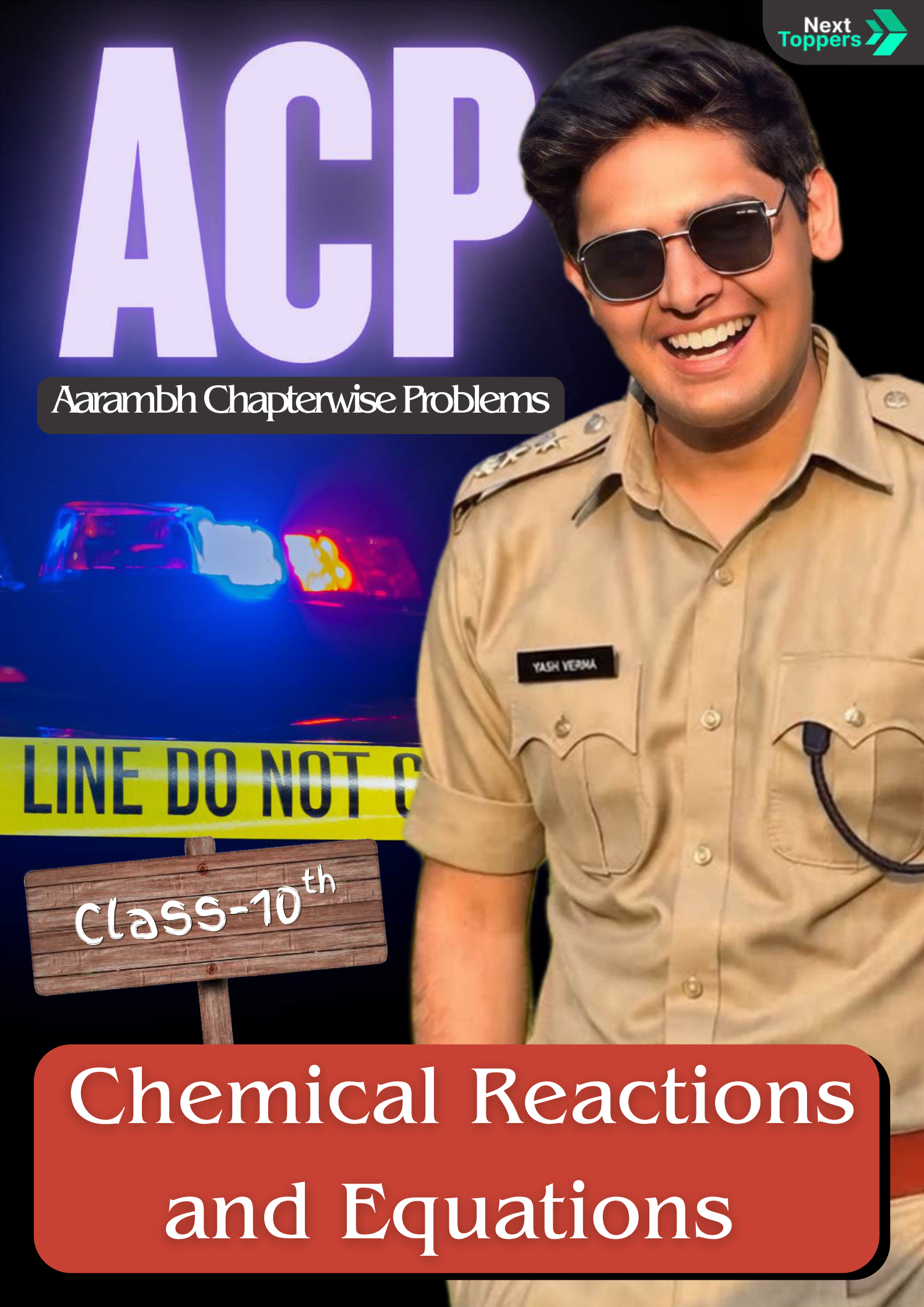
Next Toppers

ACP

Aarambh Chapterwise Problems



Chemical Reactions and Equations

Chemical Reactions and Equations

Read the question properly!

PART 1 (Basic MCQs)

1. Barium chloride, on reacting with ammonium sulphate, forms barium sulphate and ammonium chloride. Which of the following correctly represents the type of reaction involved?
i. Displacement reaction
ii. Precipitation reaction
iii. Combination reaction
iv. Double displacement reaction
(a) i only
(b) ii only
(c) iv only
(d) ii and iv only

2. Which of the following reactions is not correct
(a) $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$
(b) $2Ag + Cu(NO_3)_2 \rightarrow AgNO_3 + Cu$
(c) $Fe + CuSO_4 \rightarrow FeSO_4 + Cu$
(d) $Mg + 2HCl \rightarrow MgCl_2 + H_2$

3. Identify the correct statement $PBO + C \rightarrow Pb + CO$
(a) PbO is oxidised
(b) C act as an oxidising agent
(c) C act as a reducing agent
(d) Reaction does not represent a redox reaction.

4. Take about 5 ml of the dilute. HCl in a test tube and add a few pieces of fine zinc granules to it. Which gas is evolved?
(a) Chlorine
(b) Hydrogen
(c) HCl
(d) Nitrogen

5. A metal ribbon ' X ' burns in oxygen with a dazzling white flame, forming a white ash ' Y. The correct description of X, Y and the type of reaction is
(a) X = Ca; Y = CaO Type of reaction = Decomposition
(b) X = Mg; Y = MgO Type of reaction = Combination
(c) X = Al; Y = Al_2O_3 Type of reaction = Thermal decomposition
(d) X = Zn; Y = ZnO; Type of reaction = Endothermic

6. When aqueous solutions of potassium iodide and lead nitrate are mixed, an insoluble substance separates. The balanced chemical equation for the reaction involved is
(a) $KI + PbNO_3 \_\rightarrow PbI + KNO_3$
(b) $2KI + Pb(NO_3)_2 \_\rightarrow PbI_2 + 2KNO_3$

(c) $KI + Pb(NO_3)_2 \_\rightarrow PbI + KNO_3$
(d) $KI + PbNO_3 \_\rightarrow PbI_2 + KNO_3$

7. When green coloured ferrous sulphate crystals are heated, the colour of the crystal changes because
(a) it is decomposed to ferric oxide
(b) it loses water of crystallisation
(c) it forms SO_2
(d) it forms SO_3

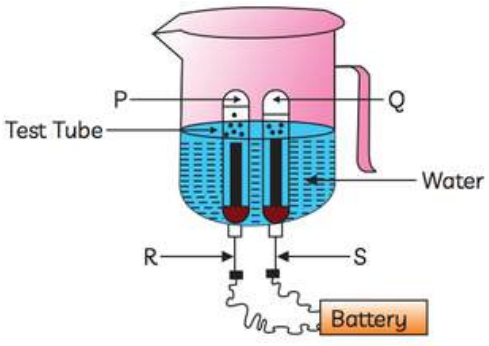
8. Which of the following statements about the given reaction are correct?
$3Fe(s) + 4H_2O(g) \rightarrow Fe_3O_4(g) + 4H_2(g)$
(i) Iron metal is getting oxidised
(ii) Water is getting reduced
(iii) Water is acting as reducing agent
(iv)Water is acting as an oxidising agent

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

9. What is observed when a solution of potassium iodide is added to silver nitrate solution?
(a) No reaction takes place
(b) White precipitate of silver iodide is formed
(c) yellow precipitate of Agl is formed
(d) Agl is soluble in water.

10. Electrolysis of water is a decomposition reaction. The mass ratio (MH : MO) of hydrogen and oxygen gases liberated at the electrodes during electrolysis of water is: (2025)
(a) 8:1
(b) 2:1
(c) 1:2
(d) 1:8

11. In the following experimental setup of electrolysis of water, if P and Q are the gases collected in the test tubes enclosing the electrodes R and S, then select the option/ options in which the matching is correct:
(i) P - Oxygen gas, R - Anode
(ii) P - Hydrogen gas, R - Cathode
(iii) Q - Hydrogen gas, S - Cathode
(iv) Q - Oxygen gas, S - Anode
Options:
(a) (i) and (ii)
(b) (iii) and (iv)
(c) (i) and (iii)
(d) (ii) and (iv)



12. The values of a, b, c and d in the following balanced chemical equation are respectively: (2025)
$aPb(NO_3)_2 \rightarrow bPbO + cNO_2 + dO_2$ are:
(a) 1, 1, 2, 1

(b) 1, 1, 1, 2
(c) 2, 2, 1, 4
(d) 2, 2, 4, 1

13. The correct balanced chemical equation showing exothermic reaction in which natural gas burns in air is:
(a) $CH_4 + O_2 \rightarrow CO_2 + 2H_2O$
(b) $CH_4 + 2O_2 \rightarrow 2CO_2 + 2H_2O$ + Energy
(c) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$
(d) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ + Energy

14. Identify the correct statement about the following reaction:
$2H_2S + SO_2 \rightarrow 2H_2O + S$ (2024)
(a) H_2S is oxidising agent and SO_2 is reducing agent.
(b) H_2S is reduced to sulphur.
(c) SO_2 is oxidising agent and H_2S is reducing agent.
(d) SO_2 is oxidised to sulphur

ASSERTION AND REASON TYPE QUESTION (1 Marks)

In the following questions a statement of Assertion is followed by a statement of Reason.
Mark the correct choice as two statements are given one labeled Assertion (A) and the other labeled Reason (R).
Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below:
(a) Both A and R are true, and R is correct explanation of the assertion.
(b) Both A and R are true, but R is not the correct explanation of the assertion.
(c) A is true, but R is false.
(d) A is false, but R is true.

15. Assertion (A): Decomposition reactions are generally endothermic reactions.
Reason (R): Decomposition of organic matter into compost is an exothermic process. (2025)

16. Assertion (A): Photosynthesis is considered as an endothermic reaction.
Reason (R): Energy gets released in the process of photosynthesis

17. Assertion (A): $MnO_2 + 4HCl \rightarrow MnCl_2 + Cl_2 + 2H_2O$ is redox reaction.
Reason (R): MnO_2 oxidises HCl to Cl_2 and gets reduced to $MnCl_2$.

18. Assertion (A): Hydrogen gas is not evolved when zinc reacts with nitric acid. Reason (R): Nitric acid oxidises the hydrogen gas produced to water and itself gets reduced. (2024)

19. Assertion (A): In the following reaction $ZnO + C \rightarrow Zn + CO$ ZnO undergoes reduction.
Reason (R): Carbon is a reducing agent that reduces ZnO to Zn. (2023)

20. Assertion (A): The reaction of quick lime with water is an exothermic reaction.
Reason (R): Quicklime reacts vigorously with water releasing a large amount of heat. (2023)

21. Assertion (A): Chemical reaction changes the physical and chemical properties of a substance.
Reason (R): Chemical change involves a change in the chemical composition of matter, and a new substance is formed.

20. Assertion (A): The reaction of quick lime with water is an exothermic reaction.
Reason (R): Quicklime reacts vigorously with water releasing a large amount of heat. (2023)

(ho jaayenge aaram se)

PART 2 (Subjective Questions)

SHORT ANSWER TYPE QUESTIONS (2 and 3 Marks)

21. In a reaction, a substance both gains oxygen and loses hydrogen. Explain how this represents oxidation and why oxidation and reduction occur together.

22. A white crystalline solid 'X' is exposed to sunlight for a long time and turns grey. When this grey substance is heated, it decomposes to give a metal 'Y' and a gas 'Z' which turns limewater milky.
(a) Identify substances X, Y and Z.
(b) Write all the chemical equations involved.
(c) Classify each reaction involved (more than one type possible).
(d) Identify the oxidising and reducing agents in the decomposition reaction.

23. Respiration is an exothermic reaction, yet it does not cause a sudden rise in body temperature. Explain why.

24. Dilip was comparing combination reactions with decomposition reactions.
Which class of chemical substances may be the product of a decomposition reaction but NOT a product of a combination reaction?

25. Give two observations that confirm a chemical reaction has taken place and explain the chemical reason behind each.

26. Explain the role of a reducing agent in converting metal oxides into metals with reference to MnO_2.

27. Trupti mixes an aqueous solution of sodium sulphate (Na_2SO_4) and an aqueous solution of copper chloride ($CuCl_2$). Will this lead to a double displacement reaction? Justify your answer.

28. Hydrated ferrous sulphate crystals are heated in a boiling tube for a few seconds. Water droplets are seen in the inner sides of test tube and the colour of the crystals change. On continuous heating, a colourless gas X with the smell of burning sulphur is evolved and a residue Y is obtained.
(A) What is the colour of the crystals before and after mild heating?
(B) Identify gas X and the residue Y formed.
(C) Write a balanced chemical equation for the above reaction.

(pahle points socho fir likho)

LONG ANSWER TYPE QUESTIONS (5 Marks)

29. A restaurant makes use of two types of cooking oils: Oil 'X' (rich in unsaturated fatty acids) and oil 'Y' (highly rich in saturated fatty acids). Both are kept in transparent containers near the kitchen window. After a few weeks, oil 'X' acquires a foul and unpleasant odour, whereas oil 'Y' does not.
(A) Identify the phenomenon affecting oil 'X' and explain why oil 'Y' is unaffected, referencing its chemical composition.
(B) The restaurant owner intends to keep oil 'X' in the refrigerator but sees condensation within the bottle. Predict the influence of moisture on the phenomenon discussed in (A) and propose an additional strategy to slow it down besides refrigeration.

30. Balance the following chemical equations and explain the method used:

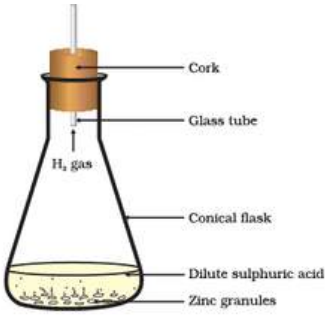
(a) $Fe + H_2O \rightarrow Fe_3O_4 + H_2$

(b) $MnO_2 + HCl \rightarrow MnCl_2 + Cl_2 + H_2O$

(c) $HNO_3 + Ca(OH)_2 \rightarrow Ca(NO_3)_2 + H_2O$

31. What happens when potassium iodide solution is added to lead nitrate solution? Write the balanced chemical equation and classify the reaction with justification.

32. Answer the following questions based on the diagram given below:



(i) What is the chemical reaction that occurs when dilute sulfuric acid reacts with zinc?

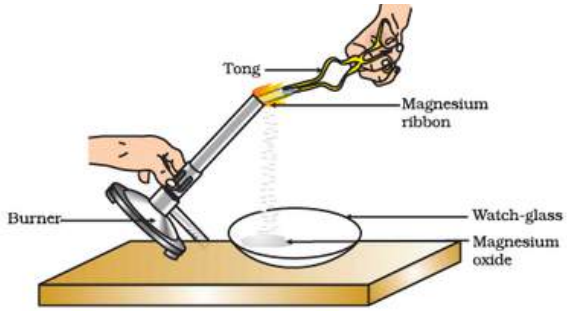
(ii) How can we test the presence of hydrogen gas during this experiment?

(iii) What is the role of zinc in this reaction?

(iv) Why do we use dilute sulfuric acid in this experiment instead of concentrated sulfuric acid?

(v) What is the significance of the "↑" symbol in the chemical equation for this reaction?

33. Answer the following questions based on the diagram given below:

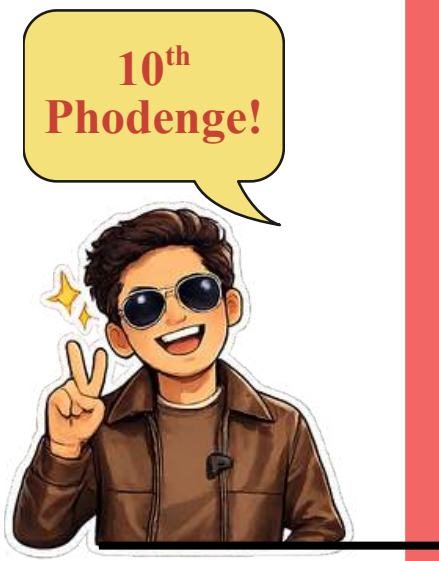


(i) What is the purpose of burning a magnesium ribbon in air in this experiment?

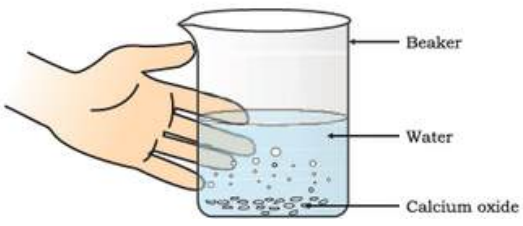
(ii) Describe the appearance of the magnesium ribbon before it is burnt.

(iii) What happens to the magnesium ribbon when it is burnt in air?

(iv) How is magnesium oxide collected in this experiment?



34. Answer the following questions based on the diagram given below:



(i) What are the reactants in the experiment for the formation of slaked lime?

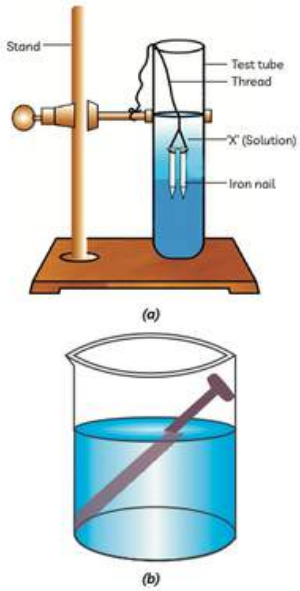
(ii) Describe the appearance of calcium oxide (CaO) before the reaction with water.

(iii) What is the chemical formula of the product formed in this experiment, and what is its common name?

(iv) Explain how the appearance of the mixture changes during the reaction between calcium oxide and water.

(v) Why is the formation of slaked lime considered a combination reaction?

35. During the time period of her experimental class, the science teacher Mrs. Priyanjali placed an experimental set-up in front of the students as shown in figure (a).



It was observed that an iron nail is immersed in a solution of a compound 'P'. After a few hours, the students observed a change in the iron nail as shown in figure (b).

(A) Identify the chemical compound 'P'.

What change did the students observe in the colour of solution of compound 'P'?

Why did this change occur?

(B) Shreya, one of the students from the class, was trying to figure out the type of reaction that took place in the given set-up.

Help her by identifying the same and give reason why this reaction is classified as such.

(C) After the experiment, the teacher told Shreya that she will demonstrate the same experiment next time with nails of two different metals. Will the same reaction take place if:

(i) Zinc nails are immersed in copper sulphate?

(ii) Copper nails are immersed in copper sulphate solution?

PART 3 (Advanced Questions)

Case Study/Source Based Question (5 Marks)

36. Three students perform different experiments:

- Student 1: Adds iron nail to copper sulphate solution and observes a colour change.
- Student 2: Adds copper metal to iron sulphate solution but observes no change.
- Student 3: Mixes potassium iodide and lead nitrate solutions and observes a yellow precipitate.

They debate about types of reactions and reactivity.

Questions:

1. Explain why Student 1 observes a reaction but Student 2 does not.
2. Identify the type of reaction in Student 1's experiment and justify.
3. Identify the type of reaction in Student 3's experiment.
4. Write the balanced chemical equation for Student 3's reaction.
5. Predict what will happen if zinc is added to copper sulphate solution. Justify your answer based on reactivity

37. An iron nail is immersed in a copper sulphate solution. Over time, the solution loses its blue colour and a reddish deposit forms on the nail.

(a) Write the balanced chemical equation and represent the reaction using ionic equations.

(b) Identify the oxidation states of all elements before and after the reaction and determine which species is oxidized and reduced.

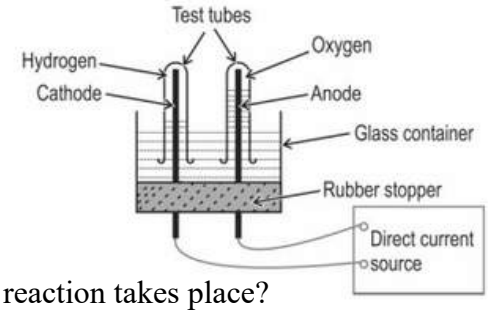
(c) Explain the feasibility of this reaction using the reactivity series and electrochemical reasoning (tendency to lose electrons).

(d) Predict and justify whether the reaction will proceed if:

(i) Copper is placed in iron(II) sulphate solution

(ii) Silver is placed in copper sulphate solution

38. The diagram below shows the set-up in which electrolysis of water takes place.

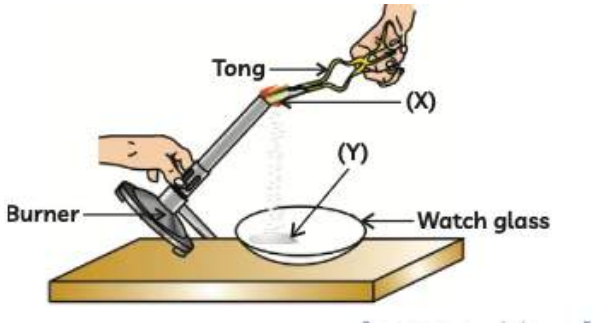


(a) What type of reaction takes place?
(b) Explain why this is an example of an endothermic reaction?
(c) The test tube containing hydrogen is removed carefully from the apparatus. A lit match stick is brought near the mouth of this test tube. The gas burns with an explosive "pop" sound.
Write a balanced chemical equation for this reaction and indicate whether energy is absorbed or released.

39. Zinc reacts with dilute hydrochloric acid to produce a gas and a salt. However, when copper is used instead of zinc, no reaction occurs.
(a) Write the balanced chemical equation for the reaction involving zinc.
(b) Explain the reaction in terms of electron transfer, clearly identifying oxidation and reduction processes.
(c) Using the reactivity series, explain why copper does not react with dilute hydrochloric acid.
(d) Predict what will happen if magnesium is used instead of zinc and compare the rate of reaction with justification.

40. A white powder used in baking releases carbon dioxide when heated or when it reacts with moisture. Over time, if left exposed to air, its effectiveness decreases.
(a) Identify the compound and write the chemical equation for its decomposition on heating.
(b) Explain the reaction in terms of thermal stability and bond breaking.
(c) Analyse why exposure to air reduces its effectiveness, including the role of moisture and unintended reactions.
(d) Suggest a method to preserve its reactivity and justify your answer chemically.

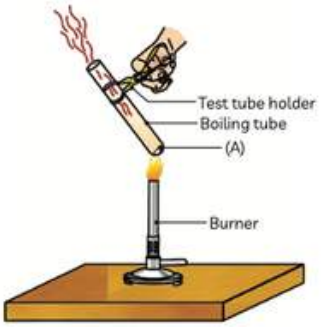
41. A 2 cm long thin ribbon of a metal ‘X’ was taken and first cleaned with sandpaper. It was then burnt using a spirit lamp or burner by holding it with a pair of tongs. The ribbon burnt with a dazzling white flame and formed a powder ‘Y’, which was collected in a watch glass.

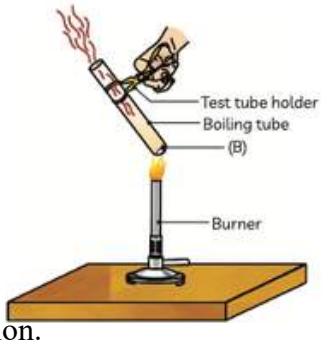


Option	(X)	(Y)
(a)	Magnesium	Magnesium carbonate
(b)	Aluminium	Aluminium oxide
(c)	Magnesium	Magnesium oxide
(d)	Iron	Iron oxide

(A) Which option correctly identifies both (X) and (Y)?
(B) The colour of the powder or ash formed when a magnesium ribbon is burnt in air is:
(a) grey
(b) black
(c) white
(d) yellow
(C) Why should a magnesium ribbon be cleaned before burning in air?
(D) Why is it advisable to wear eye protection while burning magnesium ribbon?

(E) Assertion (A): Magnesium ribbon burns with a dazzling white flame.
Reason (R): When magnesium ribbon burns in air, only heat is evolved.





42. Amit took two boiling tubes. He added about 2 grams of a green-coloured metal salt (A) in the first tube and 2 grams of a white-coloured metal salt (B) in the second tube. Both the tubes were heated by holding them with a pair of tongs. The smell of burning sulphur was observed in the first test tube, whereas a brown gas was emitted in the second test tube.
(A) The salts 'A' and 'B' are:
(a) Ferrous nitrate and lead sulphate, respectively
(b) Ferric oxide and lead nitrate, respectively
(c) Ferrous sulphate and lead nitrate, respectively
(d) Ferric oxide and lead sulphate, respectively
(B) Assertion (A): Green-coloured ferrous sulphate crystals on heating first change to dirty white and then to brownish black.
Reason (R): Ferrous sulphate crystals contain seven molecules of water of crystallisation.
(a) Both (A) and (R) are true, and (R) is the correct explanation of (A).
(b) Both (A) and (R) are true, and (R) is not the correct explanation of (A).
(c) (A) is true but (R) is false.
(d) (A) is false but (R) is true.
(C) What are the products formed when green-coloured metal salt (A) is heated?
(D) On heating white coloured metal salt (B), two gases are evolved — one is colourless and the other is brown in colour. Which gases are these?
(E) In which of the given category will you put the reaction of heating ferrous sulphate and lead nitrate?
(I) Decomposition reaction
(II) Combination reaction
(III) Endothermic reaction
(IV) Exothermic reaction
Options:
(a) Only (I)
(b) Only (II)
(c) Both (I) and (III)
(d) Both (II) and (IV)

43. A white powder used in baking releases carbon dioxide when heated or when it reacts with moisture. Over time, if left exposed to air, its effectiveness decreases.
(a) Identify the compound and write the chemical equation for its decomposition on heating.
(b) Explain the reaction in terms of thermal stability and bond breaking.
(c) Analyse why exposure to air reduces its effectiveness, including the role of moisture and unintended reactions.
(d) Suggest a method to preserve its reactivity and justify your answer chemically.

44. (A) Design an experiment to demonstrate the thermal decomposition of lead nitrate.
(B) Potassium chlorate is heated in the presence of manganese dioxide (catalyst) to give potassium chloride and oxygen. Write a balanced chemical equation for the same.
(C) Write balanced chemical equation for the reaction in part (A) stating the physical state of the reactant and the products

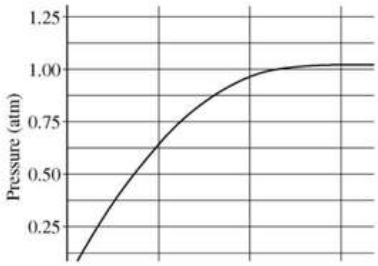
45. Marble's popularity began in ancient Rome and Greece, where white and off-white marble were used to construct a variety of structures, from hand-held sculptures to massive pillars and buildings.

1.1 The substance not likely to contain $CaCO_3$ is

a) Dolomite
b) A marble statue
c) Calcined gypsum
d) Sea shells.

1.2 A student added 10g of calcium carbonate in a rigid container, secured it tightly and started to heat it. After some time, an increase in pressure was observed, the pressure reading was then noted at intervals of 5 mins and plotted against time, in a graph as shown below. During which time interval did maximum decomposition took place?

a) 15-20 min
b) 10-15 min
c) 5-10 min
d) 0-5 min



1.3 Gas A, obtained above is a reactant for a very important biochemical process which occurs in the presence of sunlight. Identify the name of the process -

a) Respiration
b) Photosynthesis
c) Transpiration
d) sphotolysis

1.4 Marble statues are corroded or stained rain water. Identify the main reason

a) Decomposition of calcium carbonate into calcium oxide
b) Polluted water is basic in nature and reacts with calcium carbonate
c) Polluted rainwater is acidic in nature
d) Calcium carbonate dissolves in water to form calcium hydroxide

1.5 Calcium oxide can be reduced to calcium, by heating with sodium metal. Which compound would act as an oxidizing agent in the above process?

a) Sodium
b) sodium oxide
c) calcium
d) calcium oxide

- Combination Reaction – Q5, Q33, Q34, Q40
  - Decomposition Reaction – Q1, Q7, Q10, Q22, Q24, Q28, Q37, Q39, Q41, Q44, Q45
- Displacement Reaction – Q2, Q4, Q32, Q35, Q38
- Double Displacement Reaction – Q6, Q9, Q27, Q31, Q42
- Balancing Chemical Equations – Q12, Q30
- Exothermic & Endothermic Reactions – Q13, Q15, Q16, Q20, Q23, Q40
- Oxidation–Reduction (Redox Reaction) – Q3, Q8, Q14, Q17, Q18, Q19, Q26, Q36, Q43
- Electrolysis (Decomposition Reaction) – Q11, Q37
- Characteristics / Observation of Chemical Reactions – Q21, Q25, Q28
- Rancidity – Q29

SOLUTIONS

MULTIPLE CHOICE QUESTIONS [MCQ's]

1. (D)
2. (B)
3. (C)
4. (B)
5. (B)
6. (B)
7. (B)
8. (C)
9. (C)
10. (D)
11. (C)
12. (D)
13. (D)
14. (C)
15. (B)
16. (C)
17. (A)
18. (A)
19. (A)
20. (A)

SHORT ANSWER TYPE QUESTIONS:

21. A substance that gains oxygen or loses hydrogen is said to be oxidised. Both processes involve loss of electrons. Oxidation and reduction always occur together because when one substance is oxidised (loses electrons), another substance must gain those electrons (reduction). Hence, they are complementary processes.

22. (a) X = Silver chloride (AgCl), Y = Silver (Ag), Z = Chlorine gas (Cl_2)
(b) Chemical Equation: $2AgCl\ (s) \rightarrow 2Ag\ (s) + Cl_2\ (g)$ (in presence of sunlight)
(c) Type of Reaction: Decomposition reaction, Photochemical decomposition reaction, Redox reaction
(d) Oxidising and Reducing Agents:
• Ag^+ is reduced to Ag, so AgCl acts as oxidising agent
• Cl^- is oxidised to Cl_2, so Cl^- acts as reducing agent

23. Although respiration is an exothermic process, energy is released in a controlled and stepwise manner within cells through a series of biochemical reactions. This gradual release prevents a sudden increase in body temperature and allows energy to be efficiently utilized.

24. Elements, because in a decomposition reaction a compound breaks down into simpler substances which can be elements, whereas in a combination reaction substances combine to form only a compound, not elements.

25. (i) Change in colour: Indicates formation of a new substance with different properties.
(ii) Evolution of gas: Formation of bubbles shows that a new gaseous product is formed, confirming a chemical reaction.

26. A reducing agent removes oxygen from a metal oxide and itself gets oxidised. For example, in the re of MnO_2, carbon acts as a reducing agent and removes oxygen to form manganese. Thus, MnO_2 is reduced to manganese metal.

27. No, this will not lead to a double displacement reaction because no precipitate, gas, or water is formed. Both possible products ($CuSO_4$ and NaCl) are soluble in water, so no reaction occurs.

28. (A) Before heating: Green (hydrated ferrous sulphate crystals)
After mild heating: White (anhydrous ferrous sulphate)
(B) Gas X: Sulphur dioxide (SO_2) (smell of burning sulphur)
Residue Y: Ferric oxide (Fe_2O_3) (brown solid)
(C) Balanced chemical equations:
Step 1 (loss of water): $FeSO_4 \cdot 7H_2O \rightarrow FeSO_4 + 7H_2O$
Step 2 (on strong heating): $2FeSO_4 \rightarrow Fe_2O_3 + SO_2 + SO_3$

LONG ANSWER TYPE QUESTIONS:

29. (A) Rancidity is the phenomenon affecting oil 'X'. Oil 'X' contains unsaturated fatty acids with double bonds that are easily oxidised. Oil 'Y' contains saturated fatty acids without double bonds, so it is less prone to oxidation.
(B) Moisture can increase the rate of rancidity by facilitating oxidation and spoilage.
Another method: Store the oil in airtight, dark containers to prevent contact with air and light.

30. Balanced equations: (a) $3Fe + 4H_2O \rightarrow Fe_3O_4 + 4H_2$
(b) $MnO_2 + 4HCl \rightarrow MnCl_2 + Cl_2 + 2H_2O$
(c) $2HNO_3 + Ca(OH)_2 \rightarrow Ca(NO_3)_2 + 2H_2O$
Method used: Balancing is done by adjusting coefficients to make the number of atoms of each element equal on both sides. Metals are balanced first, followed by non-metals, and finally hydrogen and oxygen.

31. When potassium iodide solution is added to lead nitrate solution, a yellow precipitate of lead iodide is formed.
Reaction: $2KI + Pb(NO_3)_2 \rightarrow PbI_2 + 2KNO_3$
Type of reaction: Double displacement reaction (also a precipitation reaction) because ions are exchanged between two compounds and an insoluble solid (precipitate) is formed.

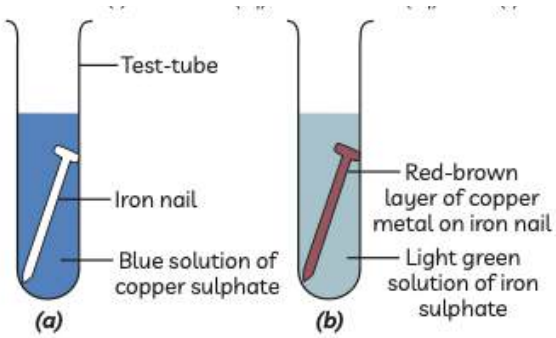
32. (i) The chemical reaction between dilute sulfuric acid and zinc is represented as:
$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2\uparrow$ In this reaction, zinc displaces hydrogen from sulfuric acid, forming zinc sulfate and hydrogen gas.
(ii) To test the presence of hydrogen gas, you can bring a burning splint near the mouth of the test tube where the reaction is happening. If you hear a "pop" sound and see a flame, it indicates the presence of hydrogen gas.
(iii) Zinc acts as a reducing agent in this reaction. It donates electrons to hydrogen ions in sulfuric acid, leading to the production of hydrogen gas.
(iv) We use dilute sulfuric acid because it is safer and less reactive than concentrated sulfuric acid. Concentrated sulfuric acid is highly corrosive and can produce a vigorous reaction with zinc, making it
(v) The "↑" symbol indicates that hydrogen gas is produced as a gas and is released into the air during the reaction. It helps us understand that hydrogen gas is one of the products of the reaction and is liberated in the form of bubbles.

33. (i) The purpose of burning a magnesium ribbon in air is to observe the reaction of magnesium with oxygen and to collect the product, which is magnesium oxide.

(ii) Before burning, the magnesium ribbon appears as a shiny, silver-colored metal strip.
(iii) When the magnesium ribbon is burnt in air, it reacts with oxygen to form magnesium oxide. During this reaction, the magnesium ribbon glows brightly and produces a white powder (magnesium oxide).
(iv) Magnesium oxide is collected in a watch-glass. It is the white powder that forms on the surface of the watch-glass as a result of the reaction between magnesium and oxygen.
(v) The balanced chemical equation for the reaction is: $2Mg(s) + O_2(g) \rightarrow 2MgO(s)$

34. (i) The reactants in this experiment are calcium oxide (CaO) and water (H_2O).
(ii) Calcium oxide appears as a white, powdery substance before the reaction with water.
(iii) The chemical formula of the product formed is calcium hydroxide ($Ca(OH)_2$), and its common name is slaked lime.
(iv) During the reaction, the mixture changes from a white, powdery substance (calcium oxide) to a thick, white, and pasty substance (slaked lime or calcium hydroxide).
(v) The formation of slaked lime is considered a combination reaction because it involves the combination of two substances, calcium oxide and water, to form a single product, calcium hydroxide, without the release of any additional substances.

35. (A) Compound 'P' is copper sulphate ($CuSO_4$).
The solution changes from blue to light green.
This happens because iron displaces copper, forming ferrous sulphate (green) and depositing copper on the iron nail.
(B) It is a single displacement reaction because iron displaces copper from its solution.
(C) (i) Yes, zinc will displace copper, so reaction will take place.
(ii) No, copper cannot displace itself, so no reaction occurs.



CASE STUDY/SOURCE BASED QUESTION:

36. (i) Student 1 observes a reaction because iron is more reactive than copper and can displace copper from copper sulphate solution. Student 2 does not observe any reaction because copper is less reactive than iron and cannot displace iron from iron sulphate solution.
(ii) The reaction in Student 1's experiment is a displacement reaction because iron displaces copper from its compound: $Fe + CuSO_4 \rightarrow FeSO_4 + Cu$
(iii) The reaction in Student 3's experiment is a double displacement reaction (also a precipitation reaction) because ions are exchanged between two compounds and an insoluble product is formed.

(iv) Balanced chemical equation: $2KI + Pb(NO_3)_2 \rightarrow PbI_2 + 2KNO_3$
(v) If zinc is added to copper sulphate solution, zinc will displace copper because zinc is more reactive than copper: $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$
This occurs due to zinc being higher in the reactivity series.

COMPETENCY BASED QUESTION:

37. (a) Balanced equation: $Fe + CuSO_4 \rightarrow FeSO_4 + Cu$
Ionic equation: $Fe + Cu^{2+} \rightarrow Fe^{2+} + Cu$
(b) Oxidation states:
Fe: $0 \rightarrow {}^{2+}$ (oxidation)
Cu: ${}^{2+} \rightarrow 0$ (reduction)
Thus, Fe is oxidized and Cu^{2+} is reduced.
(c) Iron is above copper in the reactivity series, so it has a greater tendency to lose electrons. Hence, Fe displaces Cu from its compound. This shows Fe is more electropositive and readily oxidised.

(d) (i) Copper in $FeSO_4$ → No reaction, as Cu is less reactive than Fe.
(ii) Silver in $CuSO_4$ → No reaction, as Ag is less reactive than Cu.

38. (a) It is a decomposition reaction, specifically electrolytic decomposition, as water breaks down into hydrogen and oxygen on passing electric current.
(b) This reaction is endothermic because electrical energy is absorbed to break the bonds in water and decompose it into hydrogen and oxygen gases.
(c) When hydrogen burns in oxygen, water is formed:
$2H_2 + O_2 \rightarrow 2H_2O$
This reaction is exothermic because energy is released in the form of heat.

39. (a) $Zn + 2HCl \rightarrow ZnCl_2 + H_2$
(b) $Zn \rightarrow Zn^{2+} + 2e^-$ (oxidation)
$2H^+ + 2e^- \rightarrow H_2$ (reduction)
Thus, Zn is oxidized and H^+ ions are reduced.
(c) Copper is below hydrogen in the reactivity series, so it cannot displace hydrogen from acids. Hence, no reaction occurs.
(d) Magnesium is more reactive than zinc, so it will react more vigorously: $Mg + 2HCl \rightarrow MgCl_2 + H_2$
Rate will be faster due to higher reactivity.

40. (a) Compound: Baking soda ($NaHCO_3$)
Reaction: $2NaHCO_3 \rightarrow Na_2CO_3 + CO_2 + H_2O$
(b) On heating, bonds in $NaHCO_3$ break due to low thermal stability, forming simpler substances. This requires energy (endothermic decomposition).
(c) Exposure to air (moisture + CO_2) causes slow decomposition or reaction, reducing its effectiveness. It may convert partially into sodium carbonate.
(d) It should be stored in airtight containers to prevent contact with moisture and CO_2, thereby maintaining its chemical stability and effectiveness.

41. (A) (c) Magnesium – Magnesium oxide
(B) (c) White
(C) To remove the layer of magnesium oxide from the surface so that it burns properly.
(D) Because it burns with a dazzling white flame which can damage the eyes.
(E) Assertion is true, Reason is false.

42. (A) (c) Ferrous sulphate and lead nitrate, respectively.
(B) (b) Both (A) and (R) are true, and (R) is not the correct explanation of (A).
(C) Ferric oxide, sulphur dioxide and sulphur trioxide are formed.
(D) The gases are nitrogen dioxide (brown gas) and oxygen (colourless gas).
(E) (c) Both (I) and (III).

43. (a) The compound is sodium bicarbonate ($NaHCO_3$).
Chemical equation: $2NaHCO_3(s) \rightarrow Na_2CO_3(s) + CO_2(g) + H_2O(g)$
(b) Sodium bicarbonate is thermally unstable. On heating, bonds within the bicarbonate ion break, leading to the formation of sodium carbonate, carbon dioxide, and water. The release of gases shows decomposition due to heat.
(c) When exposed to air, sodium bicarbonate reacts with moisture and slowly decomposes into sodium carbonate. Since sodium carbonate does not release CO_2 effectively, the baking efficiency decreases over time.

(d) It should be stored in an airtight container. This prevents contact with moisture and air, avoiding pr decomposition and preserving its reactivity.

44. . (A) Take a small amount of lead nitrate powder in a boiling test tube. Hold the boiling test tube with a pair of tongs and heat it gently at frst, then strongly over a fame.
Observations:
(1) The solid decomposes, forming a yellow residue (lead oxide).
(2) Brown fumes (nitrogen dioxide) are released.
(3) A colourless gas (oxygen) is also released.
(B) $2KClO_{3(s)} \xrightarrow{MnO_2} 2KCl_{(s)} + 3O_{2(g)}$
(C) $2Pb(NO_3)_{2(s)} \rightarrow 2PbO_{(s)} + 4NO_{2(g)} + O_{2(g)}$

45. 1.1 (c)
1.2 (a)
1.3 (b)
1.4 (c)
1.5 (d)