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Department: MEDICINE &amp; SURGERY

COURSE: CHEM 102

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- a  $\text{HCOOH}$  — Methanoic acid
- b  $\text{HOOCCH}_2\text{CH}_2\text{CH}_2\text{COOH}$  — Pentan-1,5-dioic acid
- c  $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$  — Butanoic acid
- d  $\text{HO}_2\text{C}-\text{CO}_2\text{H}$  — Ethanedioic acid
- e  $(\text{CH}_3(\text{CH}_2)_4\text{COOH})$  — Hexanoic acid
- f  $\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}_2\text{COOH}$  — Hex-4-enoic acid

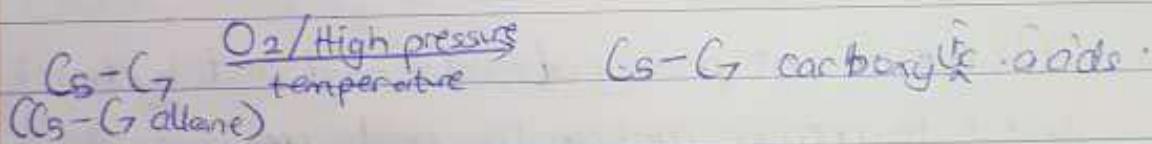
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- i Physical appearance: All simple aliphatic carboxylic acids up to C<sub>6</sub> are liquids at room temperature. Most other carboxylic acids are solids at room temperature although anhydrous carboxylic acid/acetic acid/ glacial ethanoic acid freezes to an ice-like solid below the room temperature.
- ii Boiling point: It increases with increasing relative molecular mass. Aromatic carboxylic acids are crystalline solids and have high melting points than their aliphatic counterparts of comparable relative molecular mass.
- iii Solubility: Lower molecular mass carboxylic acid with up to 4 carbon atoms in their molecules are soluble in water, this is largely due to their ability to form

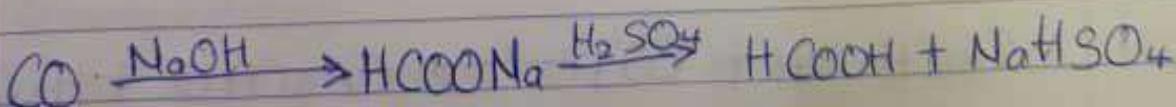
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hydrogen bond with water molecules. The water solubility of the acids decreases as the relative molecular mass increases because the structure becomes relatively more hydrocarbon in nature and covalent. All carboxylic acids are soluble in water.

3i From petroleum: Liquid phase air oxidation of C<sub>5</sub>-C<sub>7</sub> alkanes, obtainable from petroleum at high temperature and pressure will give C<sub>5</sub>-C<sub>7</sub> carboxylic acids with methanoic, propenoic and butane dicarboxylic acids as by-products.



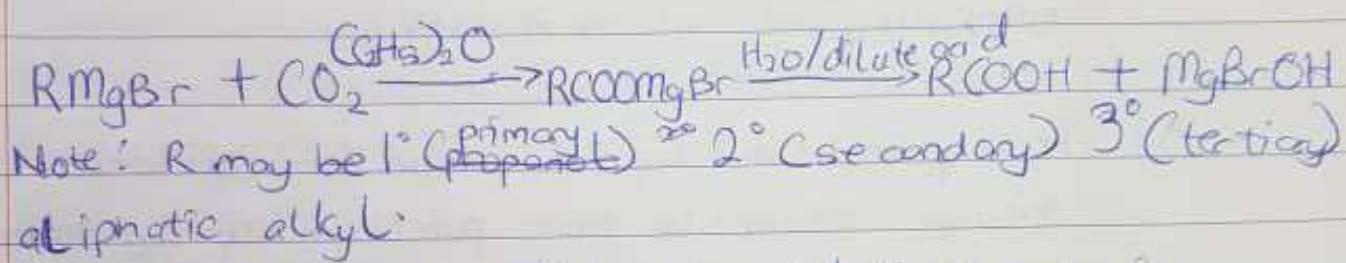
ii From carbon (I) oxide: Methanoic acid is manufactured by adding carbon (I) oxide under pressure to hot aqueous solution of sodium hydroxide. The free carboxylic acid is liberated by careful reaction with tetroxosulfate (IV) acid.



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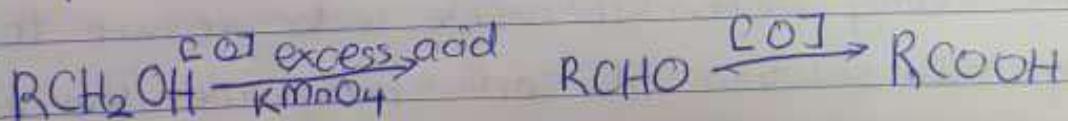
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- i) Carbonation of Grignard reagent: Aliphatic carboxylic acids are obtained by bubbling  $\text{CO}_2$  into the grignard reagent and then hydrolyzed with dilute acid.

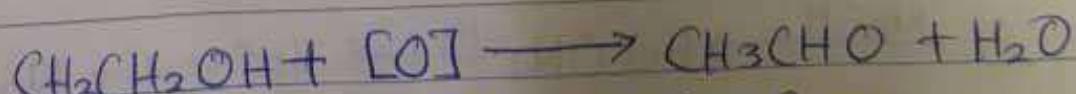


In the preparation of benzoic acid, the reagent is added to solid carbon (IV) oxide which also serves as coolant to the reaction mixture.

- ii) Oxidation of primary alcohols and aldehydes: It can be used to prepare carboxylic acids ~~as~~ using the usual oxidizing agents i.e. potassium dichromate (VI) ( $\text{K}_2\text{Cr}_2\text{O}_7$ ) or potassium manganate (VII) in acidic solution.

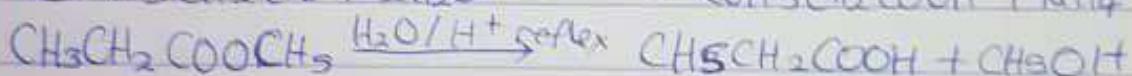
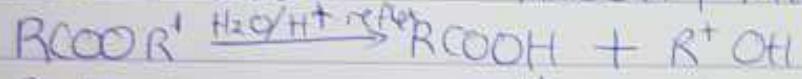
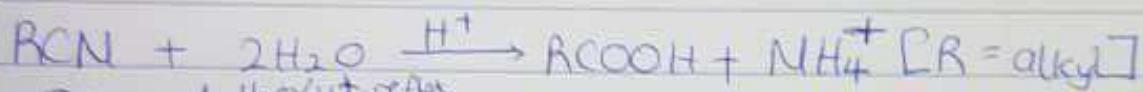


Eg Oxidation of ethanol to ethanoic acid

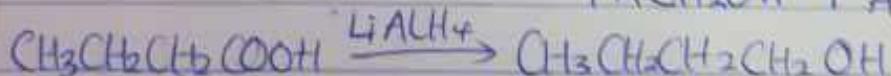
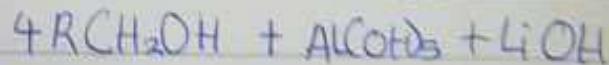
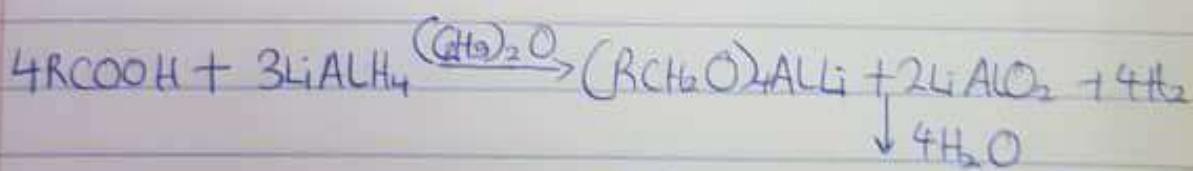


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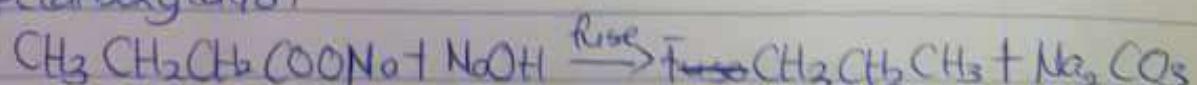
iii Hydrolysis of nitrilesesters: They undergo hydrolysis to form amides. The amides further undergo reaction in the presence of a catalyst which then forms carboxylic acid. The catalyst for this reaction is  $H^+$  or  $OH^-$ . Furthermore, the application of mild reaction condition helps increasing the reaction in the amide stage.



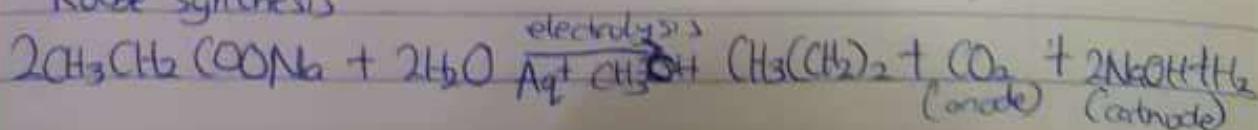
5: Reduction to primary alcohol



ii Decarboxylation



Kolbe synthesis



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iii Esterification

