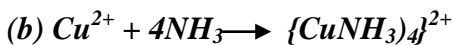


## Nitrogen and its compounds

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  $\text{NO}_2$  (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  $-196^\circ\text{C}$   
 \*MAT
  
5. a) X is Nitrogen. ✓<sup>A</sup>  
 b) It is less dense than air. ✓<sup>1/2</sup>  
 c) – In preservation of semen in artificial insemination. ✓<sup>A</sup>
  
6. a) (i) Solution A contains  $\text{Pb}^{2+}(\text{aq})$  ions ✓<sup>1/2</sup>  
 (ii) Solution B contains  $\text{Al}^{3+}(\text{aq})$  ions. ✓<sup>1/2</sup>  
 b) – A colourless liquid at cooler parts ✓<sup>A</sup> of test-tube is formed.  
 - A white residue remains in the test-tube. ✓<sup>A</sup>
  
7. a) to expel air that is in the combustion tube so that oxygen in it does not react with hot copper ✓<sup>1</sup>  
 b) brown ✓<sup>1/2</sup> copper metal will change to black ✓<sup>1/2</sup>  
 c) nitrogen ✓<sup>1</sup>
  
8. (a) To increase the surface area over which the reaction occurs hence increased rate of reaction. ✓<sup>1</sup>  
 (b)  $\text{NH}_3$  is basic and reacts with some moles of the acid hence reduction in concentration ✓<sup>1</sup>
  
9. (a) (i) The solution changes from green ✓<sup>1</sup> to brown ✓<sup>1</sup> (1 mk)  
 (ii) A brown ✓<sup>1</sup> precipitate is formed. (1 mk)  
 (b)  $\text{Fe}^{3+}(\text{aq}) + 3\text{OH}(\text{aq}) \rightarrow \text{Fe}(\text{OH})_3(\text{s})$  ✓<sup>1</sup> (1 mk) } 3
  
10. (a) – Absorbs carbon (IV) oxide from ✓<sup>1</sup> the air. (1 mk)  
 (b)  $2\text{Cu}(\text{s}) + \text{O}_2 \rightarrow 2\text{CuO}(\text{s})$  ✓<sup>1</sup> (1 mk)  
 (c) Because it has the rare gases. ✓<sup>1</sup> } 3  
(1 mk)
  
11. (a) Anion –  $\text{CO}_3$   
 Cation –  $\text{Cu}^{2+}$



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  
 $2N_2O(g) + O_2(g) \rightarrow 2NO_2(g)$   
(v) – Has no colour  
- Has a slight sweet smell  
- Fairly soluble in water ✓  
- Denser than air ✓
- (b) (i) Provides a large surface area for the absorption of ammonia gas by the water or prevent “bricking” back of water ✓  
(ii) Water would brick back into the hot preparation flask causing it to crack or break /an explosion can occur ✓  
(iii) Red litmus paper would turn to blue, blue litmus paper remains blue each ✓

13. (a) B – ammonia gas ✓1  
C - nitrogen (II) oxide (NO) ✓1  
E – water ✓1  
F – unreacted gases ✓1
- (b) The mixture of ammonia and air is passed through heated/ catalyst where ammonia (II) is oxidized to nitrogen (II) oxide. ✓1
- (c) Gases are cooled and air passed through heated/ catalyst where ammonia is further oxidized to nitrogen(IV) oxide. ✓1
- (d) Fractional distillation, ✓1/2  
Water with a lower boiling point ✓1/2 than nitric (V) acid, distills 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  $(NH_4) = 132$

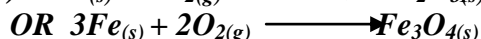
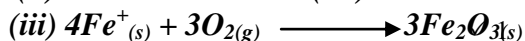
Mass of N = 28

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

g) Used as a fertilizer

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

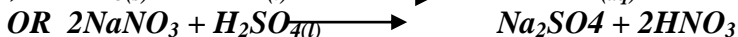
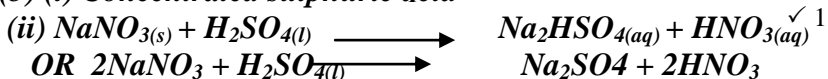
(ii) To remove carbon (IV) Oxide



(iv) Argon/Helium/Neon/Krepton

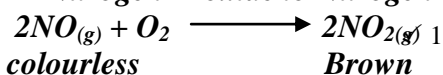
(v) Provide very low temperature so that the semen does not decompose /is not destroyed

(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<sup>✓1</sup> Nitrogen II oxide to Nitrogen IV oxide which is brown.



colourless

Brown

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

Hydrogen – Cracking of alkanes

-Electrolysis of acidified water

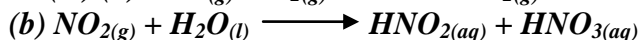
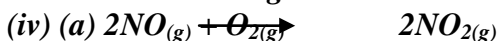
(ii) Temperature – 400°C – 500°C

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<sub>2</sub>SO<sub>4</sub> 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

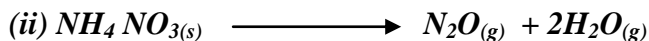
- Manufacture of explosives e.g TNT

- Manufacture of textile dyes

- Manufacture of other acids e.g. phosphoric acid

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

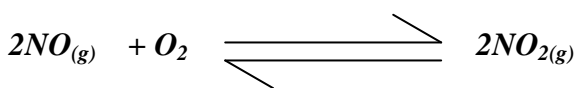
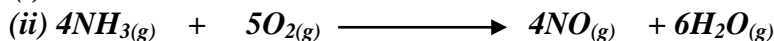
Rej. Dinitrogen oxides.



(iii) The gas is soluble in cold water.

(iv) An irritating choking smell of a gas.

(b) (i) Platinum wire.



(iii) Nitrogen (I) Oxide

Nitrogen (IV) Oxide.

<i>Colourless.</i>	<i>Reddish brown.</i>
<i>Relights a glowing splint.</i>	<i>Extinguishes a glowing splint.</i>
<i>Has a sweet smell.</i>	<i>Irritating pungent smell.</i>
<i>Fairly soluble in water.</i>	<i>Readily soluble in water.</i>

(Accept any 1 correct comparative)

(c) (i) *It corrodes/reacts with rubber and cork.*

(ii) I) Oxidized: Sulphur /S  
Reduced: Nitric (V) acid / HNO<sub>(aq)</sub>

II) *It decomposes by heat into NO<sub>2</sub> which dissolves in the acid.*

18. a) *Pass air through purifiers to remove dust particles by electrostatic precipitation. Then pass it through conc. Sodium Hydroxide to absorb CO<sub>2</sub>. Then through condensers at 25C to remove water vapour. It is further cooled to liquefy it. The liquefied air is then fractionally distilled to obtain oxygen at -183C*

b) i) X - Ammonia// NH<sub>3</sub>  
Y- Air

ii)  $4NO_{2(g)} + 2H_2O_{(s)} + O_{2(g)} \longrightarrow 4HNO_{3(aq)}$   
Accept

$2NO_{2(g)} + H_2O_{(l)} \longrightarrow HNO_{3(aq)} + HNO_{2(aq)}$   
 $2HNO_{2(aq)} + O_{2(g)} \longrightarrow 2HNO_{3(aq)}$

iii) *Through fractional distillation*

iv)  $HNO_{3(aq)} + NH_{3(g)} \longrightarrow NH_4NO_{3(aq)}$   
RMM of NH<sub>3</sub> = 17                      RFM of NH<sub>4</sub>NO<sub>3</sub> = 80  
If 80g NH<sub>4</sub>NO<sub>3</sub> \_\_\_\_\_ 17 g  
960000 \_\_\_\_\_  $\frac{960000}{80} \times 17 = 2040kg$

19. (a) *Potassium hydroxide solution*  
(b) *To remove dust particles*  
(c) *Water vapour      Moisture*  
(d) *-183°C*  
(e) *Fractional distillation of liquid air*  
(f) *Liquid air and passed through fractionating column, where nitrogen with lowest B.P -196°C 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.*

20.  $HOCl_{(aq)} + \text{Dye} \longrightarrow HCl_{(aq)} + [\text{Dye} + O]$   
Coloured                                      Colourless      ✓

$H_2SO_{3(aq)} + [\text{Dye} + O] \longrightarrow H_2SO_{4(aq)} + \text{Dye}$   
Coloured                                      Colourless

21. a) *Drying agent* ✓  $\frac{1}{2}$  which must be  $\text{CaO}$   
*Method of collection* ✓ - upward delivery  
*Workability* ✓  $\frac{1}{2}$
- b)  $2\text{NH}_4\text{Cl}_{(g)} + \text{Ca}(\text{OH})_{2(g)} \longrightarrow \text{CaCl}_{2(g)} + \text{H}_2\text{O}_{(l)} + 2\text{NH}_{3(g)}$  ✓
22. a) *Heat*  
b)  $\text{Cu}_{(g)} + \text{N}_2\text{O}_{(g)} \longrightarrow \text{CuO}_{(g)} + \text{N}_{2(g)}$   
c) - *Manufacture of ammonia*  
- *In light bulbs*  
- *As a refrigerant*
23. - *At 113°C consists of  $\text{S}_8$  rings that flow easily;*  
- *Darkens due to breaking of  $\text{S}_8$  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)  $2\text{N}_2\text{O}_{(g)} + \text{C}_{(s)} \longrightarrow \text{CO}_{2(g)} + 2\text{N}_{2(g)}$   
(ii) *Ammonium chloride and sodium nitrate*  
(iii) *The hydroxide ions ✓1 (Ammonia dissolves forming ammonia hydroxide. (1 mk)*
26. (a) E - *Ammonium chloride* ( $\frac{1}{2}$  mk)  
F - *Aluminium hydroxide* ( $\frac{1}{2}$  mk)  
(b)  $\text{Al}^{3+} + 3\text{OH}_{(aq)} \longrightarrow \text{Al}(\text{OH})_{3(s)}$
27. a) *Zinc hydroxide*  
b)  $[\text{Zn}(\text{NH}_3)_4]^{2+}$   
c)  $\text{Zn}^{2+}_{(aq)} + 2\text{OH}_{(aq)} \longrightarrow \text{Zn}(\text{OH})_2_{(s)}$
28. a) *Plantinum/platinum Rhodium* ✓1  
b)  $4\text{NH}_3(g) + 5\text{O}_2(g) \longrightarrow 4\text{NO}(g) \checkmark 1 + 6\text{H}_2\text{O}(l)$   
c) - *Fertilizers* ✓1  
- *Preparation of Nitrogen (I) oxide.*  
- *Explosives*
29. *Blue ppt ✓1 is formed which dissolves in excess to form a deep blue ✓1 solution due to formation of tetra amine Copper (II) ions*
30. (a) - *Finely divided iron impregnated by alumina ( $\text{Al}_2\text{O}_3$ )*  
- *200 atmosphere pressure*  
- *Temperature of 450°C* ✓  $\frac{1}{2}$
- b) - *CuO is reduced to Copper metal*  
-  *$\text{NH}_3$  is oxidized to water and nitrogen*
31. (a) *Colour of copper (II) Oxide changes from black to brown*  
(b) (i) *Nitrogen / $\text{N}_{2(g)}$*

**(ii) Water/H<sub>2</sub>O<sub>(l)</sub>**