

CHAPTER 4 REVIEW

Knowledge/Understanding Thinking/Investigation Communication Application

Knowledge

For each question, select the best answer from the four alternatives.

- Which statement correctly describes the law of conservation of mass? (4.1)

 - The mass of the products equals the mass of the reactants.
 - If a reaction has two products, their masses are equal.
 - The mass of the products is less than the mass of the reactants.
 - If a reaction has two reactants, their masses are equal.

- Which of the following chemical equations is balanced? (4.1)

 - $\text{CS}_2(\text{l}) + 3 \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + \text{SO}_2(\text{g})$
 - $\text{CS}_2(\text{l}) + 3 \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2 \text{SO}_2(\text{g})$
 - $\text{CS}_2(\text{l}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + \text{SO}_2(\text{g})$
 - $\text{CS}_2(\text{l}) + 3 \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 3 \text{SO}_2(\text{g})$

- Which of the following chemical equations is balanced? (4.1)

 - $\text{Fe}_3\text{O}_4(\text{s}) + 2 \text{C}(\text{s}) \rightarrow \text{Fe}(\text{s}) + 2 \text{CO}_2(\text{g})$
 - $\text{AlCl}_3(\text{aq}) + \text{Ca}(\text{s}) \rightarrow \text{Al}(\text{s}) + \text{CaCl}_2(\text{aq})$
 - $\text{NO}(\text{g}) + \text{Br}_2(\text{g}) \rightarrow \text{NOBr}(\text{g})$
 - $\text{Ca}(\text{OH})_2(\text{s}) + 2 \text{HCl}(\text{aq}) \rightarrow \text{CaCl}_2(\text{aq}) + 2 \text{H}_2\text{O}(\text{l})$

- Which of the following statements correctly describes a decomposition reaction? (4.2)

 - A compound breaks down into smaller compounds or elements.
 - Two compounds combine to make a larger compound.
 - Two elements switch places between compounds.
 - A compound changes state.

- Which equation most accurately represents the synthesis reaction between lithium and oxygen? (4.2)

 - $\text{Li}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{LiO}_2(\text{s})$
 - $2 \text{LiO}(\text{s}) \rightarrow 2 \text{Li}(\text{s}) + \text{O}_2(\text{g})$
 - $6 \text{Li}(\text{s}) + \text{O}_2(\text{g}) \rightarrow 2 \text{Li}_3\text{O}(\text{s})$
 - $4 \text{Li}(\text{s}) + \text{O}_2(\text{g}) \rightarrow 2 \text{Li}_2\text{O}(\text{s})$

- Which of the following equations represents a single displacement reaction? (4.4)

 - $\text{HNO}_3(\text{aq}) + \text{NaOH}(\text{aq}) \rightarrow \text{NaNO}_3(\text{aq}) + \text{H}_2\text{O}(\text{aq})$
 - $\text{S}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{SO}_2(\text{g})$
 - $\text{Li}(\text{s}) + \text{KCl}(\text{aq}) \rightarrow \text{K}(\text{s}) + \text{LiCl}(\text{aq})$
 - $2 \text{H}_2\text{O}_2(\text{aq}) \rightarrow 2 \text{H}_2\text{O}(\text{l}) + \text{O}_2(\text{g})$

- The activity series of metals shows

 - the relative atomic numbers of various metals
 - the relative reactivity of various elements
 - whether or not a compound is soluble
 - the ionic charges of different metallic compounds (4.4)

- What type of reaction is represented by the equation below?
 $2 \text{KClO}_3(\text{s}) \rightarrow 2 \text{KCl}(\text{s}) + 3 \text{O}_2(\text{g})$ (4.2, 4.4, 4.6)

 - single displacement
 - double displacement
 - neutralization
 - decomposition

- What type of reaction is represented by the equation below?
 $\text{LiCl}(\text{aq}) + \text{AgNO}_3(\text{aq}) \rightarrow \text{LiNO}_3(\text{aq}) + \text{AgCl}(\text{s})$ (4.2, 4.4, 4.6)

 - single displacement
 - double displacement
 - synthesis
 - decomposition

- Which of the following equations represents a precipitation reaction? (4.6)

 - $\text{H}_2\text{O}(\text{g}) + \text{CO}(\text{g}) \rightarrow \text{H}_2(\text{g}) + \text{CO}_2(\text{g})$
 - $\text{BaCO}_3(\text{s}) \rightarrow \text{BaO}(\text{s}) + \text{CO}_2(\text{g})$
 - $\text{CaO}(\text{s}) + \text{SiO}_2(\text{s}) \rightarrow \text{CaSiO}_3(\text{s})$
 - $\text{LiBr}(\text{aq}) + \text{AgNO}_3(\text{aq}) \rightarrow \text{LiNO}_3(\text{aq}) + \text{AgBr}(\text{s})$

Indicate whether each statement is true or false. If you think the statement is false, rewrite it to make it true.

- If a substance changes colour, a chemical change must have occurred. (4.1)
- A precipitate speeds the rate of a chemical reaction without being used up. (4.1)

13. Two simple reactants combine to form a more complex product in a decomposition reaction. (4.2)
14. Calcium carbonate (CaCO_3) forms calcium oxide and oxygen gas when heated. (4.2)
15. Plasma gasification uses electrical sparks to achieve extremely high temperatures. (4.3)
16. We can use the activity series to determine whether a synthesis reaction will occur. (4.3)
17. A single displacement reaction takes the form $\text{A} + \text{BC} \rightarrow \text{ABC}$. (4.4)
18. Gold is the only metal that is liquid at room temperature. (4.5)
19. A neutralization reaction between an acid and a base results in products that are more neutral than the reactants. (4.6)

Match each chemical equation from the first list with the correct type of reaction from the second list.

20. (a) $\text{MgO}(\text{aq}) + 2 \text{HCl}(\text{aq}) \rightarrow \text{MgCl}_2 + \text{H}_2\text{O}$
 (b) $2 \text{HgO}(\text{s}) \rightarrow 2 \text{Hg}(\text{l}) + \text{O}_2(\text{g})$
 (c) $\text{P}_4(\text{s}) + 6 \text{Cl}_2(\text{g}) \rightarrow 4 \text{PCl}_3(\text{l})$
 (d) $\text{KI}(\text{aq}) + \text{F}_2(\text{aq}) \rightarrow 2 \text{KF}(\text{aq}) + \text{I}_2(\text{s})$
 (i) decomposition
 (ii) synthesis
 (iii) single displacement
 (iv) double displacement
 (4.2, 4.4, 4.6)

Write a short answer to each question.

21. Describe four clues that indicate that a chemical reaction has taken place. (4.1)
22. How does a catalyst affect a reaction? (4.1)
23. What must be true for an equation to be balanced? (4.1)
24. How are coefficients different from subscripts in a chemical equation? (4.1)
25. Water and carbon dioxide combine to produce carbonic acid. What makes this change a synthesis reaction? (4.2)
26. Write the general pattern for a decomposition reaction. (4.2)
27. What is required for most decomposition reactions to proceed? (4.2)
28. In what way are the synthesis and decomposition of water opposite reactions? (4.2)
29. How is gasification different from burning garbage? (4.3)
30. Describe one useful product of plasma gasification. (4.3)
31. Describe three concerns about the gasification of landfill garbage. (4.3)
32. What is the activity series of metals? (4.4)
33. How can the relationship among metals in the activity series be used to predict whether or not displacement will occur? (4.4)
34. What does the halogen activity series indicate about the role of fluorine in reactions with compounds of other halogens? (4.4)
35. What are two ways that mercury is different from other metals? (4.5)
36. Compare the general patterns for single and double displacement reactions. (4.4, 4.6)
37. What is the state of a precipitate that results from a precipitation reaction? (4.6)
38. What does the symbol (aq) indicate? (4.6)

Understanding

39. Balance the following chemical equations: (4.1)
 - (a) $\text{NaClO}_3(\text{s}) \rightarrow \text{NaCl}(\text{s}) + \text{O}_2(\text{g})$
 - (b) $\text{C}_2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow \text{H}_2\text{O}(\text{g}) + \text{CO}_2(\text{g})$
 - (c) $\text{Na}(\text{s}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{NaOH}(\text{aq}) + \text{H}_2(\text{g})$
40. Balance the following chemical equations containing polyatomic ions: (4.1)
 - (a) $\text{Ca} + \text{HNO}_3 \rightarrow \text{H}_2 + \text{Ca}(\text{NO}_3)_2$
 - (b) $\text{Fe}(\text{NO}_3)_3 + (\text{NH}_4)_2\text{CO}_3 \rightarrow \text{Fe}_2(\text{CO}_3)_3 + \text{NH}_4\text{NO}_3$
 - (c) $\text{AgNO}_3 + \text{K}_2\text{CrO}_4 \rightarrow \text{Ag}_2\text{CrO}_4 + \text{KNO}_3$
41. During cellular respiration, an organism breaks down glucose to release a usable form of energy. Other chemicals are produced in the process. Balance the respiration equation shown below.

$$\text{C}_6\text{H}_{12}\text{O}_6(\text{aq}) + \text{O}_2(\text{aq}) \rightarrow \text{CO}_2(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{energy} \quad (4.1)$$
42. (a) List three clues that a chemical reaction has occurred.
 (b) If you observed one of these clues, would that prove that a chemical reaction has occurred? Explain. (4.1)
43. Classify these reactions as synthesis or decomposition: (4.2)
 - (a) $2 \text{H}_2\text{O}_2 \rightarrow 2 \text{H}_2\text{O} + \text{O}_2$
 - (b) $2 \text{Mg} + \text{O}_2 \rightarrow 2 \text{MgO}$
 - (c) $2 \text{Al} + 3 \text{Cl}_2 \rightarrow 2 \text{AlCl}_3$
 - (d) $\text{H}_2\text{CO}_3 \rightarrow \text{H}_2\text{O} + \text{CO}_2$ (4.2)

44. Predict the products of these synthesis or decomposition reactions. Write a balanced chemical equation to represent each reaction. (4.2)
- $\text{HgO} \rightarrow$
 - $\text{Na} + \text{O}_2 \rightarrow$
 - $\text{NH}_3 \rightarrow$
45. When heated, silver carbonate decomposes into silver oxide and a gas. (4.2)
- Identify the gas.
 - Write a balanced chemical equation for this reaction.
46. Water can be forced to decompose into hydrogen and oxygen gases. Write the balanced equation for this decomposition reaction. (4.2)
47. Some Canadian municipalities are considering gasification to deal with overcrowded landfills. (4.3)
- Which type of chemical reaction is involved in the process of gasification?
 - What conditions are required for plasma gasification?
 - Why must the product of plasma gasification be chemically treated before further use?
48. (a) Predict whether zinc will react with lead(II) sulfate.
 (b) What information did you use to make your prediction?
 (c) Name one metal (other than zinc) that, according to your information, would react with lead(II) sulfate.
 (d) Name one metal (other than zinc) that would not react with lead(II) sulfate. (4.4)
49. (a) Predict whether nickel will react with sodium chloride.
 (b) What information did you use to make your prediction? (4.4)
50. Use the activity series of metals to write a balanced chemical equation for each reaction that occurs. Write *no reaction* for any that do not. (4.4)
- $\text{Al(s)} + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow$
 - $\text{Zn(s)} + \text{Cu(NO}_3)_2(\text{aq}) \rightarrow$
 - $\text{Au(s)} + \text{KNO}_3(\text{aq}) \rightarrow$
51. Bubbling chlorine gas through a solution of potassium iodide produces elemental iodine and a solution of potassium chloride. (4.4)
- Which type of reaction occurs?
 - Write a balanced chemical equation to describe the reaction.
52. A student placed a sample of steel wool into sulfuric acid, $\text{H}_2\text{SO}_4(\text{aq})$. (4.4)
- Which type of reaction occurs?
 - Which gas is produced?
 - Write a balanced chemical equation to describe the reaction.
53. Every spring, mercury disappears from the Arctic atmosphere while the concentration of bromine increases. (4.5)
- What is the source of the bromine?
 - What do scientists believe happens to bromide ions in the presence of sunlight?
 - How might bromide be related to the disappearance of mercury?
54. Describe the solubility of each of the following compounds: (4.6)
- potassium bromide, KBr(s)
 - sodium carbonate, $\text{Na}_2\text{CO}_3(\text{s})$
 - silver acetate, $\text{AgC}_2\text{H}_3\text{O}_2(\text{s})$
55. (a) Rewrite the following chemical equation so that it includes the missing state symbols:

$$\text{CdSO}_4(\text{aq}) + \text{H}_2\text{S}(\text{aq}) \rightarrow \text{CdS}() + \text{H}_2\text{SO}_4()$$

 (b) Predict any precipitates formed in this reaction.
 (c) Explain how you determined whether there would be any precipitates. (4.6)
56. A precipitate forms in the reaction between solutions of sodium hydroxide and nickel(II) chloride. (4.6)
- Write the chemical formula for the precipitate.
 - Explain how you determined the identity of the precipitate.
57. Limestone consists mostly of calcium carbonate, $\text{CaCO}_3(\text{s})$. One way to test if a mineral is limestone is to put a small sample of it in hydrochloric acid. If bubbles appear, the sample may be limestone. (4.1, 4.6)
- The reaction produces calcium chloride, carbon dioxide, and water. Write the balanced chemical equation for the reaction.
 - What causes the bubbles?
 - How useful is this test for limestone? Explain.

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1. (a) 8. (d) 15. T
2. (b) 9. (b) 16. F
3. (d) 10. (d) 17. F
4. (a) 11. F 18. F
5. (d) 12. F 19. T
6. (c) 13. F
7. (b) 14. F
20. (a) iv (c) ii
(b) i (d) iii
39. (a) $2 \text{NaClO}_3 \rightarrow 2 \text{NaCl} + 3 \text{O}_2$
(b) $2 \text{C}_2\text{H}_2 + 5 \text{O}_2 \rightarrow 2 \text{H}_2\text{O} + 4 \text{CO}_2$
(c) $2 \text{Na} + 2 \text{H}_2\text{O} \rightarrow 2 \text{NaOH} + \text{H}_2$
40. (a) $\text{Ca} + 2 \text{HNO}_3 \rightarrow \text{H}_2 + \text{Ca}(\text{NO}_3)_2$
(b) $2 \text{Fe}(\text{NO}_3)_3 + 3 (\text{NH}_4)_2\text{CO}_3 \rightarrow \text{Fe}_2(\text{CO}_3)_3 + 6 \text{NH}_4\text{NO}_3$
(c) $2 \text{AgNO}_3 + \text{K}_2\text{CrO}_4 \rightarrow \text{Ag}_2\text{CrO}_4 + 2 \text{KNO}_3$
41. $\text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{O}_2 \rightarrow 6 \text{CO}_2 + 6 \text{H}_2\text{O}$
43. (a) decomposition (c) synthesis
(b) synthesis (d) decomposition
44. (a) $2 \text{HgO} \rightarrow 2 \text{Hg} + \text{O}_2$
(b) $4 \text{Na} + \text{O}_2 \rightarrow 2 \text{Na}_2\text{O}$
(c) $2 \text{NH}_3 \rightarrow \text{N}_2 + 3 \text{H}_2$
45. (a) carbon dioxide
(b) $\text{Ag}_2\text{CO}_3 \rightarrow \text{Ag}_2\text{O} + \text{CO}_2$
46. $2 \text{H}_2\text{O} \rightarrow \text{O}_2 + 2 \text{H}_2$
50. (a) $2 \text{Al}(\text{s}) + 3 \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{Al}_2(\text{SO}_4)_3(\text{aq}) + 3 \text{H}_2(\text{g})$
(b) $\text{Zn}(\text{s}) + \text{Cu}(\text{NO}_3)_2(\text{aq}) \rightarrow \text{Cu}(\text{s}) + \text{Zn}(\text{NO}_3)_2(\text{aq})$
(c) no reaction
51. (a) single displacement
(b) $\text{Cl}_2(\text{g}) + 2 \text{KI}(\text{aq}) \rightarrow \text{I}_2(\text{aq}) + 2 \text{KCl}(\text{aq})$
52. (a) single displacement
(b) hydrogen gas
(c) $\text{Fe}(\text{s}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{FeSO}_4(\text{aq}) + \text{H}_2(\text{g})$
54. (a) very soluble
(b) very soluble
(c) slightly soluble
55. (a) $\text{CdSO}_4(\text{aq}) + \text{H}_2\text{S}(\text{aq}) \rightarrow \text{CdS}(\text{s}) + \text{H}_2\text{SO}_4(\text{aq})$
(b) cadmium sulfide
56. (a) $\text{Ni}(\text{OH})_2$
57. (a) $\text{CaCO}_3 + 2 \text{HCl} \rightarrow \text{CaCl}_2 + \text{CO}_2 + \text{H}_2\text{O}$
(b) release of $\text{CO}_2(\text{g})$
58. (a) $\text{NH}_4\text{NO}_3 \rightarrow \text{N}_2\text{O} + 2 \text{H}_2\text{O}$
(b) decomposition
(c) $2 \text{NH}_3 + 2 \text{O}_2 \rightarrow \text{N}_2\text{O} + 3 \text{H}_2\text{O}$
(d) double displacement