

Below is a comprehensive solution for Class 10 Science Chapter 1: Chemical Reactions and Equations based on the NCERT textbook. This includes answers to all in-text questions, exercise questions, and explanations of key concepts to help you understand the chapter thoroughly. The solutions are aligned with the CBSE syllabus for the 2024-25 academic year.

Overview of Chapter 1: Chemical Reactions and Equations

This chapter introduces the basics of chemical reactions and how they are represented using chemical equations.

. **Chemical Reactions:** Processes where substances (reactants) transform into new substances (products).

.**Chemical Equations:** Symbolic representation of chemical reactions. Balancing Chemical Equations: Ensuring the number of atoms of each element is equal on both sides of the equation.

. **Types of Chemical Reactions:** Combination, decomposition, displacement, double displacement, and redox reactions.

.**Effects of Chemical Reactions:** Corrosion and rancidity as examples of oxidation in daily life.

.**Key Concepts****Chemical Reaction:** A process where reactants are converted into products with new properties.

.**Signs of a chemical reaction include:**

Change in color

Formation of gas

Change in temperature

Formation of precipitate

.**Chemical Equation:** A shorthand representation of a chemical reaction using chemical formulas.

° Example: $\text{Mg} + \text{O}_2 \rightarrow \text{MgO}$

°(unbalanced)Balanced: $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$

.**Balancing Equations:** According to the Law of Conservation of Mass, the number of atoms of each element must be equal on both sides of the equation.

.**Types of Chemical Reactions:**Combination Reaction: Two or more reactants combine to form a single product.

°Example: $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$

.Decomposition Reaction: A single compound breaks into two or more substances.

° Example: $2\text{H}_2\text{O} \rightarrow 2\text{H}_2 + \text{O}_2$ (electrolysis)

.Displacement Reaction: A more reactive element displaces a less reactive element from its compound.

°Example: $\text{Fe} + \text{CuSO}_4 \rightarrow \text{FeSO}_4 + \text{Cu}$

.Double Displacement Reaction: Exchange of ions between two compounds.

°Example: $\text{Na}_2\text{SO}_4 + \text{BaCl}_2 \rightarrow \text{BaSO}_4\downarrow + 2\text{NaCl}$

.Oxidation and Reduction (Redox): Oxidation involves loss of electrons (or gain of oxygen), and reduction involves gain of electrons (or loss of oxygen).

°Example: $\text{CuO} + \text{H}_2 \rightarrow \text{Cu} + \text{H}_2\text{O}$ (CuO is reduced, H_2 is oxidized)

.Corrosion: The degradation of metals due to reaction with oxygen and moisture (e.g., rusting of iron: $4\text{Fe} + 3\text{O}_2 + x\text{H}_2\text{O} \rightarrow 2\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}$).

Rancidity: The spoilage of food oils/fats due to oxidation, leading to bad smell/taste.

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Q1: Why should a magnesium ribbon be cleaned before burning in air?

Answer: Magnesium is a reactive metal and reacts with atmospheric oxygen to form a thin layer of magnesium oxide (MgO) on its surface. This layer is stable and prevents further reaction with oxygen. Cleaning the ribbon with sandpaper removes this MgO layer, exposing fresh magnesium for burning.

Q2: Write the balanced equation for the following chemical reactions: (i) Hydrogen + Chlorine \rightarrow Hydrogen chloride (ii) Barium chloride + Aluminium sulphate \rightarrow Barium sulphate + Aluminium chloride (iii) Sodium + Water \rightarrow Sodium hydroxide + Hydrogen

Answer: (i) $\text{H}_2(\text{g}) + \text{Cl}_2(\text{g}) \rightarrow 2\text{HCl}(\text{g})$

(ii) $3\text{BaCl}_2(\text{aq}) + \text{Al}_2(\text{SO}_4)_3(\text{aq}) \rightarrow 3\text{BaSO}_4(\text{s}) + 2\text{AlCl}_3(\text{aq})$

(iii) $2\text{Na}(\text{s}) + 2\text{H}_2\text{O}(\text{l}) \rightarrow 2\text{NaOH}(\text{aq}) + \text{H}_2(\text{g})$

Q3: Write a balanced chemical equation with state symbols for the following reactions: (i) Solutions of barium chloride and sodium sulphate in water react to give insoluble barium sulphate and the solution of sodium chloride. (ii) Sodium hydroxide

solution (in water) reacts with hydrochloric acid solution (in water) to produce sodium chloride solution and water.

Answer: (i) $\text{BaCl}_2(\text{aq}) + \text{Na}_2\text{SO}_4(\text{aq}) \rightarrow \text{BaSO}_4(\text{s}) + 2\text{NaCl}(\text{aq})$

(ii) $\text{NaOH}(\text{aq}) + \text{HCl}(\text{aq}) \rightarrow \text{NaCl}(\text{aq}) + \text{H}_2\text{O}(\text{l})$

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Q1: A solution of a substance 'X' is used for whitewashing. (i) Name the substance 'X' and write its formula. (ii) Write the reaction of the substance 'X' named in (i) above with water.

Answer: (i) Substance 'X' is quicklime (calcium oxide), and its formula is CaO .

(ii) $\text{CaO}(\text{s}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{Ca}(\text{OH})_2(\text{aq})$ (Calcium hydroxide is formed, used in whitewashing).

Q2: Why is the amount of gas collected in one of the test tubes in Activity 1.7 double the amount collected in the other? Name this gas.

Answer: In Activity 1.7, water is electrolyzed: $2\text{H}_2\text{O}(\text{l}) \rightarrow 2\text{H}_2(\text{g}) + \text{O}_2(\text{g})$.

.The balanced equation shows that two molecules of hydrogen gas (H_2) are produced for every one molecule of oxygen gas (O_2).

. Since the volume of gas is proportional to the number of molecules, the volume of hydrogen gas collected is double that of oxygen gas.

. The gas in double amount is hydrogen (H_2).

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Q1: Why does the colour of copper sulphate solution change when an iron nail is dipped in it?

Answer: When an iron nail is dipped in copper sulphate (CuSO_4) solution, iron (Fe), being more reactive than copper (Cu), displaces copper from the solution. The reaction is: $\text{Fe}(\text{s}) + \text{CuSO}_4(\text{aq}) \rightarrow \text{FeSO}_4(\text{aq}) + \text{Cu}(\text{s})$.

.The blue color of CuSO_4 solution fades as Cu^{2+} ions are replaced by Fe^{2+} ions, forming pale green FeSO_4 .

Q2: Give an example of a double displacement reaction other than the one given in Activity 1.10.

Answer: An example is the reaction between sodium hydroxide and hydrochloric acid: $\text{NaOH}(\text{aq}) + \text{HCl}(\text{aq}) \rightarrow \text{NaCl}(\text{aq}) + \text{H}_2\text{O}(\text{l})$. This is a double displacement reaction where Na^+ and H^+ exchange partners with OH^- and Cl^- .

Q3: Identify the substances that are oxidised and the substances that are reduced in the following reactions: (i) $4\text{Na(s)} + \text{O}_2\text{(g)} \rightarrow 2\text{Na}_2\text{O(s)}$ (ii) $\text{CuO(s)} + \text{H}_2\text{(g)} \rightarrow \text{Cu(s)} + \text{H}_2\text{O(l)}$

Answer: (i) Sodium (Na) is oxidized as it gains oxygen to form Na_2O . Oxygen (O_2) is reduced as it gains electrons.

(ii) Hydrogen (H_2) is oxidized as it combines with oxygen from CuO to form H_2O . Copper oxide (CuO) is reduced as copper loses oxygen to form Cu .

NCERT Exercise Questions and Answers

Q1: Which of the statements about the reaction below are incorrect? $2\text{PbO(s)} + \text{C(s)} \rightarrow 2\text{Pb(s)} + \text{CO}_2\text{(g)}$

(a) Lead is getting reduced.

(b) Carbon dioxide is getting oxidised. (c) Carbon is getting oxidised.

(d) Lead oxide is getting reduced.

(i) (a) and (b) (ii) (a) and (c) (iii) (a), (b), and (c) (iv) all

Answer: (i) (a) and (b)

Explanation: (a) Incorrect: Lead is not reduced; lead oxide (PbO) is reduced to lead (Pb) by losing oxygen.

(b) Incorrect: Carbon dioxide (CO_2) is not oxidized; it is the product of carbon (C) being oxidized.

(c) Correct: Carbon (C) is oxidized to CO_2 by gaining oxygen.

(d) Correct: Lead oxide (PbO) is reduced to lead (Pb) by losing oxygen.

Q2: The above reaction is an example of a: (a) combination reaction

(b) double displacement reaction

(c) decomposition reaction

(d) displacement reaction

Answer: (d) displacement reaction

Explanation: Carbon displaces lead from lead oxide to form lead and carbon dioxide, characteristic of a displacement reaction.

Q3: What happens when dilute hydrochloric acid is added to iron filings? Tick the correct answer. (a) Hydrogen gas and iron chloride are produced. (b) Chlorine gas and iron hydroxide are produced. (c) No reaction takes place. (d) Iron salt and water are produced.

Answer: (a) Hydrogen gas and iron chloride are produced.

Explanation: Iron reacts with dilute HCl to form iron(II) chloride (FeCl_2) and hydrogen gas:
 $\text{Fe(s)} + 2\text{HCl(aq)} \rightarrow \text{FeCl}_2\text{(aq)} + \text{H}_2\text{(g)}$.

Q4: What is a balanced chemical equation? Why should chemical equations be balanced?

Answer: A balanced chemical equation has an equal number of atoms of each element on both the reactant and product sides. It adheres to the Law of Conservation of Mass, which states that mass is neither created nor destroyed in a chemical reaction. Balancing ensures that the equation accurately represents the reaction.

Q5: Translate the following statements into chemical equations and then balance them: (a) Hydrogen gas combines with nitrogen to form ammonia. (b) Hydrogen sulphide gas burns in air to give water and sulphur dioxide. (c) Barium chloride reacts with aluminium sulphate to give aluminium chloride and a precipitate of barium sulphate. (d) Potassium metal reacts with water to give potassium hydroxide and hydrogen gas.

Answer: (a) $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g})$
(b) $2\text{H}_2\text{S}(\text{g}) + 3\text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{l}) + 2\text{SO}_2(\text{g})$ (c) $3\text{BaCl}_2(\text{aq}) + \text{Al}_2(\text{SO}_4)_3(\text{aq}) \rightarrow 2\text{AlCl}_3(\text{aq}) + 3\text{BaSO}_4(\text{s})$ (d) $2\text{K}(\text{s}) + 2\text{H}_2\text{O}(\text{l}) \rightarrow 2\text{KOH}(\text{aq}) + \text{H}_2(\text{g})$

Q6: Balance the following chemical equations: (a) $\text{HNO}_3 + \text{Ca}(\text{OH})_2 \rightarrow \text{Ca}(\text{NO}_3)_2 + \text{H}_2\text{O}$ (b) $\text{NaOH} + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + \text{H}_2\text{O}$ (c) $\text{NaCl} + \text{AgNO}_3 \rightarrow \text{AgCl} + \text{NaNO}_3$ (d) $\text{BaCl}_2 + \text{H}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + \text{HCl}$

Answer: (a) $2\text{HNO}_3 + \text{Ca}(\text{OH})_2 \rightarrow \text{Ca}(\text{NO}_3)_2 + 2\text{H}_2\text{O}$
(b) $2\text{NaOH} + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$
(c) $\text{NaCl} + \text{AgNO}_3 \rightarrow \text{AgCl} + \text{NaNO}_3$ (already balanced)
(d) $\text{BaCl}_2 + \text{H}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + 2\text{HCl}$

Q7: Write the balanced chemical equations for the following reactions: (a) Calcium hydroxide + Carbon dioxide → Calcium carbonate + Water (b) Zinc + Silver nitrate → Zinc nitrate + Silver (c) Aluminium + Copper chloride → Aluminium chloride + Copper (d) Barium chloride + Potassium sulphate → Barium sulphate + Potassium chloride

Answer: (a) $\text{Ca}(\text{OH})_2 + \text{CO}_2 \rightarrow \text{CaCO}_3 + \text{H}_2\text{O}$ (b) $\text{Zn} + 2\text{AgNO}_3 \rightarrow \text{Zn}(\text{NO}_3)_2 + 2\text{Ag}$ (c) $2\text{Al} + 3\text{CuCl}_2 \rightarrow 2\text{AlCl}_3 + 3\text{Cu}$ (d) $\text{BaCl}_2 + \text{K}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + 2\text{KCl}$

Q8: What is meant by exothermic and endothermic reactions? Give examples.

Answer: Exothermic Reaction: Releases heat to the surroundings (temperature increases).
° Example: $\text{C}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + \text{heat}$ (burning of carbon).

° Endothermic Reaction: Absorbs heat from the surroundings (temperature decreases).
° Example: $\text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$ (decomposition of limestone requires heat).

Q9: Why is respiration considered an exothermic reaction? Explain.

Answer: Respiration is an exothermic reaction because it releases energy. Glucose ($\text{C}_6\text{H}_{12}\text{O}_6$) reacts with oxygen (O_2) in cells to produce carbon dioxide (CO_2), water (H_2O), and energy: $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + \text{energy}$. The energy released is used for bodily functions, and some is lost as heat.

Q10: Why are decomposition reactions called the opposite of combination reactions? Write equations for these reactions.

Answer: Decomposition reactions break a single compound into two or more substances, while combination reactions combine two or more substances into a single compound. They are opposites in terms of process and outcome. Decomposition: $2\text{H}_2\text{O}(\text{l}) \rightarrow 2\text{H}_2(\text{g}) + \text{O}_2(\text{g})$ Combination: $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{l})$

Q11: Write one equation each for decomposition reactions where energy is supplied in the form of heat, light, or electricity.

Answer: Heat: $\text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$ (thermal decomposition) Light: $2\text{AgBr}(\text{s}) \rightarrow 2\text{Ag}(\text{s}) + \text{Br}_2(\text{g})$ (photochemical decomposition) Electricity: $2\text{H}_2\text{O}(\text{l}) \rightarrow 2\text{H}_2(\text{g}) + \text{O}_2(\text{g})$ (electrolysis)

Q12: What is the difference between displacement and double displacement reactions? Write equations for these reactions.

Answer: Displacement Reaction: A more reactive element displaces a less reactive element from its compound.

° Example: $\text{Fe}(\text{s}) + \text{CuSO}_4(\text{aq}) \rightarrow \text{FeSO}_4(\text{aq}) + \text{Cu}(\text{s})$

° Double Displacement Reaction: Ions of two compounds exchange places to form two new compounds.

° Example: $\text{Na}_2\text{SO}_4(\text{aq}) + \text{BaCl}_2(\text{aq}) \rightarrow \text{BaSO}_4(\text{s}) + 2\text{NaCl}(\text{aq})$

Q13: In the refining of silver, the recovery of silver from silver nitrate solution involved displacement by copper metal. Write down the reaction involved.

Answer: $\text{Cu}(\text{s}) + 2\text{AgNO}_3(\text{aq}) \rightarrow \text{Cu}(\text{NO}_3)_2(\text{aq}) + 2\text{Ag}(\text{s})$

Q14: What do you mean by a precipitation reaction? Explain by giving examples.

Answer: A precipitation reaction is a double displacement reaction where two aqueous solutions react to form an insoluble solid (precipitate).

° Example 1: $\text{NaCl}(\text{aq}) + \text{AgNO}_3(\text{aq}) \rightarrow \text{AgCl}(\text{s})\downarrow + \text{NaNO}_3(\text{aq})$ (AgCl is the precipitate).

° Example 2: $\text{BaCl}_2(\text{aq}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{BaSO}_4(\text{s})\downarrow + 2\text{HCl}(\text{aq})$ (BaSO₄ is the precipitate).

Q15: Explain the following in terms of gain or loss of oxygen with two examples each: (a) Oxidation (b) Reduction

Answer: Oxidation: Gain of oxygen or loss of hydrogen.

° Example 1: $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$ (Mg gains oxygen).

°Example 2: $C + O_2 \rightarrow CO_2$ (C gains oxygen). Reduction: Loss of oxygen or gain of hydrogen. Example 1: $CuO + H_2 \rightarrow Cu + H_2O$ (CuO loses oxygen). Example 2: $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$ (Fe_2O_3 loses oxygen).

Q16: A shiny brown-coloured element 'X' on heating in air becomes black in colour. Name the element 'X' and the black coloured compound formed.

Answer: Element 'X' is copper (Cu). When heated in air, it forms copper(II) oxide (CuO), which is black: $2Cu(s) + O_2(g) \rightarrow 2CuO(s)$.

Q17: Why do we apply paint on iron articles?

Answer: Paint is applied to iron articles to prevent corrosion. It acts as a barrier, preventing iron from coming into contact with oxygen and moisture, which cause rusting ($Fe_2O_3 \cdot xH_2O$).

Q18: Oil and fat containing food items are flushed with nitrogen. Why?

Answer: Flushing oil and fat-containing food items with nitrogen prevents rancidity. Nitrogen displaces oxygen, which would otherwise oxidize the fats/oils, causing bad smell and taste.

Q19: Explain the following terms with one example each: (a) Corrosion (b) Rancidity

Answer:

Corrosion: The degradation of metals due to reaction with oxygen, moisture, or other substances.

°Example: Rusting of iron: $4Fe + 3O_2 + xH_2O \rightarrow 2Fe_2O_3 \cdot xH_2O$.

°Rancidity: The oxidation of oils/fats in food, leading to unpleasant smell/taste.

°Example: Spoilage of butter when exposed to air, due to oxidation of fats.
Q20: Why do potato chips manufacturers fill the packet of chips with nitrogen gas?

Answer: Nitrogen gas is used to fill potato chip packets to prevent rancidity. It displaces oxygen, which would oxidize the oils in the chips, causing them to become rancid and develop an unpleasant taste/smell.

- **Additional Tips for Preparation** Read the NCERT Textbook: Focus on understanding concepts like balancing equations and identifying reaction types. Practice Problems: Solve previous years' CBSE questions and sample papers. Learn Key Equations: Memorize important reactions, especially those involving corrosion, rancidity, and redox. Understand Activities: Activities like electrolysis of water or displacement reactions are often asked in exams. Use Resources: Download NCERT solutions PDFs from reliable sources like Vedantu or Tiwari Academy for offline practice. This solution covers all aspects of Class 10 Science Chapter 1: Chemical Reactions and Equations.