# Unit -3 p – Block Elements – II

## Book Back

**Answer the following questions.**

**1.What is inert pair effect?**

1) As we move down the group in p–block elements the **outer $ns^2$ electrons become inert** and do not involve in chemical combination.
2) Only np electrons take part in chemical combination.
3) This is known as inert pair effect.

**2.Chalcogens belongs to p–block. Give reason**.

- Because their outer electronic configuration is **$ns^2np^4$**.
- In these elements the **last electron enters np orbital.**
- Hence they belong to p–block elements.

**3. Explain why fluorine always exhibit an oxidation state of –1?**

1) Since fluorine is the **most electronegative element** it exhibits only a negative state of –1.
2) Electronic configuration of fluorine is **$1s^22s^22p^5$.**
3) To attain noble gas configuration **it gains 1 electron** and exhibit -1 oxidation state.

**4.Give the oxidation state of halogen in the following**

**a)$OF_2$ b)$O_2F_2$ c)$Cl_2O_3$ d)$I_2O_4$**

Oxidation state of fluorine is -1

**a)$OF_2$** is –1

**b)$O_2F_2$** is –1

**c)$Cl_2O_3$**

$2x+3(-2) = 0$

$2x-6 = 0$

$2x = +6$

$\mathbf{x = +3}$

O.S of Cl is +3

**d)$I_2O_4$**

$2x+4(-2) = 0$

$2x-8 = 0$

$2x = +8$

$\mathbf{X = +4}$

O.S of I is **+4**

**5.What are inter halogen compounds? Give examples**

**Each halogen** combines with **other halogens** to form a **series of compounds** called inter halogen compounds.

**E.g :** $IF_7$.

**6. Why fluorine is more reactive than other halogens?**

- Fluorine is the **most reactive element** among halogen.
- This is due to the low value of **F–F Bond dissociation energy**.

**7.Give the uses of helium**.

1) Helium and oxygen mixture is used by divers in place of air oxygen mixture.This Prevents the painful dangerous condition called bends.
2) Helium is used to provide inert atmosphere in electric arc welding of metals.
3) Helium has lowest boiling point hence used in cryogenics)
4) Helium is much less denser than air and hence used for filling air balloons.

**8.What is the hybridisation of iodine in $IF_7$?Give its structure.**

| Interhalogen | Hybridisation | Structure |
|---|---|---|
| $IF_7$ | $Sp^3d^3$ | Pentagonal bipyramidal |

**9.Give the balanced equation for the reaction between chlorine with cold NaOH and hot NaOH?**

- Chlorine reacts with cold NaOH to give sodium hypochlorite

  $\mathbf{Cl_2+2NaOH \rightarrow NaOCl+NaCl+H_2O}$

  sodium hypochlorite
- Chlorine reacts with hot NaOH to give sodium chlorate

  $\mathbf{3Cl_2+6NaOH \rightarrow NaClO_3+5NaCl+3H_2O}$

  sodium chlorate

**10.How will you prepare chlorine in the laboratory?**

In the laboratory chlorine is prepared by the oxidation of hydrochloric acid by potassium permanganate.

$\mathbf{2KMnO_4+16HCl \rightarrow 2KCl+2MnCl_2+8H_2O+5Cl_2\uparrow}$

**11.Give the uses of sulphuric acid.**

- In the manufacture of fertilizers ,ammonium sulphate and super phosphates.
- In the manufacture of other chemicals such as hydrochloric acid, nitric acid etc.,

- As a drying agent.
- In the preparation of pigments, explosives etc.,

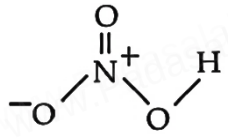
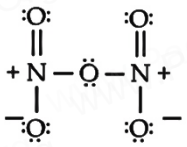
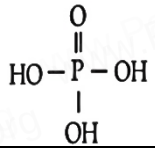
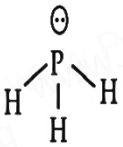
**12.Give a reason to support that sulphuric acid is a dehydrating agent.**

- Sulphuric acid is highly soluble in water.
- It has strong affinity towards water and thus it absorbs water quickly.
- Hence it can be used as a dehydrating agent.
- When dissolved in water, it forms **mono ($H_2SO_4.H_2O$) and dihydrates ($H_2SO_4.2H_2O$)**

**13.Write the reason for the anamolous behaviour of Nitrogen.**

- Small size
- High electro negativity
- Non–availability of d–orbitals in valency shell
- Chemically inert due to high bonding energy
- High ionization energy

**14.Write the molecular formula and structural formula for the following molecules**
**a)Nitric acid b)dinitrogen pentoxide c)phosphoric acid d)phosphine**

| *Compound* | *Molecular Formula* | *Structural Formula* |
|---|---|---|
| a) Nitricacid | $HNO_3$ |  |
| b)Dinitrogen pentoxide | $N_2O_5$ |  |
| c)Phosphoric acid | $H_3PO_4$ |  |
| d)Phosphine | $PH_3$ |  |

**15.Give the uses of argon.**

- Argon prevents the oxidation of hot filament and prolongs the life in filament bulbs.
- Argon is used in radio valves and tubes.

**16. Write the valence shell electronic configuration of group–15 elements.**

Valence shell electronic configuration of group 15 elements is **$ns^2np^3$.**

**17.Give two equations to illustrate the chemical behaviour of phosphine**.

**Basic Nature**

Phosphine is weakly basic and forms phosphonium salts.

$PH_3+HI \rightarrow PH_4I$

$PH_4I+H_2O \xrightarrow{\Delta} PH_3+H_3O^+ + I^-$

**Combustion**

When phosphine is heated with air or oxygen it burns to give metaphosphoric acid

$4PH_3+8O_2 \xrightarrow{\Delta} P_4O_{10}+6H_2O$

**Phosphorous pentoxide**

$P_4O_{10}+6H_2O \xrightarrow{\Delta} 4HPO_3+4H_2O$

**Metaphosphoric acid**

**18.Give a reaction between nitric acid and a basic oxide.**

Nitric acid reacts with a basic oxide to form **salt** and **water**.

**$3FeO +10HNO_3 \longrightarrow 3Fe(NO_3)_3+NO+5H_2O$.**

**19.What happens when $PCl_5$ is heated?**

On heating Phoshorous pentachloride decomposes into phosphorus trichloride and chlorine.

**$PCl_{5(g)} \longrightarrow PCl_{3(g)} + Cl_{2(g)}$.**

**20.Suggest a reason why HF is a weak acid, where as binary acids of the all other halogens are strong acids.**

- Among halogen acids, the **electronegativity difference is maximum** (1.9) in HF acid.
- Hence the **bond between H and F is stronger** and the acid HF is weaker.
- It takes tremendous amount of energy to break the H-F bond in water.

**22.What type of hybridisation occur in**

**a)$BrF_5$ b)$BrF_3$**

| S.NO | Inter Halogen Compound | Hybridisation |
|---|---|---|
| a) | $BrF_5$ | $sp^3d^2$ |
| b) | $BrF_3$ | $sp^3d$ |

**23.Complete the following reactions**

**Answer:**

***1.*** $4NaCl+MnO_2+4H_2SO_4 \longrightarrow$ **$Cl_2 + MnCl_2 + 4NaHSO_4 + 2H_2O$**

2. $NaNO_2+HCl \longrightarrow$ **$NaCl + HNO_2$**

3. $IO^{3-}+5I^{-}+6H^{+} \longrightarrow$ **$3I_2 + 3H_2O$**

4. $I_2+2S_2O_3^{2-} \longrightarrow$

5. $P_4+3NaOH+3H_2O \longrightarrow$ **$3NaH_2PO_2 + PH_3\uparrow$**
   i. sodium hypophosphitephosphine

6. $6AgNO_3+PH_3+3H_2\longrightarrow$ **$6Ag + 6HNO_3 + H_3PO_3$**

7. $4Mg+10HNO_3 \longrightarrow$ **$4Mg(NO_3)_2 + NH_4NO_3 + 3H_2O$**

8. $2KClO_3 \xrightarrow{\Delta}$ **$2KCl + 3O_2\uparrow$**

**9.** $Cu+2H_2SO_4 \longrightarrow$ **$CuSO_4 + 2H_2O + 2SO_2\uparrow$**

**10.**$2Sb+3Cl_2 \longrightarrow 2SbCl_3$

11.$2HBr+H_2SO_4 \longrightarrow$ **$2H_2O + Br_2 + SO_2$**

12.$XeF_6+3H_2O \longrightarrow$ **$XeO_3 + 6HF$**

13.$5XeO_6^{4-}+2Mn^{2+}+14H^{+} \longrightarrow$ **$2MnO_4^{-}+5XeO_3+7H_2O$**

14.$2XeOF_4+SiO_2 \longrightarrow$ **$2XeO_2F_2 + SiF_4$**

15. $Xe + 3F_2 \xrightarrow[400°C]{Ni/200atm} XeF_6$

**Book inside short answers**

**1.What is Aquaregia?.Write down its use.**

When **three parts of concentrated hydrochloric acid** and **one part of concentrated nitric acid** are mixed, Aquaregia (Royal water) is obtained.

**Use :** This is used for dissolving gold, platinum

**2.Give the uses of Xenon and radon.**

**Xenon:**

1) Xenon is used in fluorescent bulbs, flash bulbs and lasers.
2) Xenon emits an intense light in discharge tubes instantly. Due to this it is used in high speed electronic flash bulbs used by photographers

**Radon:**

**1)** Radon is radioactive and used as a **source of gamma rays**
2) Radon gas is sealed as **small capsules** and implanted in the body to destroy malignant i.e. cancer growth

**3. Give the uses of neon , argon , krypton**

**Neon:**

Neon is used in advertisement as neon sign and the brilliant red glow is caused by passing electric current through neon gas under low pressure.

**Argon:**

Argon prevents the oxidation of hot filament and **prolongs the life in filament bulbs**

**Krypton:**

1) Krypton is used in **fluorescent bulbs, flash bulbs** etc...
2) Lamps filed with krypton are **used in airports as approaching lights** as they can penetrate through dense fog.

**4.Give Uses of hydrochloric acid**

1. Hydrochloric acid is used for the manufacture of chlorine, ammonium chloride, glucose from corn starch etc.,
2. **Extraction of glue from bone** and for purification of bone black

**5. Give the Uses of chlorine**

1. Purification of **drinking water**
2. **Bleaching of cotton textiles,** paper and rayon
3. It is used in extraction of gold and platinum

**6.How will you prepare bleaching powder from chlorine**

Bleaching powder is produced by passing chlorine gas through dry slaked lime (calcium hydroxide)

$$Ca(OH)_2 + Cl_2 \longrightarrow CaOCl_2 + H_2O$$

**7.Write down tests for sulphate/sulphuric acid**

Dilute solution of sulphuric acid/aqueous solution of sulphates gives white precipitate (barium sulphate) with barium chloride solution. It can also be detected using lead acetate solution. Here a white precipitate of lead sulphate is obtained.

$$BaCl_2 + H_2SO_4 \longrightarrow BaSO_4 \downarrow + 2HCl$$

Barium sulphate (white precipitate )

$$(CH_3COO)_2Pb + H_2SO_4 \longrightarrow PbSO_4 \downarrow + CH_3COOH$$

Lead sulphate (white precipitate )

**8. Why sulphuric acid is called as strong dibasic acid**

It is a strong dibasic acid. Hence it forms two types of salts namely sulphates and bisulphates.

$$H_2SO_4 + NaOH \longrightarrow NaHSO_4 + H_2O$$

$$H_2SO_4 + 2\,NaOH \longrightarrow Na_2SO_4 + 2H_2O$$

**9.Give uses of sulphur dioxide**

1. Sulphur dioxide is used in bleaching hair, silk, wool etc...
2. It can be used for disinfecting crops and plants in agriculture.

**10. Give the uses of oxygen**

1. Oxygen is one of the essential component for the survival of living organisms.
2. It is used in welding (oxyacetylene welding)
3. Liquid oxygen is used as fuel in rockets

**11.Hybridisation and structure of xenon fluoride Compounds**

| Compound | Hybridisation | Shape / Structure |
|---|---|---|
| XeF | $sp^3d$ | Linear |
| $XeF_4$ | $sp^3d^2$ | Square planar |
| $XeF_6$ | $sp^3d^3$ | Distorted octahedron |
| $XeOF_2$ | $sp^3d$ | T Shaped |
| $XeOF_4$ | $sp^3d^2$ | Square pyramidal |
| $XeO_3$ | $sp^3$ | Pyramidal |

**12.Structure , Hybridisation of interhalogen copounds**

| Type | Structure | Hybridisation | bond pairs / lone pairs |
|---|---|---|---|
| AX | Linear | $sp^3$ | 1 / 3 |
| $AX_3$ | T shaped | $sp^3d$ | 3 / 2 |
| $AX_5$ | Square pyrimidal | $sp^3d^2$ | 5 / 1 |
| $AX_7$ | Pentagonal bipyramidal | $sp^3d^3$ | 7 / 0 |

**13.Explain about Holmes signal**

**Uses of phosphine:**

- Phosphine is used for producing smoke screen as it gives large smoke. In a ship, a pierced container with a mixture of calcium carbide and calcium phosphide, liberates phosphine and acetylene when thrown into sea.
- The liberated phosphine catches fire and ignites acetylene.
- These burning gases serves as a signal to the approaching ships. This is known as **Holmes signal**.

**14. What is Haber's process?**

The synthesis of ammonia from nitrogen and hydrogen at high pressure and optimum temperature in presence of iron catalyst is known as Haber's process.

$N_2 + 3H_2 \leftrightarrow 2NH_3$

**15. Write the uses of nitrogen**

- In the manufacture of ammonia, nitric acid and calcium cyanamide etc.
- Liquid nitrogen is used for producing low temperature required in cryosurgery and so used in biological preservation.

**16. What happens when ammonia reacts with excess of chlorine?**

With excess of chlorine ammonia reacts to give an **explosive substance nitrogen trichloride**

$2NH_3 + 6Cl_2 \longrightarrow 2NCl_3 + 6HCl$

**17. Prove that nitric acid is an oxidising agent & nitrating agent.**

Non metals like carbon, sulphur are oxidised by nitric acid.

$$C + 4HNO_3 \longrightarrow CO_2 + 4NO_2 + 2H_2O$$

Nitric acid replaces hydrogen atom from organic compounds with nitronium ion $NO^{2+}$ . This is called nitration.

$$C_6H_6 + HNO_3 \longrightarrow C_6H_5NO_2 + H_2O$$

**18. Write the uses of nitric acid**

- It is used as an oxidising agent.
- It is used in the preparation of aquaregia.
- Salts of nitric acid are used in photography ($AgNO_3$) and gunpowder for fire arms ($NaNO_3$)

**19. What is phosphorescence?**

**White phosphorous undergoes spontaneous slow oxidation** in air giving a greenish yellow glow which is visible in the dark. This is known as phosphorescence.

**20. How is phosphine prepared?**

Phosphine is prepared by the action of sodium hydroxide with white phosphorous in an inert atmosphere of carbon dioxide

$$P_4 + NaOH + CO_2 \longrightarrow 3NaH_2PO_2 + PH_3 \uparrow$$

**21. How is orthophosphoric acid prepared in the laboratory?**

When phosphorous is treated with conc. nitric acid in the presence of iodine catalyst, it is oxidised to orthophosphoric acid.

$$P_4 + 20HNO_3 \longrightarrow 4H_3PO_4 + 20NO_2 + 4H_2O$$

**22. Write about the reducing property of phosphine?**

Phosphine reduces silver nitrate into silver

$$PH_3 + 6AgNO_3 + 3H_2O \longrightarrow 6Ag + 6HNO_3 + H_3PO_3$$

**23. Write the uses of oxygen**

- Oxygen is one of the **essential component** for the survival of living organisms.
- Oxygen is used in **oxyacetylene welding**.
- Liquid oxygen is used as a **rocket fuel**.

**24. Illustrate the dehydrating property of sulphuric acid**

$$C_{12}H_{22}O_{11} + H_2SO_4 \longrightarrow 12\,C + H_2SO_4.11H_2O$$

$$HCOOH + H_2SO_4 \longrightarrow CO + H_2SO_4.H_2O$$

**25. Write about the bleaching action of chlorine.**

Chlorine is a strong oxidising and bleaching agent since it produces nascent oxygen.

$H_2O + Cl_2 \longrightarrow HCl + HOCl$

$HOCl \longrightarrow HCl + [O]$

Colouring matter + Nascent oxygen → Colourless oxidation product.

The bleaching of chlorine is permanent.

**25.Show that sodium per xenate is a strong oxidising agent**

Sodium per xenate oxidises manganese (II) ion into permanganate ion even in the absence of a catalyst

$$\mathbf{5XeO_6^{4-} + 2Mn^{2+} + 14H^+ \longrightarrow 2MnO^{4-} + 5XeO_3 + 7H_2O}$$

**See all the structure , preparation , chemical properties of compounds which may be asked in exam**

**Book inside long answers**

**1. What are the Properties of inter halogen compounds**

i. The **central atom will be the larger one**
ii. It can be formed only between two halogen and not more than two halogens.
iii. **Fluorine can't act as a central metal atom** being the smallest one
iv. Due to high electronegativity with small size fluorine helps the central atom to attain high coordination number
v. They can undergo the **auto ionization.**
vi. They are **strong oxidizing agents**

**2. Explain trend in various properties of Hydrogen halide from fluorine to iodine**

| Property | Order |
|---|---|
| Reactivity of hydrogen | Decreases from fluorine to iodine |
| Stability | Decreases from HF to HI |
| Volatility of the hydrides | HF < HI < HBr < HCl |
| Thermal stability | HF > HI > HBr > HCl |
| Boiling point | HCl < HBr < HI |
| Acid strength | Increases from HF to HI |

**3.Explain the manufacture of chlorine by electrolytic method and Deacon's process**

**Electrolytic process**

- When a solution of brine (NaCl) is electrolysed, $Na^+$ and $Cl^-$ ions are formed. Na+ ion reacts with $OH^-$ ions of water and forms sodium hydroxide.
- Hydrogen and chlorine are liberated as gases.

$$NaCl \longrightarrow Na^+ + Cl^-$$
$$H_2O \longrightarrow H^+ + OH^-$$
$$Na^+ + OH^- \longrightarrow NaOH$$

At the cathode,

$$H^+ + e^- \longrightarrow H$$
$$H + H \longrightarrow H_2$$

At the anode,

$$Cl^- \longrightarrow Cl + e^-$$
$$Cl + Cl \longrightarrow Cl_2$$

**Deacon's process**

In this process a mixture of air and hydrochloric acid is passed up a chamber containing a number of shelves, pumice stones soaked in cuprous chloride are placed. Hot gases at about 723 K are passed through a jacket that surrounds the chamber.

$$4HCl + O_2 \xrightarrow[Cu_2Cl_2]{400^oC} 2H_2O + Cl_2$$

**4.Explain about Manufacture of sulphuric acid by contact process**

The contact process involves the following steps.

i. Initially sulphur dioxide is produced by burning sulphur or iron pyrites in oxygen/air.

$$S + O_2 \rightarrow SO_2$$

$$4FeS_2 + 11O_2 \longrightarrow 2Fe_2O_3 + 8SO_2$$

ii. Sulphur dioxide formed is oxidised to sulphur trioxide by air in the presence of a catalyst such as $V_2O_5$ or platinised asbestos.

iii. The sulphur trioxide is absorbed in concentrated sulphuric acid and produces oleum ($H_2S_2O_7$). The oleum is converted into sulphuric acid by diluting it with water.

$$SO_3 + H_2SO_4 \longrightarrow H_2S_2O_7 \xrightarrow{H_2O} 2H_2SO_4$$

To maximise the yield the plant is operated at 2 bar pressure and 720 K. The sulphuric acid obtained in this process is over 96 % pure.

**5.Explain about Allotrophic forms of sulphur**

1) Sulphur exists in crystalline as well as amorphous allotrophic forms.
2) The crystalline form includes rhombic sulphur (α sulphur) and monoclinic sulphur (β sulphur). Amorphous allotropic form includes plastic sulphur (γ sulphur), milk of sulphur and colloidal sulphur.
3) Rhombic sulphur also known as α sulphur, is the only thermodynamically stable allotropic form at ordinary temperature and pressure.
4) The crystals have a characteristic yellow colour and composed of $S_8$ molecules.
5) When heated slowly above 96ºC, it converts into monoclinic sulphur. Upon cooling below
6) 96 ºC the β form converts back to α form.
7) Monoclinic sulphur also contains S8 molecules in addition to small amount of $S_6$ molecules.
8) It exists as a long needle like prism and is also called as prismatic sulphur. It is stable between 96 º - 119 ºC and slowly changes into rhombic sulphur.

9) When molten sulphur is poured into cold water a yellow rubbery ribbon of plastic sulphur is produced. They are very soft and can be stretched easily. On standing (cooling slowly) it slowly becomes hard and changes to stable rhombic Sulphur.Sulphur also exists in liquid and gaseous states. At around 140 ºC the monoclinic sulphur melts to form mobile pale yellow liquid called λ sulphur.

6. **Write about ozone**

- Ozone is an allotropic form of oxygen
- Ozone is triatomic gas
- Although negligible amounts of ozone occurs at sea level, it is formed in the upper
- atmosphere by the action of UV light.
- In the laboratory ozone is prepared by passing electrical discharge through oxygen.
- At a potential of 20,000 V about 10% of oxygen is converted into ozone, it gives a mixture known as ozonised oxygen.
- Pure ozone is obtained as a pale blue gas by the fractional distillation of liquefied ozonised oxygen.

**7.Write about the reducing property of sulphur dioxide**

i)$SO_2$ reduces chlorine into hydrochloric acid

$$\mathbf{SO_2 + 2H_2O + Cl_2 \longrightarrow H_2SO_4 + 2HCl}$$

ii)$SO_2$ reduces potassium permanganate into manganese sulphate ($Mn^{2+}$)

$$\mathbf{2KMnO_4 + 5SO_2 + 2H_2O \longrightarrow K_2SO_4 + 2MnSO_4 + 2H_2SO_4}$$

iii)$SO_2$ reduces potassium dichromate into chromic sulphate ($Cr^{3+}$)

$$\mathbf{K_2Cr_2O_7 + 3SO_2 + H_2SO_4 \longrightarrow K_2SO_4 + Cr_2(SO_4)_3 + H_2O}$$

**8. Write about the bleaching action of sulphur dioxide.**

i) In presence of water, sulphur dioxide bleaches coloured wool, silk, sponges and straw into colourless due to its reducing property

$$\mathbf{SO_2 + 2H_2O \longrightarrow H_2SO_4 + 2[H]}$$

$$\mathbf{X + 2[H] \longrightarrow XH_2}$$

Coloured colourless

ii)When the bleached product (Colourless) is allowed to stand in air, it is reoxidised by atmospheric oxygen to its original colour.

iii)Hence bleaching action of sulphur dioxide is temporary

9. **Show that sulphuric acid is an oxidising agent**

i)Sulphuric acid is an oxidising agent as it produces nascent oxygen

$H_2SO_4 \longrightarrow H_2O + SO_2 + [O]$

**Nascent oxygen**

ii)Sulphuric acid oxidises carbon into carbon dioxide

$C + 2H_2SO_4 \longrightarrow 2SO_2 + 2H_2O + CO_2$

iii)Sulphuric acid oxidises phosphorous into ortho phosphoric acid

$P_4 + 10H_2SO_4 \longrightarrow 4H_3PO_4 + 10SO_2 + 4H_2O$

iv) Sulphuric acid oxidises iodide into iodine.

$H_2SO_4 + 2HI \longrightarrow 2SO_2 + 2H_2O + I_2$

**9.How is nitric acid manufactured using Ostwald's process?**

- Ammonia prepared by Haber's process is mixed about 10 times of air.
- This mixture is preheated and passed into the catalyst chamber where they come in
- contact with platinum gauze.
- The temperature rises about 1275 K.
- The metallic gauze brings about the rapid catalytic oxidation of ammonia resulting in the
- formation of NO.
- NO is the oxidised to $NO_2$

$4NH_3 + 5O_2 \longrightarrow 4NO + 6H_2O \quad +120\ KJ$

$2NO + O_2 \longrightarrow 2NO_2$

- $NO_2$ produced is passed through a series of adsorption towers.
- $NO_2$ reacts with water to give nitric acid.
- Nitric acid formed is bleached by blowing air.

$6NO_2 + 3H_2O \longrightarrow 4HNO_3 + 2NO + H_2O$

**10. Explain the action of nitric acid on metals with one example.**

**Primary reaction**

Metal nitrate is formed with the release of nascent hydrogen.

$3Cu + 6HNO_3 \longrightarrow 3Cu(NO_3)_2 + 6(H)$

**Secondary reaction**

Nascent hydrogen produces the reduction products of nitric acid

$6(H) + 3HNO_3 \longrightarrow 3HNO_2 + 3H_2O$

**Tertiary reaction**

With dilute acid the secondary products decompose to give final products.

$3HNO_2 \longrightarrow HNO_3 + 2NO + H_2O$

Hence over all reaction is

$3Cu + 8HNO_3 \longrightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$

With concentrated acid the secondary products react to give the final products.

$HNO_2 + HNO_3 \longrightarrow 2NO_2 + H_2O$

**Hence over all reaction is**

$Cu + 4HNO_3 \longrightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2$