Q. No. 2 Part (i) CONDITIONS FOR EQUILIBRIUM:

Following are the necessary conditions for chemical equilibrium:

1. Closed Container: Equilibrium is established in a closed container:
2. Concentration: Concentration of products and reactants should not be changed.
3. Temperature: Temperature of the system should be kept constant.
4. Volume/Pressure: Volume and pressure of the system should be kept constant. $\left(P \propto \frac{1}{V}\right)$

Q. No. 2 Part (ii)

a. $HCN + H_2O \rightleftharpoons H_3O^+ + CN^-$

Bronsted Acid: **HCN** as it is a proton donar.

Bronsted Base: **H_2O** as it is proton acceptor

b. $H_2O + CO_3^{-2} \rightleftharpoons HCO_3^- + OH^-$

Bronsted Acid: **H_2O** as it is a proton donar. (H^+)

Bronsted Base: **CO_3^{-2}** as it is a proton acceptor.

c. $HS^- + H_2O \rightleftharpoons S^{-2} + H_3O^+$

Bronsted Acid: **HS^-** as it is a proton donar.

Bronsted Base: **H_2O** as it is a proton acceptor.

Q. No. 2 Part (iii) FORMATION OF CALCIUM CARBONATE:

Word Equation:

Carbonic acid + Calcium hydroxide → Calcium carbonate + Water

Chemical Equation:

$$H_2CO_3 + Ca(OH)_2 \longrightarrow CaCO_3 + H_2O$$

Balanced Equation:

$$H_2CO_{3(aq)} + Ca(OH)_{2(aq)} \longrightarrow CaCO_{3(s)} + H_2O$$

Q. No. 2 Part (iv)

a. $CH_3-C\equiv CH$

Name: Propyne

Functional Group: Alkyne (triple bond)

$R-C\equiv C-R'$

b. $CH_3CH_2-\overset{\overset{O}{\|}}{C}-H$

Name: Propanal

Functional Group: Aldehyde

$R-\overset{\overset{O}{\|}}{C}-H$

c. $CH_3-CH_2-O-CH_3$

Name: Ethyl methyl ether

Functional Group: Ether

$R-O-R'$

Q. No. 2 Part (v) HEXANE:

MOLECULAR FORMULA:

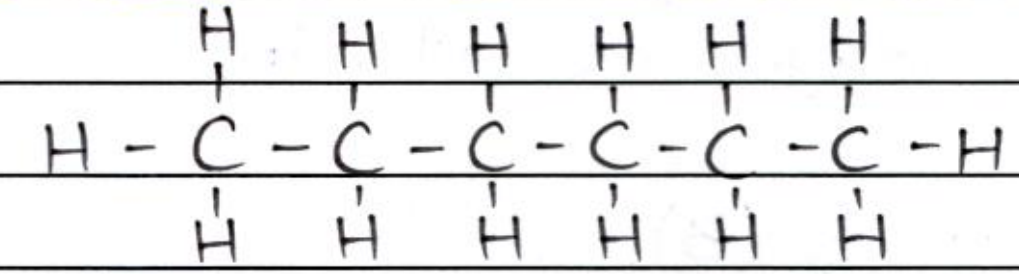
= C_nH_{2n+2} ; n = 6 (hex-)

= $C_{(6)}H_{2(6)+2}$

= C_6H_{12+2}

= C_6H_{14}

STRUCTURAL FORMULA:



CONDENSED STRUCTURAL FORMULA:

$H_3C-CH_2-CH_2-CH_2-CH_2-CH_3$

Q. No. 2 Part (vi)

REDUCTION OF ALKYL HALIDE:

a. $CH_3-Cl + 2[H] \xrightarrow[HCl_{(aq)}]{Zn} HCl + CH_4$ (methane)

(methyl chloride) (hydrochloric acid)

HYDROGENATION OF ALKENE:

b. $CH_2=CH-CH_3 + H_2 \xrightarrow[200-300^{\circ}C]{Ni} CH_3-CH_2-CH_3$

(propene) (propane)

Q. No. 2 Part (vii)

$$CH_2=CH-Cl + KOH \xrightarrow{\text{alcohol}} KCl + H_2O + \underset{\text{(ethyne)}}{CH\equiv CH} \quad (A)$$

$$CH\equiv CH \xrightarrow[Ni\,(200-300^\circ C)]{H_2} \underset{\text{(ethene)}}{CH_2=CH_2} \quad (B)$$

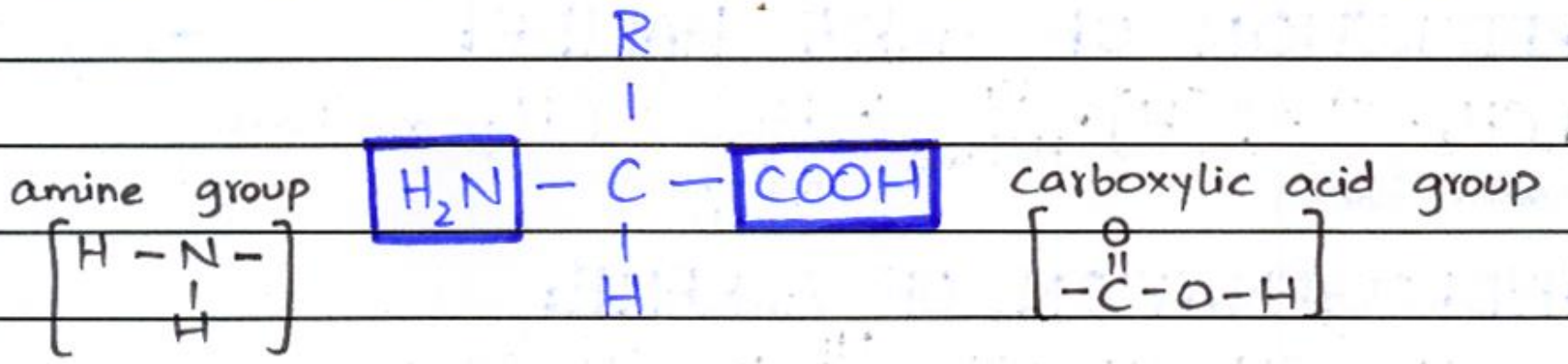
If two molecules of hydrogen are added:

$$CH\equiv CH \xrightarrow[Ni(200-300^\circ C)]{2\,H_2} \underset{\text{(ethane)}}{CH_3-CH_3} \quad (B)$$

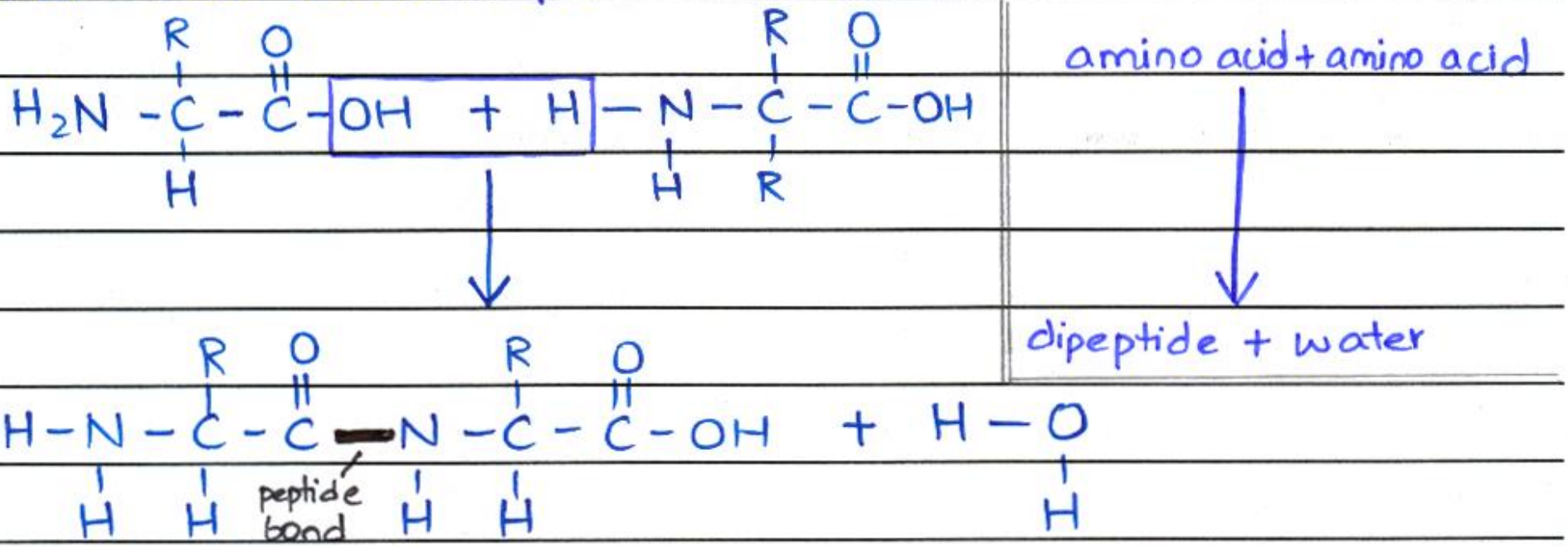
A: Ethyne

B: Ethene

Q. No. 2 Part (ix) FUNCTIONAL GROUP IN AMINO ACID:



PEPTIDE LINKAGE:



Q. No. 2 Part (X) HARMFUL EFFECTS OF NO_2 :

Nitrogen dioxide (NO_2) is a reddish brown toxic gas which is soluble in water.

Its harmful effects are:

- Headache
- Nausea
- Breathing difficulty
- Lung cancer
- Greenhouse effect (Global Warming)
- Acid Rain ($4NO_2 + O_2 + 2H_2O \rightarrow 4HNO_3$)

Q. No. 2 Part (xii) **STRANGE BEHAVIOUR OF WATER:**

Density of most liquids decreases on heating and increases on cooling. Water does not behave as such.

Anamolous Behaviour of Water:

On cooling, the density of water increases upto 4°C. Upon further cooling, its density decreases and it expands.

Thus maximum density of water is at 4°C.

This behaviour of water is called anamolous expansion.

Advantage:

Ice has less density than water so it floats on top and acts as thermal insulator, allowing fishes and aquatic organisms to survive in winter.

Q. No. 2 Part (xv) REACTION OF METHANE & CHLORINE:

Chlorine reacts explosively with methane in presence of direct sunlight.

$$CH_{4(g)} + 2Cl_{2(g)} \xrightarrow{\text{strong sunlight}} C_{(s)} + 4HCl$$

REACTIVITY OF HALOGENS WITH ALKANES:

Trend of reactivity of halogens with alkanes is:

$$F_2 > Cl_2 > Br_2 > I_2$$

Reactivity of Flourine: F_2 reacts explosively with alkanes

Reactivity of Chlorine: Cl_2 reacts slowly in a dark room at low temperature but strongly in strong sunlight.

Reactivity of Bromine: Br_2 requires strong temperature and sunlight to react with alkanes.

Reactivity of Iodine: I_2 is essentially non-reactive.

Q. No. 2 Part ( )

Q. No. 4 Part (a) (Page 1/2)

REMOVAL OF TEMPORARY WATER HARDNESS:

Temporary Hardness of Water:

Hardness of water caused by calcium or magnesium hydrogen carbonates which can be removed by boiling is called temporary hardness of water.

Methods to Remove Temporary Hardness:

There are two methods to remove the temporary hardness of water:

- By boiling
- By adding slaked lime [$Ca(OH)_2$] "Clark's Method"

1. BY BOILING:

Process:

On heating, the soluble bicarbonates are converted into insoluble carbonates, releasing carbon dioxide and eliminating water.

Equation:

$$M(HCO_3)_{2(aq)} \xrightarrow{heat} MCO_{3(s)} + CO_{2(g)} + H_2O$$

where M = calcium or magnesium

Examples:

i. $Ca(HCO_3)_{2(aq)} \xrightarrow{heat} \underset{(calcium\ carbonate)}{CaCO_{3(s)}} + H_2O + CO_{2(g)}$

(calcium bicarbonate)

ii. $Mg(HCO_3)_{2(aq)} \xrightarrow{heat} \underset{(magnesium\ carbonate)}{MgCO_{3(s)}} + H_2O + CO_{2(g)}$

(magnesium bicarbonate)

Disadvantage:

Boiling water is impractical so it is not used to remove temporary hardness of water on large scale as huge amounts of energy is required to boil water.

2. BY CLARK'S METHOD:

(Adding slaked lime – $Ca(OH)_2$)

Process:

Suitable amount of slaked lime [$Ca(OH)_2$] is added in temporary hard water. It reacts with insoluble bicarbonates to form insoluble carbonates

Equation:

$$M(HCO_3)_{2(aq)} + Ca(OH)_{2(aq)} \longrightarrow CaCO_{3(s)} + MCO_{3(s)} + 2H_2O_{(l)}$$

where M= calcium or magnesium

Examples:

i. $Ca(HCO_3)_{2(aq)} + Ca(OH)_{2(aq)} \rightarrow 2\,CaCO_{3(s)} + 2H_2O_{(l)}$

ii. $Mg(HCO_3)_{2(aq)} + Ca(OH)_{2(aq)} \longrightarrow CaCO_{3(s)} + MgCO_{3(s)} + 2H_2O_{(l)}$

Q. No. 4 Part (b) (Page 1/2)

LAYERS OF ATMOSPHERE:

Atmosphere consists of four layers:

1. Troposphere
2. Stratosphere
3. Mesosphere
4. Thermosphere

TROPOSPHERE:

The layer closest to Earth's surface is called troposphere

Tropo- :

'Tropo-' means 'changing' or 'turning'

Range:

It extends from earth's surface to 12 km above the ground

Temperature:

Temperature of troposphere is 17°C to -55°C For everage 1 km rise in altitude, the temperature gets about 6.5°C cooler.

Atmospheric Mass:

Troposphere contains most of the mass of the atmosphere (75 - 80 %)

Weather and Climate:

⇒ Weather occurs in troposphere.

⇒ Most of the water vapours and dust particles are present in this layer.

⇒ Clouds are present in this layer.

Aeroplanes:

Aeroplanes fly in troposphere.

STRATOSPHERE:

It is the second layer of atmosphere and second closest to Earth's surface.

Strato- :

'Strato-' means 'layered' or 'spread-out'.

Range:

It extends from 12 km to 50 km above the earth's surface.

Temperature:

Temperature range of stratosphere is from -55°C to -5°C.

The upper stratosphere has increased temperature due to presence of ozone.

Ozone:

Stratosphere contains largest amount of ozone, about 10 ppm (particles per million)

Ozone is responsible for rise in temperature of stratosphere.

When sunlight strikes ozone, it converts the U.V rays into heat energy.

Protection from U.V. Rays:

Ozone protects us from the ultraviolet radiations of the sun which are harmful for life on Earth.

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Q. No.3 Part (b) (Page 1/2)

LEWIS CONCEPT OF ACIDS & BASES:

History:

It was presented in 1923 by Lewis

Focus:

This theory focuses on acid-base reactions.

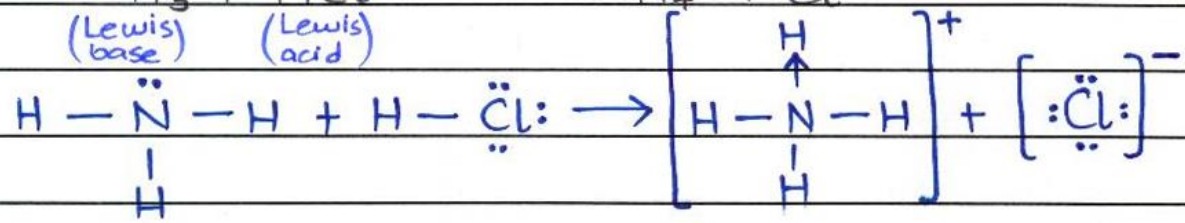
LEWIS ACID:

Definition:

A substance that can accept a pair of electrons to form co-ordinate covalent bond is a Lewis acid. It is electron-deficient species.

Example:

$$\underset{\text{(Lewis base)}}{NH_3} + \underset{\text{(Lewis acid)}}{HCl} \longrightarrow \underset{\text{(conjugate acid)}}{NH_4^+} + \underset{\text{(conjugate base)}}{Cl^-}$$



As HCl accepts an electron pair to form co-ordinate covalent bond, it is Lewis acid

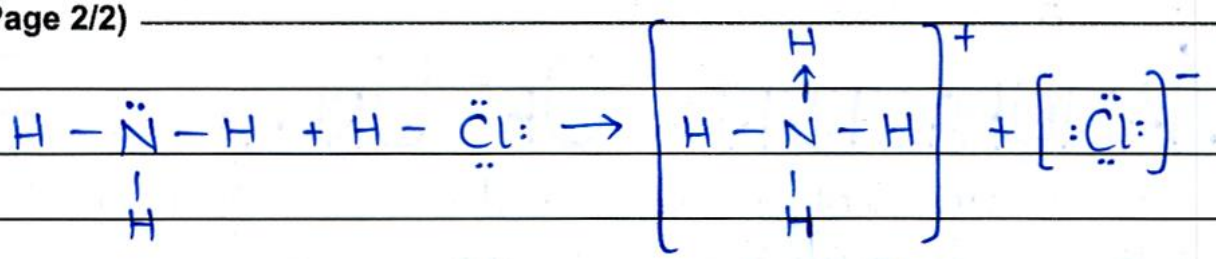
LEWIS BASE:

Definition:

A substance that can donate a pair of electrons to form co-ordinate covalent bond is a Lewis base. It is electron-rich species

Example:

$$\underset{\text{(Lewis base)}}{NH_3} + \underset{\text{(Lewis acid)}}{HCl} \longrightarrow \underset{\text{(Conjugate acid)}}{NH_4^+} + \underset{\text{(Conjugate base)}}{Cl^-}$$

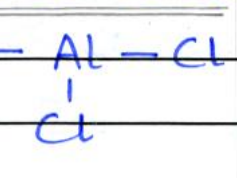


As NH_3 donates an electron pair to form co-ordinate covalent bond, it is Lewis base.

CLASSIFICATION:

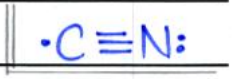
i. $AlCl_3$

It is a Lewis acid as it has incomplete octet and can accept an electron pair to form co-ordinate covalent bond.



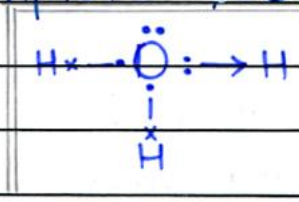
ii. CN^-

It is a Lewis base as it has complete octet and can donate an electron pair to form co-ordinate covalent bond.



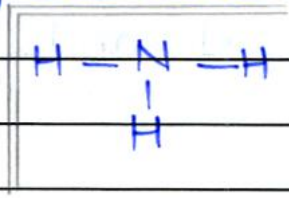
iii. H_3O^+

It is Lewis base as it has complete octet and can accomodate to donate an electron-pair



iv. NH_3

It is Lewis base as it has complete octet and can donate an electron pair to form coordinate covalent bond.



Q. No. 3 Part (a) (Page 1/2)

MANUFACTURE OF UREA:

Urea is an important synthetic fertilizer which is manufacture on large scale in industries.

RAW MATERIALS:

1. Ammonia (NH_3)
2. Carbon dioxide (CO_2)

PROCESS:

1. Reaction of NH_3 and CO_2:

$$2NH_3 + CO_2 \rightarrow H_2N-\overset{\overset{O}{\|}}{C}-O-NH_4$$

(ammonium carbamate)

2. Distillation of Ammonium Carbamate:

$$H_2N-\overset{\overset{O}{\|}}{C}-O-NH_4 \xrightarrow{heat} H_2N-\overset{\overset{O}{\|}}{C}-NH_2 + H_2O$$

(urea)

3. Evaporation of Liquid Urea and Granulation:

Liquid urea is sent to vacuum evaporaters and then cooled to form granules. Then it is sent to prilling towers to be prilled, packaged and marketed.

USES AND IMPORTANCE OF UREA:

1. Urea is a synthetic fertilizer which provides essential elements to soil for plant growth.

2. Urea contains highest percentage of nitrogen in all synthetic fertilizers i.e. 46.6%.

3. Urea does not affect the texture of soil.

4. In soil, urea hydrolyses quickly to form ammonium carbamate which is broken down into NH_3 which decomposes into N_2 and H_2.

5. Urea provides nitrogen to plants which is important because:
⇒ It is part of chlorophyll.
⇒ It is part of proteins.
⇒ It gives green colour to leaves.

6. Urea is an organic compound which is used as starting material for other compounds like:
⇒ Ammonia
⇒ Polypeptides

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