NITROGEN AND ITS COMPOUNDS MARKING SCHEME

1. N/A

2. 1991 Q28b

(i) $(NH_3)_3PO_4$ has more macro nutrients (nitrogen and phosphorous) necessary for plants. $(NH_4)_2SO_4$ / Phosphates remain longer in the soil.

(ii) Damage seeds or plants by direct contract soluble fertilizer are washed away into streams, river causing pollution hence killing micro organisms

3. 1992 Q25b-d

(b) it is easily decomposed by sunlight

(c) copper is lower than hydrogen in the reactive series hence cannot displace hydrogen gas from $HCl_{(aq)}$

(d) HNO_3 is an oxidizing agent/hence oxidize Cu to Cu/ cannot oxidize Cu to Cu^{2+}/ HCl cannot displace copper ions$(NH_4)_3PO_4$ have two nutrients(P/N) whereas $CO(NH_2)_2$ have only one nutrients/contains more nutrients/stays longer in soil/ less soluble/not easily leached.

4. 1993 Q21 P1

- cracking depreciates
- brown gas produced
- gas produced which light a glowing splint
- solid changes from white to yellow/orange

5. 1994 Q2 P2

(a) An alkali is a base that dissolve in water to give hydroxide ions.

(b) (i) Ammonia is a basic gas that is very soluble in water thus it would dissolve in water instead of being collected.

(ii) Ammonia is less dense than air and would therefore not displace air in the collection jar

(c) Hydroxide ions (OH)

(d) $\frac{120cm^3}{24000cm^3}$ = 0.005 moles

(e) (i) The ammonium phosphate solution should be heated slowly to about half the volumes and allowed to cool until crystals form, then filtered.

(ii) From the equation, 3moles of ammonia = 1mole of $(NH_4)PO_4$

$\frac{0.005}{3}$ = 0.0017

Molar mass of $(NH_4)_3PO_4$ = (14 + 4) x 3 + 31.1 + 16 x4

1mole = 149

0.0017 mole =?

0.0017 x 149 = 0.253 grams

6. 1995 Q22 P1

a) i) NO^{-3} : O3- = -6

N = + 5 (+5) (don't mark formula) (1mark)

ii) NO

N -2 0 N = + 2 (1mark)

b) Reduction ($^1/_2$) because the nitrogen ion in NO_3 gains 3 electrons ($^1/_2$) to form the nitrogen in NO. (1marks)

7. 1995 Q7 P2

(a) (i) Liquid L is water

(ii) Black copper (II) oxide changes to reddish brown because it is reduced to copper by ammonia (1mark)

(iii) $2NH_3(g) + 3CuO(s) \longrightarrow 3Cu(s) + N_2(g) + H_2O(I)$ (1 mark)

(b)

(iv) I 2 moles NH_3 ➡ 1mole N_2

$320cm^3 NH_3$ ➡ $\frac{320}{2} = 160cm^3$

II Moles of $NH_3 = \frac{320}{24000} = 0.133$

2 moles of NH_3 = 3 moles CuO

Moles of CuO – $\frac{320}{24000}$ x ½ x 3 = $^1/_5$ = 0.02 moles

RFM OF CuO = 63.5 + 16 = 79.5

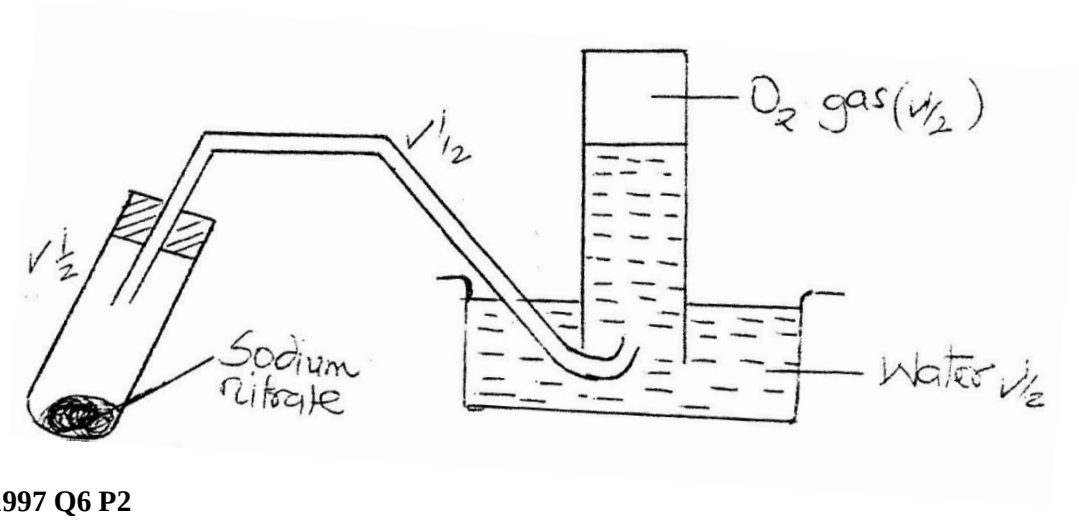
Mass of CuO = 0.02 x 79.5g = 1.59g (3marks)

(v) The excess ammonia from the reaction dissolves in the water in the beaker to form ammonium hydroxide which is a weak alkali or base of pH about 10. (2 marks)

(b) The burning splint would be extinguished (1 mark)

(c) Because it is cheaper and ammonia is made from nitrogen (1mark)

8. 1996 Q16 P1



9. 1997 Q6 P2

(a) (i) Anhydrous /fused CaCl /CaO /quick lime

(ii) To remove $CO_2 \longrightarrow 2Fe\ O_3(s)$

(iii) $4Fe(s) + 3O_2$ (g)

$3Fe(s) + 2O_{2\,(g)} \longrightarrow Fe3O_{4\,(s)}$

(i) Argon // Helium// Krypton // Neon

(ii) Provide low temperature so that semen does not decompose// destroyed (low temp. tied with storage// decompose/destroyed.

b) (i) Conc. Sulphuric acid.

(ii) $NaNO_{3(s)} + H_2SO_4(l) \longrightarrow NaHSO_4(s) + HNO_{3(g)}$ //
$NaNO_{3(s)} + H_2SO_4(l) \longrightarrow Na_2SO_4(s) + 2HNO_3$

(iii) I To avoid decomposition of nitric acid by sunlight/light

II Copper react with 50% Nitric acid to form colourless NO_2 then NO react with O_2 to form brown fumes of NO_2.

a) 1 mole NH_4NO_3 is formed from 1 M of NH_3
80Kg of Nh4NO_3 is formed from 17Kg NH_3
4800 Kg of NH_4NO_3 requires $\frac{17x4800}{80}$ kg
= 1020Kg (penalise ½ mark if units are missing or wrong.

10. 1998 Q18 P1

ALT 1
RMM of (NH_2) CO = 28 – 4 + 16 = 60
$NH_3^2 : (NH_2)_2CO$
2 x 17kg 60kg
680 kg = $\frac{60 \text{ kg x } 680}{2 \text{ x } 17}$ = 1200kg

ALT 2

Moles: 680000g = $\frac{}{17}$ 40,000 moles, 40,000 = 20,000 moles

Mg = n x R.F.M
20,000 x 60
1200000g
1200kg

11. 1998 Q22 P1

(a) Zinc/Zn
(b) $Zn\,(NH_3)_4^{2+}$

12. 1999 Q14 P1

(a) A brown ring was formed.
(b) $2KNO_3\,(s) \longrightarrow 2KNO_2\,(s) + O_2$

13. 2001 Q4b P2

(i) Hydrogen or H_2
(ii) - So that all ammonia gas can be converted to Q or NO(g) (1mark) or
- To increase the yield of gas Q or NO (g) (1 mark) OR
- For complete oxidation of ammonia or reduce the cost of Production
(iii) - NO(g) or nitrogen monoxide or nitrogen (II) oxide (1mark)

(iv) $NH_3(g) + HNO_3(aq) \rightarrow NH_4NO_3(aq)$
(½ mark for state symbols; Equation not balanced or chemical symbol joining or use of capital letters for small letter or vice versa in chemical symbols = 0 mark)

(i) - Fertilizer (don't accept manufacture of fertilizers)
- Explosives
(wrong use cancels the correct use therefore = 0mark)

14. 2002 Q24 P1

a) Being acidic, it would react with the basic ammonia(l) (2marks)
b) CaO (i)

15. 2002 Q6 P1

(a) Oxygen (1)
(b) Decomposition (1) (2 marks)

16. 2003 Q13 P1

They combine with water vapour to form acid rain which corrode building, pollute/poisonous / bad smell / Nitrating / Acidifying sort.

17. 2003 Q17

Chemical method – Insert a glowing splint into a gas jar of gas G and find it absorbed it is not N_2O inverting in air, if it doesn't turn brown its N_2O
Physical – Invert gas G over cold water if the level rises the gas is N2O
(laughing gas, nitrous oxide or sweet sickly smell.

18. 2003 Q19b

b) - Manufacture of fertilizer
- Softening temporary H2O
- Solvay process
- Removal of stains
- Smelting salts / manufacture.

19. 2003 Q26 P1

a) Ammonia being basic dissolves in water to form a basic solution
b) To prevent sucking back as ammonia is very soluble.

20. 2004 Q2 P1

a) Gas a is Nitrogen gas (i) (1mark)
b) Withdraw delivery tube from the water(1) This prevents sucking back (1) (2marks)

21. 2004 Q7 P1

(a) Is the charge that atoms have in molecules/icons (l) (2marks)
(b) -3

22. 2004 Q10 P1

It is required to break the strong N= N bond
It is required to break the triple bond. (3marks)

23. 2004 Q5 P2

a) To remove any oxide film on it i.e. layer of magnesium oxide.
b) A white solid formed which is magnesium oxide
c) The increase in mass was due to the oxygen which combines with magnesium.
d) $2Mg_{(s)} + O_{2(g)} \xrightarrow{heat} 2MgO_{(s)}$
e) The filtrate is magnesium hydroxide which is an alkaline.
There was no change in blue litmus paper but red litmus paper turned blue.

24. 2005 Q21

From equation in (d)
1 Mole of Magnesium atom combines with a mole of oxygen atom.
OR

	Mg		Oxygen
Mass	2.4		1.6
Molar mass	24		16
No. of moles	$\frac{2.4}{24} = 0.1$		$\frac{1.6}{16} = 0.1$ moles
Mole ratio	1	:	1

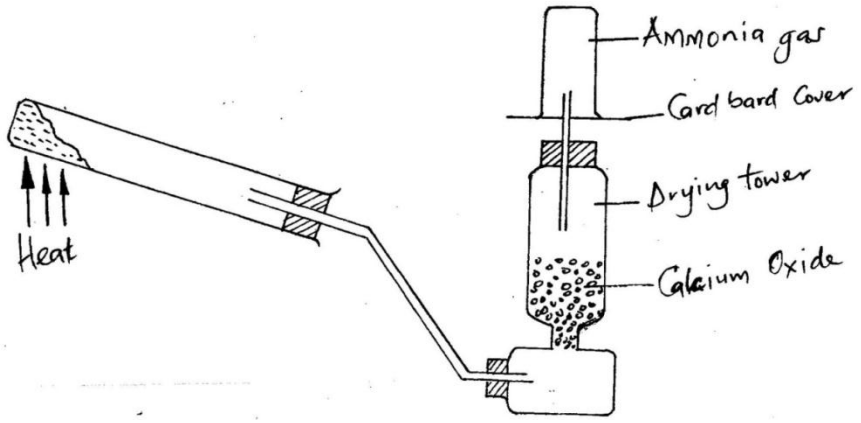
No. of moles of oxygen used = $\frac{1.6}{16} = 0.1$ moles
1 mole = $24{,}000cm^3$
0.1 mole = 24,000 x 0.1
Volume of oxygen used = $2{,}400cm^3$

25. 2005 Q25 P1

a) Nitric acid is volatile hence turns into vapour while sulphuric acid is non – volatile
b) Sodium nitrate
c) Manufacture of fertilizers eg:NH_4NO_3
Manufacture of explosive eg: TIN — Any of the four
Manufacture of dyes and drugs
Treatment of metal

26. 2005 Q2c P2

a) Copper (II) ions
b) Tetra ammine copper ions (Complete salt)
i) M is ammonium chloride
ii)



27. 2006 Q17 P2

a) Platinum

Platinum- Rhodium (1mark)

b) $4\ NH_{3(g)} + 5O_{2\ (g)} \longrightarrow 4\ NO_{(g)} + H_2O$ (1mark)

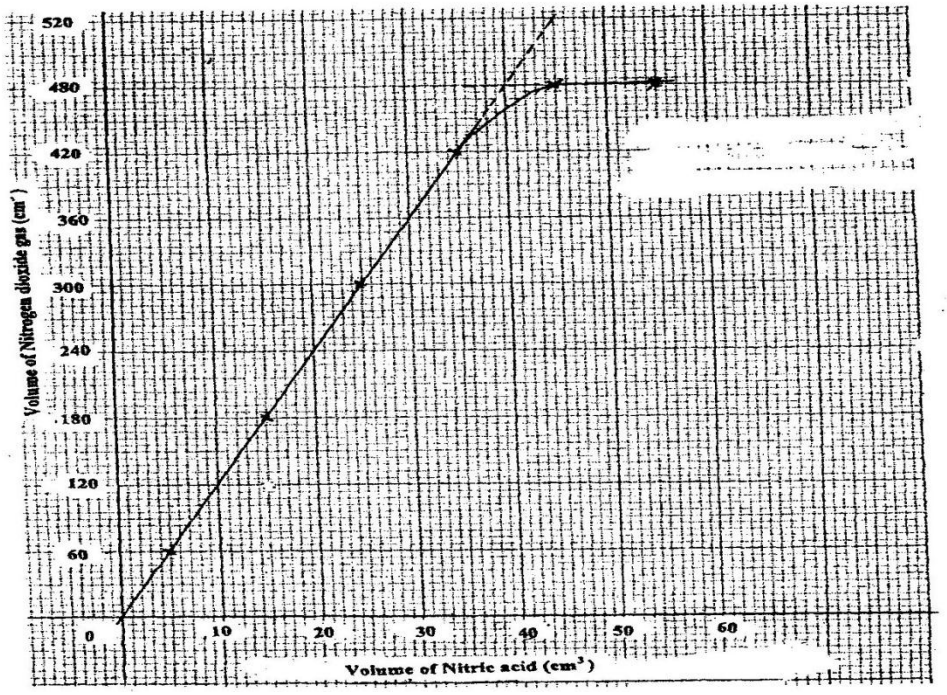
c) Fertilizers
Explosives (1mark)

28. 2006 Q7 P2

a) Nitric acid is a strong oxidizing acid. It oxidizes hydrogen gas to water (1mark)

b) Increase Molecules acquire the necessary activation energy. This increases the frequency of collisions hence the rate of reaction. (2mark)

c)



d) i) 360 cm3 (Correct value read from graph) (1mark)

ii) 40 cm^3 (Correct value read from graph) (1mark)

e) i) Moles of lead $= \frac{2.07}{2.07}$

$\therefore$ 1 mole of lead $= \frac{40}{0.01}$

$= 4000cm$ (2marks)

ii) $\frac{480}{0.01} = 48000cm^3$ (2marks)

f) i) Moles of nitric acid $= \frac{4000}{1000}$

That react with 1 mole of lead

$= 4$ (1mark)

ii) Moles of nitrogen dioxide $= \frac{48000}{24000}$

$= 2$ (1mark)

g) $Pb_{(s)} + 4HNO_{3(aq)} \longrightarrow pb(NO_3)_{2(aq)} + 2H_2O_{(l)} + 2NO_{2(g)}$

30. 2007 Q13 a P1

(a) (i) Deliquscency

31. 2007 Q6a (P2)

(a) (i) To the mixture in test tube and fresh prepared iron (II) sulphate solution.
Then add concentrated sulphuric acid to form a brown ring.

(ii) RMM of $(NH_4)_2 HPO_4 = 132$

Percentage of (N) = $\frac{28 \times 100}{132} = 21.212\%$

Mass of (N) = $\frac{21.212 \times 25}{100} = 5.303kg$

32. 2008 Q5 P1

(a) - Filter the air/ electrostatic precipitation/ Purify the air
- Pass air through NaOH in KOH to remove CO_2
- Cool to remove to remove water vapour
- Cool the remaining gases from a liquid air
- Perform fractural distillation of liquid air
- Nitrogen is collected at -196^0 C

(b) (i) Nitrogen II Oxide (NO)

(ii) $4_{-3}NH_3(g) + 3\ CUO \rightarrow 2N_2(g) + 3H_2O(l) + 3\ Cu$

Oxidation no of N in ammonia increases from -3 to 0
Oxidation number of reducing agent increases
Oxidation number Cu decreases from + 2 to O hence an oxidizing agent
Ammonia is a reducing agent

(iii) $NH_4NO_3(s)$ or $(aq) \rightarrow N_2O(g) + 2H_2O(g \text{ or } l)$

(iv) Fertilizer/explosive

(c) (i) G or G^{2+}

(ii) $E^{2+}(ag) + 2OH_{(ag)} \rightarrow E(OH)_2(s)$

33. 2009 Q13 P1

Moles of oxygen = 0.83 = 0.026 (½) / 0.0259375

Moles of $NaNO_3$ = 2 x 0.026 / 0.051875

0.05 (½) / 0.051875

R. M .M $NaCO_3$ = 85 (½)

Mass of $NaNO_3$ = converted $\frac{0.052 \times 85}{4.41}$ / 4.4094 (½)

$\frac{4.41}{8.53}$

51. 693%5

Or 183

51.7% (3 marks)

35. 2010 Q16 P1

a) Calcium

Add a few of NaOH to an aqueous solution fertilizer. It forms white ppt insoluble in excess.
Add a few drops of aqueous sulphuric acid to another white ppt portion of aqueous solution of fertilizer. Forms a white ppt insoluble in excess.

b) Ammonium ions
Heat the sample fertilizer in a test tube and test gas evolved with dump red litmus paper, it turns blue. OR Add NaOH to the sample fertilizer and heat the mixture, test gas evolved using damp red litmus paper, turns blue or introduce a glass rod dipped in conc HCl, white fumes observed.

36. 2010 Q20 P1

a) $NH_4NO_{3(s)} \longrightarrow N_2O_{(g)} + 2H_2O_{(g)/(l)}$

b) Downward displacement of warm water because it fairly soluble in cold water.

c) Both red and blue litmus will not change colour
(Rej; no observation made on paper)
(Acc: no observable change on paper)

37. 2010 Q5 P2

a) i)

(I) **Mistake**- method of gas collection is wrong
Reason – ammonia is less dense than air

(II) **Mistake** – Flash should be slanting downwards left to right
Reason – water produced may run back and brake the flask

(III) **Mistake –** moist reactants should not be used
Reason – ammonia gas will dissolved in water.

i) Calcium oxide

iii) $2NH_4Cl_{(g)} + Ca(OH)_{2(g)} \longrightarrow 2NH_{3(g)} + 2H_2O + CaCl_2$
It s reactions are (aq) $CaCl_2$ should (aq)

iv) Deep a glass rod in conc. HCl and bring it into contact with ammonia in a test tube. It forms a white fume.

b) i) Unit I
ii) **A** – nitrogen II oxide (NO)
B – Nitrogen IV oxide (NO_2)

ii) Nitrogen in NH, has an oxidation state of -3 while in HNO, it has oxidation state of +5.Increase in oxidation state is oxidation.

iv) $NH_{3(g)} + HNO_{3(aq)} \quad NH_4NO_{3(aq)}$

molar mass of NH_4NO_3 = 80

molar of NH_4NO_3 = $\frac{1000 \times 1000}{80}$

molar ratio = 1 : 1

molar mass of HNO_3 = 63

mass of HNO_3 = $\frac{1000 \times 1000 \times 63}{80}$

38. 2012 Q12 P1

(a)CaO/calcium oxide / quicklime

(b) Expose NH_3 to HCl(g) , dense white fumes form (or use equation)
Or dump red litmus paper turn blue when exposed to ammonia
Or use of indicators or
Or pass the gas in ca^{2+} ions a pale blue ppt which dissolves to give a deep blue soln is seen.
NB; Don't split the 1mark one must be complete

(c) x = steam//water vapour //water