

Topic:

1. Which of the following balanced chemical equations correctly represents the reaction between nitrogen gas and hydrogen gas to form ammonia?

- (a) $\text{N}_2(\text{g}) + \text{H}_2(\text{g}) \rightarrow \text{NH}_3(\text{g})$
- (b) $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g})$
- (c) $2\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g})$
- (d) $\text{N}_2(\text{g}) + 2\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g})$

2. When a white solid 'X' is heated, it decomposes to form a yellowish-brown gas and a solid residue. The residue turns yellow on cooling. This reaction is an example of:

- (a) Combination reaction
- (b) Decomposition reaction
- (c) Displacement reaction
- (d) Double displacement reaction

3. Which of the following metals can displace hydrogen from dilute acids?

- (a) Copper
- (b) Silver
- (c) Gold
- (d) Zinc

4. When aqueous solutions of barium chloride and sodium sulfate are mixed, a white precipitate is formed. The chemical formula of this precipitate is:

- (a) BaSO_4
- (b) NaCl
- (c) BaCl_2
- (d) Na_2SO_4

5. In the reaction: $\text{Fe}_2\text{O}_3(\text{s}) + 2\text{Al}(\text{s}) \rightarrow \text{Al}_2\text{O}_3(\text{s}) + 2\text{Fe}(\text{s})$

Which substance is getting oxidized?

(a) Fe_2O_3

(b) Al

(c) Al_2O_3

(d) Fe

6. Consider the reaction: $\text{CuO}(\text{s}) + \text{H}_2(\text{g}) \rightarrow \text{Cu}(\text{s}) + \text{H}_2\text{O}(\text{l})$

The reducing agent in this reaction is:

(a) CuO

(b) H_2

(c) Cu

(d) H_2O

7. A reaction in which heat is absorbed from the surroundings is known as:

(a) Exothermic reaction

(b) Endothermic reaction

(c) Combination reaction

(d) Decomposition reaction

8. Rusting of iron is an example of:

(a) Oxidation reaction

(b) Reduction reaction

(c) Double displacement reaction

(d) Neutralization reaction

9. Rancidity can be prevented by:

- (a) Storing food in airtight containers
- (b) Adding antioxidants
- (c) Flushing with nitrogen gas
- (d) All of the above

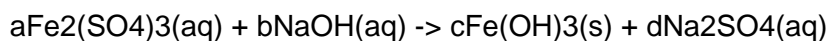
10. Consider the reaction: $2\text{Pb}(\text{NO}_3)_2(\text{s}) \rightarrow 2\text{PbO}(\text{s}) + 4\text{NO}_2(\text{g}) + \text{O}_2(\text{g})$

This reaction is an example of:

- I. Thermal decomposition
- II. Redox reaction
- III. Exothermic reaction
- IV. Combination reaction

- (a) I and II only
- (b) I and III only
- (c) I, II and III
- (d) II and IV only

11. What are the coefficients a, b, c, and d respectively, when the following equation is balanced?



- (a) 1, 3, 2, 3
- (b) 1, 6, 2, 3
- (c) 2, 6, 2, 3
- (d) 1, 6, 1, 3

12. According to the Law of Conservation of Mass, during a chemical reaction:

- (a) Mass can be created or destroyed

- (b) The total mass of reactants equals the total mass of products
- (c) The number of atoms of each element changes
- (d) Energy is always released

13. When hydrogen sulfide gas is passed through a blue solution of copper sulfate, a black precipitate of copper sulfide is formed and sulfuric acid is produced. This reaction is a type of:

- (a) Combination reaction
- (b) Decomposition reaction
- (c) Single displacement reaction
- (d) Double displacement reaction

14. Which of the following observations indicates a chemical reaction has occurred?

- I. Change in state
- II. Change in color
- III. Evolution of gas
- IV. Change in temperature

- (a) I and II only
- (b) II and III only
- (c) I, II and III only
- (d) All of the above

15. Consider the following statements regarding the reaction $2\text{Mg(s)} + \text{O}_2\text{(g)} \rightarrow 2\text{MgO(s)}$:

- I. It is a combination reaction.
- II. It is an oxidation reaction.
- III. Magnesium acts as a reducing agent.
- IV. Oxygen acts as a reducing agent.

Which of the above statements are correct?

- (a) I, II, and III only
- (b) I, II, and IV only
- (c) I, III, and IV only
- (d) All of the above

Answers

- 1. (b)
- 2. (b)
- 3. (d)
- 4. (a)
- 5. (b)
- 6. (b)
- 7. (b)
- 8. (a)
- 9. (d)
- 10. (a)
- 11. (b)
- 12. (b)
- 13. (d)
- 14. (d)
- 15. (a)

Topic: Chemical vs. Physical Changes

Section: Multiple Choice Questions

1. Which of the following is an example of a physical change?

- (a) Burning of magnesium ribbon
- (b) Digestion of food
- (c) Evaporation of water
- (d) Rusting of iron

2. A chemical change is characterized by:

- (a) Change in state only
- (b) Formation of new substances
- (c) No change in chemical composition
- (d) Easy reversibility

3. Which statement is TRUE regarding a physical change?

- (a) Energy is always absorbed.
- (b) The chemical identity of the substance changes.
- (c) It is generally reversible.
- (d) New chemical bonds are formed.

4. When a substance undergoes a chemical change, its mass:

- (a) Increases
- (b) Decreases
- (c) Remains conserved
- (d) Cannot be determined

5. The tarnishing of silver involves the formation of silver sulfide. This process is best classified as a:

- (a) Physical change
- (b) Nuclear change
- (c) Chemical change
- (d) Sublimation process

6. Which of the following observations typically indicates a chemical reaction has occurred?

- (a) A substance changes from solid to liquid.
- (b) A gas is produced.
- (c) The volume of a substance increases.
- (d) A substance changes shape.

7. Dissolving salt in water is considered a physical change because:

- (a) New chemical bonds are formed between salt and water.
- (b) The salt completely disappears.
- (c) The chemical identity of salt and water remains unchanged.
- (d) Heat is always released during the process.

8. When a piece of zinc is added to hydrochloric acid, hydrogen gas is evolved and zinc chloride is formed. This is an example of a:

- (a) Physical change only
- (b) Chemical change only
- (c) Both physical and chemical change
- (d) Nuclear change

9. Which of the following processes is exothermic and indicates a chemical change?

- (a) Melting of ice

- (b) Boiling of water
- (c) Burning of natural gas
- (d) Sublimation of dry ice

10. In a chemical equation, state symbols like (s), (l), (g), (aq) are used to represent:

- (a) The type of reaction
- (b) The physical state of reactants and products
- (c) The energy change involved
- (d) Whether the change is physical or chemical

11. The breaking of a glass bottle is a physical change because:

- (a) The glass absorbs heat.
- (b) The chemical composition of the glass remains the same.
- (c) New chemical bonds are formed.
- (d) It is an irreversible process.

12. A precipitation reaction, where an insoluble solid forms from two soluble reactants, is a clear example of:

- (a) A physical change
- (b) A chemical change
- (c) An endothermic process only
- (d) A reversible process

13. Which of the following characteristics is NOT typically associated with a chemical change?

- (a) Irreversibility
- (b) Significant energy change
- (c) Change in physical state only

(d) Formation of a precipitate

14. When iron (Fe) reacts with oxygen (O₂) to form iron oxide (Fe₂O₃), this process is a:

(a) Physical change because no new elements are formed.

(b) Chemical change because new substances with different properties are formed.

(c) Physical change because the mass is conserved.

(d) Chemical change because it is a reversible process.

15. The process of photosynthesis, where plants convert carbon dioxide and water into glucose and oxygen, is an example of:

(a) A physical change involving energy absorption.

(b) A chemical change involving the formation of new substances.

(c) A purely physical process due to phase changes.

(d) A process where the chemical composition of reactants remains unchanged.

Answers

1. (c)

2. (b)

3. (c)

4. (c)

5. (c)

6. (b)

7. (c)

8. (b)

9. (c)

10. (b)

11. (b)

12. (b)

13. (c)

14. (b)

15. (b)

Topic: Characteristics of Chemical Reactions

Section: Multiple Choice Questions

16. Which of the following is NOT typically considered an observable characteristic of a chemical reaction?

- (a) Evolution of gas
- (b) Change in shape
- (c) Formation of a precipitate
- (d) Change in temperature

17. When a small piece of sodium metal is dropped into water, it reacts vigorously, producing heat and a gas that catches fire. Which characteristic of chemical reactions is most evident in this observation?

- (a) Change in color and formation of precipitate
- (b) Evolution of gas and change in temperature
- (c) Change in state and change in shape
- (d) Formation of precipitate and change in color

18. A student mixes two colorless solutions, lead(II) nitrate and potassium iodide, and observes the immediate formation of a bright yellow solid. This observation indicates which characteristic of a chemical reaction?

- (a) Evolution of gas
- (b) Change in temperature
- (c) Formation of precipitate
- (d) Change in color

19. Which of the following reactions is characterized by an increase in temperature, indicating an exothermic process?

- (a) Dissolving ammonium chloride in water
- (b) Mixing baking soda and vinegar

(c) Combustion of methane gas

(d) Photosynthesis in plants

20. When iron nails are left exposed to moist air for a long time, they develop a reddish-brown flaky coating. This phenomenon is an example of corrosion. Which characteristic of a chemical reaction is primarily observed here?

(a) Evolution of gas

(b) Change in state

(c) Change in color

(d) Formation of precipitate

21. A glowing splint is used to test a gas produced during a chemical reaction. If the splint extinguishes, the gas is likely carbon dioxide. This test identifies which characteristic of the reaction?

(a) Change in temperature

(b) Evolution of gas

(c) Formation of precipitate

(d) Change in mass

22. Which of the following describes a situation where a chemical change has definitely occurred, based on typical observations?

(a) Ice melting into water

(b) Sugar dissolving in water

(c) Rusting of an iron gate

(d) Water boiling into steam

23. During an experiment, solid calcium carbonate is heated strongly. A gas is evolved that turns limewater milky. This observation demonstrates:

(a) A physical change involving gas evolution.

(b) A chemical change involving gas evolution.

(c) A change in state without chemical reaction.

(d) Formation of a precipitate.

24. When copper powder is heated in air, it forms a black substance. The black substance is copper(II) oxide. This change involves:

(a) Evolution of gas

(b) Formation of precipitate

(c) Change in color

(d) Change in physical state only

25. The process of respiration in living organisms is characterized by the release of energy. This indicates that respiration is an example of an:

(a) Endothermic reaction

(b) Exothermic reaction

(c) Precipitation reaction

(d) Neutralization reaction

26. Which characteristic would you NOT expect to observe when an acid reacts with a base (neutralization reaction)?

(a) Change in temperature

(b) Formation of water

(c) Evolution of gas

(d) Formation of salt

27. A chemical reaction produces a solid that settles out of a liquid solution. This solid is known as a:

(a) Reactant

(b) Product

(c) Precipitate

(d) Catalyst

28. When zinc granules are added to dilute hydrochloric acid, hydrogen gas is produced along with zinc chloride. Which observation confirms the occurrence of a chemical reaction?

- (a) Zinc granules getting dissolved
- (b) Formation of bubbles
- (c) Hydrochloric acid becoming less concentrated
- (d) The container becoming cooler

29. Rancidity, the spoilage of fats and oils, is typically observed as a change in:

- (a) Physical state and solubility
- (b) Odor and taste
- (c) Density and melting point
- (d) Volume and pressure

30. Consider the reaction: $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{SO}_3(\text{g})$. This reaction occurs spontaneously with the release of heat. Which characteristic is most directly implied by the word "spontaneously" and the release of heat?

- (a) Evolution of gas and change in color
- (b) Change in temperature (exothermic)
- (c) Formation of precipitate
- (d) Change in state from gas to liquid

Answers

16. (b)

17. (b)

18. (c)

19. (c)

20. (c)

21. (b)

22. (c)

23. (b)

24. (c)

25. (b)

26. (c)

27. (c)

28. (b)

29. (b)

30. (b)

Topic: Chemical Equations: Writing and Representing

Section: Multiple Choice Questions

31. Which of the following is an example of a chemical change?

- (a) Melting of ice
- (b) Sublimation of dry ice
- (c) Rusting of an iron nail
- (d) Dissolving salt in water

32. In the reaction: Silver nitrate (aq) + Sodium chloride (aq) \rightarrow Silver chloride (s) + Sodium nitrate (aq), which substances are the reactants?

- (a) Silver chloride and Sodium nitrate
- (b) Silver nitrate and Sodium chloride
- (c) Silver nitrate and Silver chloride
- (d) Sodium chloride and Sodium nitrate

33. When hydrochloric acid (HCl) reacts with solid magnesium (Mg) to produce hydrogen gas (H₂) and aqueous magnesium chloride (MgCl₂), what are the correct state symbols for hydrogen and magnesium chloride, respectively?

- (a) H₂(g) and MgCl₂(s)
- (b) H₂(l) and MgCl₂(aq)
- (c) H₂(g) and MgCl₂(aq)
- (d) H₂(aq) and MgCl₂(g)

34. A student adds a small piece of calcium metal to water in a beaker. They observe vigorous bubbling and the beaker feels warm to the touch. Which characteristic of a chemical reaction is NOT explicitly mentioned in this observation?

- (a) Evolution of gas
- (b) Change in temperature

(c) Formation of a precipitate

(d) Production of heat

35. The Law of Conservation of Mass states that mass is neither created nor destroyed in a chemical reaction. How does this law relate to balancing chemical equations?

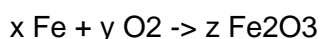
(a) It ensures that the total number of atoms on the reactant side equals the total number of atoms on the product side.

(b) It ensures that the sum of the masses of reactants is less than the sum of the masses of products.

(c) It ensures that the chemical reaction proceeds spontaneously.

(d) It ensures that the reaction is reversible.

36. What are the coefficients x, y, and z required to balance the following chemical equation?



(a) $x=2$, $y=3$, $z=1$

(b) $x=4$, $y=3$, $z=2$

(c) $x=1$, $y=1$, $z=1$

(d) $x=3$, $y=2$, $z=1$

37. The reaction in which two or more reactants combine to form a single product is called a:

(a) Decomposition reaction

(b) Displacement reaction

(c) Combination reaction

(d) Double displacement reaction

38. When potassium chlorate (KClO_3) is heated, it decomposes to form potassium chloride (KCl) and oxygen gas (O_2). This is an example of a:

(a) Combination reaction

(b) Decomposition reaction

(c) Displacement reaction

(d) Neutralization reaction

39. Zinc metal reacts with copper sulfate solution to form zinc sulfate solution and copper metal. This type of reaction is classified as a:

(a) Double displacement reaction

(b) Decomposition reaction

(c) Displacement reaction

(d) Neutralization reaction

40. When an aqueous solution of lead(II) nitrate is mixed with an aqueous solution of potassium iodide, a yellow precipitate of lead(II) iodide is formed. This is an example of a:

(a) Combination reaction

(b) Precipitation reaction

(c) Oxidation reaction

(d) Single displacement reaction

41. Consider the balanced chemical equation: $2\text{Al(s)} + 3\text{H}_2\text{SO}_4\text{(aq)} \rightarrow \text{Al}_2(\text{SO}_4)_3\text{(aq)} + 3\text{H}_2\text{(g)}$. If 0.6 moles of H_2SO_4 react completely, how many moles of $\text{Al}_2(\text{SO}_4)_3$ will be produced?

(a) 0.1 moles

(b) 0.2 moles

(c) 0.3 moles

(d) 0.6 moles

42. In the reaction: $\text{CuO(s)} + \text{H}_2\text{(g)} \rightarrow \text{Cu(s)} + \text{H}_2\text{O(l)}$, which species is being reduced?

(a) CuO

(b) H_2

(c) Cu

(d) H_2O

43. Which of the following observations indicates an endothermic reaction?

- (a) The reaction mixture becomes warmer.
- (b) The temperature of the surroundings increases.
- (c) Heat energy is absorbed from the surroundings.
- (d) The reaction vessel feels hot to the touch.

44. A solution of an acid is mixed with a solution of a base. This reaction typically produces salt and water. This type of reaction is known as:

- (a) Oxidation reaction
- (b) Precipitation reaction
- (c) Neutralization reaction
- (d) Redox reaction

45. The process by which fats and oils in food materials are oxidized, leading to changes in smell and taste, is known as:

- (a) Corrosion
- (b) Hydrogenation
- (c) Rancidity
- (d) Saponification

Answers

31. (c)

32. (b)

33. (c)

34. (c)

35. (a)

36. (b)

37. (c)

38. (b)

39. (c)

40. (b)

41. (b)

42. (a)

43. (c)

44. (c)

45. (c)

Topic: Reactants and Products

Section: Multiple Choice Questions

46. In a balanced chemical equation, the substances that undergo a chemical change and are written on the left side of the arrow are called:

- a) Products
- b) Residues
- c) Reactants
- d) Catalysts

47. When methane (CH_4) burns in oxygen (O_2) to produce carbon dioxide (CO_2) and water (H_2O), which of the following represents the products of this reaction?

- a) CH_4 and O_2
- b) CO_2 and H_2O
- c) CH_4 only
- d) O_2 only

48. According to the Law of Conservation of Mass, the total mass of the reactants in a chemical reaction must be:

- a) Less than the total mass of the products
- b) Greater than the total mass of the products
- c) Equal to the total mass of the products
- d) Unrelated to the total mass of the products

49. Which of the following statements best describes the relationship between physical changes and the formation of new products?

- a) Physical changes always result in the formation of new chemical products.
- b) Physical changes alter the chemical composition, creating new products.
- c) Physical changes involve a change in state or form, but do not create new chemical products.

d) Physical changes are reversible and produce different chemical products upon reversal.

50. One of the characteristics indicating a chemical reaction has occurred is the formation of a precipitate. A precipitate is typically a:

a) Soluble solid product formed in a gaseous reaction.

b) Gaseous product formed from two liquid reactants.

c) Insoluble solid product formed from two soluble reactants in solution.

d) Liquid product formed from two solid reactants.

51. In the chemical equation $2\text{Na(s)} + \text{Cl}_2\text{(g)} \rightarrow 2\text{NaCl(s)}$, what do the state symbols (s) and (g) indicate for the reactants?

a) (s) means solid product, (g) means gaseous product.

b) (s) means soluble reactant, (g) means general reactant.

c) (s) means solid reactant, (g) means gaseous reactant.

d) (s) means standard reactant, (g) means vigorous reactant.

52. When the equation for the decomposition of hydrogen peroxide (H_2O_2) into water (H_2O) and oxygen (O_2) is balanced, what is the ratio of reactant (H_2O_2) to one of its products (O_2)?

a) 1:1

b) 2:1

c) 1:2

d) 2:2

53. Consider the combination reaction between magnesium (Mg) and oxygen (O_2) to form magnesium oxide (MgO). In this reaction:

a) Magnesium oxide is the only reactant.

b) Oxygen is the only product.

c) Magnesium and oxygen are the reactants, and magnesium oxide is the product.

d) Magnesium is the product, and oxygen is the reactant.

54. The decomposition of calcium carbonate (CaCO_3) upon heating produces calcium oxide (CaO) and carbon dioxide (CO_2). What are the products of this decomposition reaction?

- a) CaCO_3 only
- b) CaO and CO_2
- c) CaCO_3 and CO_2
- d) CaO only

55. In the single displacement reaction where zinc (Zn) reacts with copper(II) sulfate (CuSO_4) solution, what are the products formed?

- a) ZnSO_4 and Cu
- b) CuZn and SO_4
- c) ZnS and CuO_4
- d) ZnCuSO_4

56. A common example of a double displacement reaction is the reaction between silver nitrate (AgNO_3) and sodium chloride (NaCl). Which product forms a white precipitate in this reaction?

- a) Sodium nitrate (NaNO_3)
- b) Silver chloride (AgCl)
- c) Sodium silver (NaAg)
- d) Chlorine nitrate (ClNO_3)

57. When an acid reacts with a base in a neutralization reaction, the characteristic products formed are:

- a) Only salt
- b) Only water
- c) Salt and water
- d) Acid and base

58. In the redox reaction: $\text{Fe}_2\text{O}_3(\text{s}) + 3\text{CO}(\text{g}) \rightarrow 2\text{Fe}(\text{s}) + 3\text{CO}_2(\text{g})$, which species is the reduced product?

a) Fe_2O_3

b) CO

c) Fe

d) CO_2

59. If a chemical reaction releases heat energy into the surroundings, it is classified as an exothermic reaction. In such reactions, the energy content of the products is typically:

a) Higher than the energy content of the reactants.

b) Lower than the energy content of the reactants.

c) Equal to the energy content of the reactants.

d) Unrelated to the energy content of the reactants.

60. Rancidity is a process where fats and oils, especially in food, undergo oxidation. The unpleasant smell and taste associated with rancid food are due to the formation of:

a) Simple sugars and proteins.

b) Volatile aldehydes and ketones.

c) Long-chain saturated fatty acids.

d) Inorganic salts and water.

Answers

46. (c)

47. (b)

48. (c)

49. (c)

50. (c)

51. (c)

52. (b)

53. (c)

54. (b)

55. (a)

56. (b)

57. (c)

58. (c)

59. (b)

60. (b)

Topic: State Symbols in Equations

61. Which of the following state symbols correctly represents a substance dissolved in water?

- (a) (l)
- (b) (s)
- (c) (aq)
- (d) (g)

62. Explain the primary reason for including state symbols in a chemical equation.

63. Write the appropriate state symbol for each of the following substances under standard room conditions (25 degrees C, 1 atm):

- (i) Liquid water
- (ii) Oxygen gas
- (iii) Solid sodium chloride
- (iv) Glucose dissolved in water

64. Consider the balanced chemical equation: $\text{AgNO}_3(\text{aq}) + \text{NaCl}(\text{aq}) \rightarrow \text{AgCl}(\text{s}) + \text{NaNO}_3(\text{aq})$. What does the state symbol (s) next to AgCl indicate about the reaction?

- (a) AgCl is a gas
- (b) AgCl is a liquid
- (c) AgCl is a soluble solid
- (d) AgCl is a precipitate

65. Differentiate between the state symbols (l) and (aq) in the context of chemical equations, providing an example for each.

66. A student is balancing the equation for the complete combustion of methane. Methane is a gas, and oxygen is a gas. The products are carbon dioxide gas and liquid water. Write the complete balanced chemical equation for this reaction including all necessary state symbols.

67. In the reaction $\text{Fe}(\text{s}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{FeSO}_4(\text{aq}) + \text{H}_2(\text{g})$, what does the state symbol (g) next to H₂ signify?

(a) Hydrogen is dissolved in water.

(b) Hydrogen is a solid.

(c) Hydrogen is released as a gas.

(d) Hydrogen is in its liquid state.

68. When solid calcium carbonate is heated strongly, it decomposes to form solid calcium oxide and carbon dioxide gas. Write the chemical equation for this reaction, including state symbols.

69. Why is it important for the state symbol of a substance to accurately reflect its physical state under the reaction conditions, rather than just its common state at room temperature?

70. Which of the following equations correctly represents the formation of a precipitate?

(a) $\text{H}_2\text{SO}_4(\text{aq}) + 2\text{NaOH}(\text{aq}) \rightarrow \text{Na}_2\text{SO}_4(\text{aq}) + 2\text{H}_2\text{O}(\text{l})$

(b) $\text{CaCl}_2(\text{aq}) + \text{Na}_2\text{CO}_3(\text{aq}) \rightarrow \text{CaCO}_3(\text{s}) + 2\text{NaCl}(\text{aq})$

(c) $\text{Zn}(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{ZnCl}_2(\text{aq}) + \text{H}_2(\text{g})$

(d) $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g})$

71. State symbols can sometimes provide clues about the type of reaction occurring. Explain how the presence of (s) on the product side of a double displacement reaction equation indicates a specific type of reaction.

72. Identify and correct the error in state symbol usage in the following equation:

$\text{Zn}(\text{aq}) + \text{CuSO}_4(\text{s}) \rightarrow \text{ZnSO}_4(\text{aq}) + \text{Cu}(\text{s})$

73. Discuss how state symbols might be affected or might need to be carefully considered when a reaction is performed at an elevated temperature, for instance, above the boiling point of water.

74. In which of the following scenarios would a reactant's state symbol change from its standard room temperature state due to unusual reaction conditions?

(a) A solid reactant is heated until it melts before reacting.

(b) A gas reactant is bubbled through a liquid solution.

(c) A solid reactant dissolves in water to form an aqueous solution.

(d) A liquid reactant is used as a solvent for another reactant.

75. Barium chloride solution reacts with sodium sulfate solution to form a white precipitate of barium sulfate and a solution of sodium chloride. Write the complete balanced chemical equation for this reaction, including all appropriate state symbols.

Answers

61. (c)

62. To indicate the physical state of reactants and products under reaction conditions, which helps in predicting reaction outcomes, understanding reaction mechanisms, and interpreting observations like precipitation or gas evolution.

63. (i) (l) (ii) (g) (iii) (s) (iv) (aq)

64. (d)

65. (l) denotes a pure substance in its liquid state, e.g., $\text{H}_2\text{O}(\text{l})$ for liquid water. (aq) denotes a substance dissolved in water, forming an aqueous solution, e.g., $\text{NaCl}(\text{aq})$ for sodium chloride dissolved in water.

66. $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l})$

67. (c)

68. $\text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$

69. Because the physical state can significantly influence the reaction pathway, rate, or even whether a reaction occurs. For example, a solid might need to be melted or dissolved to react effectively, or a gas might only react under specific pressure conditions.

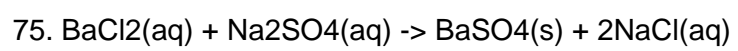
70. (b)

71. The presence of (s) on the product side of a double displacement reaction equation, especially when two aqueous reactants combine, indicates that an insoluble solid, known as a precipitate, has formed. This type of reaction is specifically called a precipitation reaction.

72. Error: Zn is shown as (aq) but zinc is a solid metal. CuSO_4 is shown as (s) but it should be (aq) as it reacts as a solution. Corrected Equation: $\text{Zn}(\text{s}) + \text{CuSO}_4(\text{aq}) \rightarrow \text{ZnSO}_4(\text{aq}) + \text{Cu}(\text{s})$

73. If a reaction is performed at an elevated temperature, especially above the boiling point of water (100 degrees C), water would exist as a gas (steam) rather than a liquid. Similarly, substances that are typically solid or liquid at room temperature might become liquids or gases, respectively, at higher temperatures. State symbols must then reflect these changes (e.g., $\text{H}_2\text{O}(\text{g})$ instead of $\text{H}_2\text{O}(\text{l})$), as the physical state directly impacts the reaction's kinetics and mechanisms.

74. (a)



Topic: Law of Conservation of Mass

Section: Multiple Choice Questions

76. Which of the following statements best describes the Law of Conservation of Mass?

- a) In a chemical reaction, the total mass of the products is always greater than the total mass of the reactants.
- b) Matter can be created or destroyed, but not transformed, during a chemical reaction.
- c) The total mass of the reactants equals the total mass of the products in a closed system.
- d) The mass of an individual atom changes during a chemical reaction.

77. Explain why balancing chemical equations is a direct consequence and application of the Law of Conservation of Mass.

78. A student observes that when a burning candle is placed in an inverted jar, the flame eventually extinguishes, and the mass of the candle decreases. Which statement correctly accounts for this observation in relation to the Law of Conservation of Mass?

- a) The Law of Conservation of Mass is violated because mass is lost as the candle burns.
- b) The decrease in candle mass is due to the physical change of melting wax, not a chemical reaction.
- c) The products of combustion (carbon dioxide and water vapor) have escaped into the atmosphere, so the mass appears to decrease but is conserved in a closed system.
- d) The oxygen inside the jar is converted into heat, thus reducing the total mass.

79. When 24.3 g of magnesium ribbon is burned in air, it combines with oxygen to form 40.3 g of magnesium oxide. Calculate the mass of oxygen that reacted.

80. How does the Law of Conservation of Mass apply to physical changes, such as the melting of ice or the evaporation of water?

81. Consider the characteristics of a chemical reaction where new substances are formed. How does the Law of Conservation of Mass reconcile with the formation of entirely new substances with different properties?

- a) The atoms themselves are destroyed and new ones created, but their total mass remains constant.
- b) The atoms are rearranged, not created or destroyed, ensuring the total mass of atoms before and after the reaction is the same.
- c) The law only applies to the conservation of energy, not mass, in chemical reactions.

d) New substances have entirely different masses than the reactants, which violates the law.

82. In a reaction, 10.0 g of calcium carbonate (CaCO_3) decomposes upon heating to produce 5.6 g of calcium oxide (CaO) and carbon dioxide (CO_2) gas. Calculate the mass of carbon dioxide produced.

83. Describe a simple experiment that could be performed in a school laboratory to demonstrate the Law of Conservation of Mass. Include the necessary apparatus and expected observations.

84. Which statement is TRUE regarding the Law of Conservation of Mass and chemical equations?

a) The number of molecules on the reactant side must always equal the number of molecules on the product side.

b) The sum of the coefficients on the reactant side must equal the sum of the coefficients on the product side.

c) The total number of atoms of each element must be equal on both sides of a chemical equation.

d) The state symbols (s), (l), (g), (aq) must always be included for the law to apply.

85. How does the Law of Conservation of Mass specifically relate to decomposition reactions, where a single reactant breaks down into two or more simpler products?

86. When 100.0 g of lead (II) nitrate solution is mixed with 50.0 g of potassium iodide solution, a yellow precipitate of lead (II) iodide is formed along with potassium nitrate in solution. If 23.0 g of lead (II) iodide precipitate is collected and filtered, and 120.0 g of potassium nitrate solution remains, what is the total mass of the products, and does this align with the Law of Conservation of Mass?

87. Distinguish between an open system and a closed system in the context of verifying the Law of Conservation of Mass during a chemical reaction. Provide an example of a reaction where using an open system might lead to a misleading conclusion about mass conservation.

88. When iron rusts, it combines with oxygen from the air to form iron oxides, and the rusted object appears to gain mass. Which of the following statements correctly explains this phenomenon in relation to the Law of Conservation of Mass?

a) Rusting is a physical change, so mass is not conserved.

b) The oxygen atoms are converted into iron atoms, leading to a mass increase.

c) The mass gain is due to the incorporation of oxygen atoms from the atmosphere into the iron, so the total mass of the iron and oxygen combined remains constant.

d) The Law of Conservation of Mass does not apply to slow chemical reactions like rusting.

89. A student mixes 25.0 mL of 0.5 M hydrochloric acid (HCl) with 25.0 mL of 0.5 M sodium hydroxide (NaOH) in a beaker. The reaction is: $\text{HCl(aq)} + \text{NaOH(aq)} \rightarrow \text{NaCl(aq)} + \text{H}_2\text{O(l)}$. If the initial total mass

of the reactants and the beaker was 150.0 g, what would be the expected total mass of the products and the beaker after the reaction, assuming it occurs in a closed system? Justify your answer.

90. Discuss the significance of the Law of Conservation of Mass in the historical development of chemistry and its role in establishing chemistry as a quantitative science.

Answers

76. (c)

77. Balancing ensures that the number of atoms of each element on the reactant side equals the number of atoms of the same element on the product side, thus demonstrating that matter (mass) is neither created nor destroyed.

78. (c)

79. 16.0 g

80. In physical changes, the total mass of the substance remains constant because the chemical identity of the substance does not change; only its form or state changes, so no atoms are lost or gained.

81. (b)

82. 4.4 g

83. Apparatus: Conical flask, rubber stopper, small test tube, thread, barium chloride solution, sodium sulfate solution, weighing balance. Procedure: Pour barium chloride solution into the flask and sodium sulfate solution into the test tube. Carefully suspend the test tube inside the flask using a thread, ensuring the solutions do not mix. Stopper the flask. Weigh the entire apparatus. Tilt the flask to mix the solutions and observe the precipitation. Weigh the apparatus again. Expected observation: The mass before and after mixing remains the same.

84. (c)

85. The total mass of the simpler products formed must be equal to the mass of the original single reactant that decomposed.

86. Total mass of products = Mass of lead(II) iodide + Mass of potassium nitrate solution = 23.0 g + 120.0 g = 143.0 g. Total mass of reactants = Mass of lead(II) nitrate solution + Mass of potassium iodide solution = 100.0 g + 50.0 g = 150.0 g. This does not align, which implies either the remaining solution mass given (120g) includes the mass of the precipitate that was separated, or it's a trick question where a portion of the potassium nitrate solution was also separated. Assuming the question meant 120.0 g *of only the potassium nitrate solution* was recovered after separation of precipitate: 150.0g (reactants) vs 143.0g (products). This implies some mass was unaccounted for or the numbers are not perfectly balanced for an ideal scenario. A more direct answer considering LCM: The total mass of products (including any gas or solution formed) must equal the total mass of the reactants if no substance escaped. Given 150.0 g of reactants, the total mass of products should also be 150.0 g.

87. An open system allows matter (and energy) to escape or enter, potentially leading to an apparent change in mass during a reaction (e.g., gas escaping or entering). A closed system prevents matter exchange, ensuring that any mass change observed is due to the transformation of substances within the system, thus allowing for verification of mass conservation. Example: Burning magnesium in an open beaker. The mass of the solid product (magnesium oxide) will appear to be greater than the initial mass of magnesium because oxygen from the air (reactant) has been incorporated.

88. (c)

89. The expected total mass of the products and the beaker would remain 150.0 g. This is because the reaction occurs in a closed system, and the Law of Conservation of Mass states that mass is neither created nor destroyed in a chemical reaction; it is merely rearranged. Therefore, the total mass before and after the reaction must be conserved.

90. The Law of Conservation of Mass, primarily formulated by Antoine Lavoisier, shifted chemistry from a qualitative to a quantitative science. Before its acceptance, ideas like phlogiston theory (mass loss during burning) were prevalent. Lavoisier's meticulous experiments demonstrating mass conservation provided a fundamental principle, allowing chemists to accurately predict product masses, balance equations, and understand stoichiometry, thereby laying the groundwork for modern chemical theory and experimentation.

Topic: Balancing Chemical Equations

Section: Multiple Choice Questions

91. The balanced chemical equation for the reaction of hydrogen gas with oxygen gas to form water is:

- (a) $\text{H}_2 + \text{O}_2 \rightarrow \text{H}_2\text{O}$
- (b) $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$
- (c) $\text{H}_2 + 2\text{O}_2 \rightarrow 2\text{H}_2\text{O}$
- (d) $2\text{H}_2 + 2\text{O}_2 \rightarrow 2\text{H}_2\text{O}$

92. According to the Law of Conservation of Mass, a chemical equation must be balanced because:

- (a) It ensures that the number of atoms of each element is the same on both sides of the equation.
- (b) It indicates the physical states of reactants and products.
- (c) It determines the rate of the reaction.
- (d) It specifies whether the reaction is exothermic or endothermic.

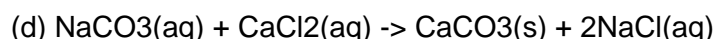
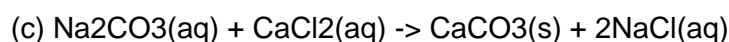
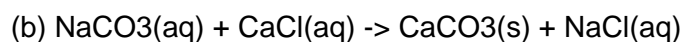
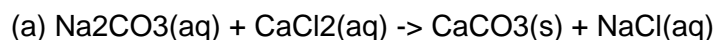
93. When the equation $\text{Fe}_2\text{O}_3(\text{s}) + \text{CO}(\text{g}) \rightarrow \text{Fe}(\text{s}) + \text{CO}_2(\text{g})$ is balanced, the sum of the coefficients of the reactants is:

- (a) 3
- (b) 4
- (c) 5
- (d) 6

94. Which of the following equations is correctly balanced?

- (a) $\text{KClO}_3 \rightarrow \text{KCl} + \text{O}_2$
- (b) $2\text{KClO}_3 \rightarrow 2\text{KCl} + 3\text{O}_2$
- (c) $\text{KClO}_3 \rightarrow \text{KCl} + 3\text{O}_2$
- (d) $2\text{KClO}_3 \rightarrow \text{KCl} + 3\text{O}_2$

95. When aqueous sodium carbonate reacts with aqueous calcium chloride, calcium carbonate precipitate and aqueous sodium chloride are formed. The balanced equation for this reaction is:



96. The balanced equation $2\text{N}_2\text{O}_5(\text{g}) \rightarrow 4\text{NO}_2(\text{g}) + \text{O}_2(\text{g})$ represents which type of chemical reaction?

(a) Combination reaction

(b) Decomposition reaction

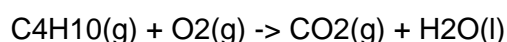
(c) Displacement reaction

(d) Double displacement reaction

General Questions

97. Explain the importance of balancing a chemical equation with reference to the Law of Conservation of Mass.

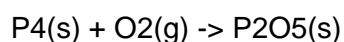
98. Balance the following chemical equation:



99. Balance the following chemical equation:



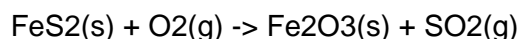
100. Balance the following chemical equation:



101. Balance the following chemical equation, including state symbols:

Aqueous solutions of lead(II) nitrate and potassium iodide react to form solid lead(II) iodide and aqueous potassium nitrate.

102. Balance the following chemical equation:



103. When sodium hydroxide solution is added to iron(III) chloride solution, a precipitate of iron(III) hydroxide and aqueous sodium chloride are formed. Write the balanced chemical equation for this reaction, including state symbols.

104. Consider the unbalanced equation: $\text{NH}_3(\text{g}) + \text{O}_2(\text{g}) \rightarrow \text{NO}(\text{g}) + \text{H}_2\text{O}(\text{g})$. Balance this equation and state the mole ratio of NO produced to O_2 consumed.

105. A student attempted to balance the reaction: $\text{Mg}(\text{s}) + \text{N}_2(\text{g}) \rightarrow \text{Mg}_3\text{N}_2(\text{s})$ and wrote $2\text{Mg} + \text{N}_2 \rightarrow \text{Mg}_3\text{N}_2$. Identify the error in the student's attempt and provide the correct balanced equation.

Answers

91. (b)

92. (a)

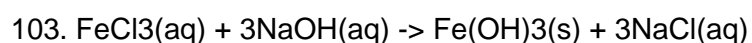
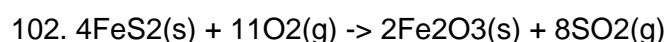
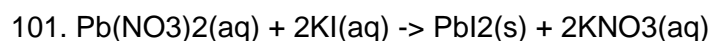
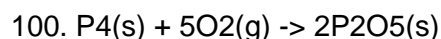
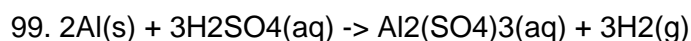
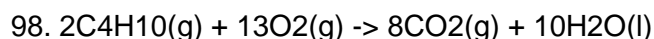
93. (b)

94. (b)

95. (c)

96. (b)

97. Balancing ensures that the number of atoms of each element on the reactant side is equal to the number of atoms of the same element on the product side. This is crucial because the Law of Conservation of Mass states that mass is neither created nor destroyed in a chemical reaction.



104. Balanced equation: $4\text{NH}_3(\text{g}) + 5\text{O}_2(\text{g}) \rightarrow 4\text{NO}(\text{g}) + 6\text{H}_2\text{O}(\text{g})$. The mole ratio of NO produced to O_2 consumed is 4:5.

105. The error is that the student did not balance the magnesium atoms correctly. In Mg_3N_2 , there are 3 magnesium atoms, but the student only placed a coefficient of 2 in front of Mg. The correct balanced equation is: $3\text{Mg(s)} + \text{N}_2\text{(g)} \rightarrow \text{Mg}_3\text{N}_2\text{(s)}$.

Topic: Combination Reactions

Section: Multiple Choice Questions

106. Which of the following best describes a combination reaction?

- (a) A reaction in which a single reactant breaks down to form two or more simpler products.
- (b) A reaction in which two or more reactants combine to form a single product.
- (c) A reaction in which one element replaces another element in a compound.
- (d) A reaction in which two compounds exchange ions to form two new compounds.

107. When magnesium ribbon burns in air, it combines with oxygen to form magnesium oxide. The balanced chemical equation for this reaction is:

- (a) $\text{Mg} + \text{O}_2 \rightarrow \text{MgO}$
- (b) $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$
- (c) $\text{Mg} + 2\text{O} \rightarrow \text{MgO}_2$
- (d) $2\text{Mg} + \text{O} \rightarrow \text{Mg}_2\text{O}$

108. The reaction of quicklime (calcium oxide) with water to form slaked lime (calcium hydroxide) is an example of a combination reaction. What is a prominent characteristic observed during this reaction?

- (a) Formation of a precipitate
- (b) Absorption of heat from the surroundings
- (c) Release of a significant amount of heat
- (d) Production of a gas with effervescence

109. Identify the combination reaction among the following chemical equations:

- (a) $2\text{KClO}_3(\text{s}) \rightarrow 2\text{KCl}(\text{s}) + 3\text{O}_2(\text{g})$
- (b) $\text{Zn}(\text{s}) + \text{CuSO}_4(\text{aq}) \rightarrow \text{ZnSO}_4(\text{aq}) + \text{Cu}(\text{s})$
- (c) $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g})$
- (d) $\text{AgNO}_3(\text{aq}) + \text{NaCl}(\text{aq}) \rightarrow \text{AgCl}(\text{s}) + \text{NaNO}_3(\text{aq})$

110. According to the Law of Conservation of Mass, if 4.0 g of hydrogen gas reacts completely with 32.0 g of oxygen gas to form water, what mass of water is expected to be produced?

- (a) 28.0 g
- (b) 36.0 g
- (c) 32.0 g
- (d) 4.0 g

111. Which of the following compounds can be formed by the combination of two simpler compounds?

- (a) H₂O
- (b) NH₄Cl
- (c) CO₂
- (d) NaCl

112. When iron filings are mixed with sulfur powder and heated, a black solid is formed. This is a combination reaction. What type of energy change is typically associated with such a reaction that forms a stable product?

- (a) Endothermic, requiring continuous heat input.
- (b) Exothermic, releasing heat.
- (c) Neither endothermic nor exothermic.
- (d) Depends on the amount of catalyst used.

113. In the reaction $2\text{Na(s)} + \text{Cl}_2\text{(g)} \rightarrow 2\text{NaCl(s)}$, which of the following statements is correct regarding the oxidation states?

- (a) Sodium is oxidized from +1 to 0.
- (b) Chlorine is reduced from 0 to -1.
- (c) Both sodium and chlorine are oxidized.
- (d) This is not a redox reaction.

114. How does a combination reaction fundamentally differ from a decomposition reaction?

- (a) Combination reactions involve heat absorption, while decomposition reactions release heat.
- (b) Combination reactions result in a single product from multiple reactants, while decomposition reactions involve a single reactant breaking into multiple products.
- (c) Combination reactions always produce a gas, while decomposition reactions always produce a solid.
- (d) Combination reactions are always reversible, while decomposition reactions are always irreversible.

115. Predict the product when carbon (C) burns completely in excess oxygen (O₂).

- (a) CO
- (b) C₂O₃
- (c) CO₂
- (d) C₃O₂

116. When sulfur dioxide gas (SO₂) reacts with oxygen gas (O₂) in the presence of a catalyst, sulfur trioxide (SO₃) is formed. This reaction represents:

- (a) An element combining with a compound.
- (b) Two compounds combining.
- (c) Two elements combining.
- (d) A compound decomposing.

117. What are the correct stoichiometric coefficients for the reactants to balance the following combination reaction: $\text{Al} + \text{O}_2 \rightarrow \text{Al}_2\text{O}_3$?

- (a) 2, 3
- (b) 4, 3
- (c) 3, 2
- (d) 1, 1

118. Which of the following is NOT an example of a combination reaction?

- (a) Burning of coal: $\text{C(s)} + \text{O}_2\text{(g)} \rightarrow \text{CO}_2\text{(g)}$

(b) Formation of water: $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{l})$

(c) Rusting of iron: $4\text{Fe}(\text{s}) + 3\text{O}_2(\text{g}) \rightarrow 2\text{Fe}_2\text{O}_3(\text{s})$

(d) Heating of lead nitrate: $2\text{Pb}(\text{NO}_3)_2(\text{s}) \rightarrow 2\text{PbO}(\text{s}) + 4\text{NO}_2(\text{g}) + \text{O}_2(\text{g})$

119. The process of making cement clinker involves the combination of various raw materials like limestone and clay at high temperatures. Which of the following describes the overall nature of such a reaction where complex compounds are formed from simpler ones?

(a) Double displacement

(b) Precipitation

(c) Combination

(d) Neutralization

120. Consider the combination reaction: $\text{A} + \text{B} \rightarrow \text{AB}$. If this reaction is highly exothermic, what does this imply about the stability of the product AB compared to the reactants A and B?

(a) AB is less stable than A and B, as energy is released.

(b) AB is more stable than A and B, as energy is released.

(c) The stability of AB is independent of the energy released.

(d) The reaction is likely to be reversible, favoring the reactants.

Answers

106. (b)

107. (b)

108. (c)

109. (c)

110. (b)

111. (b)

112. (b)

113. (b)

114. (b)

115. (c)

116. (a)

117. (b)

118. (d)

119. (c)

120. (b)

Topic: Decomposition Reactions

121. Which statement best describes a decomposition reaction?

- a) Two or more reactants combine to form a single product.
- b) A single reactant breaks down to form two or more simpler products.
- c) An element replaces another element in a compound.
- d) Two compounds exchange ions to form new compounds.

122. Decomposition reactions are typically:

- a) Exothermic, releasing heat.
- b) Endothermic, absorbing heat or energy.
- c) Neither exothermic nor endothermic.
- d) Initiated by light only.

123. When calcium carbonate is heated strongly, it decomposes to form calcium oxide and carbon dioxide. This process is an example of:

- a) Electrolytic decomposition.
- b) Photolytic decomposition.
- c) Thermal decomposition.
- d) Combination reaction.

124. The decomposition of water into hydrogen and oxygen gas by passing an electric current through it is known as:

- a) Photolysis.
- b) Thermolysis.
- c) Electrolysis.
- d) Displacement.

125. Silver chloride decomposes into silver metal and chlorine gas when exposed to sunlight. This type of decomposition reaction is used in:

- a) Electroplating.
- b) Black and white photography.
- c) Combustion.
- d) Neutralization reactions.

126. Consider the balanced chemical equation for the decomposition of potassium chlorate (KClO_3) to potassium chloride (KCl) and oxygen gas (O_2). What are the coefficients for KClO_3 , KCl , and O_2 respectively?

- a) 1, 1, 3
- b) 2, 2, 3
- c) 2, 2, 6
- d) 2, 1, 3

127. When ferrous sulfate (FeSO_4) crystals are heated, they decompose to produce ferric oxide (Fe_2O_3), sulfur dioxide (SO_2), and sulfur trioxide (SO_3). This reaction exhibits:

- a) Formation of two gaseous products and one solid product.
- b) A change in the oxidation state of iron from +2 to +3.
- c) An exothermic process.
- d) Both a and b.

128. Which of the following is NOT a characteristic feature of decomposition reactions?

- a) A single compound breaks down.
- b) Energy is usually required to break bonds.
- c) Multiple products are formed from one reactant.
- d) Two reactants combine to form a single product.

129. During the thermal decomposition of lead nitrate ($\text{Pb}(\text{NO}_3)_2$), a brown gas is evolved. This brown gas is:

- a) Nitrogen gas (N₂).
- b) Nitric oxide (NO).
- c) Nitrogen dioxide (NO₂).
- d) Dinitrogen tetroxide (N₂O₄).

130. A substance 'X' undergoes decomposition when heated to form a solid 'Y' and a gas 'Z'. If 'Z' relights a glowing splint, then 'X' could be:

- a) Calcium carbonate.
- b) Potassium chlorate.
- c) Hydrogen peroxide.
- d) Silver bromide.

131. If 100 g of calcium carbonate (CaCO₃) completely decomposes according to the equation $\text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$, what is the approximate mass of carbon dioxide gas produced? (Atomic masses: Ca=40, C=12, O=16)

- a) 44 g
- b) 56 g
- c) 100 g
- d) 22 g

132. Which of the following reactions is NOT an example of a decomposition reaction?

- a) $2\text{H}_2\text{O}(\text{l}) \rightarrow 2\text{H}_2(\text{g}) + \text{O}_2(\text{g})$
- b) $\text{C}_6\text{H}_{12}\text{O}_6(\text{s}) \rightarrow 6\text{C}(\text{s}) + 6\text{H}_2\text{O}(\text{g})$
- c) $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}(\text{s}) \rightarrow \text{CuSO}_4(\text{s}) + 5\text{H}_2\text{O}(\text{g})$
- d) $\text{Fe}(\text{s}) + \text{CuSO}_4(\text{aq}) \rightarrow \text{FeSO}_4(\text{aq}) + \text{Cu}(\text{s})$

133. The decomposition of hydrogen peroxide (H₂O₂) into water and oxygen can be accelerated by adding manganese dioxide (MnO₂). In this reaction, MnO₂ acts as a:

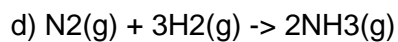
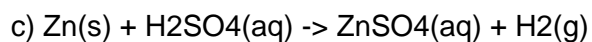
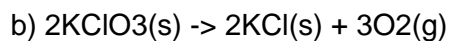
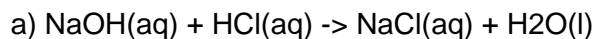
- a) Reactant.

b) Product.

c) Catalyst.

d) Inhibitor.

134. Identify the decomposition reaction among the following:



135. Which factor is most crucial in determining whether a compound will undergo thermal decomposition at a specific temperature?

a) The concentration of the reactant.

b) The strength of the chemical bonds within the compound.

c) The presence of a catalyst.

d) The pressure of the surroundings.

Answers

121. (b)

122. (b)

123. (c)

124. (c)

125. (b)

126. (b)

127. (d)

128. (d)

129. (c)

130. (b)

131. (a)

132. (d)

133. (c)

134. (b)

135. (b)

Topic: Displacement Reactions

Section: Multiple Choice Questions

136. Which of the following reactions is an example of a displacement reaction?

- (a) $\text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$
- (b) $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{l})$
- (c) $\text{Mg}(\text{s}) + \text{CuSO}_4(\text{aq}) \rightarrow \text{MgSO}_4(\text{aq}) + \text{Cu}(\text{s})$
- (d) $\text{NaCl}(\text{aq}) + \text{AgNO}_3(\text{aq}) \rightarrow \text{AgCl}(\text{s}) + \text{NaNO}_3(\text{aq})$

137. Which of the following metals will NOT displace hydrogen from dilute hydrochloric acid?

- (a) Zinc
- (b) Magnesium
- (c) Copper
- (d) Iron

138. When iron filings are added to a copper sulfate solution, the correct balanced chemical equation for the reaction that occurs is:

- (a) $\text{Fe}(\text{s}) + \text{CuSO}_4(\text{aq}) \rightarrow \text{FeSO}_4(\text{aq}) + \text{Cu}(\text{s})$
- (b) $2\text{Fe}(\text{s}) + 3\text{CuSO}_4(\text{aq}) \rightarrow \text{Fe}_2(\text{SO}_4)_3(\text{aq}) + 3\text{Cu}(\text{s})$
- (c) $\text{Fe}(\text{s}) + \text{CuS}(\text{aq}) \rightarrow \text{FeS}(\text{aq}) + \text{Cu}(\text{s})$
- (d) $\text{Fe}(\text{s}) + \text{CuSO}_4(\text{aq}) \rightarrow \text{FeCu}(\text{s}) + \text{SO}_4(\text{aq})$

139. Chlorine gas is bubbled through a solution of potassium iodide. Which of the following observations is expected?

- (a) Formation of a white precipitate
- (b) Solution turns brown
- (c) Evolution of a pungent gas
- (d) No visible change

140. Consider the reaction: $\text{Zn(s)} + \text{Pb(NO}_3)_2(\text{aq}) \rightarrow \text{Zn(NO}_3)_2(\text{aq}) + \text{Pb(s)}$. In this reaction, the species that is oxidized is:

- (a) Zn(s)
- (b) $\text{Pb(NO}_3)_2(\text{aq})$
- (c) $\text{Zn(NO}_3)_2(\text{aq})$
- (d) Pb(s)

141. A metal X can displace metal Y from its salt solution, but cannot displace metal Z from its salt solution. The order of reactivity of these metals from most reactive to least reactive is:

- (a) $X > Y > Z$
- (b) $Z > X > Y$
- (c) $Y > X > Z$
- (d) $Z > Y > X$

142. Which of the following statements is TRUE regarding a displacement reaction?

- (a) A less reactive element displaces a more reactive element from its compound.
- (b) The reacting species must always be in aqueous solution.
- (c) It is a type of redox reaction where oxidation and reduction occur simultaneously.
- (d) Two different compounds react to form two new compounds.

143. Which of the following reactions, involving magnesium, is an example of a displacement reaction?

- (a) $2\text{Mg(s)} + \text{O}_2(\text{g}) \rightarrow 2\text{MgO(s)}$
- (b) $\text{MgO(s)} + 2\text{HCl(aq)} \rightarrow \text{MgCl}_2(\text{aq}) + \text{H}_2\text{O(l)}$
- (c) $\text{Mg(s)} + 2\text{HCl(aq)} \rightarrow \text{MgCl}_2(\text{aq}) + \text{H}_2(\text{g})$
- (d) $\text{MgCl}_2(\text{aq}) + 2\text{NaOH(aq)} \rightarrow \text{Mg(OH)}_2(\text{s}) + 2\text{NaCl(aq)}$

144. Which of the following reactions involves the displacement of hydrogen by a metal from water?

- (a) $2\text{Na(s)} + 2\text{H}_2\text{O(l)} \rightarrow 2\text{NaOH(aq)} + \text{H}_2\text{(g)}$
- (b) $\text{Mg(s)} + 2\text{HCl(aq)} \rightarrow \text{MgCl}_2\text{(aq)} + \text{H}_2\text{(g)}$
- (c) $2\text{Al(s)} + 6\text{H}_2\text{O(l)} \rightarrow 2\text{Al(OH)}_3\text{(s)} + 3\text{H}_2\text{(g)}$ (steam)
- (d) Both (a) and (c)

145. When a strip of copper is placed in a solution of silver nitrate, a reaction occurs. What are the products of this reaction?

- (a) CuNO_3 and Ag
- (b) $\text{Cu(NO}_3)_2$ and Ag
- (c) CuNO_3 and AgNO_3
- (d) No reaction occurs

146. Four metals W, X, Y, and Z are tested for their reactivity.

- X displaces Y from its salt solution.
- W displaces X from its salt solution.
- Y displaces Z from its salt solution.

What is the correct order of reactivity from most to least reactive?

- (a) $W > X > Y > Z$
- (b) $X > W > Y > Z$
- (c) $W > Y > X > Z$
- (d) $Z > Y > X > W$

147. A student wants to store a solution of copper sulfate. Which of the following containers would be most suitable to prevent any reaction?

- (a) Zinc container
- (b) Iron container
- (c) Aluminium container

(d) Glass container

148. In the displacement reaction, $A + BX \rightarrow AX + B$, for the reaction to proceed spontaneously, which condition must generally be met?

(a) A must be less reactive than B.

(b) AX must be more soluble than BX.

(c) A must be more reactive than B.

(d) B must be a non-metal.

149. Which of the following halogens will displace bromine from an aqueous solution of potassium bromide?

(a) Iodine

(b) Chlorine

(c) Fluorine

(d) Both (b) and (c)

150. Which of the following statements about state symbols in displacement reactions is incorrect?

(a) The displacing metal is usually in solid state (s).

(b) The displaced metal often forms a solid precipitate (s).

(c) The salt solutions are typically in aqueous state (aq).

(d) Hydrogen displaced from acids is always in liquid state (l).

Answers

136. (c)

137. (c)

138. (a)

139. (b)

140. (a)

141. (b)

142. (c)

143. (c)

144. (d)

145. (b)

146. (a)

147. (d)

148. (c)

149. (d)

150. (d)

Topic: Double Displacement Reactions

Section: Multiple Choice Questions

151. Which of the following balanced chemical equations represents a double displacement reaction?

- a) $2\text{Mg(s)} + \text{O}_2\text{(g)} \rightarrow 2\text{MgO(s)}$
- b) $\text{AgNO}_3\text{(aq)} + \text{NaCl(aq)} \rightarrow \text{AgCl(s)} + \text{NaNO}_3\text{(aq)}$
- c) $\text{Zn(s)} + \text{CuSO}_4\text{(aq)} \rightarrow \text{ZnSO}_4\text{(aq)} + \text{Cu(s)}$
- d) $\text{CaCO}_3\text{(s)} \rightarrow \text{CaO(s)} + \text{CO}_2\text{(g)}$

152. In a typical double displacement reaction, what is often the visible evidence that a chemical change has occurred, especially in precipitation reactions?

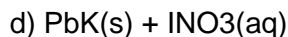
- a) Change in temperature (exothermic or endothermic)
- b) Formation of a new solid (precipitate)
- c) Release of light energy
- d) Increase in volume of the solution

153. When an acid reacts with an active metal carbonate, a double displacement reaction occurs, which typically results in the evolution of a gas. Which gas is commonly produced in such a reaction?

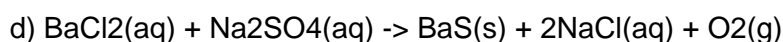
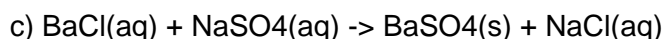
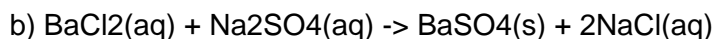
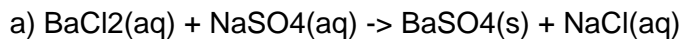
- a) Hydrogen gas
- b) Oxygen gas
- c) Carbon dioxide gas
- d) Nitrogen gas

154. Predict the products of the double displacement reaction between aqueous lead(II) nitrate ($\text{Pb(NO}_3)_2$) and aqueous potassium iodide (KI).

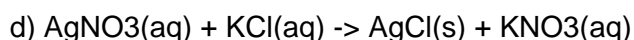
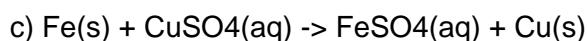
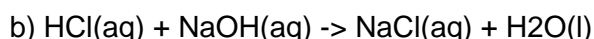
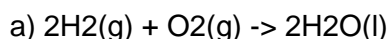
- a) $\text{PbI(s)} + \text{KNO}_3\text{(aq)}$
- b) $\text{PbI}_2\text{(s)} + \text{KNO}_3\text{(aq)}$
- c) $\text{Pb(NO}_3)_2\text{(s)} + \text{K}_2\text{I(aq)}$



155. When aqueous barium chloride reacts with aqueous sodium sulfate, a white precipitate is formed. Which balanced chemical equation correctly represents this reaction, including state symbols?



156. Which of the following reactions is an example of a neutralization reaction, which is a specific type of double displacement reaction?



157. In the double displacement reaction between aqueous silver nitrate (AgNO3) and aqueous sodium chloride (NaCl), which product is the insoluble precipitate?

a) Sodium nitrate

b) Silver chloride

c) Silver nitrate

d) Sodium chloride

158. A student mixes two aqueous solutions, and a yellow precipitate is immediately observed. If one of the solutions was aqueous lead(II) nitrate, which of the following could have been the other solution?

a) Potassium nitrate

b) Sodium chloride

c) Potassium iodide

d) Calcium bromide

159. The removal of calcium ions, which cause hardness in water, by adding sodium carbonate is an example of a double displacement reaction. What is the precipitate formed in this process?

- a) Sodium carbonate
- b) Calcium carbonate
- c) Sodium hydroxide
- d) Calcium hydroxide

160. What is the net ionic equation for the neutralization reaction between aqueous nitric acid (HNO₃) and aqueous potassium hydroxide (KOH)?

- a) $\text{HNO}_3(\text{aq}) + \text{KOH}(\text{aq}) \rightarrow \text{KNO}_3(\text{aq}) + \text{H}_2\text{O}(\text{l})$
- b) $\text{H}^+(\text{aq}) + \text{NO}_3^-(\text{aq}) + \text{K}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{K}^+(\text{aq}) + \text{NO}_3^-(\text{aq}) + \text{H}_2\text{O}(\text{l})$
- c) $\text{H}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l})$
- d) $\text{K}^+(\text{aq}) + \text{NO}_3^-(\text{aq}) \rightarrow \text{KNO}_3(\text{aq})$

161. In the reaction between aqueous copper(II) sulfate and aqueous sodium hydroxide, which results in the formation of copper(II) hydroxide precipitate and aqueous sodium sulfate, what are the spectator ions?

- a) Cu^{2+} and SO_4^{2-}
- b) Na^+ and OH^-
- c) SO_4^{2-} and Na^+
- d) Cu^{2+} and OH^-

162. How does a double displacement reaction fundamentally differ from a single displacement reaction?

- a) Double displacement involves the exchange of ions, while single displacement involves one element replacing another.
- b) Double displacement always forms a precipitate, while single displacement always forms a gas.
- c) Double displacement requires a catalyst, while single displacement does not.
- d) Double displacement releases energy, while single displacement absorbs energy.

163. For a double displacement reaction to occur and be observable, at least one of the products must typically be:

- a) A strong acid
- b) A strong base
- c) Insoluble (precipitate), a gas, or a covalent molecule like water
- d) An element in its standard state

164. When aqueous solutions of potassium carbonate (K_2CO_3) and nitric acid (HNO_3) are mixed, a double displacement reaction occurs. Which statement about the products formed is correct?

- a) Potassium nitrate, water, and oxygen gas are formed.
- b) Potassium nitrate and carbon dioxide gas are formed.
- c) Potassium nitrate, water, and carbon dioxide gas are formed.
- d) Potassium carbonate and nitric acid remain unreacted, as no reaction occurs.

165. A double displacement reaction that produces water and a salt from an acid and a base is specifically classified as which type of reaction?

- a) Precipitation reaction
- b) Decomposition reaction
- c) Neutralization reaction
- d) Redox reaction

Answers

151. (b)

152. (b)

153. (c)

154. (b)

155. (b)

156. (b)

157. (b)

158. (c)

159. (b)

160. (c)

161. (c)

162. (a)

163. (c)

164. (c)

165. (c)

Topic: Precipitation Reactions

Section: Multiple Choice Questions

166. Which of the following is a characteristic observation that indicates a precipitation reaction has occurred?

- (a) The solution becomes warm.
- (b) A gas is produced and bubbles are seen.
- (c) A solid separates from the solution.
- (d) The color of the solution changes from clear to dark.

167. Which of the following ionic compounds is most likely to form a precipitate when mixed with an aqueous solution containing chloride ions?

- (a) Sodium nitrate
- (b) Potassium sulfate
- (c) Silver(I) nitrate
- (d) Ammonium bromide

168. When aqueous solutions of barium chloride (BaCl_2) and sodium sulfate (Na_2SO_4) are mixed, a precipitate is formed. What is the chemical formula of this precipitate?

- (a) NaCl
- (b) BaSO_4
- (c) BaCl_2
- (d) Na_2SO_4

169. Consider the reaction: $\text{Pb}(\text{NO}_3)_2(\text{aq}) + 2\text{KI}(\text{aq}) \rightarrow \text{PbI}_2(\text{s}) + 2\text{KNO}_3(\text{aq})$. Which of the following statements is true about this reaction?

- (a) It is a combination reaction.
- (b) Potassium nitrate is the precipitate.
- (c) Lead(II) iodide is the insoluble product.

(d) It is a neutralization reaction.

170. In the precipitation reaction between aqueous silver nitrate and aqueous sodium chloride, what are the spectator ions?

(a) Ag^+ and Cl^-

(b) Na^+ and NO_3^-

(c) Ag^+ and Na^+

(d) Cl^- and NO_3^-

171. Which of the following combinations of aqueous solutions will most likely produce a precipitate?

(a) Sodium nitrate and potassium chloride

(b) Ammonium chloride and lithium nitrate

(c) Barium chloride and sodium carbonate

(d) Nitric acid and potassium hydroxide

172. A precipitation reaction is a specific type of double displacement reaction where:

(a) A gas is evolved and escapes from the solution.

(b) Two soluble ionic compounds react to form one or more insoluble products.

(c) Heat is absorbed from the surroundings.

(d) An acid and a base react to form salt and water.

173. The primary driving force for the formation of a precipitate in an aqueous solution is typically:

(a) The formation of a gaseous product.

(b) The formation of water molecules.

(c) The insolubility of one of the product compounds.

(d) A significant temperature change in the reaction mixture.

174. In a balanced chemical equation for a precipitation reaction, what state symbol is commonly used to denote the precipitate?

- (a) (aq)
- (b) (g)
- (c) (l)
- (d) (s)

175. According to the Law of Conservation of Mass, when aqueous solutions of two different salts react to form a precipitate, the total mass of the products (precipitate + soluble product) will be:

- (a) Less than the total mass of the reactants.
- (b) Greater than the total mass of the reactants.
- (c) Exactly equal to the total mass of the reactants.
- (d) Unpredictable and depends on the specific reaction.

176. Hard water often contains dissolved calcium ions (Ca^{2+}). When soap is used in hard water, it reacts with Ca^{2+} ions to form an insoluble solid, causing "soap scum." This process is an example of a:

- (a) Neutralization reaction.
- (b) Combustion reaction.
- (c) Precipitation reaction.
- (d) Redox reaction.

177. Which of the following reactions is NOT a precipitation reaction?

- (a) $\text{AgNO}_3(\text{aq}) + \text{NaCl}(\text{aq}) \rightarrow \text{AgCl}(\text{s}) + \text{NaNO}_3(\text{aq})$
- (b) $\text{K}_2\text{CO}_3(\text{aq}) + \text{CaCl}_2(\text{aq}) \rightarrow \text{CaCO}_3(\text{s}) + 2\text{KCl}(\text{aq})$
- (c) $\text{NaOH}(\text{aq}) + \text{HCl}(\text{aq}) \rightarrow \text{NaCl}(\text{aq}) + \text{H}_2\text{O}(\text{l})$
- (d) $\text{FeSO}_4(\text{aq}) + 2\text{NaOH}(\text{aq}) \rightarrow \text{Fe}(\text{OH})_2(\text{s}) + \text{Na}_2\text{SO}_4(\text{aq})$

178. When aqueous solutions of iron(III) chloride (FeCl_3) and sodium hydroxide (NaOH) are mixed, the precipitate formed is:

- (a) FeCl_3
- (b) NaCl
- (c) $\text{Fe}(\text{OH})_3$
- (d) NaOH

179. An unknown solution contains either BaCl_2 or FeCl_3 . When a few drops of aqueous sodium sulfate are added, a white precipitate forms. If sodium hydroxide solution is then added to the remaining solution, no further precipitate forms. Which compound was originally in the unknown solution?

- (a) BaCl_2
- (b) FeCl_3
- (c) Both BaCl_2 and FeCl_3
- (d) Neither BaCl_2 nor FeCl_3

180. A student mixes equal volumes of 0.1 M solutions of $\text{Pb}(\text{NO}_3)_2$ and KCl . Which of the following observations is expected?

- (a) No reaction occurs.
- (b) A white precipitate forms.
- (c) A colorless solution results.
- (d) A gas is evolved.

Answers

- 166. (c)
- 167. (c)
- 168. (b)
- 169. (c)
- 170. (b)
- 171. (c)

172. (b)

173. (c)

174. (d)

175. (c)

176. (c)

177. (c)

178. (c)

179. (a)

180. (b)

Topic: Neutralization Reactions

181. Which of the following is a product of a typical neutralization reaction?

- (a) Carbon dioxide
- (b) Salt and water
- (c) Hydrogen gas
- (d) Oxygen gas

182. The reaction between a strong acid and a strong base is generally:

- (a) Endothermic
- (b) Exothermic
- (c) Neither exothermic nor endothermic
- (d) Reversible

183. What is the pH of the solution formed when a strong acid completely neutralizes a strong base?

- (a) Less than 7
- (b) Equal to 7
- (c) Greater than 7
- (d) Depends on the specific acid and base

184. Which of the following statements is true about the spectator ions in the neutralization reaction between HCl and NaOH?

- (a) H^+ and OH^- are spectator ions.
- (b) Na^+ and Cl^- are spectator ions.
- (c) H^+ and Cl^- are spectator ions.
- (d) Na^+ and OH^- are spectator ions.

185. Define neutralization reaction and state its general word equation.

186. Write a balanced chemical equation for the neutralization reaction between acetic acid (CH_3COOH) and potassium hydroxide (KOH). Include state symbols.
187. Explain why neutralization reactions are often classified as a specific type of double displacement reaction.
188. A farmer observes that the soil in his field is too acidic. What common substance could he add to neutralize the soil, and why is this an example of a neutralization reaction?
189. When phenolphthalein indicator is added to an acidic solution, it remains colorless. Describe the color change observed if a base is slowly added to this acidic solution until neutralization occurs.
190. What is the net ionic equation for the neutralization reaction between any strong acid and any strong base?
191. Complete and balance the following equation, including state symbols:
- $$\text{Al}(\text{OH})_3(\text{s}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow$$
192. During a neutralization titration, if a strong acid is completely neutralized by a strong base, what will be the pH of the resulting solution? Explain your answer.
193. Give two practical applications of neutralization reactions in daily life or industry, other than antacids.
194. Differentiate between a neutralization reaction and a precipitation reaction, considering reactants and products.
195. A student observes that when a certain acid is mixed with a certain base, the test tube feels warm to the touch. What term describes this type of reaction in terms of energy change, and why is this often the case for neutralization reactions?

Answers

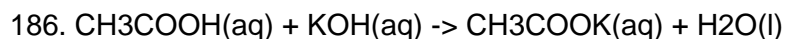
181. (b)

182. (b)

183. (b)

184. (b)

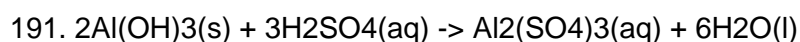
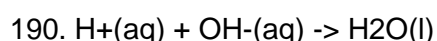
185. A neutralization reaction is a chemical reaction in which an acid and a base react quantitatively with each other to form a salt and water.



187. Neutralization reactions involve the exchange of ions between the acid and the base. The hydrogen ion (H^+) from the acid combines with the hydroxide ion (OH^-) from the base to form water, while the remaining cation from the base and anion from the acid combine to form a salt. This pattern of ion exchange between two compounds to form two new compounds is characteristic of a double displacement reaction.

188. He could add slaked lime (calcium hydroxide, $\text{Ca}(\text{OH})_2$) or quicklime (calcium oxide, CaO). This is a neutralization reaction because the basic calcium hydroxide or calcium oxide reacts with the acidic components in the soil to form a salt and water, thereby increasing the soil pH.

189. It will turn pink.



192. The pH of the resulting solution will be equal to 7. This is because the salt formed from a strong acid and a strong base (e.g., NaCl , K_2SO_4) does not hydrolyze in water, meaning it does not produce excess H^+ or OH^- ions, leaving the solution neutral.

193. 1. Toothpaste: Contains mild bases (e.g., sodium bicarbonate) to neutralize acids produced by bacteria in the mouth, preventing tooth decay.

2. Treatment of industrial wastewater: Acidic or basic effluents are neutralized before discharge to prevent environmental damage.

194. Neutralization reaction: Reactants are typically an acid and a base, and the products are a salt and water. There is typically no precipitate formed, as the products are often soluble or water itself.

195. This describes an exothermic reaction. Neutralization reactions are typically exothermic because the formation of stable covalent bonds in water (H_2O) from the H^+ and OH^- ions releases a significant amount of energy, which is generally greater than the energy required to break the bonds in the original acid and base.

Topic: Oxidation and Reduction (Redox) Reactions

Section: Multiple Choice Questions

196. Which of the following processes involves the gain of oxygen?

- (a) Reduction
- (b) Oxidation
- (c) Neutralization
- (d) Displacement

197. In the reaction $\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$, which substance is oxidized?

- (a) Fe_2O_3
- (b) CO
- (c) Fe
- (d) CO_2

198. An oxidizing agent is a substance that:

- (a) undergoes oxidation.
- (b) causes reduction of another substance.
- (c) gains hydrogen.
- (d) loses electrons.

199. What is the oxidation state of sulfur in H_2SO_4 ?

- (a) +2
- (b) +4
- (c) +6
- (d) +8

200. The process of corrosion, such as rusting of iron, is an example of:

- (a) Decomposition reaction
- (b) Double displacement reaction
- (c) Redox reaction
- (d) Neutralization reaction

201. Which of the following is a reducing agent?

- (a) O_2
- (b) F_2
- (c) Na
- (d) Cl_2

202. When an atom loses electrons, it is said to be:

- (a) Reduced
- (b) Oxidized
- (c) Neutralized
- (d) Precipitated

203. In the reaction $2H_2S + SO_2 \rightarrow 3S + 2H_2O$, which substance acts as the oxidizing agent?

- (a) H_2S
- (b) SO_2
- (c) S
- (d) H_2O

204. Rancidity in food items is primarily caused by:

- (a) Hydrolysis of fats and oils
- (b) Oxidation of fats and oils

(c) Reduction of fats and oils

(d) Polymerization of fats and oils

205. Consider the reaction: $\text{Zn(s)} + \text{CuSO}_4\text{(aq)} \rightarrow \text{ZnSO}_4\text{(aq)} + \text{Cu(s)}$. In this reaction, copper undergoes:

(a) Oxidation

(b) Reduction

(c) Neither oxidation nor reduction

(d) Both oxidation and reduction

206. What is the change in oxidation state of chromium in the following reaction: $\text{Cr}_2\text{O}_7^{2-} \rightarrow \text{Cr}^{3+}$?

(a) From +6 to +3 (reduction)

(b) From +3 to +6 (oxidation)

(c) From +7 to +3 (reduction)

(d) From +6 to +3 (oxidation)

207. Which of the following statements is true for a redox reaction?

(a) Oxidation and reduction always occur simultaneously.

(b) Oxidation always precedes reduction.

(c) Only oxidation occurs.

(d) Only reduction occurs.

208. When hydrogen is added to a substance, it is considered:

(a) Oxidation

(b) Reduction

(c) Hydrolysis

(d) Dehydrogenation

209. In the reaction $\text{MnO}_2 + 4\text{HCl} \rightarrow \text{MnCl}_2 + \text{Cl}_2 + 2\text{H}_2\text{O}$, which element is oxidized?

(a) Mn

(b) O

(c) H

(d) Cl

210. Which of the following reactions is NOT a redox reaction?

(a) $\text{C(s)} + \text{O}_2\text{(g)} \rightarrow \text{CO}_2\text{(g)}$

(b) $\text{AgNO}_3\text{(aq)} + \text{NaCl(aq)} \rightarrow \text{AgCl(s)} + \text{NaNO}_3\text{(aq)}$

(c) $2\text{KClO}_3\text{(s)} \rightarrow 2\text{KCl(s)} + 3\text{O}_2\text{(g)}$

(d) $2\text{Na(s)} + \text{Cl}_2\text{(g)} \rightarrow 2\text{NaCl(s)}$

Answers

196. (b)

197. (b)

198. (b)

199. (c)

200. (c)

201. (c)

202. (b)

203. (b)

204. (b)

205. (b)

206. (a)

207. (a)

208. (b)

209. (d)

210. (b)

Topic: Exothermic and Endothermic Reactions

211. Which of the following best describes an exothermic reaction?

- a) A reaction that absorbs heat from its surroundings.
- b) A reaction that releases heat to its surroundings.
- c) A reaction that requires continuous heat input to proceed.
- d) A reaction that results in a decrease in temperature of the system.

212. An endothermic reaction is characterized by:

- a) A net release of energy in the form of heat.
- b) A net absorption of energy from the surroundings.
- c) An increase in the temperature of the reaction mixture.
- d) The formation of stronger bonds than the bonds broken.

213. Which of these common processes is an example of an exothermic change?

- a) Melting of ice.
- b) Photosynthesis in plants.
- c) Burning of natural gas.
- d) Evaporation of water.

214. Which of the following processes is primarily endothermic?

- a) Respiration in living organisms.
- b) The setting of concrete.
- c) The decomposition of calcium carbonate.
- d) The combustion of magnesium ribbon.

215. When an exothermic reaction occurs in a sealed container, what typically happens to the temperature of the container and its contents?

- a) The temperature decreases because energy is absorbed.
- b) The temperature increases because energy is released.
- c) The temperature remains constant because energy is conserved.
- d) The temperature fluctuates unpredictably.

216. A student observes that when two chemicals are mixed, the temperature of the mixture drops significantly. This observation indicates that the reaction is:

- a) Exothermic, as heat is being released.
- b) Endothermic, as heat is being absorbed.
- c) Neutral, as there is no change in energy.
- d) A physical change, not a chemical reaction.

217. In a chemical equation, how is the heat released in an exothermic reaction typically represented?

- a) As a reactant on the left side of the equation.
- b) As a product on the right side of the equation.
- c) As a catalyst above the arrow.
- d) As a negative sign next to the arrow.

218. For a chemical reaction, the enthalpy change (ΔH) is given as -500 kJ/mol . This indicates that the reaction is:

- a) Endothermic, absorbing 500 kJ/mol of energy.
- b) Exothermic, releasing 500 kJ/mol of energy.
- c) A decomposition reaction, requiring 500 kJ/mol of energy.
- d) A reversible reaction, with no net energy change.

219. If a reaction has a positive enthalpy change ($\Delta H > 0$), it signifies that the reaction:

- a) Releases energy to the surroundings.

- b) Is spontaneous at all temperatures.
- c) Absorbs energy from the surroundings.
- d) Is always a combustion reaction.

220. In an endothermic reaction, the energy required to break bonds in the reactants is:

- a) Less than the energy released when new bonds form in the products.
- b) Equal to the energy released when new bonds form in the products.
- c) Greater than the energy released when new bonds form in the products.
- d) Independent of the energy released from bond formation.

221. A disposable cold pack used for first aid typically contains ammonium nitrate and water. When these are mixed, the pack becomes cold. This indicates that the reaction is:

- a) Exothermic, due to the release of heat.
- b) Endothermic, due to the absorption of heat.
- c) A physical change, as no new substances are formed.
- d) A neutralization reaction, releasing cold.

222. Many decomposition reactions, such as the thermal decomposition of limestone (calcium carbonate), require heating to proceed. This suggests that these reactions are generally:

- a) Exothermic, releasing heat upon decomposition.
- b) Endothermic, absorbing heat for decomposition.
- c) Redox reactions, involving electron transfer.
- d) Reversible, easily reforming the original compound.

223. The neutralization reaction between a strong acid and a strong base in aqueous solution is typically accompanied by a noticeable increase in temperature. This classifies neutralization as a type of:

- a) Endothermic reaction.
- b) Decomposition reaction.

c) Exothermic reaction.

d) Precipitation reaction.

224. When liquid water freezes to form ice, energy is released to the surroundings. This physical change is therefore considered:

a) An endothermic process.

b) An exothermic process.

c) A sublimation process.

d) A chemical reaction.

225. Which statement correctly differentiates between a physical change and a chemical reaction in terms of energy?

a) Physical changes always involve larger energy changes than chemical reactions.

b) Chemical reactions always release energy, while physical changes always absorb energy.

c) Both physical changes and chemical reactions can involve absorption or release of energy.

d) Energy changes only occur in chemical reactions, not in physical changes.

Answers

211. (b)

212. (b)

213. (c)

214. (c)

215. (b)

216. (b)

217. (b)

218. (b)

219. (c)

220. (c)

221. (b)

222. (b)

223. (c)

224. (b)

225. (c)

Topic: Corrosion

Section: Multiple Choice Questions

226. Which of the following best describes corrosion?

- (a) The process of an alloy forming from two or more metals.
- (b) The natural process which converts a refined metal to a more stable form, such as its oxide, hydroxide, or sulfide.
- (c) The process of extracting metals from their ores.
- (d) The chemical reaction where a substance loses electrons to an oxidizing agent.

227. State the two essential conditions required for the rusting of iron.

228. The chemical formula for rust is approximately:

- (a) FeO
- (b) $\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}$
- (c) $\text{Fe}(\text{OH})_2$
- (d) FeS

229. Explain how galvanization prevents the rusting of iron.

230. Identify the oxidizing agent and the reducing agent in the process of rusting of iron.

231. Is corrosion considered a physical change or a chemical change? Justify your answer.

232. Gold and Platinum are often referred to as 'noble metals' due to their resistance to corrosion. This resistance is primarily because:

- (a) They are very heavy metals.
- (b) They have very low reactivity and do not easily react with oxygen or moisture.
- (c) They form a protective oxide layer immediately upon exposure to air.
- (d) They are excellent conductors of electricity.

233. Anodising is a method used to protect aluminium from corrosion. Briefly describe the process of anodising and how it prevents corrosion.

234. Differentiate between 'rusting' and 'corrosion'.

235. Which of the following factors would generally slow down the rate of corrosion of an iron object?

(a) Presence of dissolved salts in water.

(b) High humidity.

(c) Painting the surface of the iron object.

(d) Contact with a more reactive metal like magnesium.

236. Both corrosion and rancidity involve oxidation reactions. Explain one key difference between the two processes in terms of the substances affected and the resulting change.

237. Give an example of a metal that forms a passive, protective oxide layer on its surface, thereby preventing further corrosion.

238. Write a balanced chemical equation for the formation of the green coating on copper objects exposed to moist air for a long time. (Assume the coating is basic copper carbonate, $\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2$).

239. Corrosion is often described as an electrochemical process. Briefly explain what this means in the context of rusting.

240. Discuss one significant economic impact and one environmental impact of corrosion.

Answers

226. (b)

227. Oxygen and water (moisture).

228. (b)

229. Zinc, being more reactive than iron, preferentially oxidizes, protecting the iron (sacrificial protection).

230. Oxidizing agent: Oxygen; Reducing agent: Iron.

231. Chemical change; New substance (rust) with different properties is formed.

232. (b)

233. Electrolytic process forming a thick, protective aluminium oxide layer on the surface of aluminium.

234. Corrosion is general deterioration of material; rusting is specific corrosion of iron due to oxygen and water.

235. (c)

236. Corrosion affects metals, leading to structural degradation; Rancidity affects fats/oils in food, leading to unpleasant smell/taste.

237. Aluminium (or Chromium).

238. $2\text{Cu(s)} + \text{H}_2\text{O(l)} + \text{CO}_2\text{(g)} + \text{O}_2\text{(g)} \rightarrow \text{CuCO}_3 \cdot \text{Cu(OH)}_2\text{(s)}$

239. It involves formation of anode and cathode regions on the metal surface, with electron and ion transfer in presence of an electrolyte (water).

240. Economic: High costs for replacement and repair of corroded infrastructure. Environmental: Release of toxic corrosion products and resource depletion from manufacturing replacements.

Topic: Rancidity

Section: Multiple Choice Questions

241. Rancidity in food items is primarily caused by:

- (a) Hydrolysis of carbohydrates
- (b) Oxidation of fats and oils
- (c) Polymerization of proteins
- (d) Reduction of vitamins

242. Which of the following is a characteristic sign of rancidity in food?

- (a) Increased moisture content
- (b) Sweet taste
- (c) Unpleasant smell and taste
- (d) Brittleness

243. The process of rancidity is an example of a:

- (a) Displacement reaction
- (b) Decomposition reaction
- (c) Oxidation reaction
- (d) Neutralization reaction

244. To prevent rancidity, potato chips are often flushed with an inert gas. Which gas is commonly used for this purpose?

- (a) Oxygen
- (b) Carbon dioxide
- (c) Nitrogen
- (d) Hydrogen

245. Antioxidants are substances added to fatty foods to:

- (a) Promote bacterial growth
- (b) Increase their calorific value
- (c) Slow down the oxidation process
- (d) Enhance their color

246. Which of the following conditions accelerates the process of rancidity?

- (a) Low temperature
- (b) Exclusion of light
- (c) Presence of moisture and air
- (d) Vacuum packaging

247. When fats and oils become rancid, they typically produce compounds like aldehydes and ketones. This change is classified as:

- (a) A physical change
- (b) A reversible change
- (c) A chemical change
- (d) A phase transition

248. Rancidity due to the action of microorganisms that produce lipases is known as:

- (a) Oxidative rancidity
- (b) Hydrolytic rancidity
- (c) Ketonic rancidity
- (d) Photolytic rancidity

249. Storing food in airtight containers helps prevent rancidity by:

- (a) Increasing the temperature

- (b) Removing moisture content
- (c) Limiting exposure to oxygen
- (d) Promoting acid production

250. The unpleasant odor associated with rancid butter is primarily due to the breakdown of triglycerides into:

- (a) Sugars
- (b) Amino acids
- (c) Short-chain fatty acids and glycerol
- (d) Complex carbohydrates

251. Which statement correctly describes the role of an antioxidant in preventing rancidity?

- (a) It reacts with water to form an insoluble precipitate.
- (b) It acts as a reducing agent, donating electrons to free radicals.
- (c) It physically coats the food, preventing oxygen contact.
- (d) It acts as an oxidizing agent, deactivating enzymes.

252. Refrigeration helps in preventing rancidity mainly by:

- (a) Introducing inert gases into the food.
- (b) Reducing the rate of chemical reactions, including oxidation.
- (c) Absorbing moisture from the food.
- (d) Converting fats into indigestible forms.

253. Consider the following methods used to prevent rancidity:

- I. Adding antioxidants like BHA and BHT.
- II. Storing food in the dark.
- III. Flusing with nitrogen gas.

IV. Keeping food at room temperature.

Which of these methods are effective in preventing rancidity?

- (a) I, II, and III only
- (b) I and IV only
- (c) II, III, and IV only
- (d) All of the above

254. A student observes that a packet of chips left open for a few days develops a bitter taste and foul smell. This phenomenon is best explained as:

- (a) Fermentation due to yeast
- (b) Polymerization of starch
- (c) Oxidative rancidity of oils
- (d) Hydrolytic breakdown of proteins

255. In the context of oxidation-reduction reactions, the oxygen molecules causing rancidity act as:

- (a) Reducing agents
- (b) Catalysts
- (c) Oxidizing agents
- (d) Neutralizing agents

Answers

241. (b)

242. (c)

243. (c)

244. (c)

245. (c)

246. (c)

247. (c)

248. (b)

249. (c)

250. (c)

251. (b)

252. (b)

253. (a)

254. (c)

255. (c)