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T.D.C. Part-I (Hons)

**GROUP 15 ELEMENTS:**

Group 15 elements are also called nitrogen family.Group 15 elements outer most electronic configuration is ns2np3.The electronic configuration of group 15 elements may be represented as below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ELEMENTS | ATOMIC NO. | ELECTRONIC CONFIGURATION | CLASS | PERIODS |
| Nitrogen[N] | 7 | [He]2S22P3 | IIIA | 2 |
| Phosphorus[P] | 15 | [Ne]3S23P3 | IIIA | 3 |
| Arsenic | 33 | [Ar]3d10 4s24p3 | IIIA | 4 |
| Antimony | 51 | [Kr]4d10 5s25p3 | IIIA | 5 |
| Bismuth  | 83 | [Xe]5d106s26p3 | IIIA | 6 |

**Comparative study** :

 **1. Hydrides :**

All the elements of this group from volatile of the formula MH3, NH3, PH3, ASH3 (arsine) . SbH3 (Stibine) and BiH3 ( Bismultine) . The lighter element also form hydride of the formula M2H4Vi2.N2H4 (Hydrazine) p2H4 (diphosphine) and AS2H4(diarsine) . nitrogen froms hydride of the formula HN3 as well . This is called hydrazoic acid .

 **2. Halides** :

 All the elements of this group from tri and penta halide of the general formula MX3 and MX5.These are mostly covalent and only partly ionic.

**3.Oxide:** All the elements of this group from tri and penta oxide of the general formula P2O5 and P2O3.

**Nitric Acid [HNO3]**

**Preparation:**

1. NaNO3 react with H2SO4 and then give nitric acid.

NaNO3 + HNO3 → NaHSO4 + HNO3

2. Ammonium react with O2 in presence of Pt at 750-900 and then gives NO.NO reacts with O2and then gives NO2. NO2 reacs with water and O2 and then gives HNO3.

2NH3 + 5O2 4NO + 6 H2O

2NO + O2 → 2NO2

4NO2 + 2H2O + O2 →2HNO3

**Properties:**

1. It is colourless liquid .

2. It is soluble in water .

**3. Reaction with CuO :** It reacts with Cuo and then gives Cu(NO3)2.

 Cuo + 2HNO3 = Cu (NO3)2 + H2O

**4. Reaction with Na2S :** It reacts with Na2S and than gives NaNO3 and H2S .

CuO + Na2S = NaNO3 + H2S

**5. Reaction with S :** HNO3 reacts with S and then gives H2SO4

2HNO3 H2O + 2NO2 +O ($×$3

S + 3O → SO3

SO3 + H2O → H2SO4

6HNO3 +S→ H2SO4 + 6NO2 + 2H2O

**6. Reaction with I2 :** conc nitric acid reacts with I2 and then given Iodic acid

2HNO3 → H2O + 2NO2 +O ($×5$

I2 + 5O → I2O5

I2O5 + H2O → 2HIO3

I2 + 10 HNO3 → 2HIO3  + 10NO2 + 5H2O

**7. Reaction with Fe :** Dil HNO3 reacts with Fe and then gives Fe(NO3)2 and ammonium nitrate .

Fe + 2HNO3 → Fe(NO3)2 + 2H ($×4$

2HNO3 + 8H → NH4NO3 +3H2O

4Fe +10HNO3 → 4Fe( NO3)2 + NH4NO3 +3H2O

**8. Reaction with conc HNO3 :** conc HNO3 reacts with Fe and then gives NO2 .

Fe +3HNO → Fe(NO3)2 + 3H

HNO3 + H → NO2 + H2O (3

Fe + 6HNO3 → Fe(NO2)2 +3NO2 + 3H2O

**9. Reaction with Na2CO3 :** It reacts with Na2CO3 and then gives NaNO3 .

NaCO3 + HNO3 → NaNO3 +CO2 + H2O

**10. Reaction with KOH :** It reacts with KOH and then gives KNO3 .

KOH + HNO3 → KNO3 + H2O

**11. Reaction with Na2SO3 :** It reacts with Na2SO3 and then gives NaNO3.

 Na2SO3 + HNO3 → NaNO3 + H2O + SO3

**12. Reaction with C** :It reacts with C and then gives CO2 .

2HNO3 → 2NO2 + H2O + O ($×$2

 C + 2O → CO2

C + 4HNO3 → 4NO2 +CO2 + 2H2O

**13. Reaction with P :** It reacts with P and then gives H3PO4.

 2HNO3 → 2NO2 + H2O + O ($×$10

 4P + 10(O) → 2P2 O5

2P2O5 +6H2O → 4H3PO4

4P + 20HNO3 →4H3PO4 + 20NO2 + 4H2O

USES : 1. It is used as prepn of H2SO4 .

2. It is used as medicine .

**Hydrazine [NH2-NH2]**

**Preparation:**

1.Ammonia react with NaOCl and then gives NH2Cl .Then react with ammonia and then give hydrazine hydrochloride.Then react with sodium methoxide in presence dry CH3OH and then gives hydrazine.

NH2-Cl + NaO-Cl → NH2Cl + NaOH

NH2Cl + H-NH2 $\rightarrow $ NH2-NH2 . HCl

NH2-NH2 . HCl + NaOCH3 $→$ NH2-NH2 + CH3OH + NaCl

**Properties:**

1. It is colourless .
2. It is soluble in water.
3. **Action of heat:** on heating with Hydrazine and then give ammonia and nitrogen.

NH2-NH2 $→$ 4NH3 + N2

1. **Reaction with O2 :** It reacts with O2 and then give N2

 NH2-NH2 + O2 $→$ N2 + 2H2O

**USES:**

1. It is used as reducing agent.
2. It is used as a fuel in rockets.

**HYDRAZOIC ACID [N3H]**

**PREPARATION :**

1. HNO3 reacts with sodamide and then give NaN3 .Then reacts with H2SO4 and then gives hydrazoic acid.

2HNO3 + NaNH2 → NaN3 + 2H2O + 2O2

2 NaN3 + H2SO4  → 2N3H + Na2SO4

1. NH3 reacts with HNO2 and then gives N3H.

NH3 + 2 HNO2 → N3H + O2 + H2O

**PROPERTIES:**

1. It is colourless liquid.
2. It is poisonous.
3. **Action of heat:** on heating with N3H then gives azide ion.

N3H $→$ H+ + N3-  [3N3H $→$ 4N2 + NH3]

1. **Reaction with HCl:** It react with HCl and then gives NH3 & N2.

N3H + 2HCl → NH3 + N2 + Cl2

1. **Reaction with Mg:** It reacts with Mg and then gives (N3)2Mg.

2N3H + Mg → (N3)2Mg + H2

1. **Reaction with Al:** It reacts with Al and then gives (N3)2Al.

6N3H + 2Al → 2(N3)3Al + H2

USES:

1. It used as dyes.
2. It is used as detonator.

**HYDROXYL AMINE [NH2OH]**

**PREPARATION :**

1. On reduction with NO in presence of Sn/HCl then gives hydroxyl amine .

 NO + 3(H) $→$ NH2OH

1. On reduction with HNO3 and then gives hydroxyl amine .

HNO3 + 6(H) → NH2OH + 2H2O

**PROPERTIES:**

1. It is colourless.
2. It is soluble in water.
3. **Action of heat:** On heating with NH2OH and then gives N2 & NH3.

3NH2OH $→$ N2 + NH3 +3H2O

4NH2OH $→$ N2O +2 NH3 +3H2O

1. **Reaction with HNO3:** NH2OH reacts with HNO3 and then gives NO.

NH2OH + HNO3 → 2NO + 2H2O

**USES:**

1. It is used as a reducing agent.
2. It is used as a oxidizing agent .