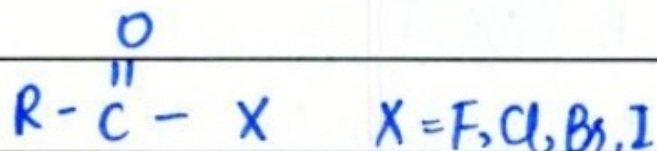
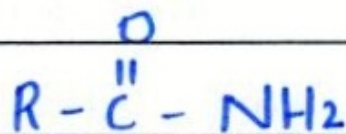


Q. No. 2 Part (i) Difference between functional groups:

i- Acid halide and acid amide:



It has halide ion with carbonyl carbon.

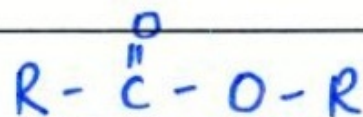


It has amide with carbonyl carbon.

ii. Ether and Ester:

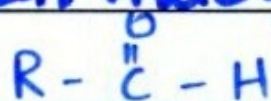


Two R groups are joined by Oxygen.

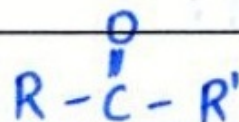


It is formed by dehydration of acid and alcohol. (esterification)

iii. Aldehyde and Ketone:



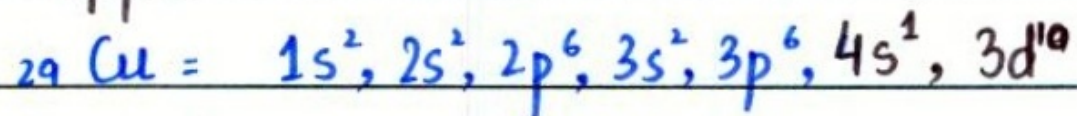
Here R can be H. $-\overset{\overset{O}{\parallel}}{C}-$ must be attached to at least one hydrogen.



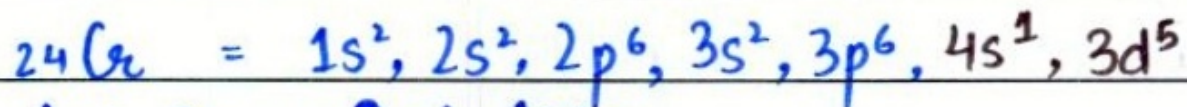
Carbonyl carbon must be attached to carbons only.

Q. No. 2 Part (ii) Electronic configuration of Cu and Cr:

Copper:



Chromium:



Auf Bau Principle:

It states that:

“electrons fill the low energy orbit that is available first.”

Both have incomplete 4s orbital. This is to gain **stability**. Since half filled and completely filled orbitals are much more stable than partially filled orbitals.

Q. No. 2 Part (iii) Fajan's Rule:

It states that:

"The smaller is the atom with higher charge density, the more covalent is the compound."

Examples:

i. $PbCl_2$ and $PbCl_4$:

In $PbCl_2$, the ion Pb^{+2} is larger as compared to Pb^{+4} (in $PbCl_4$). Pb^{+4} has higher charge density. Hence we conclude $PbCl_4$ is more covalent whereas $PbCl_2$ is more ionic.

ii. $SnCl_2$ and $SnCl_4$:

In $SnCl_2$, Sn^{+2} ion has large size with lesser charge density whereas $SnCl_4$ has Sn^{+4} ion i.e. smaller size with high charge density. $SnCl_2$ is more ionic and $SnCl_4$ is more covalent.

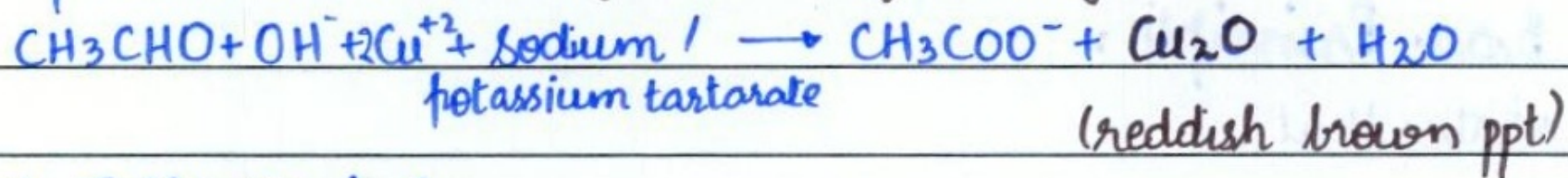
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Q. No. 2 Part (iv) Difference of aldehydes and ketones:

Aldehydes and ketones can be differentiated by:

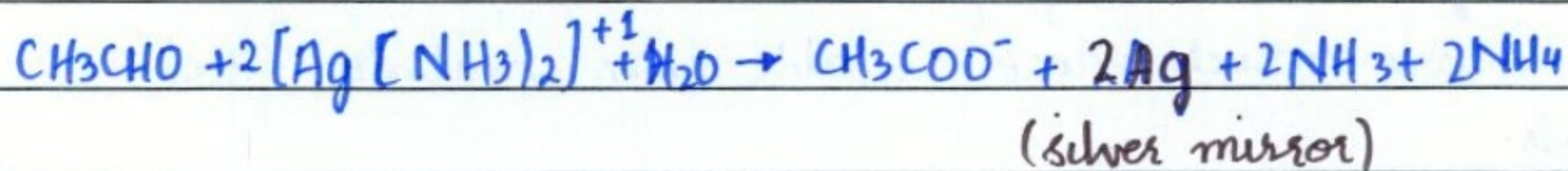
i. Fehling's Reagent:

This test is given by aldehyde. If reddish brown ppt is produced, it is confirmation of aldehyde.



ii. Tollen's test:

This test is not given by ketone. Appearance of silver mirror confirms presence of aldehyde.

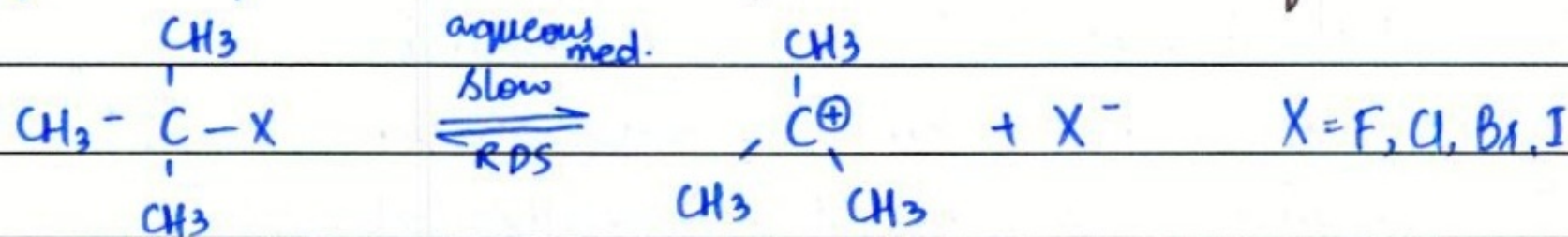


Q. No. 2 Part (v) Mechanism of SN₁ Reaction:

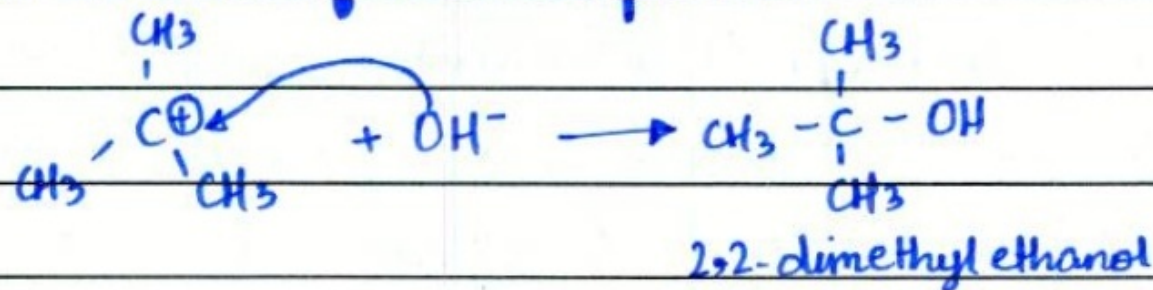
SN₁ reaction is most favoured by tertiary halides in polar solvent. It is uni-molecular two step reaction.

i. Formation of carbocation:

Carbocation ~~is~~ is formed by reversible dissociation in first step. This is slow step and RDS. It is first order reaction.



ii. Attack of nucleophile:



Q. No. 2 Part (vi) Equilibrium between $\text{Cr}_2\text{O}_7^{2-}$ and CrO_4^{2-} :

Chromates and dichromates are converted into each other.

They exist in equilibrium.

Conversion of Chromate to Dichromate:

To convert chromate to dichromate, we add H^+ .



(bright yellow)

(orange)

Conversion of Dichromate to chromate:

For the conversion of dichromate to chromate, add few drops of OH^- . H^+ concentration will be reduced hence equilibrium shifts backwards.



(orange)

(bright yellow)

Q. No. 2 Part (vii) Green House Effect:

Radiations from Sun continuously enter the Earth's atmosphere. These radiations are absorbed by gases in Earth's atmosphere such as CO_2 and H_2O .

They emit radiations of longer wavelength (IR radiations) which get entrapped in Earth's atmosphere.

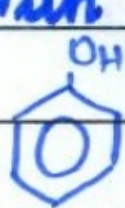
"The absorption of electromagnetic radiation of shorter wavelength and emission of longer wavelength radiation (IR radiation) by CO_2 and H_2O in Earth's atmosphere is green house effect."

It results in global warming. It is mainly caused by H_2O due to higher concentration. The temperature of earth is 15°C in average. If CO_2 goes from 330 ppm to 400 ppm, the temperature rises about 1°C .

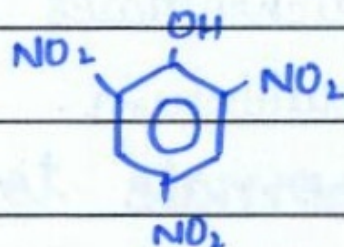
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Q. No. 2 Part (viii) Reactions of Phenol:

i. With conc HNO₃:



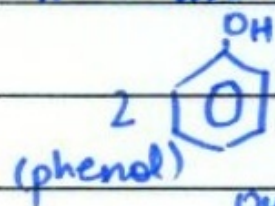
+ conc HNO₃



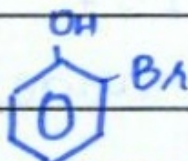
phenol

2,4,6 trinitrophenol

ii. With aqueous Br₂:



+ Br₂

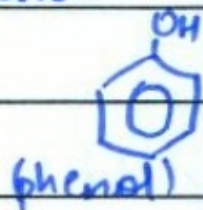


(2-bromophenol)

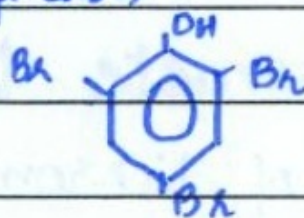
+



Br (4-bromophenol)



+ Br₂ (excess)



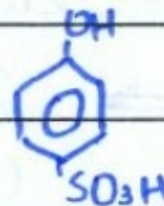
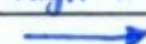
2,4,6 tribromophenol (white ppt)

iii. Conc. H₂SO₄



+ conc. H₂SO₄

high T



(para position is obtained
in rigorous conditions)

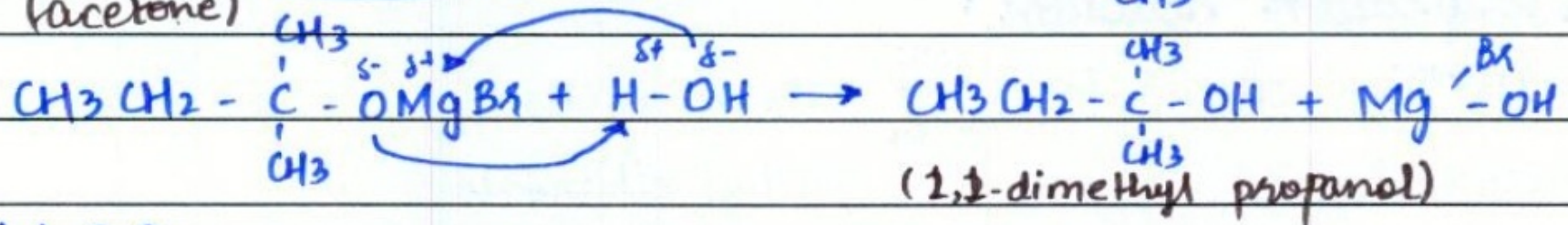
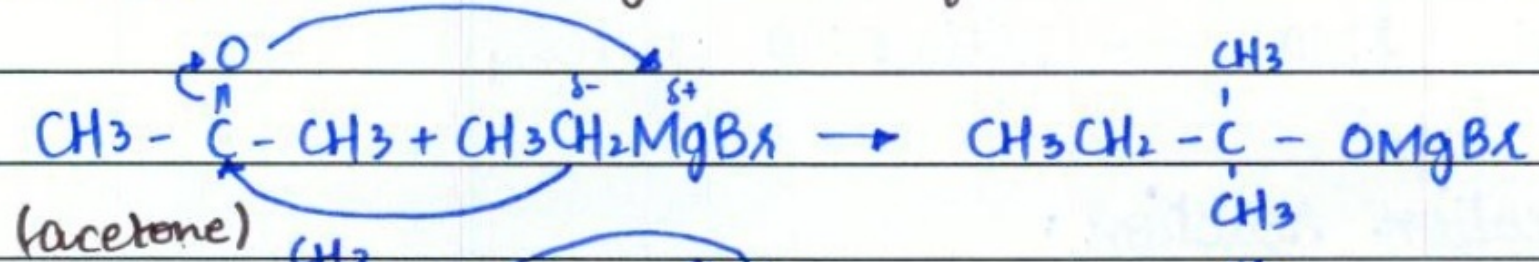
Q. No. 2 Part (ix) Differences between E₁ and E₂:

Properties	E ₁	E ₂
Steps	It is two step reaction.	It is one step rxn.
Molecularity	It is unimolecular reaction.	It is bimolecular reaction.
Reaction kinetics	It is first order reaction. Rate \propto [substrate]	It is second order reaction. Rate \propto [substrate][base]
carbocation	Carbocation is formed	No carbocation formation.
transition state	No transition state formation.	Transition state is formed.

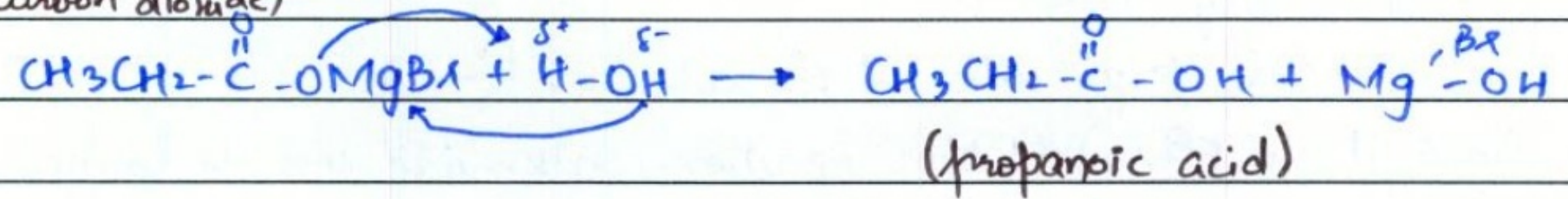
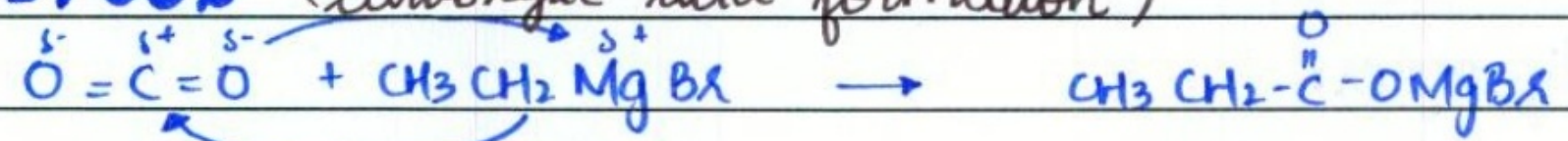
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Q. No. 2 Part (x) **Reactions of Grignard's reagent:**

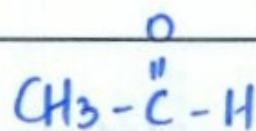
a) Acetone (tertiary alcohol formation):



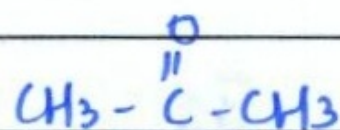
b) CO₂ (carboxylic acid formation)



Q. No. 2 Part (xi) Reactivity of acetaldehyde and acetone:



acetaldehyde



acetone.

Acetaldehyde is more reactive than acetone because of the following reasons:

i- Steric Hindrance:

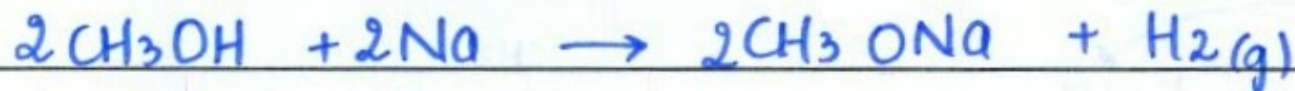
Acetone has bulky groups attached hence the attack of Nucleophile on electrophilic carbon becomes difficult.

ii. Electron donating effect of CH_3 :

The methyl groups attached with carbonyl carbon lessen the electrophilicity of carbonyl carbon hence reduce reactivity.

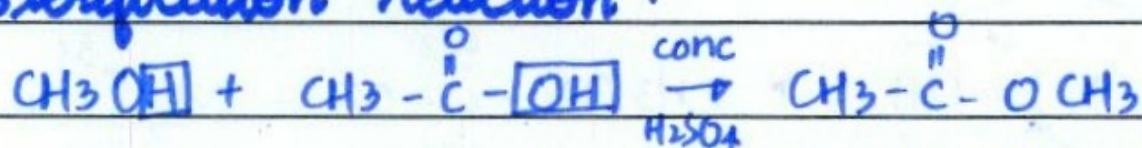
Q. No. 2 Part (xii) O-H bond cleavage in alcohols:

i. Reaction with metals:



methyl alcohol

ii. Esterification reaction:

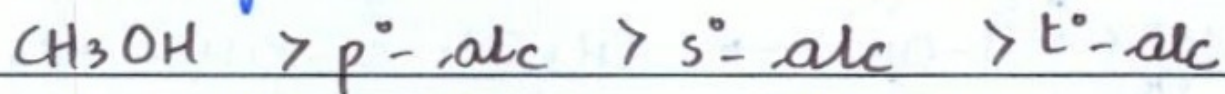


methanol

methyl ethanoate

Reactivity order:

The reactivity order is



Since it is E^\ominus substitution reaction, alkoxide ion is formed as p° -alkoxide is most stable so p° -alc is most reactive.

Q. No. 2 Part (xiii) Relative atomic mass of Mg:

Data:

Mg-24 mass = 24 amu

% age abundance = 78.70%

Mg-25 mass = 25 amu

% age abundance = 10.13%

Mg-26 mass = 26 amu

% age abundance = 11.17%

Relative atomic mass of Mg = ?

Solution:

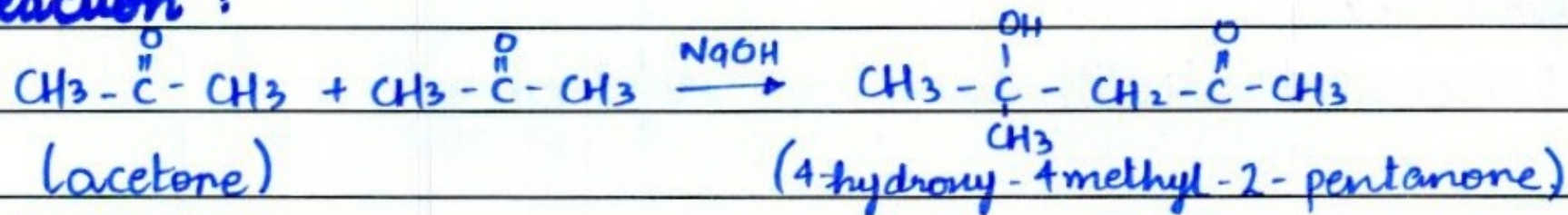
$$\text{Relative atomic mass} = \frac{(\text{Relative abundance} \times \text{mass})_1 + (\text{Relative abundance} \times \text{mass})_2 + \dots}{100}$$

$$\text{Relative atomic mass of Mg} = \frac{24 \times 78.70\% + 25 \times 10.13\% + 26 \times 11.17\%}{100}$$

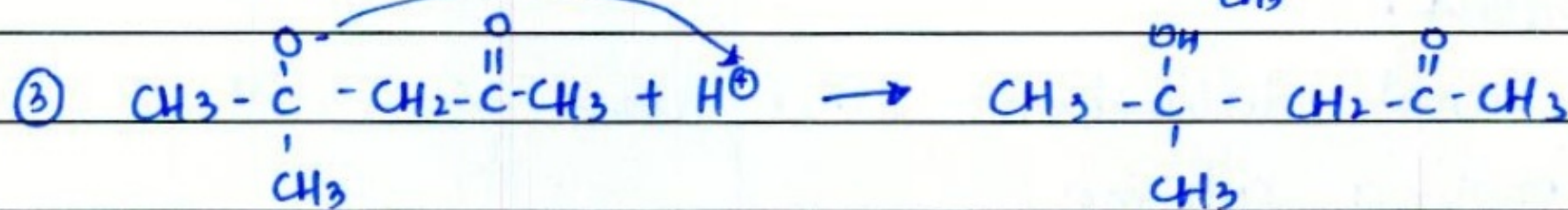
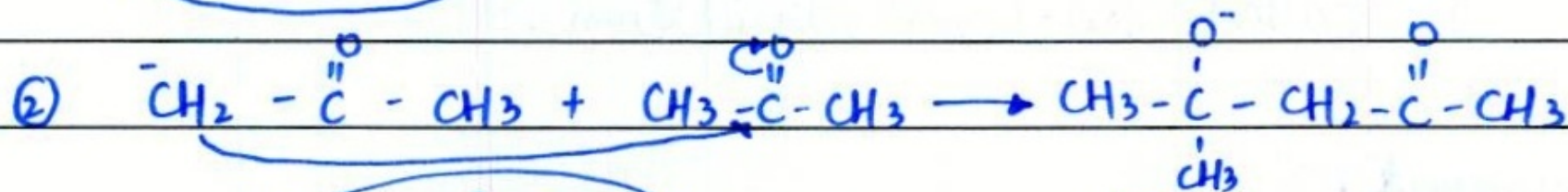
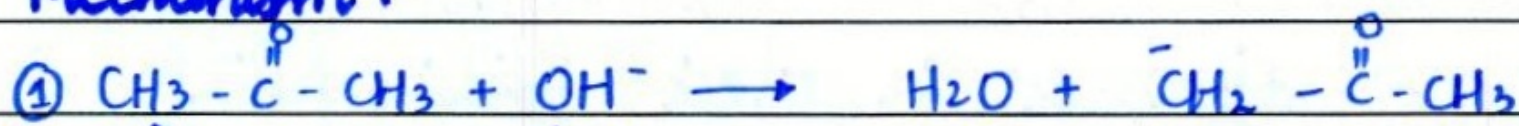
$$\text{Relative atomic mass of Mg} = 24.32 \text{ amu}$$

Q. No. 2 Part (xiv) Aldol condensation of acetone.

Reaction :



Mechanism :



(4-hydroxy-4-methyl-2-pentanone)

Refining of Crude oil

Crude oil / Petroleum is the thick black sticky liquid that seeps out of the ground in some parts of the world.

Refining:

Definition:

"Separation of crude oil in various products that are useful is termed as refining."

Basic principle:

The basic principle in refining of crude oil is fractional distillation.

Definition:

Fractional distillation is defined as.

"Separation of crude oil into products on the basis of **difference in their boiling point** is called fractional distillation."

Instrument:

Fractional distillation takes place in tall fractionating column.

Process:

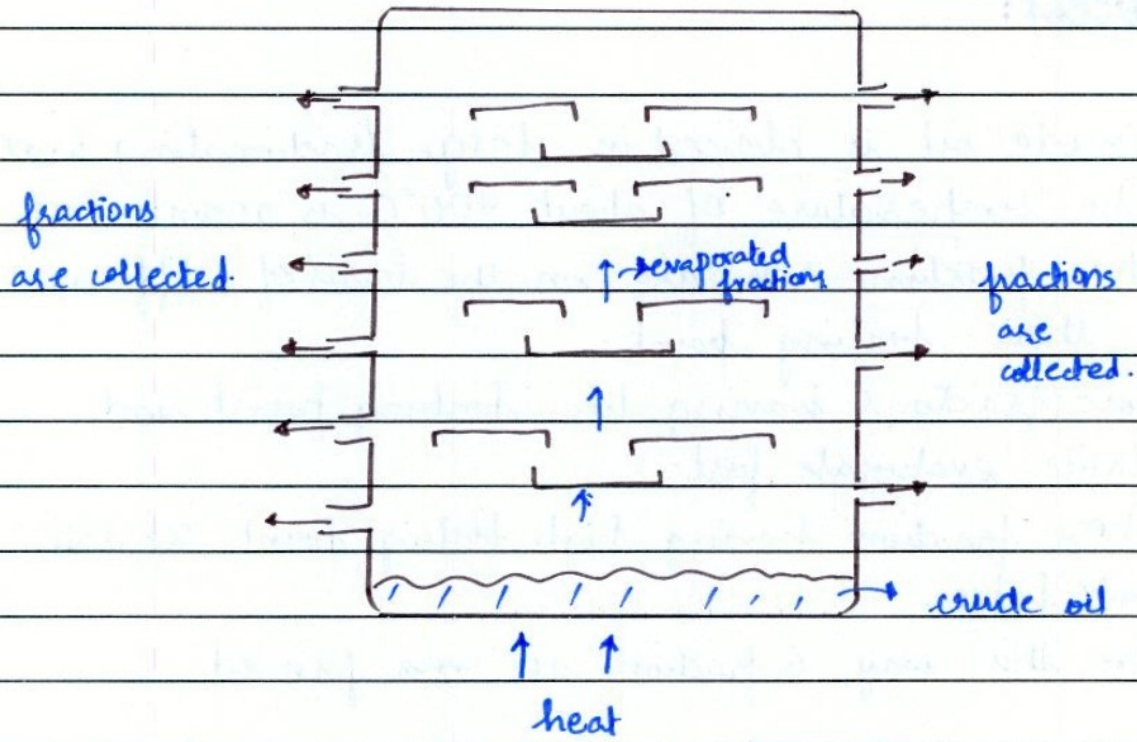
1. Crude oil is placed in large fractionating tower.
2. The temperature of about 400°C is maintained.
3. The fractions separate on the basis of difference in their boiling point.
4. Those fractions having low boiling point and volatile evaporate first.
5. These fractions having high boiling point separate out later.
6. In this way, 6 fractions are formed.

Fractions:

- The useful products obtained are called fractions.
- 6 fractions are obtained.

They are listed below:

1. Fuel gas, LPG, refinery gas.
2. Petroleum, gasoline
3. Naphtha
4. Kerosene, Paraffin
5. Heavy fuel oil, lubricating oil, diesel oil, grease.
6. Diesel, petrol
7. Residue (Bitumen, wax) etc.



Fractionating Tower

Oxidation State of IV-A Elements

+4 oxidation state of Carbon and Silicon:

Carbon and Silicon have +4 oxidation state only because the valence electrons are present in ns^2, np^2 . The energy difference is low hence all $4e^-$ take part in bonding. Only in that case, stability could be achieved because energy difference of ns and np is very less.

+4 and +2 oxidation state of Ge, Sn, Pb:

These compounds can exist in both +2 and +4 oxidation state.

+4 oxidation state:

If all ns^2 and np^2 electrons take part in bonding, +4 oxidation state is achieved.

+2 oxidation state:

- In this case, only np^2 electrons take part in bond formation.
- The energy difference between ns^2 and np^2 is high hence compound can gain stability by participation of np^2 electrons only. This is due to the phenomenon of inert pair effect.

Inert pair effect:

"In this effect, only np^2 electrons take part whereas ns^2 electrons are shielded due to energy difference is called inert pair effect."

Comparison of stability of +2 and +4:

As we move from top to bottom down the group, the stability of +2 increases.

i. Germanium:

Ge^{+4} is more stable than Ge^{+2} . Hence Ge^{+2} tends to loose e^- and oxidize itself to Ge^{+4} .

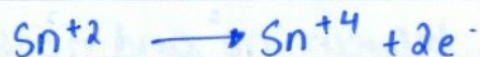


Hence Ge^{+2} is strong reducing agent.

Stability: $Ge^{+4} > Ge^{+2}$

ii. Tin:

Sn^{+4} is more stable than Sn^{+2} . Sn^{+2} oxidizes itself to Sn^{+4} . It tends to loose e^- .



Hence, Sn^{+2} is strong reducing agent.

Stability order is

$Sn^{+4} > Sn^{+2}$

Lead:

Pb^{+2} is more stable than Pb^{+4} . Pb^{+4} tends to lose ^{gain} e^- and form Pb^{+2} .



Hence Pb^{+4} is strong oxidizing agent.

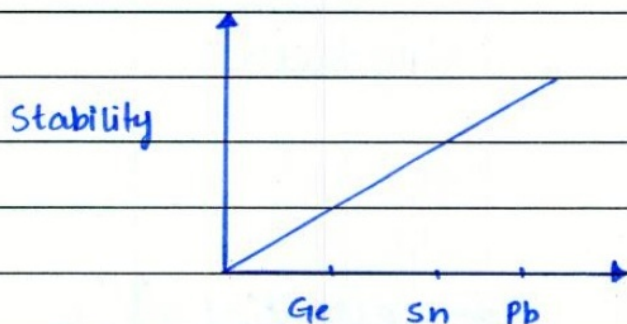
The order of stability is:



Representation through graph:

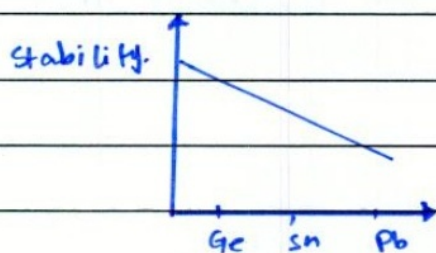
i. +2 ions:

Stability of +2 ions increases down the group.



ii. +4 ions:

Stability of +4 ions decrease down the group



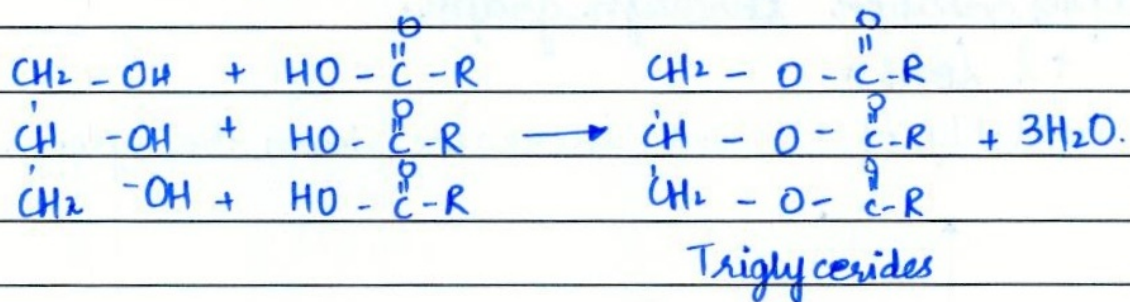
Lipids

Definition :

"Lipids are the organic molecules of animal or plant origin which belong to heterogenous group of classes."

Formation :

They are formed by the reaction of fatty acid and alcohol (glycerol). This is esterification reaction:



Difference :

Essential lipids

The lipids which are not manufactured in body are known as essential lipids.

Non-essential lipids

The lipids which are manufactured in body are non-essential lipids.

Definition

Uses

They are used for proper brain function, healthy vision and regulating other functions.

Their consumption can help reducing the risk of heart attack.

Types

It has two types. omega-6 and omega-3.

It consists of saturated fat, trans fat, cholesterol.

Sources

Omega-6: flax vegetable oil and nut.

They are present in olive oil, peanut and butter.

Omega-3: flax seeds, walnuts, fatty fish.

Saturated fat: cheese, meat.

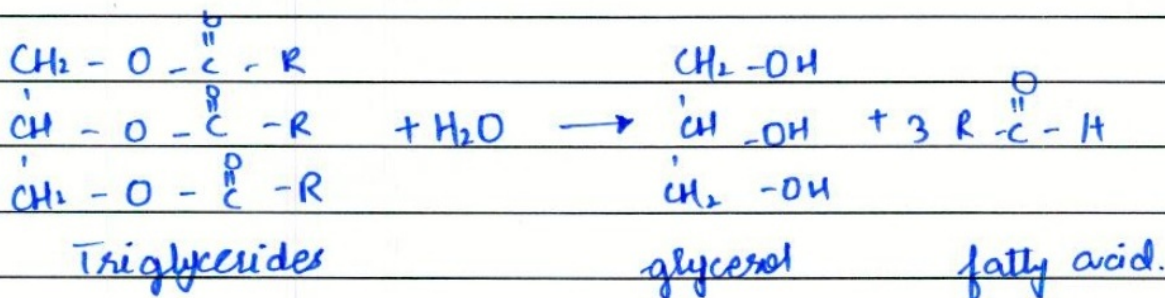
Trans fat: hydrogenated material, fried food.

Cholesterol: animal fat.

Reaction of Triglyceride:

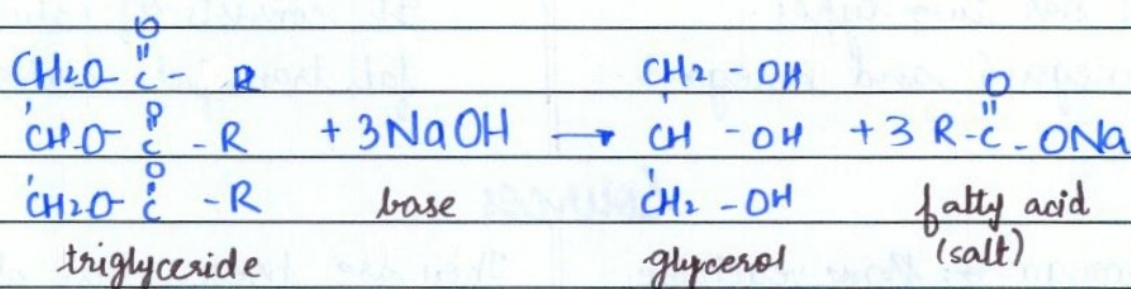
i- Hydrolysis:

The hydrolysis of triglyceride is done by lipase enzyme.



Saponification:

The hydrolysis of triglyceride in presence of base such as NaOH yielding glycerol and sodium salt of carboxylic acid is called saponification.



Sodium salt of carboxylic acid is known as fatty acid. The polar part forms bond with H₂O whereas R group attaches with stain. When rinsed, the fabric is washed.

Glycerol: The alcohol which consists of three OH on ~~carbo~~ consecutive carbon atoms are called glycerol.

Order of Acidic Strength

The order of acidic strength of carboxylic acid, phenol and ether is given by:

Strength of acidity:

Carboxylic acid > Phenols > Alcohols.

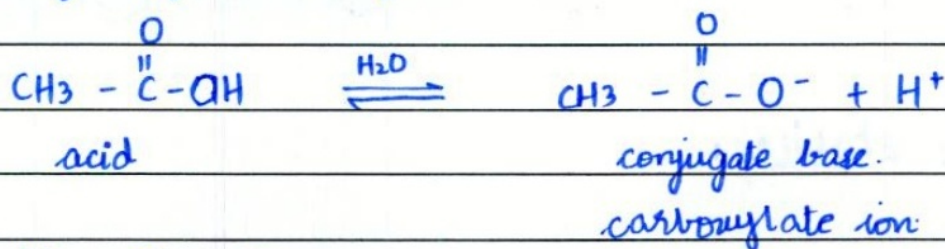
Carboxylic acid:

The strongest among these are carboxylic acids.

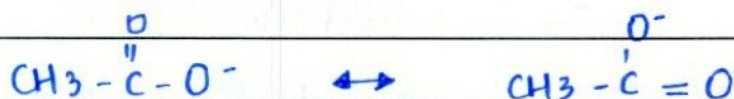
pKa value: pKa value of carboxylic acid is around 5.

The smaller is the pKa value, the stronger is the acid.

Hydrolysis of carboxylic acid:



Resonating Structures :



Reason for stability:

Both structures are equally contributing resonating structures. Because of this reason are very stable. Hence carboxylic acid is very strong.

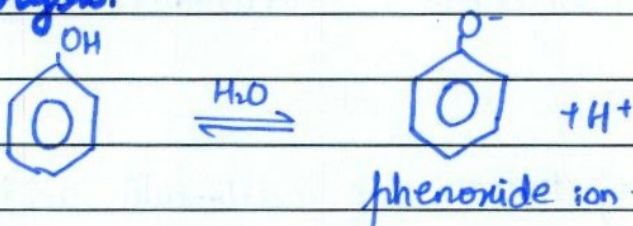
Phenol:

Phenol is less acidic than carboxylic acid but more acidic than alcohols.

pKa value:

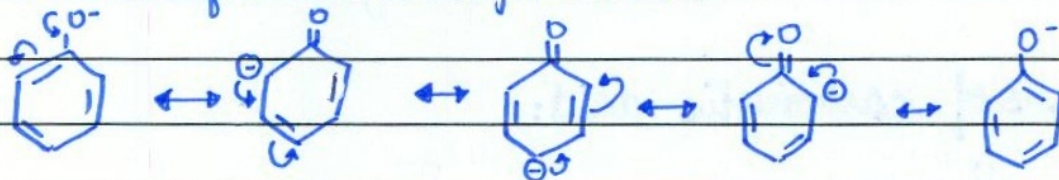
The pKa value of phenol is about 10.

Hydrolysis:



Resonating structures:

It has five resonating structures.



Reason for stability:

Due to the five resonating structures, the stability of phenoxide ion is greatly increased. For the reason that phenoxide ion is stable, phenol becomes acidic.

Q. No. 6 (Page 3)

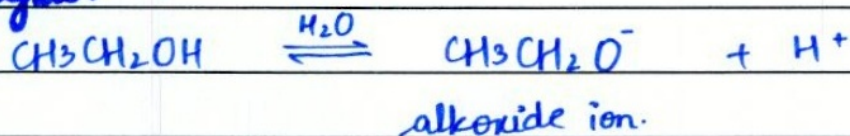
Alcohol:

Alcohol is least acidic among the three.

pKa value:

The pKa value of alcohol is about 16-20

Hydrolysis:



Alkoxide ion:

Because of the electron donating effect of R-group, the stability of alkoxide is reduced. Hence is less acidic.

Stability of Conjugate Base:

Carboxylate ion > phenoxide ion > alkoxide ion.

Acidity:

carboxylic acid > phenol > alcohol.

Alcohol

It has a low acid group pKa

low value:

The pKa value of alcohol is about 16-20

Hydroxide



always low

Alcohol base:

Because of the electron withdrawing effect of the oxygen atom, the acidity of alcohols is reduced, hence the pKa is high.

Acidity of conjugate base:

Conjugate base of alcohol is alkoxide ion

Acidity:

Alcohol is a weak acid

