PREVIOUS YEAR QUESTIONS
(Chapterwise)

CHAPTER NAME: NITRIC ACID

SUMMARY POINTS

Concept	Details/Notes
Thermal Decomposition of Nitrates	- **Observation**: Certain metal nitrates decompose to form specific residues. Example: Copper nitrate decomposes to give black copper oxide. **Equation**: $2Cu(NO_3)_2 \xrightarrow{\text{heat}} 2CuO + 4NO_2 + O_2$ **Key Insight**: Transition metal nitrates often form oxides upon heating.
Reaction with Metals	- Concentrated HNO_3: Strong oxidizing agent. **Example**: $Cu + 4HNO_3 \rightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$ (brown fumes of NO_2). - Dilute HNO_3: Reacts less vigorously. **Example**: $3Cu + 8HNO_3 \rightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$.
Reaction with Non-Metals	- Sulfur: Oxidized to H_2SO_4 with concentrated HNO_3. **Example**: $S + 6HNO_3 \rightarrow H_2SO_4 + 6NO_2 + 2H_2O$. - Carbon: Oxidized to CO_2. **Equation**: $C + 4HNO_3 \rightarrow CO_2 + 4NO_2 + 2H_2O$.
Salt Formation	- Concentrated H_2SO_4 reacts with nitrates to form nitrosyl or nitrate salts: **Example**: $KNO_3 + H_2SO_4 \xrightarrow{200^\circ C} KHSO_4 + HNO_3$.
Brown Ring Test	- Detects NO_3^- ions. - **Procedure**: Add freshly prepared ferrous sulfate ($FeSO_4$) and concentrated H_2SO_4. A brown ring forms due to $[Fe(H_2O)_5(NO)]^{2+}$. - **Observation**: Fresh $FeSO_4$ ensures NO is not oxidized before forming the complex.
Lab Preparation of Nitric Acid	- **Reaction**: $KNO_3 + H_2SO_4 \xrightarrow{heat} KHSO_4 + HNO_3$. - Glass apparatus used due to HNO_3's highly corrosive nature.
Oxidizing Nature	- HNO_3 oxidizes metals and non-metals to higher oxidation states. - HNO_3 appears yellow over time due to decomposition, forming NO_2: **Reaction**: $4HNO_3 \xrightarrow{\text{light/heat}} 2H_2O + 4NO_2 + O_2$.
Reaction with Sulfur	- Sulfur reacts with concentrated HNO_3 to form H_2SO_4 and NO_2: **Reaction**: $S + 6HNO_3 \rightarrow H_2SO_4 + 6NO_2 + 2H_2O$.
Action on Ammonia	- Forms ammonium nitrate: **Reaction**: $NH_3 + HNO_3 \rightarrow NH_4NO_3$.

Important Chemical Equations

Reaction Type	Equation
Thermal decomposition of copper nitrate	$2Cu(NO_3)_2 \xrightarrow{\text{heat}} 2CuO + 4NO_2 + O_2$
Reaction of copper with concentrated HNO_3	$Cu + 4HNO_3 \rightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$
Reaction of sulfur with HNO_3	$S + 6HNO_3 \rightarrow H_2SO_4 + 6NO_2 + 2H_2O$
Reaction of potassium nitrate and H_2SO_4	$KNO_3 + H_2SO_4 \xrightarrow{200^\circ C} KHSO_4 + HNO_3$
Formation of ammonium nitrate	$NH_3 + HNO_3 \rightarrow NH_4NO_3$
Oxidation of carbon by HNO_3	$C + 4HNO_3 \rightarrow CO_2 + 4NO_2 + 2H_2O$

Notes for Quick Reference

1. **Decomposition Colors**:
   - NO_2: Brown fumes, toxic gas.
   - Residues depend on metal type: $Cu(NO_3)_2 \rightarrow CuO$ (black).
2. **Oxidizing Strength**: HNO_3 oxidizes metals/non-metals, forming NO, NO_2, or acids.
3. **Brown Ring Test**: Fresh $FeSO_4$ prevents oxidation of NO before forming the characteristic brown ring.
4. **Safety**: Glass is mandatory in lab setups for nitric acid to avoid corrosion.

Q.NO.: 1	**Complete the following sentence by choosing the correct answer from the bracket:** **The metal nitrate which on thermal decomposition forms a black residue is_____.** **[zinc nitrate/copper nitrate]**	**YEAR** **[2024]**
ANS.:	Copper nitrate. When copper nitrate undergoes thermal decomposition, it forms a black residue of copper oxide.	
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Q.NO.: 2	**Give balanced equation for the following reactions: a. Copper reacts with concentrated Nitric acid.**	**YEAR** **[2024]**
ANS.:	$Cu + 4HNO_3 \rightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$	
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Q.NO.: 3	**The salt formed when concentrated sulphuric acid reacts with KNO; above 200°C:** **a. K2SO4** **b. K2SO** **c. KHSO4** **d. KHSO;**	**YEAR** **[2023]**
ANS.:	(a) K_2SO_4. The reaction also produces nitric acid (HNO_3).	
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Q.NO.: 4	**Complete and balance the following equation:** **a. Cu + Conc. HNO3 →→→**	**YEAR** **[2023]**
ANS.:	$Cu + 4HNO_3 \rightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$	
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Q.NO.: 5	**The gas formed, when calcium bisulphite reacts with dilute HNO_3:** **a. Sulphur trioxide** **b. Hydrogen** **c. Sulphur dioxide** **d. Hydrogen sulphide**	**YEAR** **[2022]**
ANS.:	(c) Sulphur dioxide. Any metal sulphite or bisulphite, when reacted with an acid, produces salt, water, and sulphur dioxide.	
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Q.NO.: 6	**State the observation for the following:** **(a) Carbon reacts with hot concentrated nitric acid.**	**YEAR** **[2022]**
ANS.:	Carbon reacts with hot concentrated nitric acid to produce carbon dioxide, water, and reddish-brown fumes of nitrogen dioxide gas.	
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Q.NO.: 7	**Write balanced equation for the following conversions:** **(a) Ferric nitrate from ferric hydroxide and nitric acid.**	**YEAR** **[2021]**
ANS.:	$Fe(OH)_3 + 3HNO_3 \rightarrow Fe(NO_3)_3 + 3H_2O$	
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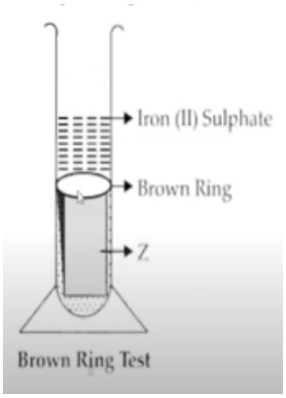
Q.NO.: 8	**Study the diagram, which shows the Brown Ring Test and answer the questions given below:**	**YEAR** **[2021]**

	 **(a) Which ion is determined by Brown Ring Test?** **(b) Why is freshly prepared iron [II] sulphate used in the test?** **(c) Name the substance Z.**	
ANS.:	(a) Nitrate ion (NO^{3-}). (b) Ferrous sulphate ($FeSO_4$), upon exposure to the atmosphere, oxidizes to ferric sulphate ($Fe_2(SO_4)_3$. The brown ring test does not work with ferric sulphate, hence freshly prepared ferrous sulphate is used. (c) Concentrated sulphuric acid (H_2SO_4).	
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Q.NO.: 9	**Identify the acid in each case:** **(a) The acid formed when sulphur reacts with concentrated nitric acid.** **(b) The acid formed when potassium nitrate reacts with a least volatile acid.**	**YEAR** **[2021]**
ANS.:	(i) Sulphuric acid (H_2SO_4). (ii) Nitric acid (HNO_3).	
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Q.NO.: 10	**State one relevant observation for each of the following reactions:** **(i) Action of concentrated nitric acid on copper.**	**YEAR** **[2020]**
ANS.:	Reddish-brown fumes of nitrogen dioxide gas are liberated when copper reacts with concentrated nitric acid.	

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Q.NO.: 11	**Write a balanced chemical equation for the following:** **(i) Reaction of carbon powder and concentrated nitric acid.**	YEAR [2020]
ANS.:	$C + 4HNO_3 \rightarrow CO_2 + 4NO_2 + 2H_2O$	
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Q.NO.: 12	**State one relevant reason for the following:** **(i) Concentrated nitric acid appears yellow, when it is left for a while in a glass bottle.**	YEAR [2020]
ANS.:	Pure nitric acid is colorless and unstable. It decomposes slightly even at ordinary temperatures and in the presence of sunlight. The decomposition results in the formation of reddish-brown nitrogen dioxide, which dissolves, giving a slight yellow color.	
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Q.NO.: 13	**State one observation for each of the following:** **(i) Concentrated nitric acid is reacted with sulphur.** **(ii) Lead nitrate is heated strongly in a test tube.**	YEAR [2019]
ANS.:	(i) Reddish-brown nitrogen dioxide gas evolves. (ii) Lead nitrate turns into a yellow residue of lead oxide, and reddish-brown fumes of nitrogen dioxide gas evolve.	
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Q.NO.: 14	**Complete the following equations:** **(i) S+Conc. HNO3 →→** **(ii) Cu + dil. HNO3 →→**	YEAR [2019]
ANS.:	(i) $S + 6HNO_3 \rightarrow H_2SO_4 + 6NO_2 + 2H_2O$ (ii) $3Cu + 8HNO_3 \rightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$	

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Q.NO.: 15	**Identify the substance underlined:** **(i) The dilute acid which is an oxidizing agent.**	YEAR [2019]
ANS.:	Nitric acid	
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Q.NO.: 16	**Name the gas that is produced in each of the following cases:** **(i) Sulphur is oxidized by concentrated nitric acid.** **(ii) Action of cold and dilute nitric acid on copper.**	YEAR [2018]
ANS.:	(i) Nitrogen dioxide (NO_2) (ii) Nitric oxide (NO)	
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Q.NO.: 17	**Give a chemical test to distinguish between the following pairs of chemicals:** **(i) Sodium chloride solution and Sodium nitrate solution**	YEAR [2018]
ANS.:	Add silver nitrate solution to the given solutions. Sodium chloride reacts to form a white precipitate, soluble in ammonium hydroxide (NH_4OH) and insoluble in dilute nitric acid (HNO_3). Sodium nitrate solution does not form any precipitate.	
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Q.NO.: 18	**(i) What is the type of salt formed when the reactants are heated at a suitable temperature for the preparation of Nitric acid?** **(ii) State why for the preparation of Nitric acid, the complete apparatus** **is made up of glass.**	YEAR [2018]
ANS.:	(i) Acid salt.	

	(ii) The vapors of nitric acid are highly corrosive and attack rubber or cork. For this reason, an all-glass apparatus is used in the laboratory preparation of nitric acid.	
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Q.NO.: 19	**Write a balanced chemical equation for the following:** **(i) Action of cold and dilute Nitric acid on Copper.**	**YEAR** **[2017]**
ANS.:	$3Cu + 8HNO_3 \rightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$	
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Q.NO.: 20	**Give a balanced chemical equation for each of the following:** **(i) Action of conc. Nitric acid on Sulphur.** **(ii) Laboratory preparation of Nitric acid.** **(iii) Reaction of Ammonia with Nitric acid.**	**YEAR** **[2017]**
ANS.:	(i) $S + 6HNO_3 \rightarrow H_2SO_4 + 6NO_2 + 2H_2O$ (ii) $KNO_3 + H_2SO_4$ (conc.) $\rightarrow KHSO_4 + HNO_3$ (below 200°C) (iii) $NH_3 + HNO_3 \rightarrow NH_4NO_3$	
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Q.NO.: 21	**Write balanced chemical equation for the following:** **(i) Action of hot and concentrated Nitric acid on copper.**	**YEAR** **[2016]**
ANS.:	$Cu + 4HNO_3 \rightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$	
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Q.NO.: 22	**Fill in the blanks using he appropriate words given below:** **(Sulphur dioxide, Nitrogen dioxide, Nitric oxide, Sulphuric acid)** **(i) Cold, dilute nitric acid reacts with copper to give.....** **(ii) Hot, concentrated nitric acid reacts with sulphur to form.**	**YEAR** **[2016]**

ANS.:	(i) Nitric oxide (NO). (ii) Nitrogen dioxide (NO_2).	
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Q.NO.: 23	**Identify the acid which matches the following description:** **a. The acid which is prepared by catalytic oxidation of ammonia.**	**YEAR** **[2015]**
ANS.:	Nitric acid (HNO_3). This process is called the Ostwald process.	
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Q.NO.: 24	**Explain the following:** **a. Dilute nitric acid is generally considered a typical acid but not so in its reaction with metals.** **b. Concentrated nitric acid appears yellow when it is left standing in a glass bottle.** **c. Explain why an all-glass apparatus is used in the laboratory preparation of nitric acid.**	**YEAR** **[2015]**
ANS.:	(a) Dilute nitric acid reacts with almost all metals except noble metals like platinum and gold. When reacting with metals, it doesn't behave as a typical acid because nitric acid acts as a strong oxidant. The oxidizing character of nitric acid dominates, preventing the liberation of hydrogen gas and instead forming water. (b) Pure nitric acid is colorless. Concentrated nitric acid is unstable and undergoes decomposition even at room temperature. This decomposition forms reddish-brown nitrogen dioxide gas, which dissolves in the acid, giving it a yellow color. (c) The apparatus used for the laboratory preparation of nitric acid is made entirely of glass because the vapors of nitric acid are highly corrosive and react with cork, rubber, etc.	
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