

Nitrogen and its compounds

1. (i) $4\text{HN}_3(\text{g}) + 5\text{O}_2(\text{g}) \rightarrow 4\text{NO}(\text{g}) + 6\text{H}_2\text{O}(\text{g})$
 (ii) Act as catalyst
 (iii) $\text{Zn}(\text{NH}_3)_4^{2+}$

2. a) Platinum/ copper
 b) Brown fumes √
 Hot rod continues to glow red
 - NO formed reacts with oxygen to form NO_2 (brown fumes)
 - Reaction highly exothermic

3. a) Calcium hydroxide
 b) $\text{Ca}(\text{OH})_2(\text{g}) + 2\text{NH}_4\text{Cl}(\text{g}) \rightarrow 2\text{NH}_3(\text{g}) + \text{CaCl}_2 + 2\text{H}_2\text{O}(\text{L})$

4. (a) It neutralizes air to prevent violent combustion reaction from occurring.
 (b) Its inert and have very low b.pt of -196°C
 *MAT

5. a) X is Nitrogen. √¹
 b) It is less dense than air. √²
 c) – In preservation of semen in artificial insemination. √¹

6. a) (i) Solution A contains $\text{Pb}^{2+}(\text{aq})$ ions √²
 (ii) Solution B contains $\text{Al}^{3+}(\text{aq})$ ions. √²
 b) – A colourless liquid at cooler parts √¹ of test-tube is formed.
 - A white residue remains in the test-tube. √¹

7. a) to expel air that is in the combustion tube so that oxygen in it does not react with hot copper √¹
 b) brown √^{1/2} copper metal will change to black √^{1/2}
 c) nitrogen √¹

8. (a) To increase the surface area over which the reaction occurs hence increased rate of reaction. P1
 (b) NH_3 is basic and reacts with some moles of the acid hence reduction in concentration P1

9. (a) (i) The solution changes from green √¹ to brown √¹ (1 mk)
 (ii) A brown √¹ precipitate is formed. (1 mk) 3

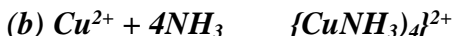


10. (a) – Absorbs carbon (IV) oxide from $\sqrt{1}$ the air. (1 mk)



(c) Because it has the rare gases. $\sqrt{1}$ (1 mk)

11. (a) Anion – CO_3
Cation – Cu^{2+}

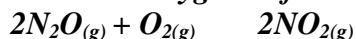


12. (a) (i) $NH_4NO_3 (s) \rightarrow N_2O (g) + 2H_2O (g)$
 (ii) NH_4NO_3 should not be heated further if the quantity remaining is small because it may explode

or A mixture of NH_4Cl & KNO_3 can be used instead of NH_4NO_3 leading to double decomposition taking place safely without explosion

(iii) Anhydrous calcium chloride in a U-tube

(iv) Reacts with oxygen to form brown fumes of Nitrogen (IV) Oxide



(v) – Has no colour

- Has a slight sweet smell

- Fairly soluble in water P

- Denser than air P

(b) (i) Provides a large surface area for the absorption of ammonia gas by the water or prevent “bricking” back of water P

(ii) Water would brick back into the hot preparation flask causing it to crack or break /an explosion can occur P

(iii) Red litmus paper would turn to blue, blue litmus paper remains blue each P

13. (a) B – ammonia gas P1
 C - nitrogen (II) oxide (NO) P1
 E – water P1
 F – unreacted gases P1

(b) The mixture of ammonia and air is passed through heated/ catalyst where ammonia (II) is oxidized to nitrogen (II) oxide. P1

(c) Gases are cooled and air passed through heated/ catalyst where ammonia is further oxidized to nitrogen(IV) oxide. P1

(d) Fractional distillation, P^{1/2}

Water with a lower boiling point P^{1/2} than nitric (V) acid, distills left leaving the concentrates acid.

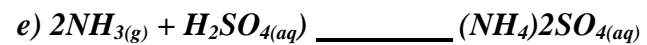
14. a)i) Fractional distillation
 ii) Argon

- b) A Sulphur
 B Ammonia gas
 C Oteum

D Amonium sulphate

- c) i) *Finely divided iron*
ii) *Vanadium (v) Oxide*

d) *Speeds up the rate of reaction by lowering the activation energy*



f) *R.M.M of (NH₄) = 132*

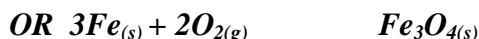
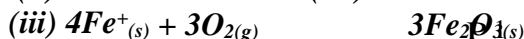
Mass of N = 28

$$\% N = \frac{28}{132} \times 100 = 21.212\%$$

g) Used as a fertilizer

15. (a) (i) Fused calcium chloride /Cao (quick lime)

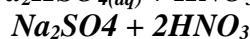
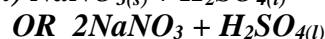
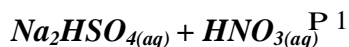
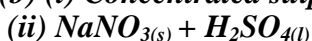
(ii) To remove carbon (IV) Oxide



(iv) Argon/Helium/Neon/Krypton

(v) Provide very low temperature so that the semen does not decompose /is not destroyed

(b) (i) Concentrated sulphuric acid



(reject unbalanced chemical equation)

(b) Copper reacts with 50% nitric acid to give nitrogen II Oxide which is colourless. Air oxidizes^{P 1} Nitrogen II oxide to Nitrogen IV oxide which is brown.



16. (a) (i) Nitrogen – Fractional distillation of liquid air –(1/2 mk)

Hydrogen – Cracking of alkanes

-Electrolysis of acidified water

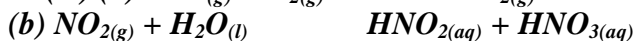
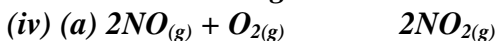
(ii) Temperature – 400°C – 500°C

Pressure – 400atm – 500atm

Catalyst – finely divided iron

(iii) Catalyst P – Nickel

Gas M – Nitrogen IV oxide



(v) To a small portion of the nitrate liquid in a test tube add equal amount of freshly prepared iron (II) sulphate followed by some drops of conc. H_2SO_4 slowly on the sides. If a brown ring forms on the boundary of the two solutions, a nitrate is confirmed.

(vii) – Manufacture of nitrogenous fertilizers

- Manufacture of synthetic fibres e.g nylon

- Manufacture of explosives e.g TNT

- Manufacture of textile dyes

- Manufacture of other acids e.g. phosphoric acid

17. (a) (i) Nitrogen (I) Oxides.

Rej. Dinitrogen oxides.



(iii) *The gas is soluble in cold water.*

(iv) *An irritating choking smell of a gas.*

(b) (i) *Platinum wire.*



distils out first and liquid oxygen with highest distil out last.

(g) Nitrogen in liquid form is used as a refrigerant e.g. in storing semen for artificial insemination

- Used as a raw material in Haber process e.t.c

II. Air is a mixture because:

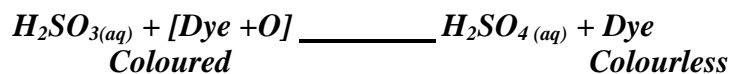
- It contains gases which are not chemically combined

- - The gases are not in fixed ratios.



Coloured

Colourless \checkmark



21. a) *Drying agent* \checkmark $1/2$ which must be *CaO*
Method of collection \checkmark - *upward delivery*
Workability \checkmark $1/2$
- b) $2NH_4Cl_{(g)} + Ca(OH)_{2(g)} \xrightarrow{\hspace{2cm}} CaCl_{2(g)} + H_2O_{(l)} + 2NH_{3(g)}$ \checkmark
22. a) *Heat*
 b) $Cu_{(g)} + N_2O_{(g)} \xrightarrow{\hspace{2cm}} CuO_{(g)} + N_{2(g)}$
 c) - *Manufacture of ammonia*
 - *In light bulbs*
 - *As a refrigerant*
23. - *At 113°C consists of S₈ rings that flow easily;*
 - *Darkens due to breaking of S₈ rings and forming long chains consisting of thousands of atoms. The chains also entangle;*
 - *The long chains consisting of thousands of atoms. The chains also entangle;*
 - *The long chains break near b.p. to form shorter one;*
24. *Difference is at the cathode electrode where in concentrated sodium chloride sodium is deposited while in dilute sodium chloride, hydrogen is liberated, because*
25. (i) $2N_2O_{(g)} + C_{(s)} \xrightarrow{\hspace{2cm}} Co_{2(g)} + 2N_{2(g)}$
 (ii) *Ammonium chloride and sodium nitrate*
 (iii) *The hydroxide ions \checkmark 1 (Ammonia dissolves forming ammonia hydroxide.(1 mk)*
26. (a) *E - Ammonium chloride* ($1/2$ mk)
F - Aluminium hydroxide ($1/2$ mk)
 (b) $Al_{3+} + 3OH_{(aq)} \xrightarrow{\hspace{2cm}} Al(OH)_{3(s)}$
27. a) *Zinc hydroxide*
 b) $[Zn(NH_3)_4]^{2+}$
 c) $Zn^{2+}_{(aq)} + 2OH_{(aq)} \xrightarrow{\hspace{2cm}} Zn(OH)_2_{(s)}$
28. a) *Plantinum/platinum Rhodium P1*
 b) $4NH_3(g) + 5O_2(g) \xrightarrow{\hspace{2cm}} 4NO(g) P1 + 6H_2O(l)$
 c) - *Fertilizers P1*
 - *Preparation of Nitrogen (I) oxide.*
 - *Explosives*

29. *Blue ppt $P1$ is formed which dissolves in excess to form a deep blue $P1$ solution due to formation of tetra amine Copper (II) ions*
30. (a) *- Finely divided iron impregnated by alumina (Al_2O_3)*
- 200 atmosphere pressure
- Temperature of $450^\circ C$ P $\frac{1}{2}$
- b) *- CuO is reduced to Copper metal*
- NH_3 is oxidized to water and nitrogen

31. (a) *Colour of copper (II) Oxide changes from black to brown*
(b) (i) *Nitrogen /N_{2(g)}*
(ii) *Water/H₂O_(l)*