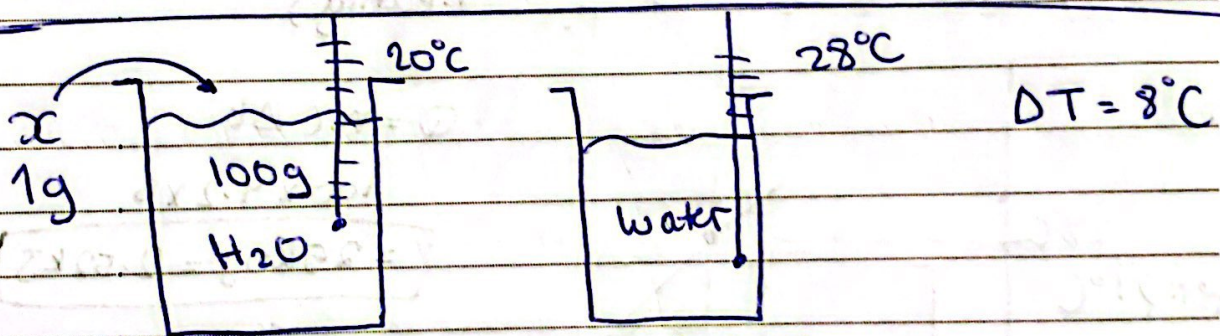
plan an exp. to show which one produced more energy

take a known mass of water with known initial temp. in a copper can.

take a known mass of fuel A. Ignite the fuel and record the final mass and initial temp of water.

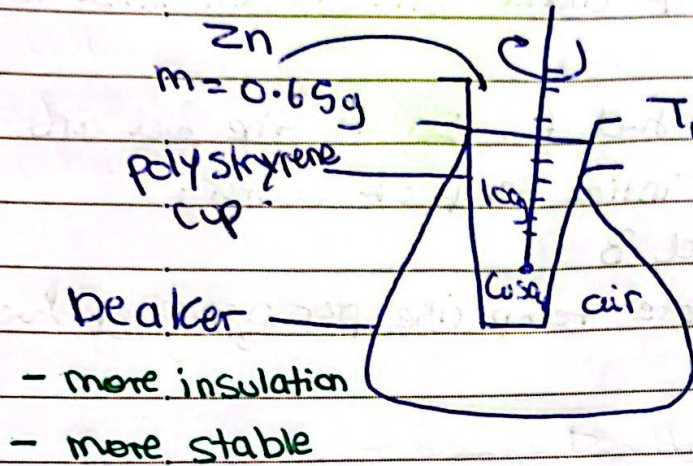
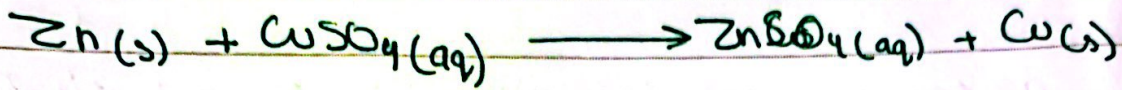
Repeat the exp. using fuel B

the fuel which cause more temp rise per gram of fuel produce more energy.



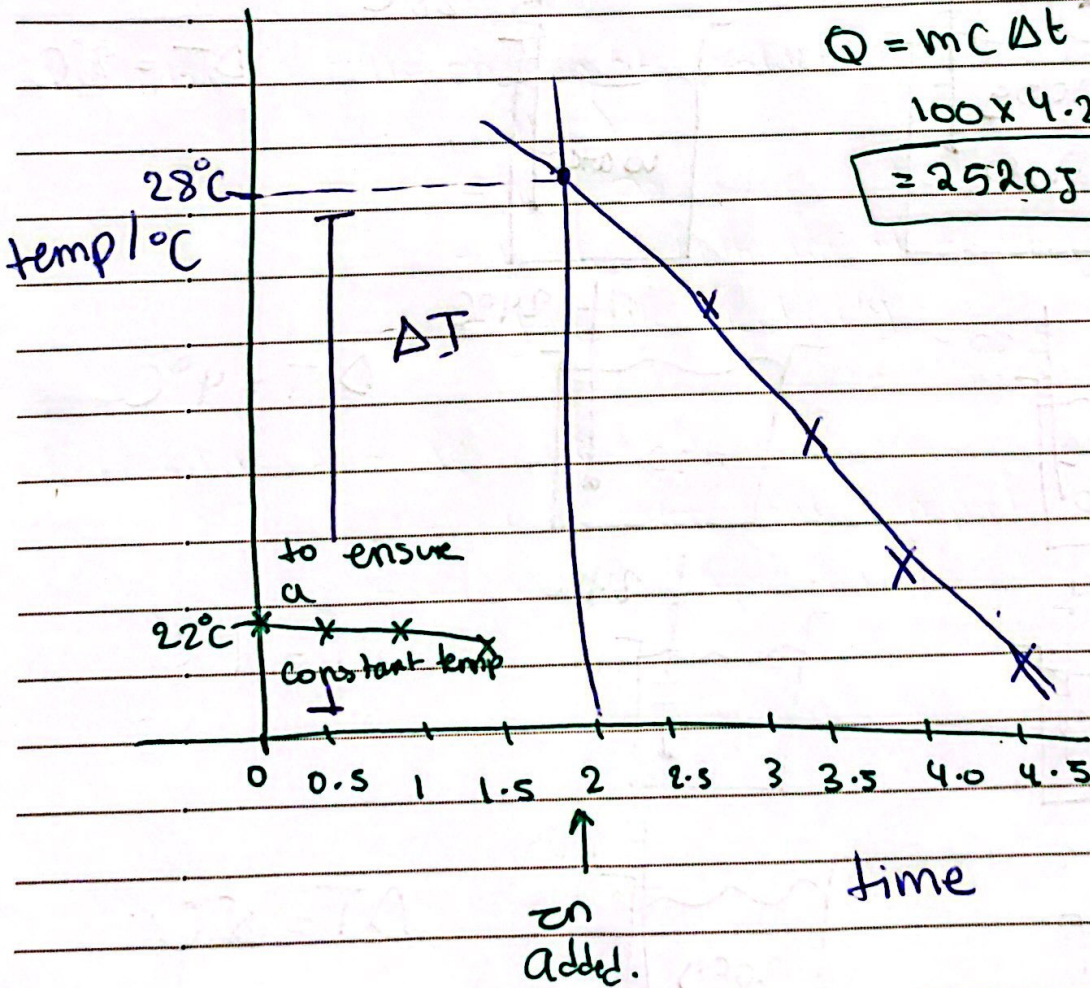
~~Water tray~~

measuring ΔH displacement.



Stir with thermometer
to distribute heat equally
(slowly to avoid over
heating)

- more insulation
- more stable



$$Q = mc\Delta t$$

$$100 \times 4.2 \times 6$$

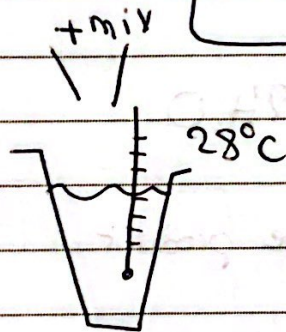
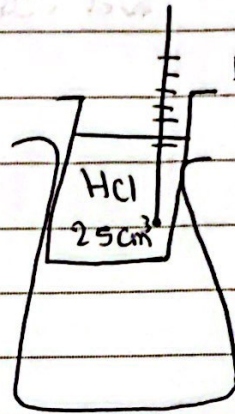
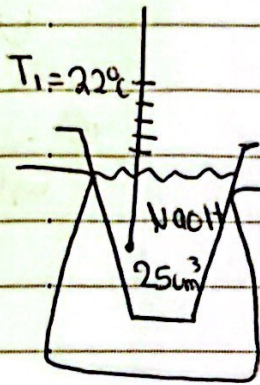
$$= 2520 \text{ J} = 2.52 \text{ kJ}$$

(don't read
thermo)

Thursday

10/11/22

measuring ΔH neutralization



Specific heat capacity = $4.2\text{ J/g}^\circ\text{C}$

$$d = 1\text{ g/cm}^3$$

$$Q = mc\Delta t$$

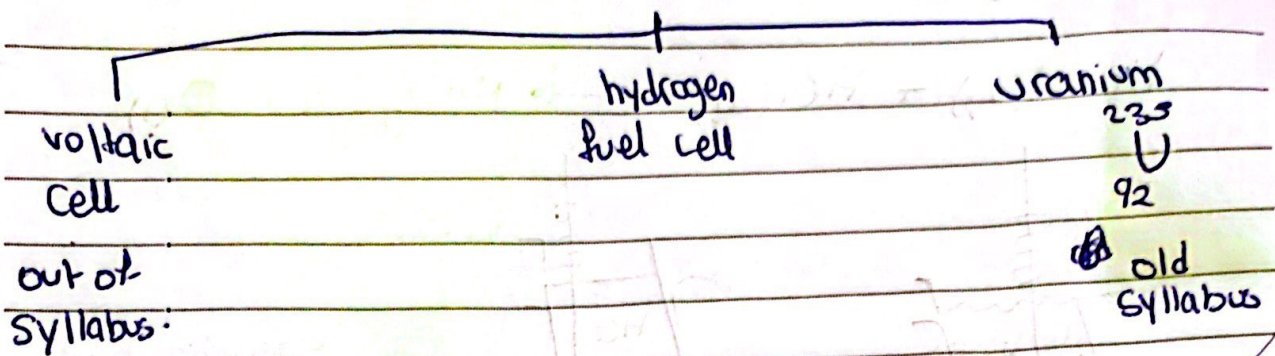
$$Q = (50) \times 4.2 \times 6$$

$$= 1260\text{ J}$$

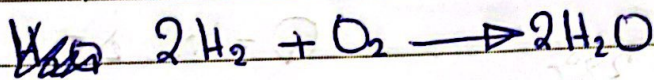
Tuesday.

15/11/22.

Alternative resources of energy



hydrogen fuel cell:-

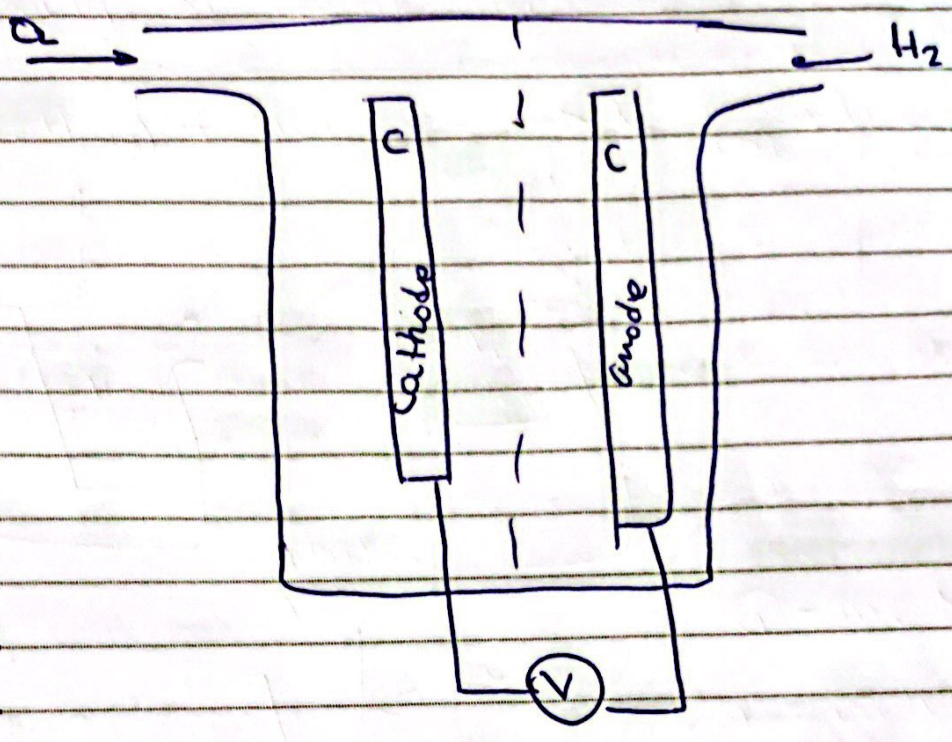


advantages: only one waste product
(H_2O)

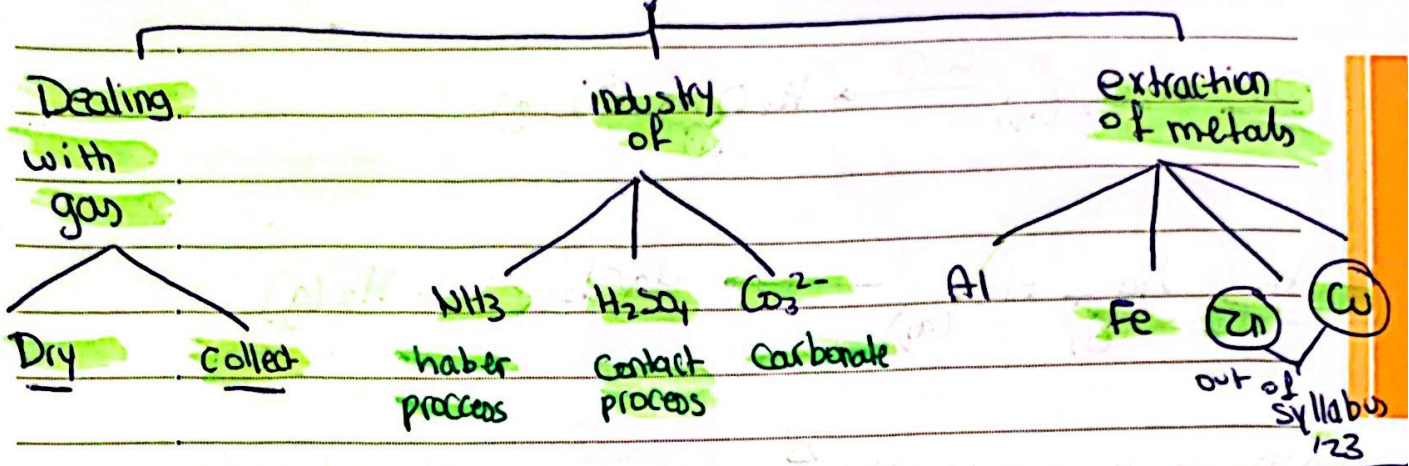
- no CO_2
- produce high amount of energy
- generate electricity.

disadvantages: - expensive.

- hard to store and transport
- Risk of explosion



Industrial Chemistry

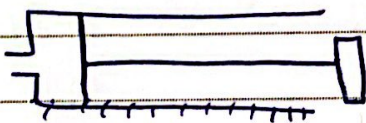


Dealing with gas

Rxn $\xrightarrow{\text{wet}}$ gas \rightarrow dry \rightarrow collect

(*) Collect gas.

gas syringe



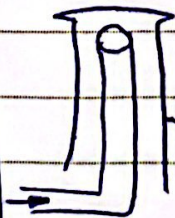
- used to collect + measure the volume of gas.

- no mixing with other gases.

Delivery tube

upward delivery

downward delivery

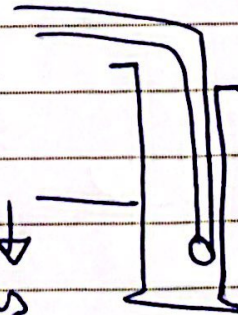


less dense than air

* mix with air

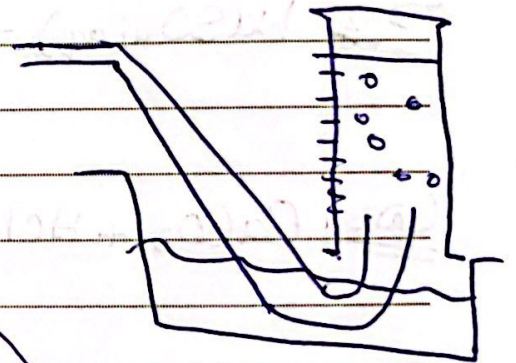
* can escape.

gas jar.



more dense than air

Over water

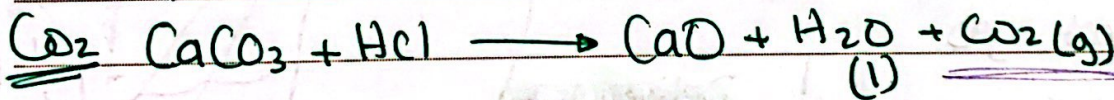
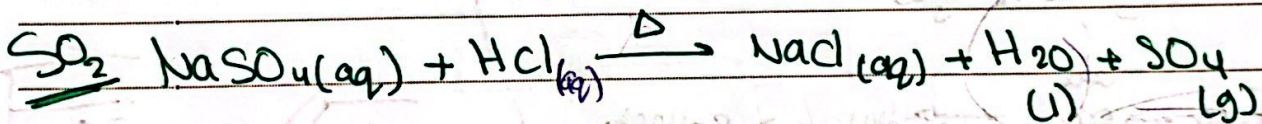
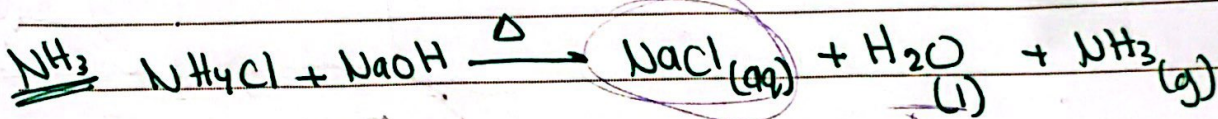
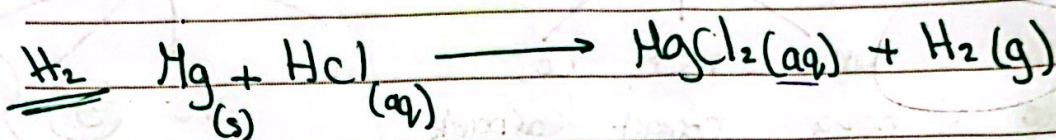
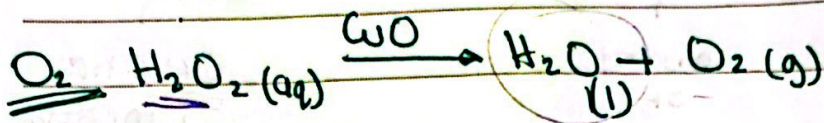


only for insoluble gas.

Saturday

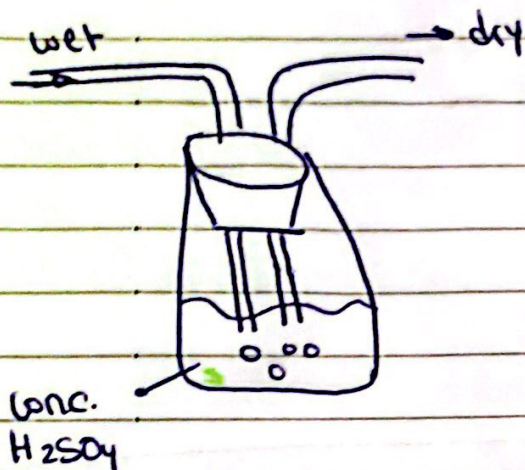
19/11/22

wet gases:



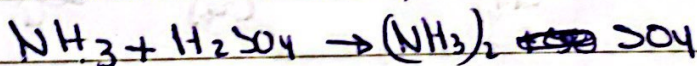
Drying gas

① Concentrated H_2SO_4

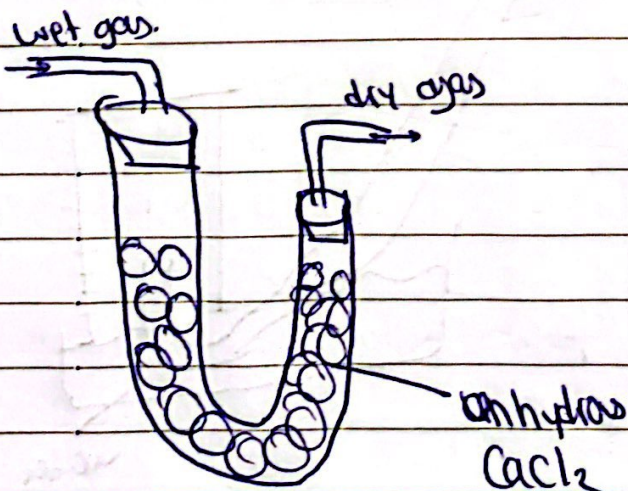


H_2SO_4 (becomes dilute)
used to dry any gas except NH_3

it neutralize the H_2SO_4



② anhydrous $CaCl_2$ pink.



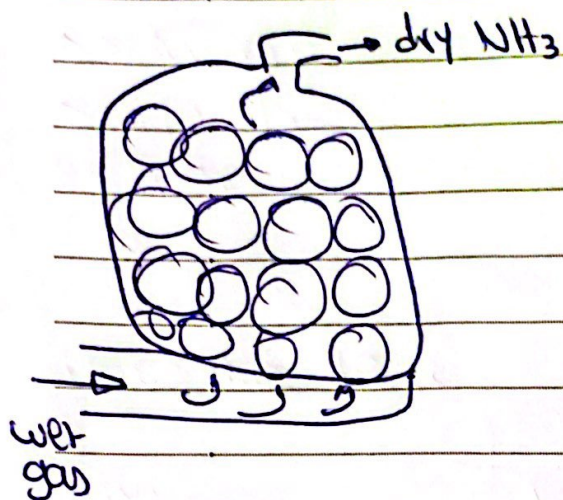
used to dry any gas except
for NH_3

Saturday

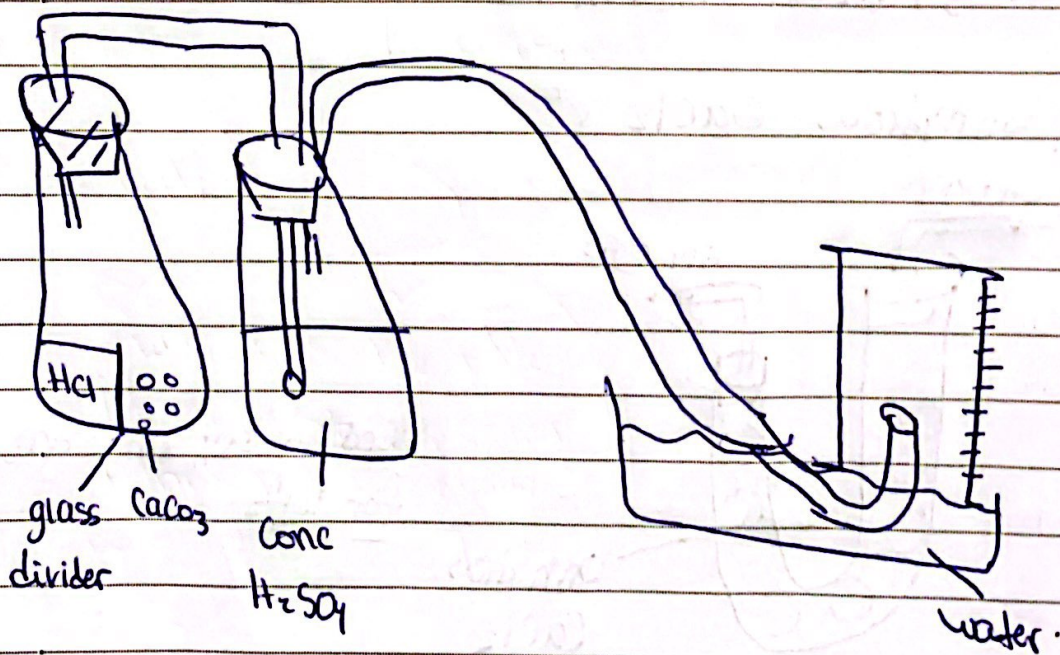
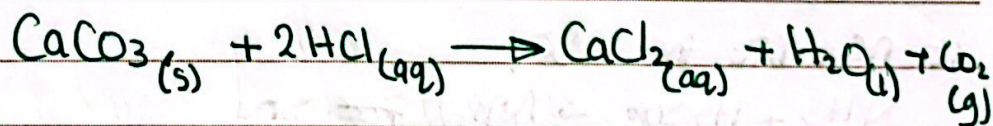
19/11/22

③ Calcium Oxide

CaO



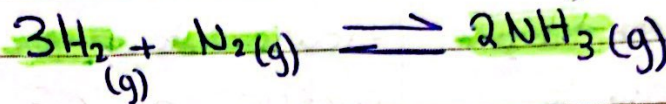
✚ Draw a suitable apparatus used to collect + measure volume of dry CO₂ (insoluble) gas from.



Tuesday

22/11/22

Industry of ammonia "haber process"



Prepare Fertilizers.

$\Delta H = -ve$

reaction is exothermic

how to obtain

① nitrogen - Fractional distillation of liquid

↓
different
B.P

↓
Cooling water
high pressure.

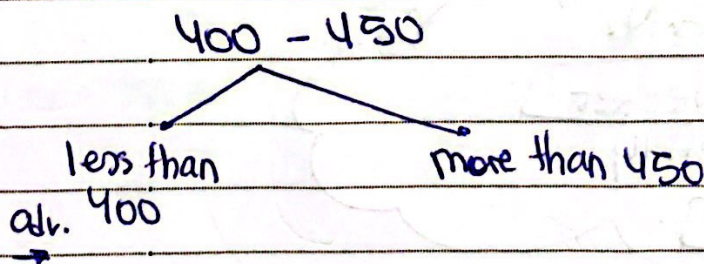
② hydrogen - ① Cracking of Alkanes (organic chemistry)

(methane)



essential conditions

1) temp. 400-450°C



Tuesday

22/11/22

less than 400:

adv:-

- higher yield of NH_3
- shift forward to exo side

dis:-

- slower rate.
- particles bse k.E
- less effective collisions per unit time

more than 450°C

adv:-

- faster rate

dis:-

- less yield
- shift backward endo side.

2) Pressure : 200 Atm

adv:-

- more yield of NH_3
- faster rate.

dis:-

- risk of explosion
- expensive.

3) Fe Catalyst.

add excess $\text{H}_2 + \text{N}_2$

return back to convecher

remove NH_3 immediately

by cooling

Tuesday.

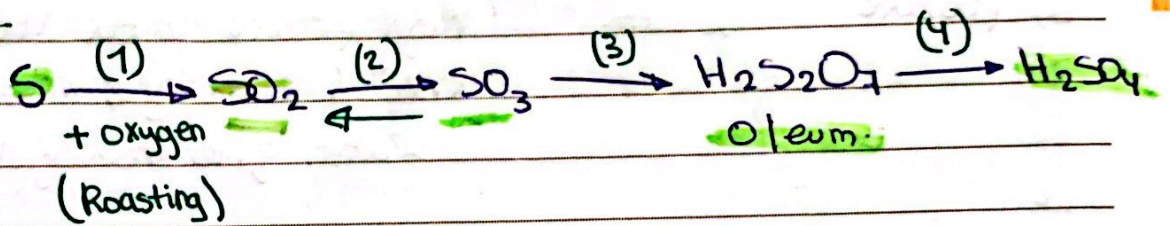
22/11/22

uses of ammonia:

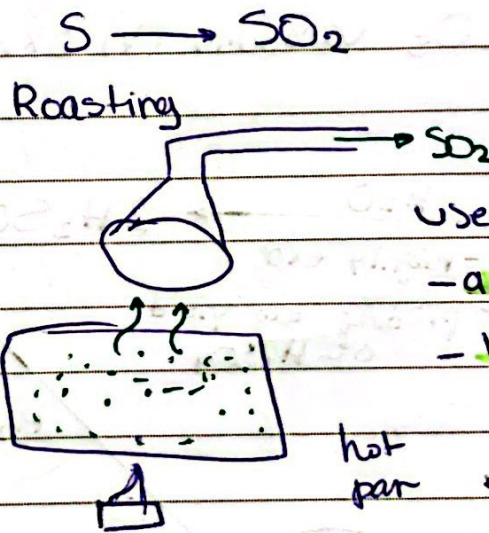
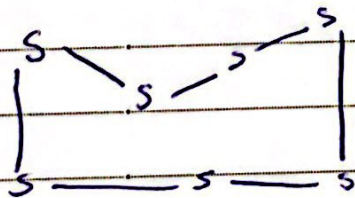
- 1- Fertilizers.
- 2- Cleaning detergents.
- 3- Smelling salts.

* Contact process:

Stages:-



- group 6
- valency 2
- yellow solid.
- S_8



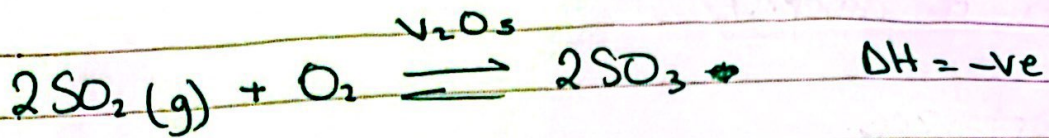
- uses of SO_2
- acid rain (causes)
 - kills bacteria (sterilization)
 - paper industry
 - bleaching agent

- uses: medicine
- rubber
- match

ore: ZnS

Thursday

24/11/22

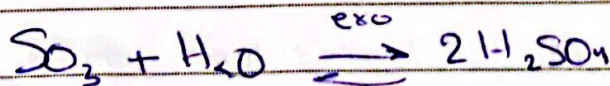
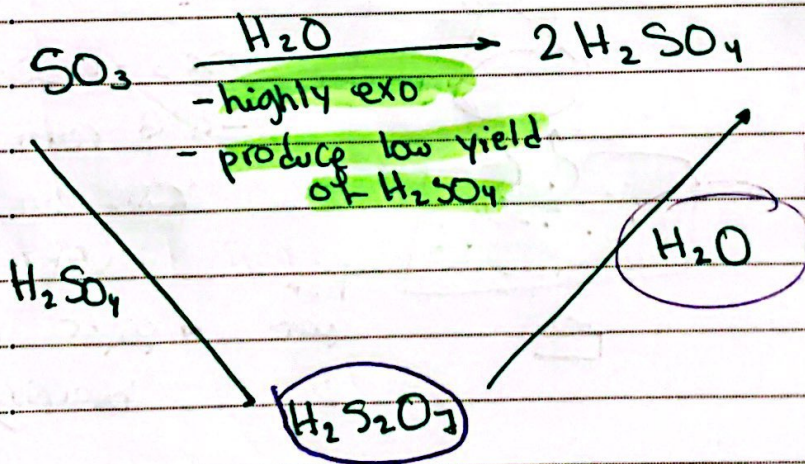


essential conditions:-

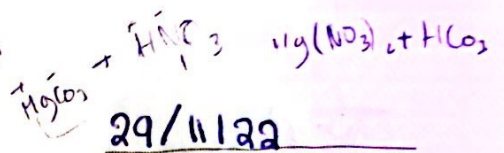
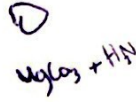
1) temp. $400^\circ - 450^\circ\text{C}$

2) pressure 2 atm "high pressure favour the forward rxn" (fewer gas moles)
 2 atm gives max yield of SO_3

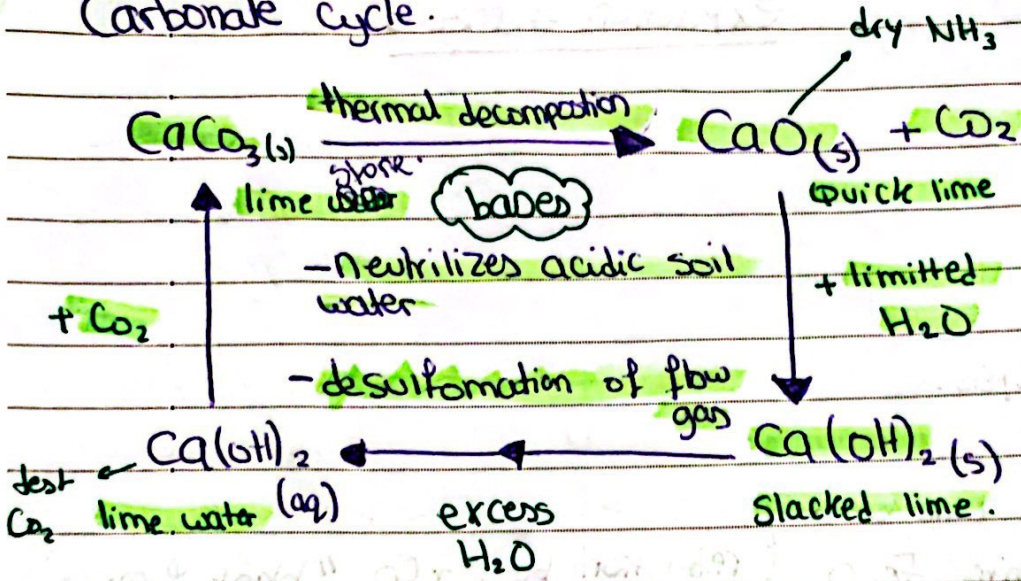
3) catalyst V_2O_5 vanadium (V) oxide.



Tuesday



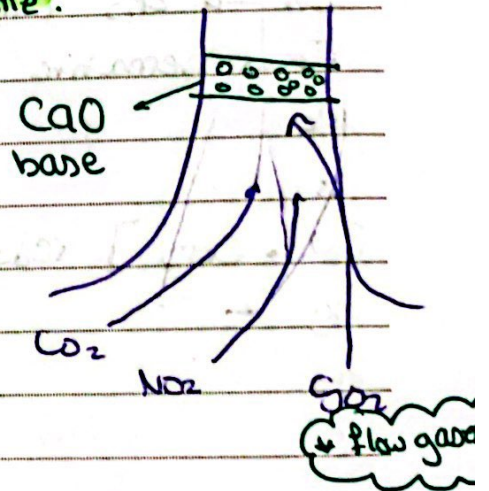
Carbonate cycle.



uses of $\text{CaCO}_3(\text{s})$

→ building

→ extraction of iron



Tuesday

29/11/22

extraction of metals

K

Na

Li

Ca

Hg

bauxite

Al_2O_3 Al] electrolysis.

C, CO

Zn \rightarrow ZnS zinc blend

Fe \rightarrow hematite Fe_2O_3 } reduction by C+CO "blast furnace"

Pb

H

Cu \rightarrow CuS] reduction by H_2

Ag

Au

Pt

Extraction of Iron:-

ore: Fe_2O_3 "hematite"

method: reduction by C & CO

place: blast furnace

raw materials: Fe_2O_3 mixed with SiO_2

\Rightarrow acidic impurities.

$CaCO_3$ "lime water"

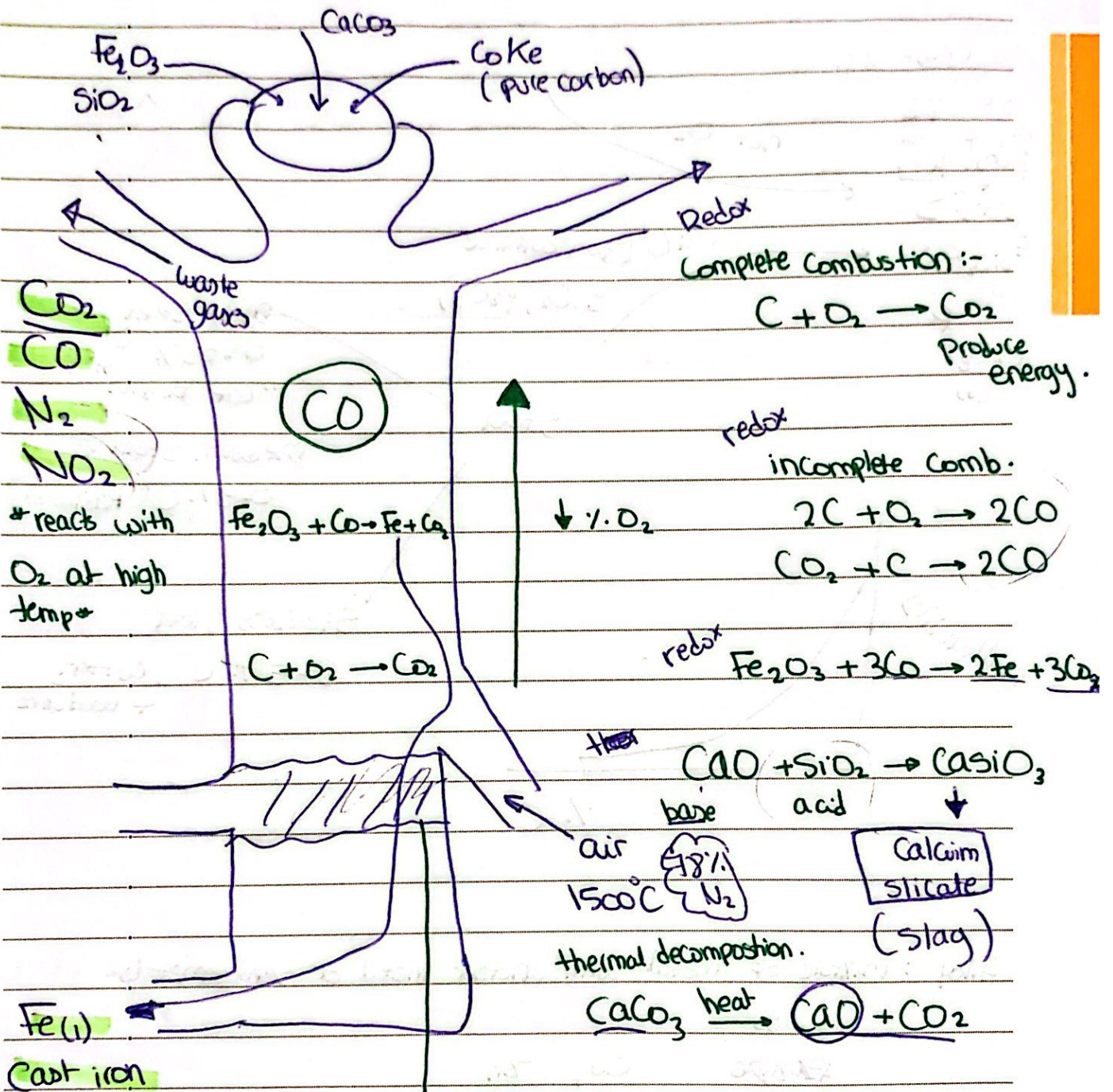
Coke "Carbon" "pure"

air $1500^\circ C$

Wednesday

30/11/22

Extraction of iron:-



Slag : forms a protective layer that prevents the rxn of Fe_2O_3 (importance)

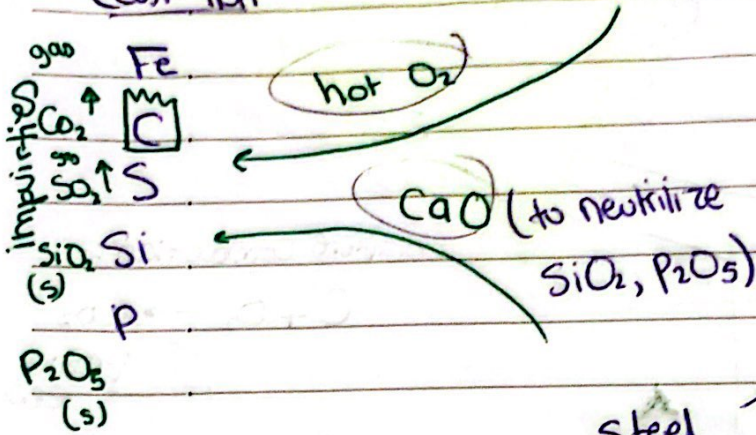
used: to make roads.

Wednesday

30/11/22

★ Steel making. "Oxygen base process"

Cast iron



Steel

mild steel

0.03% C

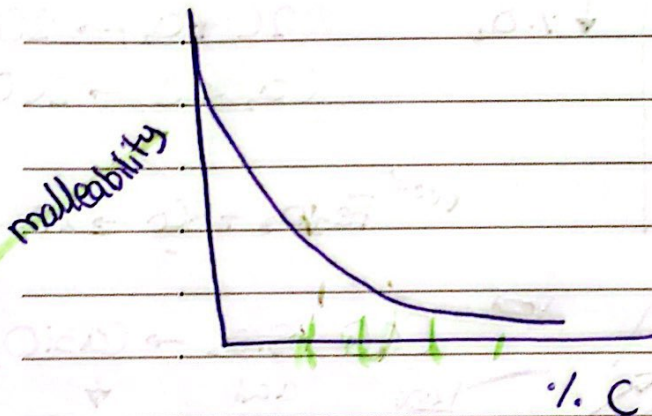
"Car bodies"

medium steel

0.3% C "Railways"

Stainless steel

3-5% C, cutlery + watches



Alloy: mixture of metal with another metal or semi-metals.

brass

~~brass~~ Cu, Zn

bronze Cu, Sn

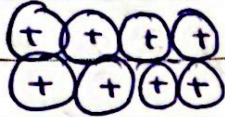
Steel Fe, C, Ni, Cr

Wednesday

30/11/22.

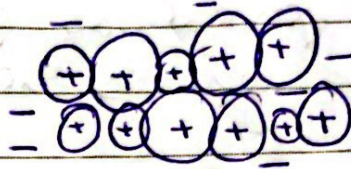
Metal

Cu



Brass

Cu, Zn



harder

different sizes of metals.

✦ Extraction of zinc

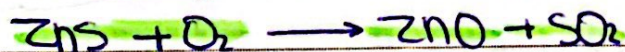
Ore: Zinc blende ZnS

method: reduction by $C + CO$

place: Blast furnace.

$C + CO$ and H_2 can only reduce metals only ~~when~~ in their oxide ore.

Step 1:- Roasting with hot oxygen



Thursday

1/12/22

the temp. inside the furnace 1500°C
and the b.p of zinc is 907°C
~~Solid~~ so it produced as pure gas must condense
and the other impurities since they have high B.p stay
in furnace