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19/EN01/017 Petroleum Engineering
CHM102 Assignment

1. HCOOH - Methanoic Acid
 $\text{HOOCCH}_2\text{CH}_2\text{COOH}$ - Pentan-1,5-dioic acid
 $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$ - Butanoic acid
 $\text{H}_2\text{C}=\text{CO}_2\text{H}$ - Ethanoic acid
 $\text{CH}_3(\text{CH}_2)_4\text{COOH}$ - Hexanoic acid
 $\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}_2\text{COOH}$ - Hex-2-enoic acid

2. Physical properties of Carboxylic acid under:

Physical appearance:

All simple aliphatic carboxylic acids up to C_6 are liquid at room temperature. Most other carboxylic acids are solid at room temperature although anhydrous carboxylic acid (acetic acid) also known as glacial acetic acid freezes to an ice-like solid below the room temperature.

Boiling points

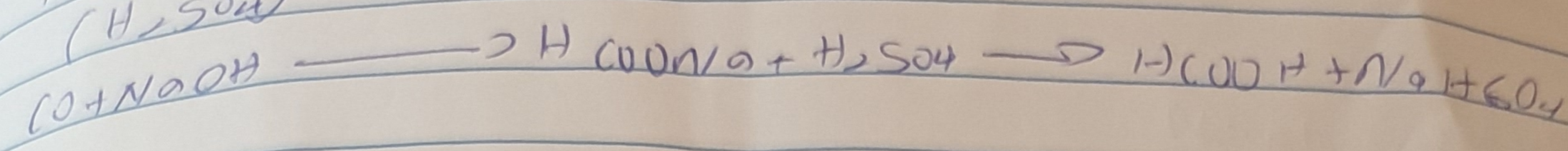
Boiling point increases with increase in relative molecular mass. Aromatic carboxylic acids are crystalline solids and have higher melting points than their aliphatic counterparts of relative molecular mass.

Solubility

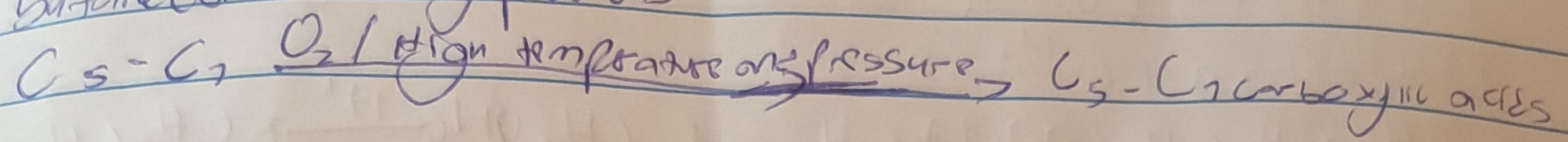
Lower molecular mass carboxylic acid with up to four carbon atoms are soluble in water, this largely due to their ability to form hydrogen bonds with water molecules. The water solubility of the acids decreases as the relative molecular mass increases because the structure becomes relatively more hydrocarbon in nature hence compound. All carboxylic acids are soluble in organic solvents.

Industrial Preparations

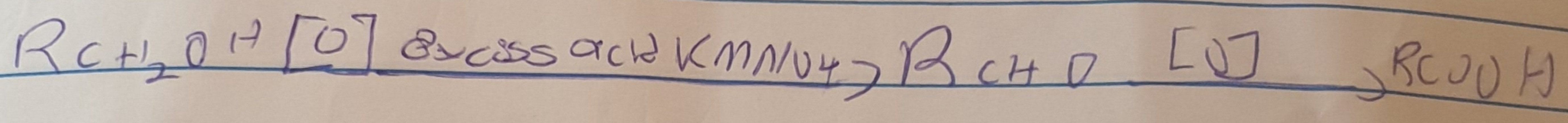
i) From carbon(II) oxide: Methanoic acid is manufactured by adding carbon(II) oxide under pressure to hot aqueous solution of sodium hydroxide. The free carboxylic acid is separated by careful reaction with tetraoxosulphate(VI) acid (H₂SO₄)



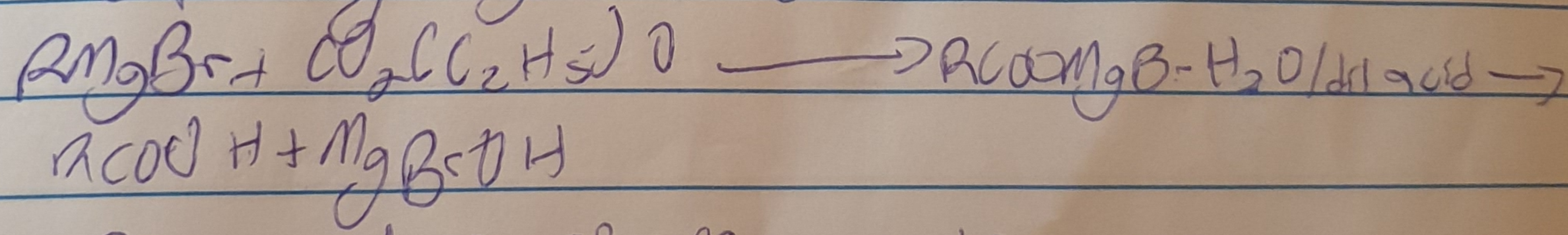
ii) From petroleum: Liquid phase oxidation of C₅-C₇ alkanes at high temperature and pressure will give C₅-C₇ carboxylic acids with methanoic, propanoic and butanedioic acids by products



iii) Oxidation of primary alcohols and aldehydes: Oxidation of primary alcohols and aldehydes can be used to prepare carboxylic acids using the usual oxidizing agents like K₂Cr₂O₇ or KMnO₄ in acidic solution



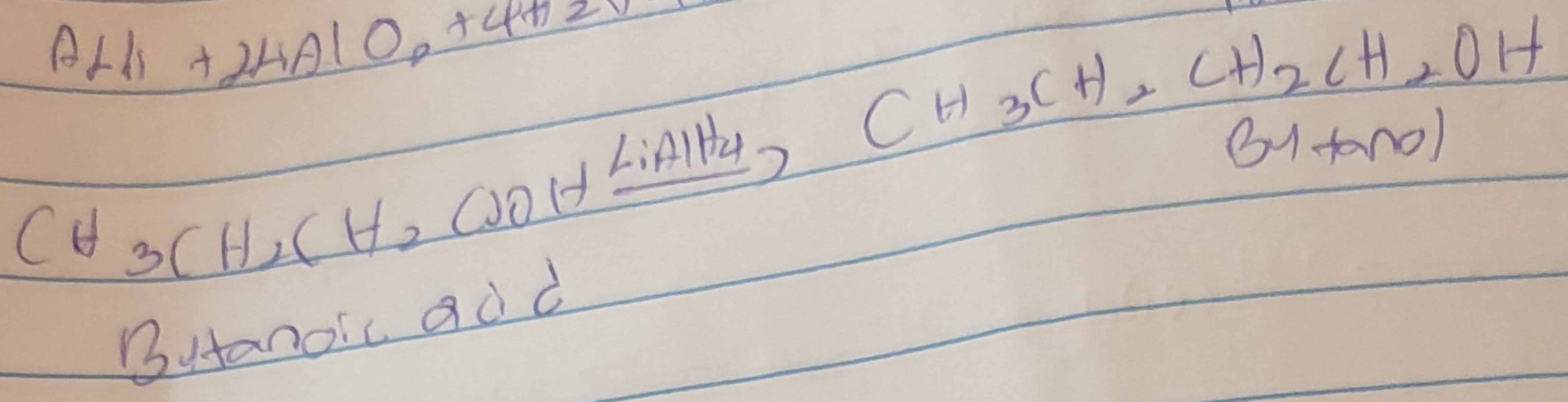
iv) Carbonation of Grignard reagent: Aliphatic carboxylic acids are obtained by bubbling carbon(II) oxide into the Grignard reagent and then hydrolyzed with dilute acid



R may be 1^o, 2^o, 3^o aliphatic alkyl or aryl radical.

5. Chemical reaction: $4RCOOH + 3AlH_4 + (C_2H_5)_2O \rightarrow$

i) Reduction of primary alcohol: $4RCHO + AlH_4 + H_2O \rightarrow 4RCH_2OH + Al(OH)_3 + 2H_2$



ii) Decarboxylation: $2CH_3CH_2COONa + NaOH \xrightarrow{heat} CH_3CH_2CH_3 + Na_2CO_3$

iii) Esterification of carboxylic acids:
 $CH_3CH_2CH_2COOH + CH_3CH_2CH_2COOH \xrightarrow{H^+} CH_3CH_2CH_2COOCH_2CH_2CH_3 + H_2O$
 $CH_3CH_2CH_2COOH + CH_3CH_2CH_2OH \xrightarrow{H^+} CH_3CH_2CH_2COOCH_2CH_2CH_3 + H_2O$