Pakistan School
Kingdom of Bahrain

Grade :10th

Subject: Chemistry

Welcome to
E-Learning

ImaanBoosters

#seekingknowledge


CHEMISTRY
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Periodic Table of the Elements

1												13	14	15	16	17	18
1 H 1.01	2																2 He 4.00
3 Li 6.94	4 Be 9.01											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.30	3	4	5	6	7	8	9	10	11	12	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95
19 K 30.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.61	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (97.91)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.75	52 Te 127.60	53 I 126.90	54 Xe 131.29
55 Cs 132.91	56 Ba 137.33	57 La 138.91	72 Hf 178.49	73 Ta 180.95	74 W 183.85	75 Re 186.21	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po (208.98)	85 At (209.99)	86 Rn (222.02)
87 Fr (223.02)	88 Ra (226.03)	89 Ac (227.03)	104 Rf (261.11)	105 Ha (262.11)	106 Sg (263.12)												

58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (144.91)	62 Sm 150.36	63 Eu 151.97	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04	71 Lu 174.97
90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np (237.05)	94 Pu (244.06)	95 Am (243.06)	96 Cm (247.07)	97 Bk (247.07)	98 Cf (251.08)	99 Es (252.08)	100 Fm (257.10)	101 Md (258.10)	102 No (259.10)	103 Lr (262.11)

Virtual Classroom Rules

Select a quiet place to study.

Be on time.

Come to class prepared in every way to learn and participate.

Virtual Classroom Rules

Be respectful.

Listen to & follow directions.

Turn off your video before joining the class.

I hope you will follow all the above mentioned rules to make your dear teacher happy.

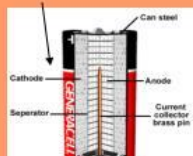
ENGAGING STARTER

STARTER What are the similarities between these substances?

What are the differences?

Acids

Alkalis



TOPIC:

COMPARISON BETWEEN :

- **Arrhenius Theory**
- **Bronsted Lowery theory**
- **Lewis Theory**

Lesson Objectives:

- **By the end of this lesson, students will be able to:**

- **Describe Arrhenius ,Bronsted Lowery and Lewis concept of Acids and Bases.**
- **Differentiae Arrhenius ,Bronsted Lowery and Lewis concept of Acids and Bases.**
- **Recognise Arrhenius ,Bronsted Lowery and Lewis Acids and Bases.**

Arrhenius theory

Introduction:

In 1887,a Swedish chemist Svante Arrhenius proposed the first successful theory of acids and bases .

Statement:

According to this theory,

ACID An acid is a substance that ionizes in water to produce H^+ ions.

Example:

$$HCl \rightarrow H^+ + Cl^-$$

$$HNO_3 \rightarrow H^+ + NO_3^{-1}$$

BASE A base is a substance that ionizes in water to produce OH^- ions.

Example:

$$NaOH \rightarrow Na^+ + OH^{-1}$$

$$KOH \rightarrow K^+ + OH^{-1}$$

Arrhenius Examples

- **Arrhenius Acids:**
  - $HCl \rightarrow H^+ + Cl^-$
  - $HNO_3 \rightarrow H^+ + NO_3^-$
- **Arrhenius Bases:**
  - $NaOH \rightarrow Na^+ + OH^-$
  - $Ca(OH)_2 \rightarrow Ca^{2+} + 2OH^-$


Cl^-
H^+
Na^+
OH^-

Activity

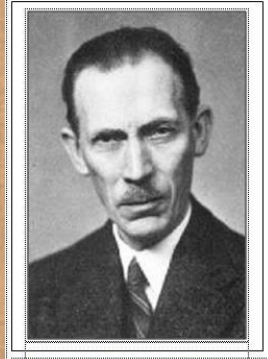
- **Q: Write equations showing the ionization of of the following as Arrhenius acids.**
- **a) HI b) H_2SO_4**

- **Q: Write equations showing the ionization of the following as Arrhenius Bases.**
- **a) $Mg(OH)_2$ b) $Zn(OH)_2$**

Limitations:

- Arrhenius theory has its limitations .It applies to aqueous solutions. It does not explain why compounds such as CO_2 , SO_2 etc are acids .Why substance like NH_3 are bases? There is no H in CO_2 and OH in NH_3
- **Dissatisfaction of Arrhenius theory(Defects):**
- i) There are certain substances which do not give H^+ ions but still they are acidic in solution. e.g. $AlCl_3$
- ii) There are substances which do not give OH^- ions in H_2O but are basic in nature.

Bronsted-Lowery theory


Johannes Nicolaus Bronsted


Thomas Martin Lowry

Introduction:

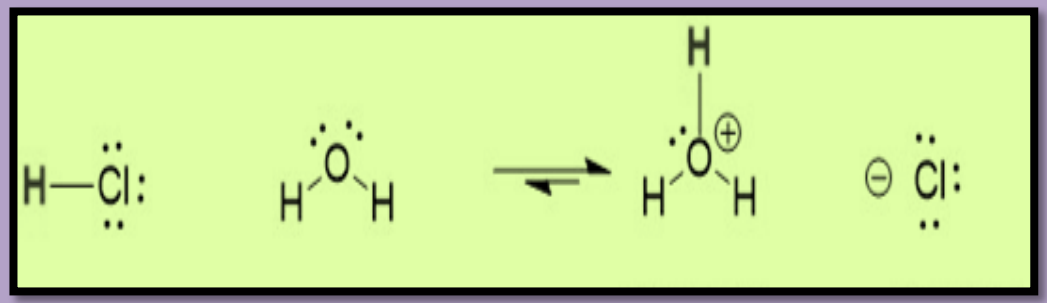
In 1923 J.N Bronsted and T.M Lowery independently proposed another theory to overcome the shortcomings of Arrhenius theory this theory is known as Bronsted Lowery theory.

Statement:

According to this theory:

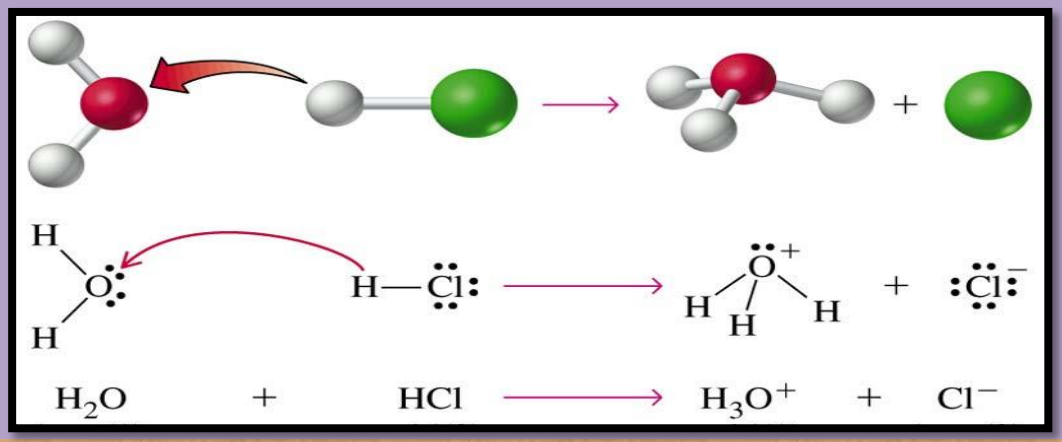
ACID ⟶ An acid it is a Proton Donor

BASE ⟶ A base is a Proton acceptor

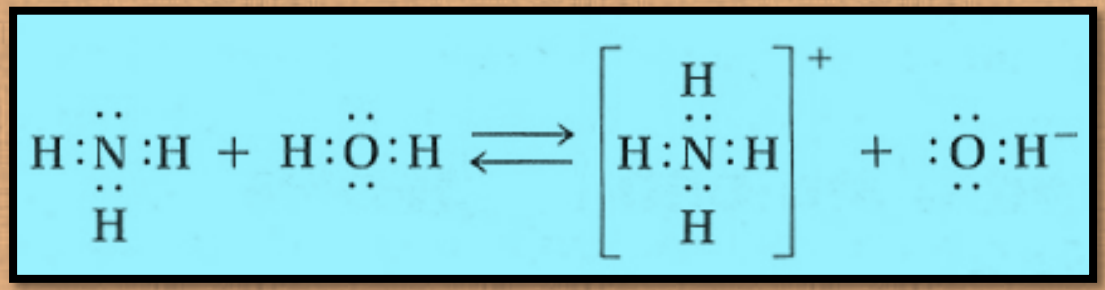


Example: (1)

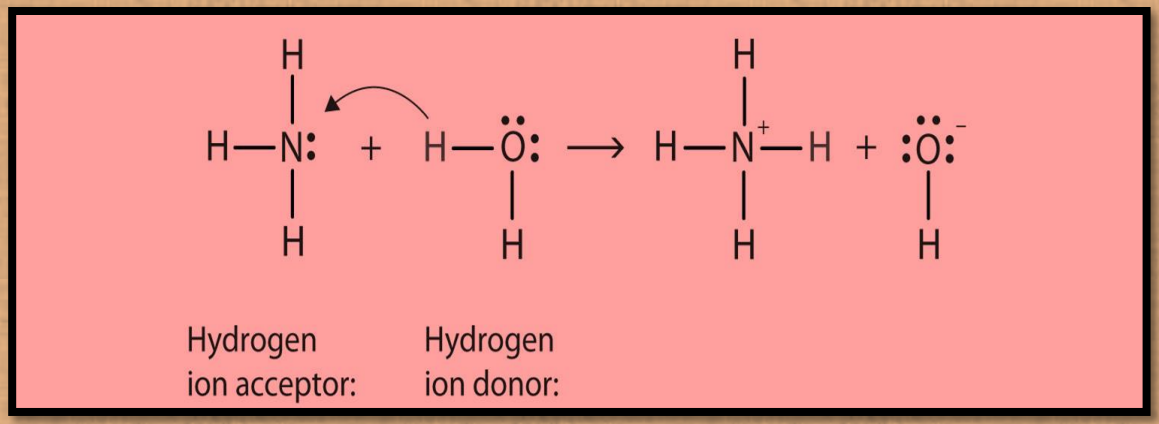
Consider the following example:



Example: (2)



MECHANISM:



Limitations:

Consider above two examples. In one example water molecule acccept a Proton and and in the other water donates a Proton. This means water behaves like an acid as well as a base. It is amphoteric in nature. Substances that react with both acids and bases are called amphoteric substances.

Dissatisfaction of Bronsted –Lowry theory(Defects):

Bronsted-Lowry concept it is also not so comprehensive because following this concept certain compounds cannot be considered as acids or bases although they act as acids or bases for example sulphur trioxide(SO_3) it is an acid but it cannot donate a Proton similarly calcium oxide(CaO) it is a base but it cannot accept a proton.

A Bronsted–Lowry acid is a proton (H^+) donor.
A Bronsted–Lowry base is a proton (H^+) acceptor.

ethanoate ion hydronium ion

$$CH_3COOH_{(aq)} + H_2O_{(l)} \rightleftharpoons CH_3COO^-_{(aq)} + H_3O^+_{(aq)}$$

BRONSTED LOWRY CONCEPT

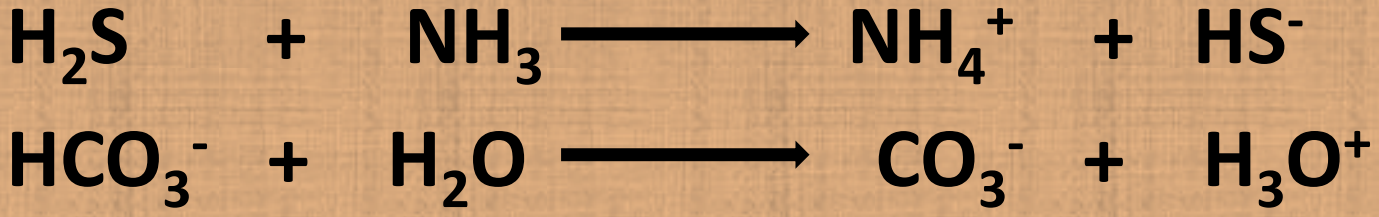
- AN ACID IS A SPECIES THAT LOSE A PROTON (H^+ IONS)
- BASE IS A SPECIES THAT ACCEPT A PROTON

EXAMPLE

- HCL $\rightleftharpoons$ $H^+ + Cl^-$
- H_2SO_4 $\rightleftharpoons$ $2H^+ + SO42^-$
- NH3 + H^+ $\rightleftharpoons$ $NH4^+$

Activity

Q: Identify Bronsted acids and Bronsted bases in the following reactions:



Lewis theory

Introduction:

In 1923 G.N Lewis proposed an acid-base theory that focuses on reaction .This concept is more general than either the Arrhenius theory or the Bronsted Lowery theory.

Statement

According to this theory:

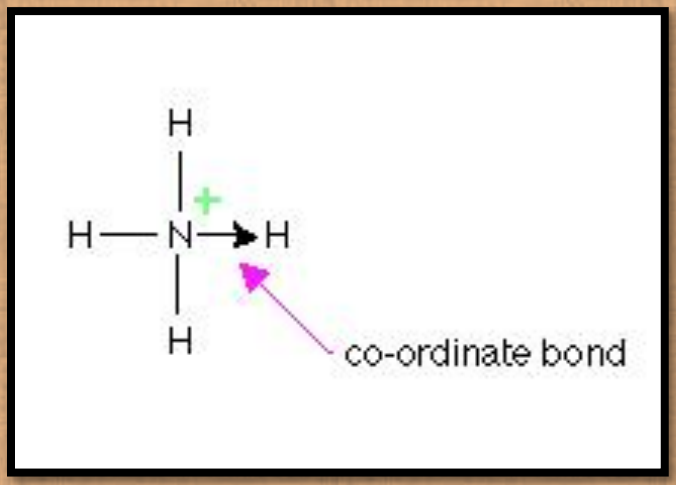
ACID ⟶ A Lewis acid is a substance that can accept a pair of electrons to form a Coordinate Covalent bond.

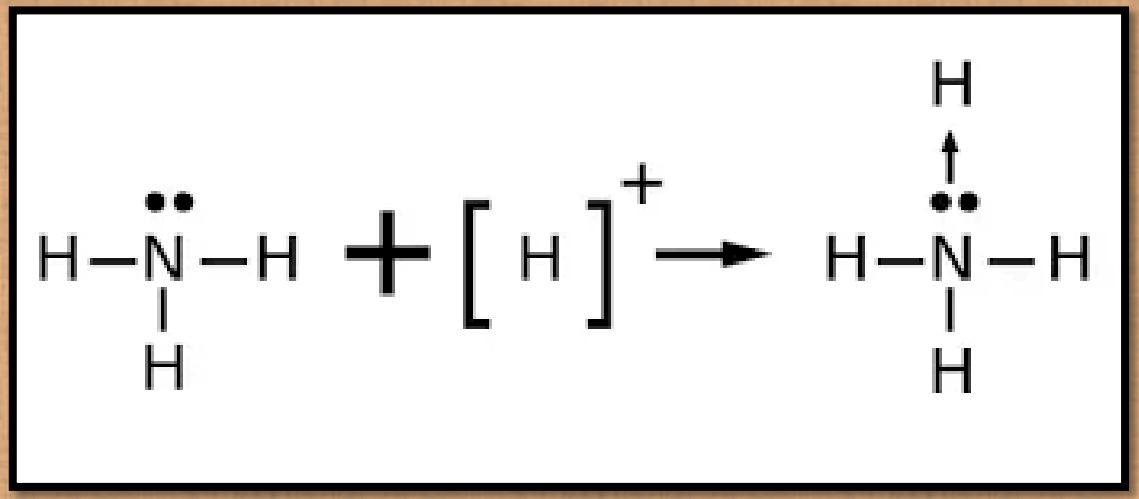
BASE ⟶ A Lewis base is a substance that can donate a pair of electrons to form a Coordinate Covalent bond.

In Lewis acid base reaction a Coordinate Covalent bond is formed between the acid and the base.

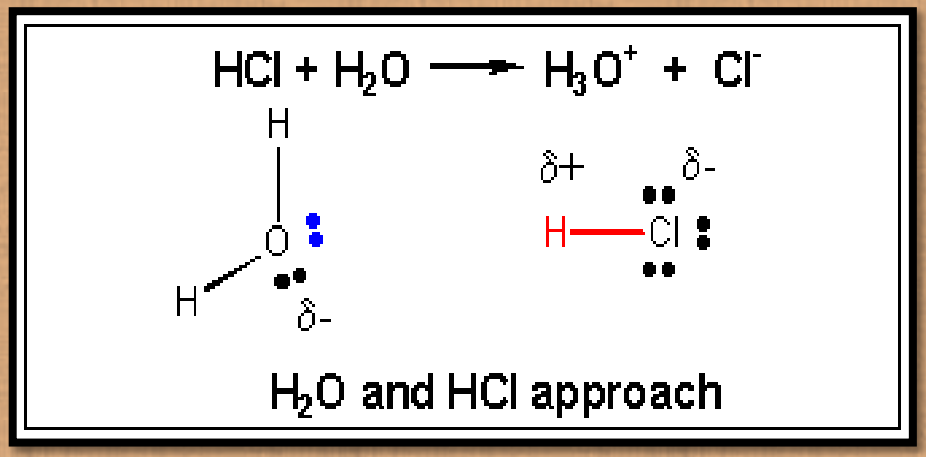
Coordinate covalent Bond

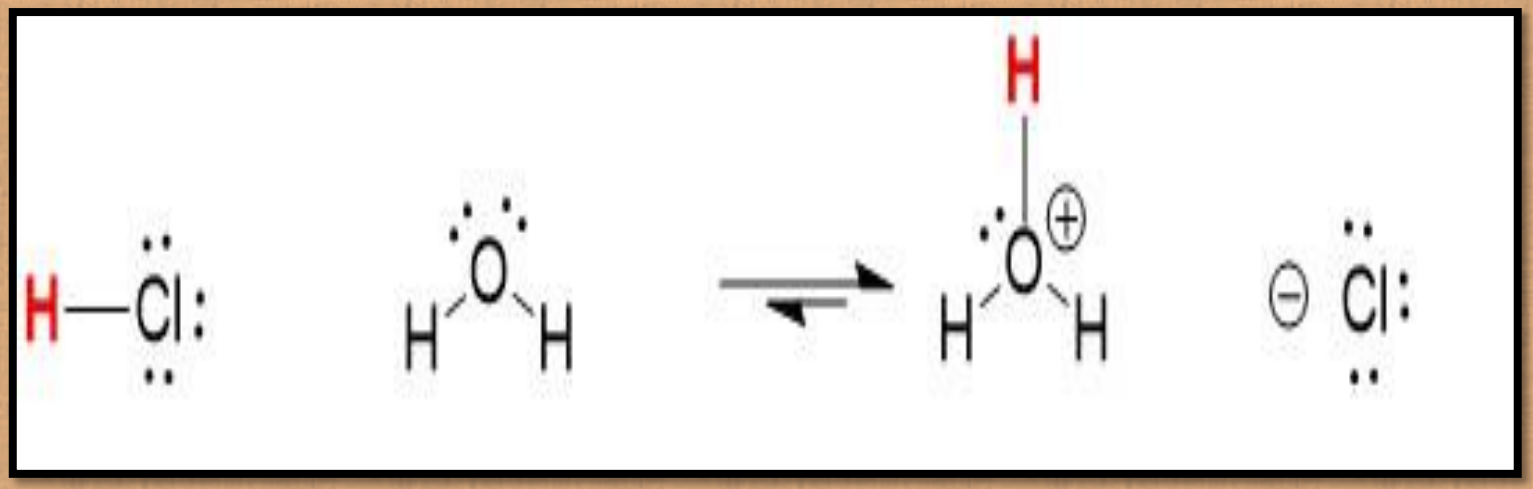
- A Covalent bond (also called dative covalent bond) is a covalent bond (a share pair of electron) in which both shared electrons come from the same atom. It is denoted by an arrow.
- A dative bond is indicated by drawing an arrow pointing from the atom that donates the lone pair of electron towards the atom that accept the pair of electron



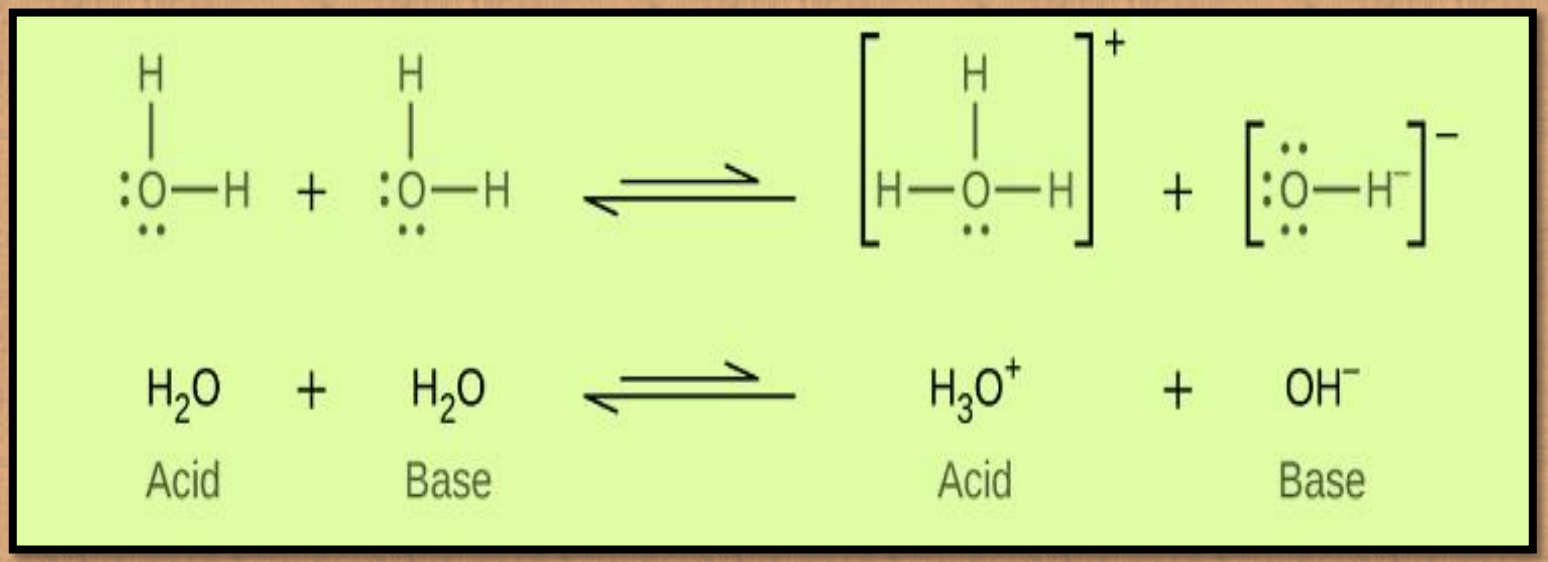


(1)Reaction between HCl and H_2O:

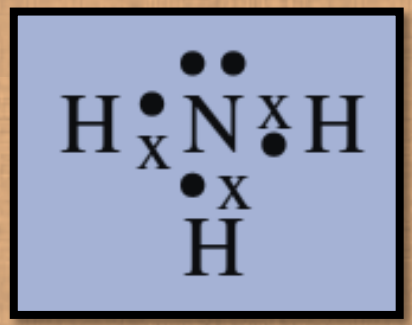


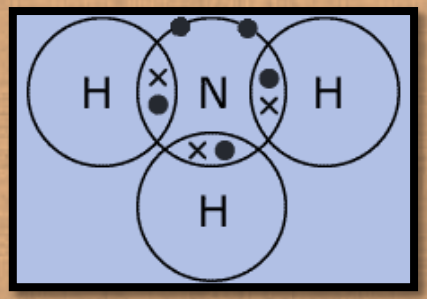


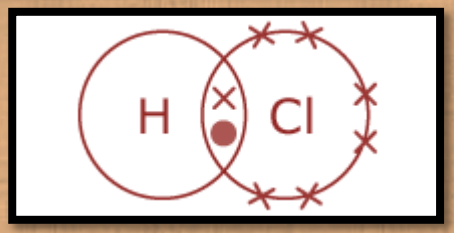
(2) Reaction between H_2O and H_2O

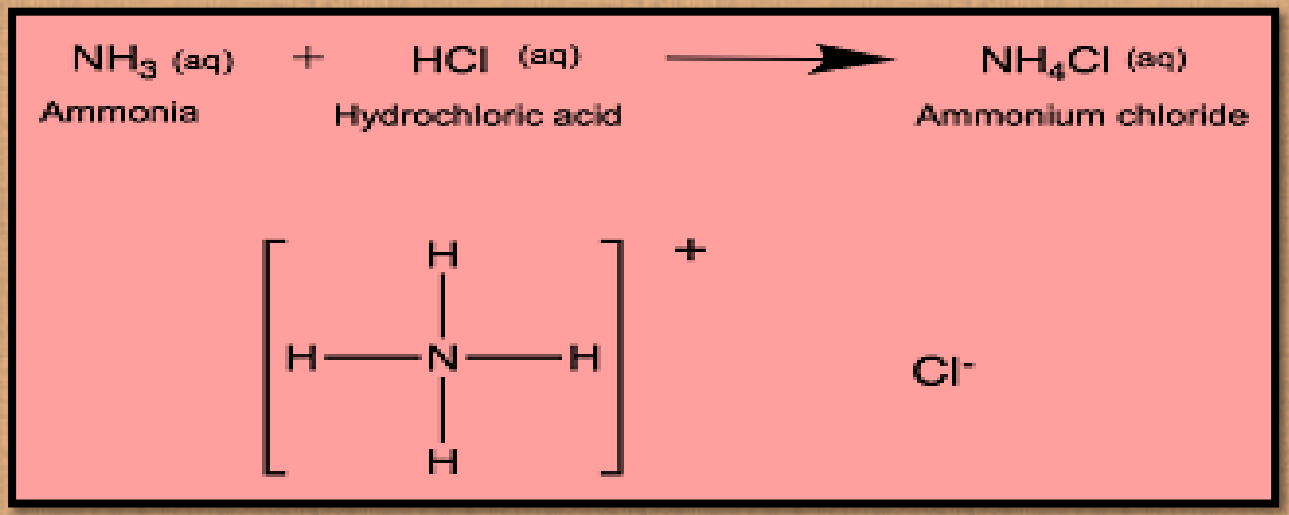


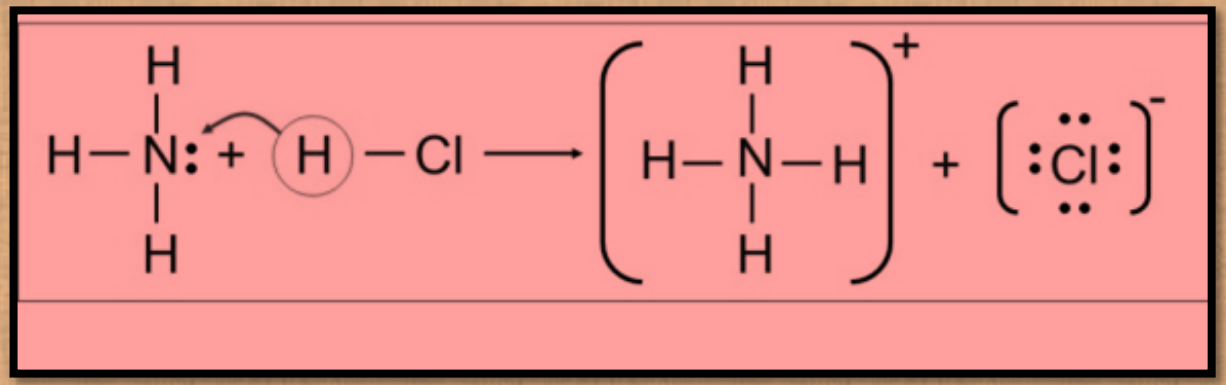
(3) Reaction between HCl and NH_3



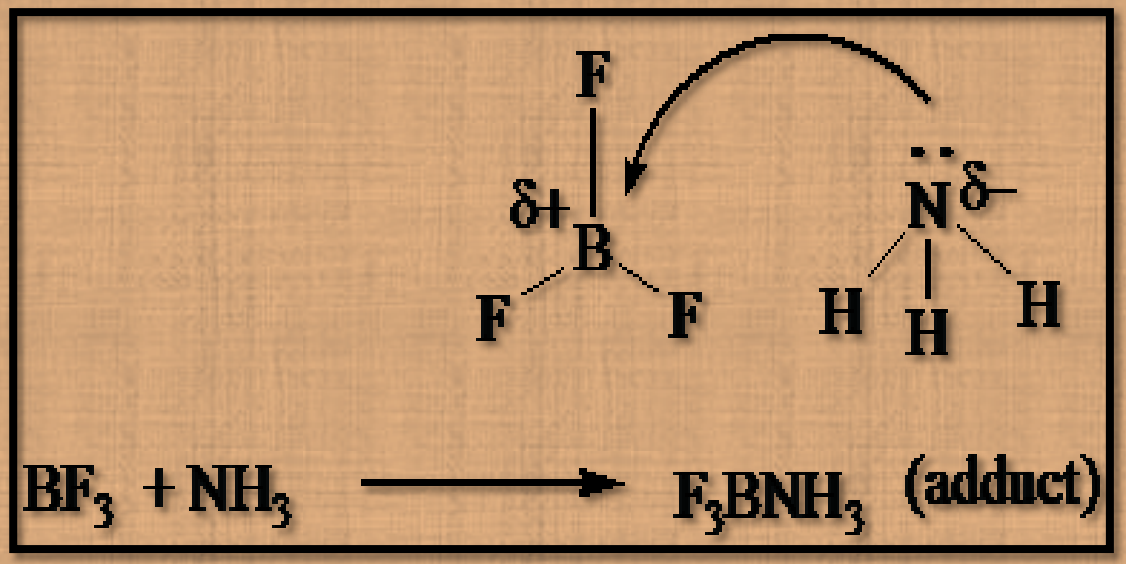


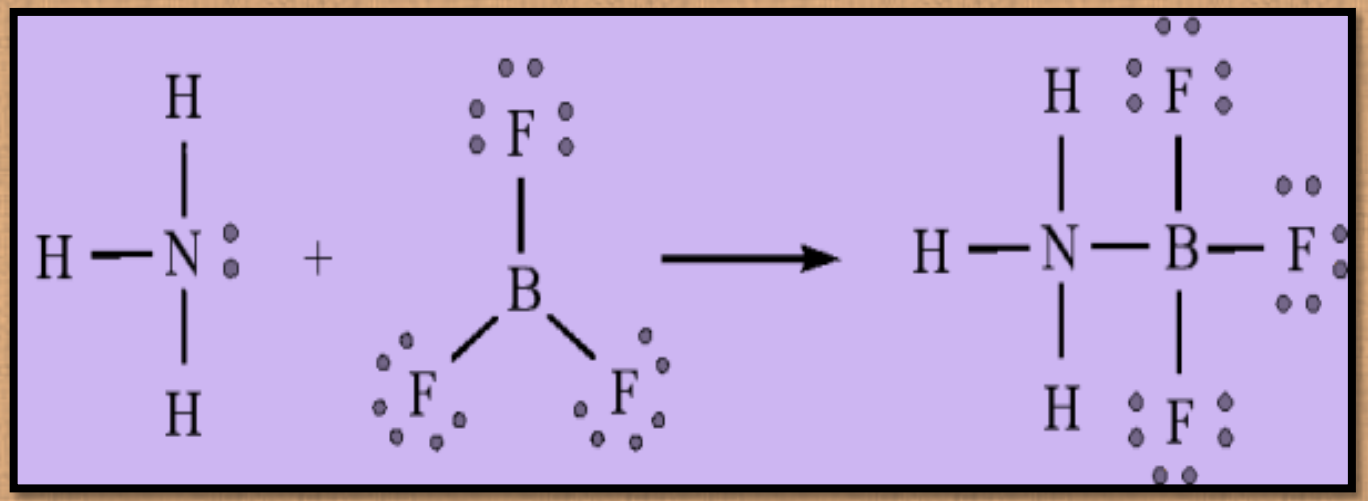






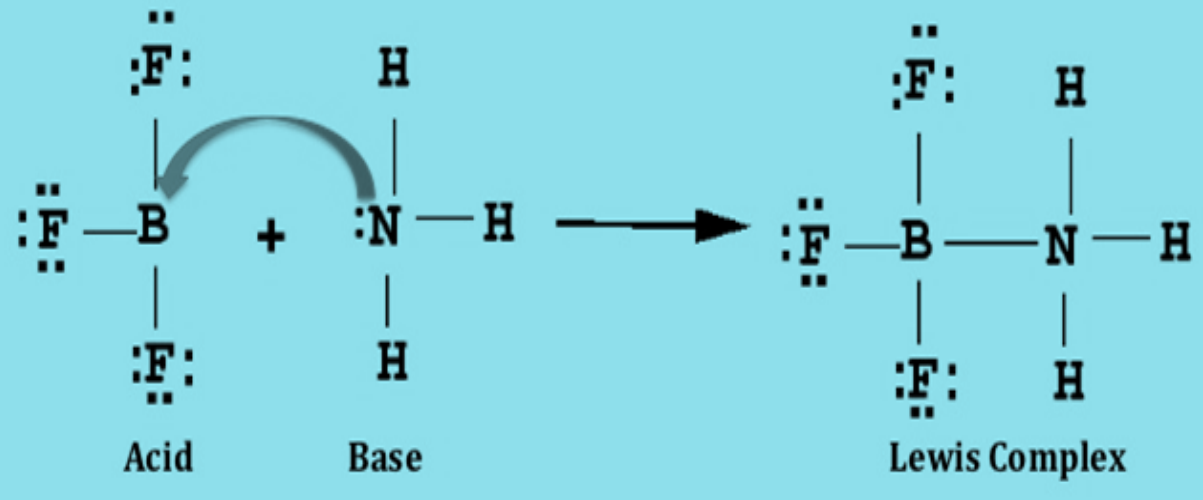
(4) Reaction between BF_3 and NH_3





$BF_3 + NH_3 \rightarrow ?$

Consider the molecules BF_3 and NH_3. If we determine the Lewis structure of BF_3 and NH_3, we find that **B** is octet deficient and can accept a lone pair. While **N** is capable of donating a lone pair. **N** donates a pair of electrons to **B**, creating a coordinate covalent bond between them.



Lewis Acids

Points to remember for identification of Lewis Acids & Bases

The following species can act as Lewis Acids:

- **Substances in which the central atom has incomplete octet.**

e.g.: BF_3 $AlCl_3$ $FeCl_3$

Simple cations can act as Lewis Acid.

e.g.: H^+, it includes all those simple cations, having capability to accept electron pair.

- **All cations can act as Lewis acid since they have deficiency of an electron pair.**

But there are some exceptional cases like: Na^+ , K^+ , Ca^+ which cannot act as Lewis acid because they cannot accept electrons, they are electropositive elements they always donate electrons.

e.g. : H^+ , Ag^+ can act has Lewis acid because their electronegativity is higher than other metals so, can accept electron pair easily.

Lewis Bases

- Neutral species having at least one lone pair of electron

For example: NH_3, Amines ($R\text{-}NH_2$),

Alcohols (R-OH) are Lewis bases because they contain lone pair of electron.

e.g. NH_3 , $R\text{-}NH_2$, R-OH , H_2O

- Negatively charged species are anions ,

e.g.: Cl^- , OH^- etc, act as Lewis bases because they have ability to donate electron pair.

Activity

- **Q: Identify the Lewis acid and the Lewis base in the following examples:**
- **F^- + BF_3 → $[BF_4]^-$**
- **Cu^{+2} + $4NH_3$ → $[Cu(NH_3)_4]^{+2}$**

COMPARISON BETWEEN ARRHENIUS, BRONSTED-LOWRY & LEWIS THEORY

The Arrhenius Theory	The Brønsted-Lowry Theory	The Lewis Theory
Acids are substances that contain hydrogen Bases are substances that contain hydroxyl, OH, group	An acid is a proton donor (H^+). A base is a proton acceptor.	Acids are electron pair acceptors. Bases are electron pair donors.
HCl and NaOH	NH_3 and H_2O	BF_3 and NH_3

Plenary

Q: Classify following substances as Lewis acid and bases.

F^- , H_2O , BF_3 ,Ag^+ , CN^-

Q: Why NH_3 act as Bronsted-Lowry Base?

Q:Which of the following cannot be classified as Arrhenius acid?

A) HNO_3 B) H_2CO_3 C) CO_2 D) H_2SO_4

Home Work

Do practice of question No.5,6,8,10,11,12, from the Review questions


Let's Stop COVID-19
Stay
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Stay Safe
WORK
FROM HOME


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