CONCEPTS OF ACIDS AND BASES

The concepts of an acid and a base are ancient ones that modern chemical sciences has adopted and refined. The item acid originate from the Latin word "Acidos" meaning sour while the term alkali is an Arabic word for the ashes that comes from burning certain plants. Acid has long been recognize as a distinctive class compound whose aqueous solution exhibit some properties namely:

1. Characteristics sour taste
2. Ability to change the color of litmus from blue to red.
3. Reaction with bases to form salt and water.

Now the word alkali is synonymous with bases and has long been associated with classes of compound whose aqueous salts are extended by a bitter taste, a soapy feeling when applied to the solution, ability to restore the original blue color of litmus that has been turned red by acids and the ability to react with acids to form salt.

ACID – BASE CONCCEPT

Some call it acid –base theories. It should first be noted that the so – called acid – base theories are in reality definition of what an acid and a base is. They are not actual theory in the sense of valence bond or molecular orbital theory e.t.c. The difference between the various acid – base concept is based on which is most convenient to use in a particular situation.

Arrhenius concept

This was formulated in 1890 by the Swedish chemist, Svante Arrhenius, according to this theory, an acidic substance is one in which molecular unit contain at least one hydrogen atom that can dissociate or ionize when dissolve In water producing a hydrated H^+ and an anion.

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Example

$HCL \rightarrow H^+ + CL^-$

$CH_3COOH \rightarrow H^+ + H_3CCOO^-$

An Arrhenius acid must therefore contain hydrogen. However there are substances that do not themselves contain hydrogen but still yield H^+ when dissolve in water. E.g BF_3.

A more operational definition of Arrhenius acid is that it is a substance that yield an excess of hydrogen ions when dissolves in water. Some important point to be understood about Hydrogen in acids are as follows...

- Although all Arrhenius acid containing hydrogen, not all hydrogen atoms in a substance are capable of dissociating. E.g the CH_3 .hydrogen atoms in acetic acid are non – acidic.
- Those hydrogen that do dissociate can do so to different degrees. Acid such as HCL and HNO_3 are effectively 100% dissociated in solution and are thus called or categorize as strong acids. However, most organic acid such as CH_3COOH are weak acids and only a small fraction of the acid are dissociated in moist solution. Other examples of weak acids are inorganic acids as HF and HCN.
- Acids that possess more than one dissociable hydrogen atoms are known as polyprotic acids. E.g sulphuric acids H_2SO and phosphoric acid H_3PO_4. They are strong acids because they 100% ionize or dissociate in water.

BASE

Just as an Arrhenius acid liberate hydrogen ion into a solution, an Arrhenius base yields hydroxide ion when dissolved in H_2O

$NaOH \rightarrow Na^+ + OH^-$.

CONCEPTS OF ACIDS AND BASES

Here, NaOH is an Arrhenius base because it contain OH^-. However, other substances which do not contain hydroxides ion can nevertheless produce them by reactions with water and are therefore classified as bases.

Two classes of such substances are the metal oxides and the hydrogen compound of certain non- metal.

E.g

$Na_2O + H2O \rightarrow 2NaOH \rightarrow 2Na^+ + 2OH^-$

$NH_3 + H2O \rightarrow NH_4^+ + OH^-$

BRWOSTED LOWRY CONCEPT

This concept was formulated in 1923 by Johannes Nicolaus BrΘnsted and Martin Lowry.

They define acids as substances that will gives us a proton to a base. i.e are proton donor.

While bases are substances that accept proton from an acid. i.e proton acceptor.

Note that for aqueous solution, the browsted lowry definition does not defile appreciably from Arrhenius definition of hydrogen ion (acid) and hydroxide ion (base).

$HA + B \rightarrow BH^+ + A^-$

↓

H^+ donor (ACID) H^+ acceptor (BASE)

In this regards. The ionizations of an acid by water is just one example of acid – base reaction.

$HCL + H_2O \rightarrow H_3O^+ + CL^-$

↓ ↓ ↓

Acid Base Conjugate acid conjugate base

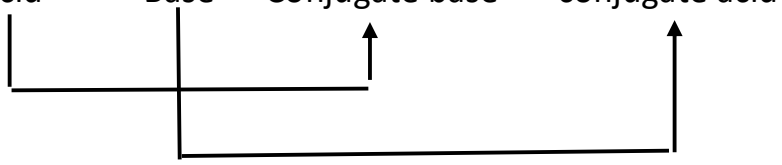
CONCEPTS OF ACIDS AND BASES

Conjugate acid – base pair

Chemical species with formulas that differ by one proton are known as conjugate acid – base pair. It should be noted that the stronger acid and the stronger base of each conjugate acid – base pairs react to form the weaker acid and base.

1. $HC_2H_3O_2 + H_2O \rightarrow C_2H_3O_2^- + H_3O^+$

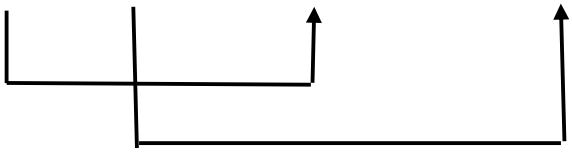
Acid Base Conjugate base conjugate acid



Conjugate acid – base pair

2. $HF + SO_3^{2-} \rightarrow F^- + HSO_3^- \downarrow$

ACID BASE Conjugate base conjugate acid



Conjugate acid – base pair

Please the continuation of this will be in a picture form. Just to save time.

Omo stat test dey o…lol

Scroll down for the rest of the examples and exercise. Then some note underneath. Thanks for your understanding.

I am Steve stemma

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(2) $HF + SO_3^{2-} \longrightarrow F^- + HSO_3^-$

Acid base

Conjugate acid-base pair

(3) Water as an acid/base (i.e Auto-ionization). This dissociation is the auto ionization of water

$H_2O \longrightarrow H^+ + OH^-$

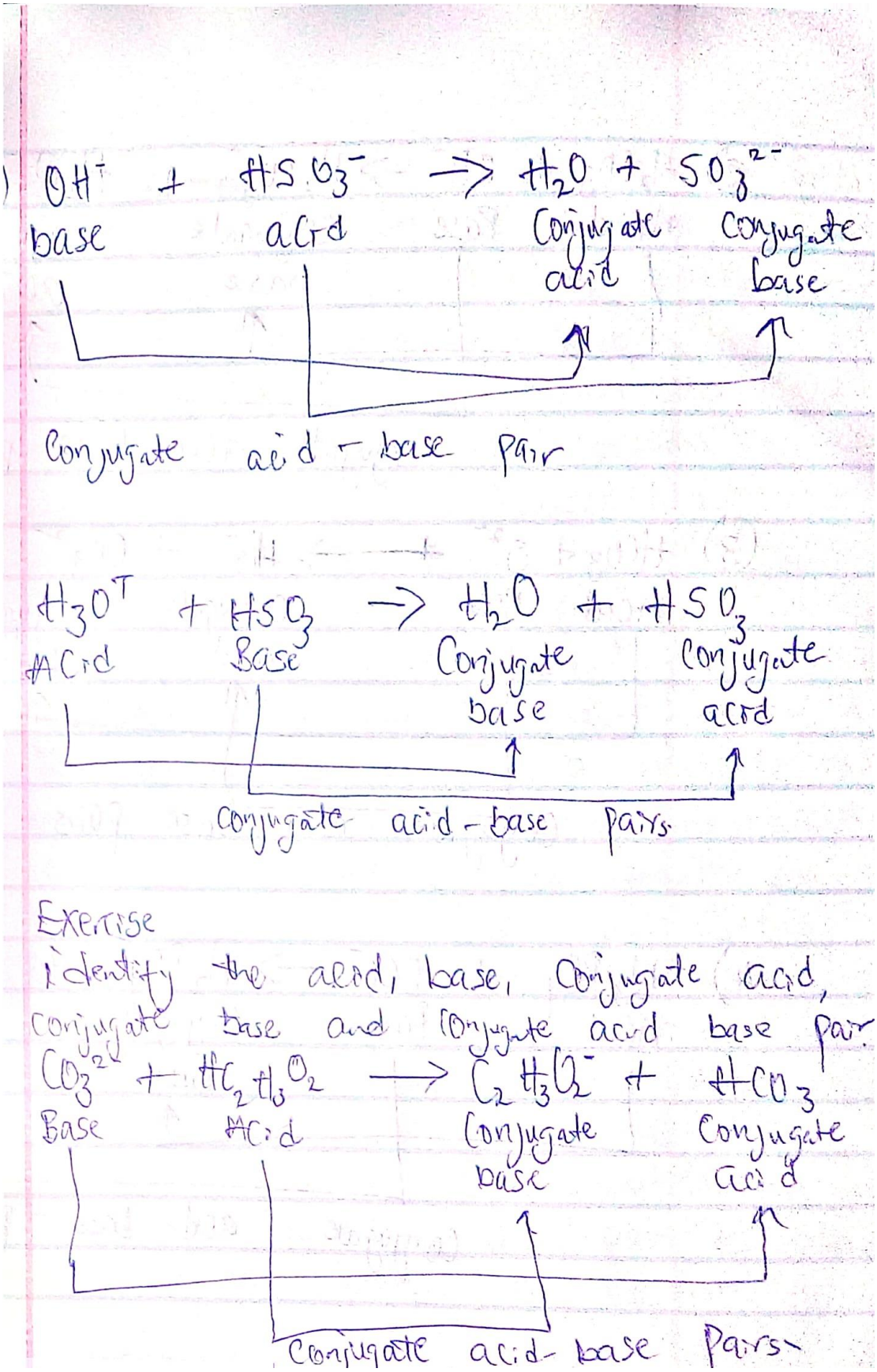
Examples

$H_2O + H_2O \longrightarrow OH^- + H_3O^+$

Acid Base Conjugate base Conjugate acid

Conjugate acid-base pair

CONCEPTS OF ACIDS AND BASES



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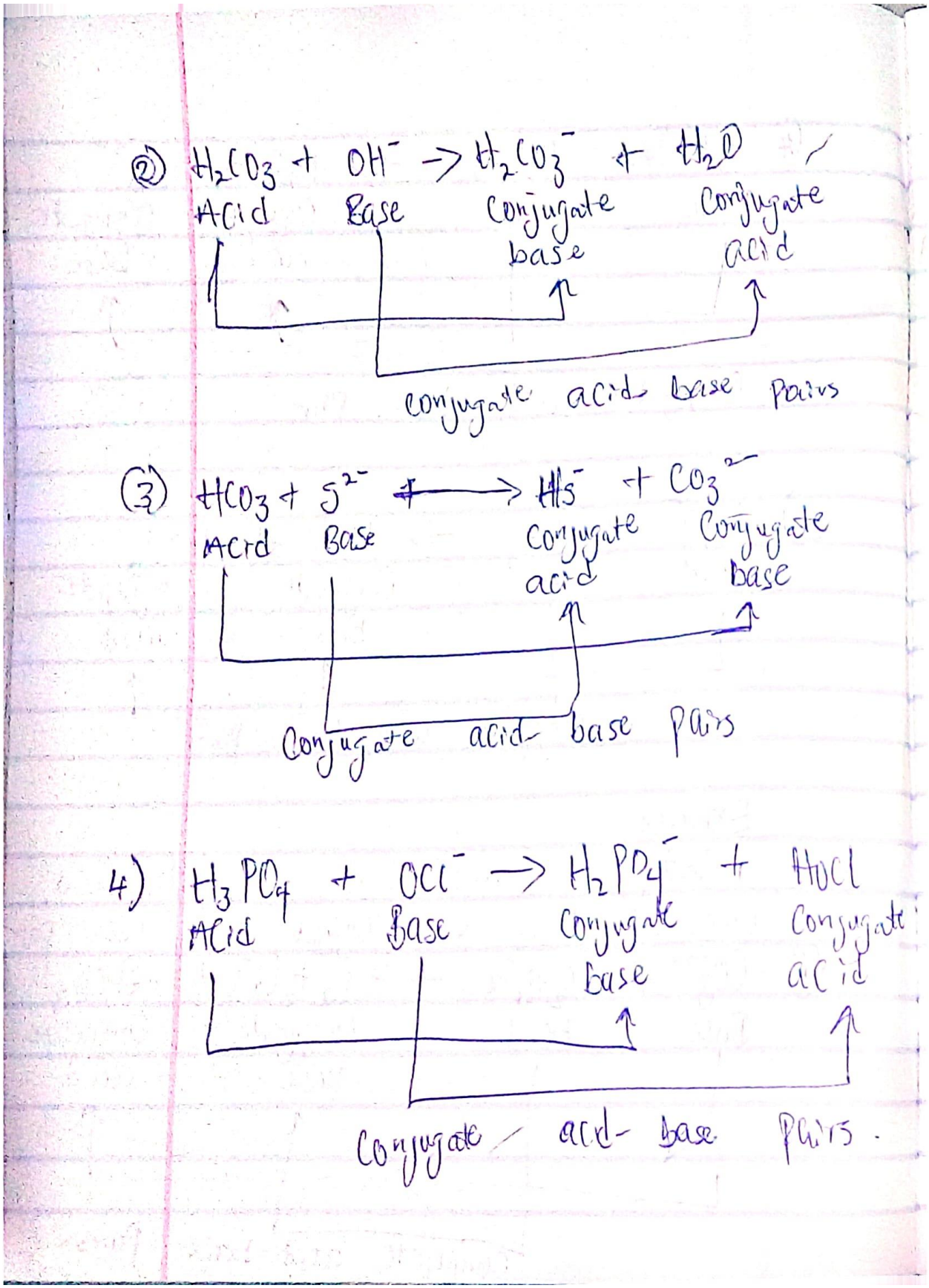


CONCEPTS OF ACIDS AND BASES

This was formulated in 1923 by G.N Lewis. He proposed a definition of acid base behavior in terms of election pair donation and acceptance. The Lewis definition is perhaps the most widely used of all acid base concept because of its simplicity and wide acceptability.

Accordingly, he define an acid as a substance that accept a pair of electron to form a substance that coordinate covalent bond while a base is a substance that donate a pair of electron to form coordinate covalent bond. Since a base can accept a proton because it can donate an electron pair. All Lewis bases are browsted bases and vice – versa.

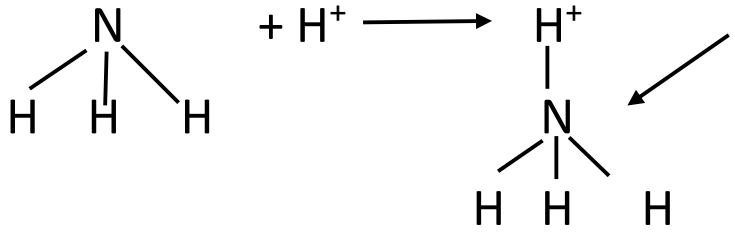
Lewis definition of acid however include compounds which do not have the tendency to donate protons. E.g. BF_3, $AlCl_3$, BCl_3 e.t.c These substances are capable of accepting lone pair of electrons by the presence of electron deficient metal atoms.

$BF_3 + NH_3 \rightarrow F_3B^- + NH_3^-$

A general illustration of Lewis acid and Lewis base concept is as follows

$A^+ \quad + \quad B^- \quad \rightarrow \quad A - B$

LEWIS ACID LEWIS BASE Coordinate covalent bond.



Coordinate covalent bond