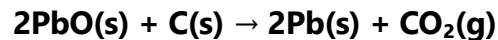


Chapter 1: Chemical Reactions and Equations

Exercise Solutions

1. Which of the statements about the reaction below are incorrect?



- (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)

Solution: In this reaction:

- PbO loses oxygen $\rightarrow$ Pb (reduction)
 - C gains oxygen $\rightarrow$ CO₂ (oxidation)
 - Therefore: (a) correct, (b) incorrect, (c) correct, (d) correct Answer: **(i) (a) and (b)**
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The above reaction is an example of a:

- (a) combination reaction
- (b) double displacement reaction
- (c) decomposition reaction
- (d) displacement reaction

Solution: Aluminum displaces iron from iron oxide. This is a displacement reaction. Answer: **(d) displacement reaction**

3. What happens when dilute hydrochloric acid is added to iron fillings?

- (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

Solution: $\text{Fe} + 2\text{HCl} \rightarrow \text{FeCl}_2 + \text{H}_2$ Iron reacts with HCl to produce hydrogen gas and iron chloride.
Answer: **(a) Hydrogen gas and iron chloride are produced**

4. What is a balanced chemical equation? Why should chemical equations be balanced?

Solution: A balanced chemical equation has equal number of atoms of each element on both sides.

Why balance equations:

- Law of conservation of mass - atoms cannot be created or destroyed
 - Mass of reactants = Mass of products
 - Helps in stoichiometric calculations
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5. Translate the following statements into chemical equations and then balance them:

a) Hydrogen gas combines with nitrogen to form ammonia $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$

b) Hydrogen sulphide gas burns in air to give water and sulphur dioxide $2\text{H}_2\text{S} + 3\text{O}_2 \rightarrow 2\text{H}_2\text{O} + 2\text{SO}_2$

c) Barium chloride reacts with aluminium sulphate to give aluminium chloride and a precipitate of barium sulphate $3\text{BaCl}_2 + \text{Al}_2(\text{SO}_4)_3 \rightarrow 2\text{AlCl}_3 + 3\text{BaSO}_4$

d) Potassium metal reacts with water to give potassium hydroxide and hydrogen gas $2\text{K} + 2\text{H}_2\text{O} \rightarrow 2\text{KOH} + \text{H}_2$

6. Balance the following chemical equations:

a) $\text{HNO}_3 + \text{Ca}(\text{OH})_2 \rightarrow \text{Ca}(\text{NO}_3)_2 + \text{H}_2\text{O}$ $2\text{HNO}_3 + \text{Ca}(\text{OH})_2 \rightarrow \text{Ca}(\text{NO}_3)_2 + 2\text{H}_2\text{O}$

b) $\text{NaOH} + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + \text{H}_2\text{O}$ $2\text{NaOH} + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$

c) $\text{NaCl} + \text{AgNO}_3 \rightarrow \text{AgCl} + \text{NaNO}_3$ $\text{NaCl} + \text{AgNO}_3 \rightarrow \text{AgCl} + \text{NaNO}_3$ (already balanced)

d) $\text{BaCl}_2 + \text{H}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + \text{HCl}$ $\text{BaCl}_2 + \text{H}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + 2\text{HCl}$

7. Write balanced chemical equations for the following reactions:

a) Calcium hydroxide + Carbon dioxide → Calcium carbonate + Water $\text{Ca}(\text{OH})_2 + \text{CO}_2 \rightarrow \text{CaCO}_3 + \text{H}_2\text{O}$

b) Zinc + Silver nitrate → Zinc nitrate + Silver $\text{Zn} + 2\text{AgNO}_3 \rightarrow \text{Zn}(\text{NO}_3)_2 + 2\text{Ag}$

c) Aluminium + Copper chloride → Aluminium chloride + Copper $2\text{Al} + 3\text{CuCl}_2 \rightarrow 2\text{AlCl}_3 + 3\text{Cu}$

d) Barium chloride + Potassium sulphate → Barium sulphate + Potassium chloride $\text{BaCl}_2 + \text{K}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + 2\text{KCl}$

8. Write balanced chemical equations and identify the type of reaction:

a) Potassium bromide(aq) + Barium iodide(aq) → Potassium iodide(aq) + Barium bromide(s)

$2\text{KBr} + \text{BaI}_2 \rightarrow 2\text{KI} + \text{BaBr}_2$ **Type:** Double displacement reaction

b) Zinc carbonate(s) → Zinc oxide(s) + Carbon dioxide(g) $\text{ZnCO}_3 \rightarrow \text{ZnO} + \text{CO}_2$ **Type:**

Decomposition reaction

c) Hydrogen(g) + Chlorine(g) → Hydrogen chloride(g) $\text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl}$ **Type:** Combination

reaction

d) Magnesium(s) + Hydrochloric acid(aq) → Magnesium chloride(aq) + Hydrogen(g) $\text{Mg} +$

$2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$ **Type:** Displacement reaction

9. What does one mean by exothermic and endothermic reactions? Give examples.

Solution: Exothermic reactions: Release heat energy

- Examples: Combustion of methane, respiration, neutralization
- $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O} + \text{Heat}$

Endothermic reactions: Absorb heat energy

- Examples: Decomposition reactions, photosynthesis
 - $\text{CaCO}_3 + \text{Heat} \rightarrow \text{CaO} + \text{CO}_2$
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10. Why is respiration considered an exothermic reaction? Explain.

Solution: Respiration releases energy when glucose is broken down: $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + \text{Energy (ATP)}$

This energy is used for:

- Body functions
 - Movement
 - Maintaining body temperature
 - Cellular processes
-

11. Why are decomposition reactions called the opposite of combination reactions? Write equations.

Solution: Combination: Two or more reactants $\rightarrow$ Single product $A + B \rightarrow AB$

Decomposition: Single reactant $\rightarrow$ Two or more products $AB \rightarrow A + B$

Examples:

- Combination: $2H_2 + O_2 \rightarrow 2H_2O$
 - Decomposition: $2H_2O \rightarrow 2H_2 + O_2$
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12. Write one equation each for decomposition reactions where energy is supplied in the form of heat, light or electricity.

Solution: Heat (Thermal decomposition): $CaCO_3 + \text{Heat} \rightarrow CaO + CO_2$

Light (Photodecomposition): $2AgCl + \text{Sunlight} \rightarrow 2Ag + Cl_2$

Electricity (Electrolysis): $2H_2O + \text{Electricity} \rightarrow 2H_2 + O_2$

13. What is the difference between displacement and double displacement reactions? Write equations.

Solution: Displacement reaction: More reactive element displaces less reactive element $A + BC \rightarrow AC + B$
Example: $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$

Double displacement reaction: Exchange of ions between compounds $AB + CD \rightarrow AD + CB$
Example: $AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$

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

Solution: $Cu + 2AgNO_3 \rightarrow Cu(NO_3)_2 + 2Ag$

Copper is more reactive than silver, so it displaces silver from silver nitrate solution.

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

Solution: Precipitation reaction: Reaction that produces an insoluble solid (precipitate)

Examples:

- $AgNO_3 + NaCl \rightarrow AgCl\downarrow + NaNO_3$ (white precipitate)
- $BaCl_2 + Na_2SO_4 \rightarrow BaSO_4\downarrow + 2NaCl$ (white precipitate)

The arrow pointing down ($\downarrow$) indicates precipitate formation.

16. Explain oxidation and reduction in terms of gain or loss of oxygen with two examples each:

Solution: a) Oxidation (Gain of oxygen):

- $2\text{Cu} + \text{O}_2 \rightarrow 2\text{CuO}$ (copper gains oxygen)
- $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$ (carbon gains oxygen)

b) Reduction (Loss of oxygen):

- $\text{CuO} + \text{H}_2 \rightarrow \text{Cu} + \text{H}_2\text{O}$ (copper oxide loses oxygen)
 - $\text{ZnO} + \text{C} \rightarrow \text{Zn} + \text{CO}$ (zinc oxide loses oxygen)
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17. A shiny brown coloured element 'X' on heating in air becomes black in colour. Name the element 'X' and the black coloured compound formed.

Solution:

- Element X = Copper (Cu)
 - Black compound = Copper oxide (CuO)
 - Reaction: $2\text{Cu} + \text{O}_2 \rightarrow 2\text{CuO}$
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18. Why do we apply paint on iron articles?

Solution: Paint prevents iron from rusting by:

- Creating a barrier between iron and air/moisture
- Preventing oxygen and water from reaching iron surface
- Stopping the oxidation process that causes rust formation

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

Solution:

- Prevents rancidity (oxidation of fats and oils)
 - Nitrogen is inert gas - doesn't react with food
 - Displaces oxygen that causes spoilage
 - Extends shelf life of packaged foods
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20. Explain the following terms with one example each:

a) Corrosion Attack of metals by moisture, acids, etc. Example: Rusting of iron - $4\text{Fe} + 3\text{O}_2 + 2x\text{H}_2\text{O} \rightarrow 2\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}$

b) Rancidity Oxidation of fats and oils causing bad smell and taste. Example: Butter becoming rancid when exposed to air for long time.

Answer Key:

1. (i), 2. (d), 3. (a), 4-20. Descriptive answers as provided above