

ILM KI DUNYA
CLASS

CHEMISTRY : 12TH

CHAPTER - 4
QUESTIONS

SECTION - LONG

GROUP VA AND VIA ELEMENTS.

Q.1 How does nitrogen differ from other elements of group V A?

RWP-2008

Ans: Difference of nitrogen from other elements of group V A

	Nitrogen	Other elements of groups V A
1	Nitrogen is a gas	Phosphorous arsenic, antimony and bismuth are solids
2	It exists in diatomic state (N ₂)	These elements do not exist in diatomic state
3	It occurs in free state as well as in combined state	These elements do not exist freely in nature.
4	It is non-metal	As and Sb are metalloids and Bi is a good metal
5	It does not form complex due to non-availability of d-orbitals	Other elements of group VA have empty d-orbitals and can accept electron pairs to form complexes.
6	Nitrogen has -3, +1, +2, +3, +4 and +5 oxidation states.	Elements of group VA have -3, +3 and +5 oxidation states.

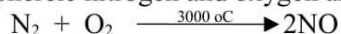
Q.2 Discuss Birkland Eyde process for manufacture of HNO₃.

BWP-2008, FBD-2010, GRW, MTN, DGK, LHR-2015, FBD-2015, MTN-2018

Ans: **Birkland Eyde process for manufacture of nitric acid.**

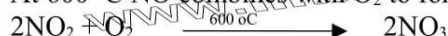
This process consists of the following steps.

- i. Atmospheric nitrogen and oxygen are combined to give nitric oxide in an electric arc (3000 °C).

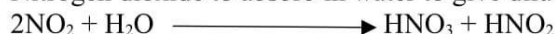


No formed is cooled quickly to 1000 °C at which it does not decompose.

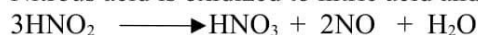
- ii. At 600 °C NO combines with O₂ to form NO₂.



- iii. Nitrogen dioxide is absorbed in water to give dilute HNO₃ along with nitrous acid.



- iv. Nitrous acid is oxidized to nitric acid and nitric oxide which is re-oxidized to NO₂

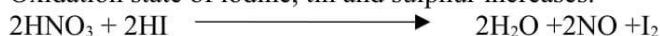


Q.3 Justify with one example of each that HNO₃ is an acid, and oxidizing agent and nitrating agent.

GRW-2009

Ans: **Nitrous acid as oxidizing agent:**

HNO₃ acts as an oxidizing agent and oxidizes HI, SO₂ and SnCl₂ into I₂, H₂SO₄ and SnCl₄ respectively. Oxidation state of iodine, tin and sulphur increases.



Continue.....p/2.....

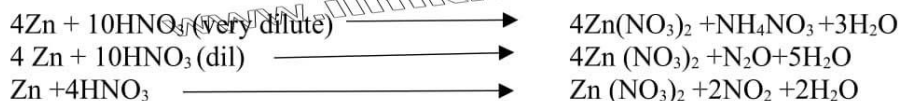
Nitrating mixture consists of Sulphuric acid (H_2SO_4) and Nitric acid. If you will look into the mechanism of **nitration** (see image below), first step comprises of generation of "nitronium ion". In order to do so, Sulphuric acid protonates nitric acid. So H_2SO_4 acts as an acid while HNO_3 which accepts proton acts a base.



Q.4 State three reactions of zinc with nitric acid, considering HNO_3 as very dilute, dilute and concentrated.

GRW- 2008

Ans: Zinc give different products depending upon the concentration of acid and temperature. Very dilute nitric acid give NH_4NO_3 . Moderately dilute nitric acid give nitrous oxide while concentrated nitric acid and NO_2 .



Q.5 Write down the chemical equations when dilute HNO_3 reacts with:

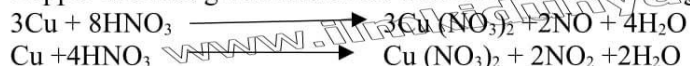
MTN - 2009

(a) Copper (b) Manganese (c) NaOH (d) Zn

Ans: **(a) Copper**

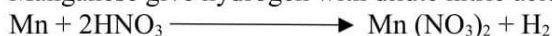
SWL-2014,SGD-2015,GRW-2018

Copper and lead give nitric oxide with dilute acid and nitrogen dioxide with concentrated acid.



(b) Manganese

Manganese give hydrogen with dilute nitric acid.



(c) NaOH



(c) Zn



Q.6 Write down the balance chemical equation and name of products formed with Conc. HNO_3 react with.

Zn, Sn, Hg, Ag.

DGK - 2009, SGD, SWL-, 2014, 2015

Ans: Zn.

Zn:



Sn:



Hg:



Ag:



Continue.....p/3.....

Q.7 Give reaction HNO_3 with : (i) C (ii) S (iii) Mg (iv) H_2S **FBD - 2008**

Ans: It oxidizes non-metals to their corresponding oxides.

(i) C



(ii) S



(iii) Mg



(iv) H_2S



Q.8 Complete and Balance the following equations:

MTN - 2008

(i) $\text{H}_2\text{S} + \text{NO}_2$ (ii) $\text{HNO}_3 + \text{CaO}$ (iii) $\text{KNO}_3 + \text{H}_2\text{SO}_4$ (iv) $\text{Cu} + \text{HNO}_3$ (conc)

Ans: (i) $\text{H}_2\text{S} + \text{NO}_2 \longrightarrow \text{H}_2\text{O} + \text{S} + \text{NO}$



Q.9 Complete and balance the following equations:

LHR - 2009

Ans: (i) $\text{Pb}(\text{NO}_3)_2$ (ii) $\text{HNO}_2 + \text{NH}_3$ (iii) $\text{HNO}_2 + (\text{NH}_2)_2\text{CO}$ (iv) $\text{H}_2\text{S} + \text{NO}$

(i) $\text{Pb}(\text{NO}_3)_2$:



(ii) $\text{HNO}_2 + \text{NH}_3$



(iii) $\text{HNO}_2 + (\text{NH}_2)_2\text{CO}$



(iv) $\text{H}_2\text{S} + \text{NO}$



Q.10 Write down occurrence of Phosphorus.

Ans: 1. Phosphorus is the second members of group V A its name come from Greek word meaning “

Light

hearing”. Unlike nitrogen it does not occur in Free State in nature. Most of the phosphorous is formed in deposit of phosphate rock, i.e. impure $\text{Ca}_3(\text{PO}_4)_2$ and apatite .

2. As a constituent of plant and animal tissues. It is essential for their normal growth. It occurs especially in seeds, the yolk of eggs, the nerves, brain and bone marrow, usually in the form of lecithine. Lecithins are important constituents of cell membrane, particularly in the brain. Lecithins

are examples of phospholipids.

3. In the form of calcium phosphate. It is essential constituent of bone. Bone ash which contains

80%

calcium phosphate is an important source of phosphorus.

Continue.....p/4.....

:- 4 :-

Q.11 Write down occurrence of oxygen

- Ans:
- (i) Oxygen is the most widely distributed and common of all the elements, comprising about 50% of earth's crust.
 - (ii) About one-fourth of the atmospheric air by weight consists of free oxygen, and water contains nearly 89% of combined oxygen.
 - (iii) The calcium carbonate which occurs in chalk, limestone, marble etc. contains 48% oxygen.
 - (iv) silica which is found in flint, quartz etc. contains more than 53% oxygen by weight.

Q.12 Write down occurrence of Sulphur

- Ans:
- i) Sulphur is also widely distributed in nature both as free and in combined forms.
 - ii) Many important metallic ores of sulphides are, e.g. **galena zinc blende cinnabar, copper pyrite, iron pyrite, stibnite** etc.
 - iii) Some important sulphates are also found in nature, e.g. **gypsum heavy spar**
2. Sulphur also occurs in organic compounds in **animals** and **vegetables** like **onions, garlic, and mustard, hair, many oils, eggs, proteins** etc.
 3. It also occurs as a constituent of coal and petroleum.

Q.13 Write the properties of white phosphorous. How it is converted to red phosphorous.

SGD - 2010

Ans: **White Phosphorus:**

- White phosphorus consists of individual tetrahedral P_4 molecules.
- It is a waxy solid that melts at 44°C and boils at 280°C .
- In P-P-P bond angle is 60° which is less than normal bond angle. Due to smaller angle, it has strain and **very reactive**.
- It is soluble in benzene and carbon tetrachloride.
- When P_4 molecules are heated above 700°C , it dissociates to form P_2 molecules. White phosphorus is toxic and when it contacts with skin, produces painful slow heating burns.

Red Phosphorus:

- Red phosphorus is less reactive and less poisonous than white phosphorus.
- Red phosphorus is prepared by heating white phosphorous in the presence of little iodine or sulphur as catalyst upto 250°C in vacuum. It is formed by joining the P_4 molecules at their corners to form a macromolecule.

Q.14 Describe methods for preparation P_2O_5 .

SGD – 2008

Ans: **Phosphorus Pentoxide:**

Preparation:

It is prepared by burning phosphorus in excess of dry air.



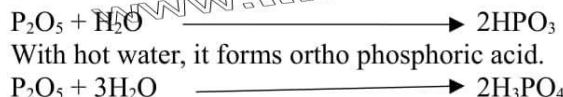
Properties of Phosphorus pentoxide:

It is a white hygroscopic powder having a faint, garlic like odor due to the presence of traces of P_2O_5 . It sublimes at 360°C .

Chemical Reactions:

1. Reaction with cold and hot water:

With cold water phosphorus pentoxide forms Meta phosphoric acid.

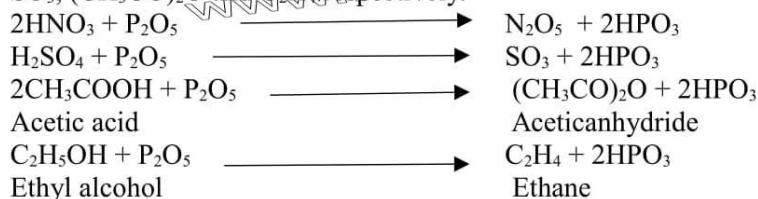


Continue.....p/5.....

:- 5 :-

Q.15 “P₂O₅” is a powerful dehydrating agent”. Justify the statement by four example. **MTN - 2008**

Ans: It is a powerful dehydrating agent on reacting with HNO₃, H₂SO₄, CH₃COOH and C₂H₅OH, it give N₂O₅, SO₃, (CH₃CO)₂O and C₂H₄ respectively.



Q.16 Give eight points to the similarities of oxygen with sulphur.

LHR, MTN – 2008, RWP-2009, AJK, LHR-2015

Ans: **Oxygen**

Sulphur

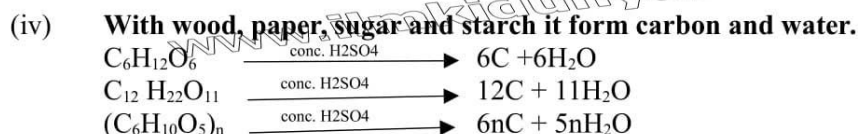
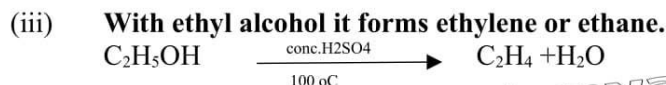
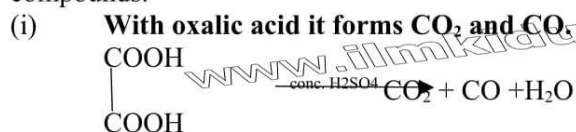
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|--|--|
| <ol style="list-style-type: none"> 1. It is gas at ordinary temperature. 2. Oxygen is sparingly soluble in water 3. It is paramagnetic in nature 4. It does not react with acids. 5. It does not react with water. 6. It does not react with alkalis. 7. Oxygen helps in combustion. 8. It shows maximum -2 oxidation state. | <ol style="list-style-type: none"> 1. It is solid at ordinary temperature. 2. Sulphur is not soluble in water. 3. It is diamagnetic in nature. 4. It is readily oxidized by conc. Sulphuric acid or nitric acid 5. When steam is passed through boiling sulphur, a little hydrogen sulphide and sulphur dioxide are formed. 6. It reacts with alkali solution and forms sulphides and Thiosulphates. 7. Sulphur is itself combustible. 8. It shows oxidation states of -2, +2, +4 and +6 |
|--|--|

Q.17 “H₂SO₄” is a very good dehydrating agent.“ Give four examples.

LHR – 2008, DGK, SGD-2015

Ans: **Reactions as a dehydrating agent:**

H₂SO₄ has a great affinity for water, so it acts as dehydrating agent and eliminates water from different compounds.



:- 6 :-

Q.18 Write contact process for the manufacturing of sulphuric acid.

Ans: (i) Contact process is better than lead chamber process for manufacturing of H_2SO_4 because in contact

process 100% H_2SO_4 is obtained in this process. SO_3 is dissolved in conc. H_2SO_4 which forms oleum. Oleum on desired changes to H_2SO_4 .



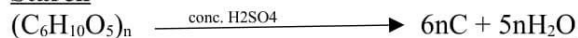
(ii) Solid catalyst V_2O_5 is used and there is no chance of nitrogen oxide impurities.

Q.19 Give the reactions of H_2SO_4 with: (i) Oxalic acid (ii) Starch (iii) Sulphur (iv) H_2S **RWP-2008**

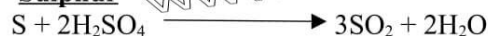
Ans: (i) **Oxalic Acid:**



(ii) **Starch**



(iii) **Sulphur**



(iv) **H_2S**



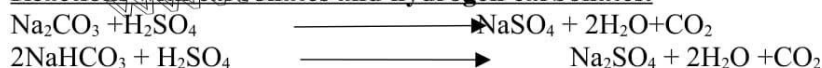
Q.20 Give reactions of H_2SO_4 as an acid.

RWP – 2015,DGK.,HR-2018

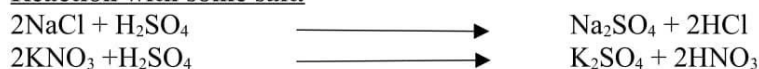
Ans: 1. **It reacts with alkalis to form salt and water.**



2. **Reactions with carbonates and hydrogen carbonates.**



3. **Reaction with some salt.**



Q.21 Describe the chemistry of the industrial preparation of sulphuric acid from sulphur by the contact process.

Ans: **Manufacture of sulphuric acid.**

Sulphuric acid is being manufactured commonly by contact process.

Contact Process:

This method was developed by **Knietsch in Germany**. Basically it involves the catalytic combination of sulphur and oxygen to form SO_2 in the presence of V_2O_5 which acts as catalyst.

Following process are involved during the manufacturing of sulphuric acid by **contact process**.

Principle of contact process:

SO_2 obtained by burning sulphur or iron pyrites is oxidized to SO_3 in the presence of catalyst V_2O_5

The best yield of SO_2 can be obtained by using excess of oxygen or air and keeping the temperature between 400-500 °C

SO_2 formed is absorbed in concentrated H_2SO_4 and “Oleum” form can be converted to sulphuric acid of any strength by mixing adequate quantity of water.

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:- 7 :-

Following steps are involved in the manufacture of sulphuric acid by contact process.

a. **Sulphur burner (Production of SO_2).**

In sulphur burner, sulphur or iron pyrite is reacted in excess of air and SO_2 is formed.



b. **Purifying unit of SO_2 :**

SO_2 is purified from impurities like dust and arsenic oxide, to avoid poisoning of the catalyst purifying unit consists of the following parts.

i. **Dust Chamber:**

Steam is injected to remove dust particles from the gases.

ii. **Cooling pipes:**

The gases are passed through lead pipes to cool them to 100 °C

iii. **Scrubbers:**

The cooled gases are washed by a spray of water, as SO_2 is not soluble in water at high temperature.

iv. **Drying Tower:**

The moisture of gases is removed by concentrated H_2SO_4 trickling down through the coke filled in this tower.

v. **Arsenic Purifier:**

Arsenic oxide is then removed by passing the gases through a chamber provided with shelves packed with freshly prepared Ferric hydroxide $\text{Fe}(\text{OH})_3$.

vi. **Testing box:**

In this box, a beam of light is introduced which indicates the presence or absence of solid particles. If solid particles are present, the gases are sent back for further purification.

c. **Contact chamber:**

Pre-heated gases at 400 -500 °C are passed through vertical iron columns packed with the catalyst V_2O_5 . Here SO_2 is oxidized to SO_3 .

The reaction is highly exothermic so no heating is required when the reaction is started.

d. **Absorption Unit:**

The SO_3 obtained from the contact tower is dissolved in 98% H_2SO_4 to form ‘oleum’ H_2SO_4 . It can be diluted with water to get any required concentration of sulphuric acid.



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