

Candidate Name: _____ Roll No: _____ Time: 2.5 to 3 Hours Max. Marks: 80
Syllabus Scope: Ch-1 Chemical Reactions & Equations | Ch-2 Acids, Bases & Salts | Ch-3 Metals & Non-Metals

SECTION A: OBJECTIVE & MULTI-CONCEPT MCQS (1 MARK EACH)

CBSE Most Repeated 15-Year Archive & Tricky Official SQP Questions

Q1. When lead nitrate powder is heated in a dry boiling tube, brown fumes of gas 'X' and a gas 'Y' that rekindles a glowing splint are produced, leaving a residue 'Z'. What are X, Y, and the color of Z when hot and cold?

REPEATED 6+ TIMES (2012, 15, 18, 20, 23)

- (a) $X = \text{NO}_2$, $Y = \text{O}_2$, Z = Reddish-brown (hot), Yellow (cold) (b) $X = \text{N}_2\text{O}$, $Y = \text{O}_2$, Z = White (hot), Yellow (cold)
(c) $X = \text{NO}$, $Y = \text{CO}_2$, Z = Dark brown (hot), Black (cold) (d) $X = \text{NO}_2$, $Y = \text{N}_2$, Z = Yellow (hot), White (cold)

Q2. In the redox reaction: $\text{MnO}_2 + 4\text{HCl} \rightarrow \text{MnCl}_2 + 2\text{H}_2\text{O} + \text{Cl}_2$, the species oxidized and the oxidizing agent are respectively:

CBSE 2013, 2016, 2021, 2024

- (a) HCl is oxidized and MnO_2 is the oxidizing agent (b) MnO_2 is oxidized and HCl is the oxidizing agent
(c) HCl is oxidized and Cl_2 is the oxidizing agent (d) MnO_2 is reduced and MnCl_2 is the oxidizing agent

Q3. Solid calcium oxide reacts vigorously with water to form slaked lime: $\text{CaO(s)} + \text{H}_2\text{O(l)} \rightarrow \text{Ca(OH)}_2\text{(aq)} + \text{Heat}$. This reaction is classified as:

CBSE SQP & BOARD 2017, 2020

- (a) Endothermic combination reaction (b) Exothermic combination reaction forming an acidic solution
(c) Exothermic combination reaction forming a basic solution (d) Exothermic decomposition reaction

Q4. An aqueous solution turns red litmus paper blue. Excess addition of which of the following reagents would reverse this color change?

CBSE NCERT EXEMPLAR & REPEATED 2014, 2019, 2023

- (a) Baking powder (b) Lime water [Ca(OH)_2]
(c) Ammonium hydroxide solution (d) Hydrochloric acid

Q5. A metal 'X' is dipped in aqueous CuSO_4 solution. After 30 minutes, the deep blue color turns light green, and a reddish-brown coating forms on 'X'. What is 'X', and what type of reaction occurred?

CBSE 2011, 2015, 2022

- (a) Metal is Ag; Double displacement reaction (b) Metal is Fe; Single displacement redox reaction
(c) Metal is Al; Decomposition reaction (d) Metal is Pb; Neutralization reaction

Q6. The correct chemical formula and number of molecules of water of crystallization for Plaster of Paris and Gypsum respectively are:

CBSE 2015, 2018, 2020, 2024

- (a) $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ and $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$ (b) $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$ and $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$
(c) $2\text{CaSO}_4 \cdot \text{H}_2\text{O}$ and $\text{CaSO}_4 \cdot 5\text{H}_2\text{O}$ (d) $\text{CaSO}_4 \cdot \text{H}_2\text{O}$ and $\text{CaSO}_4 \cdot 10\text{H}_2\text{O}$

Q7. An element 'A' is soft enough to be cut with a knife and reacts vigorously with cold water catching fire. When exposed to air, it tarnishes immediately. It is preserved under:

CBSE 2010, 2013, 2017, 2023

- (a) Water, because it is non-polar (b) Alcohol, to prevent volatilization
(c) Kerosene oil, to shield from moisture and O_2 (d) Liquid nitrogen, to reduce its vapor pressure

Q8. Which of the following oxides is *amphoteric* in nature, reacting with both acids and bases to yield salt and water?

CBSE 2012, 2016, 2019, 2023

- (a) Na_2O (b) CaO
(c) Al_2O_3 (d) K_2O

Q9. Electrical wires have a protective outer coating of an insulating material. The substance commonly used is:

CBSE SQP 2023 & BOARD 2024

- (a) Magnesium oxide (b) Polyvinyl chloride (PVC)
(c) Graphite paste (d) Copper sulphate crystals

Q10. A solution of substance 'X' used for white-washing reacts with CO_2 in air to form a hard, shiny layer of 'Y' on walls after 2 to 3 days. 'X' and 'Y' are:

CBSE 2011, 2014, 2018, 2022

- (a) $\text{X} = \text{CaO}$, $\text{Y} = \text{Ca(OH)}_2$ (b) $\text{X} = \text{Ca(OH)}_2$, $\text{Y} = \text{CaCO}_3$
(c) $\text{X} = \text{CaCO}_3$, $\text{Y} = \text{Ca(OH)}_2$ (d) $\text{X} = \text{Ca(HCO}_3)_2$, $\text{Y} = \text{CaO}$

SECTION B: ASSERTION & REASONING (1 MARK EACH)

CBSE Standard: (a) Both A and R true, R explains A | (b) Both A and R true, R does NOT explain A | (c) A true, R false | (d) A false, R true

Q11. Assertion (A): Dihydrogen gas is not evolved when most metals react with concentrated or dilute nitric acid.

Reason (R): HNO_3 is a powerful oxidizing agent that oxidizes evolved H_2 into water and is itself reduced to oxides of nitrogen.

CBSE 2013, 2016, 2019, 2021, 2024

Q12. Assertion (A): Pure dry HCl gas does not alter the color of dry blue litmus paper.

Reason (R): Hydrogen ions (H^+) can only be generated in the presence of water to form hydronium ions (H_3O^+), which exhibit acidic properties.

CBSE 2015, 2018, 2022

Q13. Assertion (A): While diluting an acid, water should never be poured directly into concentrated sulfuric acid.

Reason (R): The process of dissolving an acid in water is highly endothermic, causing the glass container to contract and crack.

CBSE SQP & BOARD 2017, 2020, 2023

Q14. Assertion (A): Ionic compounds generally have high melting and boiling points.

Reason (R): A large amount of energy is required to break the strong inter-ionic electrostatic forces of attraction holding the crystal lattice together.

CBSE 2014, 2017, 2023

SECTION C: SHORT ANSWER QUESTIONS (2 MARKS EACH)

Board Exam Favorite 2-Markers: Definitions, Reaction Balancing, and Color Dynamics

Q15. 2 g of silver chloride (AgCl) is placed in a china dish and exposed to sunlight for some time.

REPEATED 5+ TIMES (CBSE 2011, 2014, 2017, 2020, 2024)

- State the color change observed in the salt. Give the balanced chemical equation for the reaction.
- Identify the type of chemical reaction and state one major commercial application of this phenomenon.

Q16. An aqueous solution of a metal sulfate 'P' reacts with barium chloride solution to yield an insoluble white precipitate 'Q' and sodium chloride solution.

CBSE 2012, 2016, 2021

- Identify 'P' and 'Q'. Write the balanced molecular equation for the reaction.
- Under which broad type of chemical reaction is this transformation classified? Justify your classification.

Q17. A knife used to cut fruit was left unwashed. After a few days, dark stains and pits appeared on the blade.

CBSE BOARD 2015, 2019, 2023

1. Name the phenomenon responsible for this deterioration. What constituent in fruit juices accelerates this process?
2. Give two practical and effective methods employed at an industrial level to prevent rust formation on iron articles.

Q18. Write balanced chemical equations for the following industrial processes:

CBSE 2013, 2018, 2022

1. Iron reacting with red-hot steam.
2. Heating calcium carbonate strongly during the manufacturing of quicklime.

Q19. A compound 'X' of sodium is used as an antacid to relieve hyperacidity and in soda-acid fire extinguishers.

CBSE 2010, 2014, 2018, 2023

1. Identify compound 'X' and state its common name and chemical formula.
2. Write the balanced chemical equation showing the thermal decomposition of compound 'X'.

Q20. Differentiate between **calcination** and **roasting** with one suitable balanced chemical equation for each using zinc ores.

CBSE 2011, 2015, 2019, 2024

SECTION D: SHORT ANSWER & TRICKY REASONING (3 MARKS EACH)

Board Exam 3-Markers: Deductions, Multi-Step Reactions, and Metal Properties

Q21. The Green Vitriol Decomposition: When 2 g of ferrous sulphate crystals ($\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$) are heated in a dry boiling tube:

CBSE 2010, 2013, 2016, 2018, 2022, 2024

1. Describe the two distinct color changes observed sequentially during continuous heating.
2. Write the balanced chemical equation for the thermal decomposition of the anhydrous salt.
3. Name the two gases evolved and state their characteristic odor. What happens when these gases are tested with wet blue litmus paper?

Q22. The Baking Soda & Washing Soda Cycle: A white powder 'A' is produced by reacting brine with carbon dioxide and ammonia. When 'A' is heated, it produces a basic salt 'B', water, and gas 'C'. Recrystallization of 'B' from water yields compound 'D'.

CBSE 2012, 2017, 2021, 2023

1. Identify compounds 'A', 'B', 'C', and 'D'.
2. Write balanced chemical equations for: (i) Formation of 'B' from 'A', and (ii) Recrystallization of 'B' to form 'D'.
3. State two important industrial or domestic uses of compound 'D'.

Q23. Metals, Acids, and the Nitric Acid Exception: Samples of four metals — Zinc (Zn), Copper (Cu), Magnesium (Mg), and Iron (Fe) — were treated with dilute hydrochloric acid and dilute nitric acid separately.

CBSE BOARD & SQP ARCHIVE

1. Arrange these four metals in decreasing order of reactivity with dilute HCl. Which metal shows no reaction at all at room temperature? Explain why.
2. Name two specific metals that can evolve hydrogen gas even with very dilute (~1%) nitric acid.
3. Write the balanced equation when iron reacts with dilute hydrochloric acid.

Q24. Electrolytic Refining of Blister Copper: During the electrolytic refining of impure copper:

REPEATED 6+ TIMES (CBSE 2011, 2014, 2016, 2019, 2023)

1. What are the materials chosen for: (i) the anode, (ii) the cathode, and (iii) the electrolyte?
2. Write the chemical half-reactions occurring at the anode and cathode during electrolysis.
3. What is "anode mud"? Name two precious metals found concentrated in anode mud.

Q25. Tooth Decay & Everyday pH Applications: The oral cavity maintains a dynamic pH balance that directly impacts dental health. **CBSE 2015, 2018, 2022**

1. At what pH threshold does tooth decay actively commence? Name the hardest chemical substance in the human body composing tooth enamel, and give its chemical formula.
2. Explain the biochemical mechanism of tooth decay. How does brushing teeth with toothpaste prevent this?
3. Why does a bee sting cause intense pain and burning, whereas a wasp sting is treated differently? Name the acid injected by a bee sting and an effective household remedy.

Q26. Ionic Bonding & Electron Dot Representations: Magnesium (Atomic number = 12) combines with Chlorine (Atomic number = 17) to form magnesium chloride. **CBSE 2014, 2017, 2020, 2024**

1. Write the electronic configurations of Magnesium and Chlorine atoms.
2. Depict the formation of magnesium chloride (MgCl_2) by the transfer of electrons using electron-dot structures.
3. Explain why solid magnesium chloride does not conduct electricity, whereas its molten or aqueous solution conducts electricity efficiently.

SECTION E: COMPETENCY & CASE-BASED QUESTIONS (4 MARKS EACH)

Real-World Case Studies & Data Analysis Based on the 2026–27 Evaluation Pattern

Q27. Case Study 1: The Chlor-Alkali Industry & Disinfectant Synthesis

When electricity is passed through a cold, concentrated aqueous solution of sodium chloride (commonly called brine), it decomposes in a process termed the **chlor-alkali process**. The products formed are of enormous industrial significance: chlorine gas is liberated at the anode, hydrogen gas is liberated at the cathode, and sodium hydroxide remains in solution. When the chlorine gas produced is treated with dry slaked lime, it yields a commercially indispensable bleaching agent.

1. Write the balanced overall chemical equation for the chlor-alkali process, including physical state symbols. (1 mark)
2. Name the chemical compound produced when chlorine gas is passed over dry slaked lime $[\text{Ca}(\text{OH})_2]$. Give its common name and write the balanced chemical equation for its synthesis. (1 mark)
3. Why does a sample of bleaching powder smell strongly of chlorine when left exposed to the atmosphere for a prolonged period? Write the equation for this reaction. (1 mark)
4. State two important industrial uses of hydrogen gas obtained as a byproduct in this electrolysis. (1 mark)

Q28. Case Study 2: Exothermic Displacement Reactions & Thermite Railway Welding

Certain metal displacement reactions release an enormous quantity of heat, classified as highly exothermic reactions. The thermal energy produced is so intense that the reduced metal is obtained in a molten liquid state. This remarkable principle is utilized in the **Thermite process** to join cracked railway tracks and heavy cracked machinery parts on-site without requiring large smelting furnaces.

1. Name the two reactants present in a thermite mixture used for welding railway tracks. (1 mark)
2. Write the balanced chemical equation for the thermite reaction between iron(III) oxide and aluminum powder. State why iron is obtained in molten form. (1 mark)
3. Identify the substance oxidized and the substance reduced in this reaction. Justify on the basis of oxygen transfer. (1 mark)
4. Can carbon or coke be used instead of aluminum to reduce ferric oxide for the exact same track welding application? Explain why or why not. (1 mark)

SECTION F: LONG ANSWER SYNTHESIS & EXPERIMENTAL PROVING (5 MARKS EACH)

Q29. Complete Metallurgy & Reduction Schemes: Metals occur in the Earth's crust in combined states as minerals and ores. The extraction strategy depends directly on the reactivity of the metal. **CBSE 2011, 2013, 2016, 2018, 2021, 2024**

1. **Extraction of Low Reactivity Metals:** Describe how pure copper is extracted from its sulfide ore, copper glance (Cu_2S).

Write all balanced chemical equations involved in this auto-reduction process.

2. **Extraction of Moderate Reactivity Metals:**

- Explain why carbonate ores like calamine (ZnCO_3) and sulfide ores like zinc blende (ZnS) are converted into metal oxides before reduction.
- Give balanced equations for the calcination of ZnCO_3 and roasting of ZnS .
- Write the reaction showing the reduction of zinc oxide using carbon (coke).

3. **Extraction of Highly Reactive Metals:** Explain why metals like Sodium (Na) and Aluminum (Al) cannot be extracted by carbon reduction of their oxides. Describe the method used to obtain metallic sodium from molten sodium chloride.

Q30. Multi-Part Deductive Inorganic Analysis: A yellow compound 'A' is used as an oxidizing agent in laboratory tests and as a disinfectant. **CBSE 2014, 2019, 2023 HOTS PATTERN**

1. A metal nitrate 'P' upon strong heating in a test tube decrepitates and gives off a brown pungent gas 'Q', a gas 'R' that rekindles a burning splinter, and a yellow solid 'S' that turns reddish-brown when hot. Identify 'P', 'Q', 'R', and 'S'. Write the balanced chemical equation.
2. When potassium iodide solution is added to an aqueous solution of 'P', a brilliant yellow precipitate 'T' is formed.
 - Identify 'T'. Write the balanced chemical equation and classify the reaction type.
3. An organic compound / food acid present in sour milk is 'M'. What is 'M'? When baking soda is added to vinegar, rapid effervescence is observed. Name the gas evolved and describe the standard confirmatory test with lime water.