

Chemical Reactions 4

Synthesis and Decomposition Reactions

INFORMATION

Synthesis Reactions

Synthesis reactions (also called direct combination reactions) are characterized as having multiple reactants, but only a single product. The reactions shown below are **complete reactions**. This means that the reactants and products are shown. In this activity, you will be trying to identify the products. This is known as **reaction prediction**.

Study the following reactions for similarities:

- | | |
|-------------------------------------------------------------------------|-------------------------------------------------------------------------|
| 1. $2 \text{Na} + \text{Cl}_2 \rightarrow 2 \text{NaCl}$ | 7. $\text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl}$ |
| 2. $\text{H}_2\text{O} + \text{SO}_3 \rightarrow \text{H}_2\text{SO}_4$ | 8. $\text{H}_2\text{O} + \text{CO}_2 \rightarrow \text{H}_2\text{CO}_3$ |
| 3. $\text{H}_2 + \text{Br}_2 \rightarrow 2\text{HBr}$ | 9. $\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2$ |
| 4. $\text{ZnO} + \text{H}_2\text{O} \rightarrow \text{No Rxn}$ | 10. $2 \text{Al} + 3 \text{Br}_2 \rightarrow 2\text{AlBr}_3$ |
| 5. $\text{Na}_2\text{O} + \text{H}_2\text{O} \rightarrow 2\text{NaOH}$ | 11. $\text{MgO} + \text{H}_2\text{O} \rightarrow \text{Mg(OH)}_2$ |
| 6. $\text{H}_2\text{O} + \text{SO}_2 \rightarrow \text{H}_2\text{SO}_3$ | 12. $3 \text{Mg} + \text{N}_2 \rightarrow \text{Mg}_3\text{N}$ |

Critical Thinking Questions

1. How many groups or types of synthesis reactions can you identify? Write down the numbers for the similar reactions (group them by the types you can identify).
2. For each group that you identified, rewrite the reactions and then try to write a general reaction. Use 'M' to designate a metal, 'X' to designate a non-metal, 'O' to designate oxygen, and 'H' to designate hydrogen.

Decomposition Reactions

Decomposition reactions are characterized as having only one reactant and multiple products. Study the following reactions looking for similarities:

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|--------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| 1. $\text{Ca(OH)}_2 + \text{heat} \rightarrow \text{CaO} + \text{H}_2\text{O}$ | 8. $\text{NaOH} + \text{heat} \rightarrow \text{No Rxn}$ |
| 2. $2\text{NaNO}_3 + \text{heat} \rightarrow 2\text{NaNO}_2 + \text{O}_2$ | 9. $2\text{Pb(NO}_3)_2 + \text{heat} \rightarrow \text{PbO} + \text{NO}_2 + \text{O}_2$ |
| 3. $\text{ZnSO}_4 + \text{heat} \rightarrow \text{ZnO} + \text{SO}_3$ | 10. $\text{Na}_2\text{SO}_4 + \text{heat} \rightarrow \text{No Rxn}$ |
| 4. $\text{CsNO}_3 + \text{heat} \rightarrow 2\text{CsNO}_2 + \text{O}_2$ | 11. $\text{CuSO}_4 + \text{heat} \rightarrow \text{CuO} + \text{SO}_3$ |
| 5. $\text{Pb(OH)}_2 + \text{heat} \rightarrow \text{PbO} + \text{H}_2\text{O}$ | 12. $\text{Li}_2\text{SO}_4 + \text{heat} \rightarrow \text{No Rxn}$ |
| 6. $\text{CaSO}_4 + \text{heat} \rightarrow \text{No Rxn}$ | 13. $\text{RbOH} + \text{Heat} \rightarrow \text{No Rxn}$ |
| 7. $2\text{KClO}_3 + \text{heat} \rightarrow 2\text{KCl} + 3\text{O}_2$ | 14. $\text{Ca(OH)}_2 + \text{Heat} \rightarrow \text{CaO} + \text{H}_2\text{O}$ |

Critical Thinking Questions

1. How many groups or types of synthesis reactions can you identify? Write down the numbers for the similar reactions (group them by the types you can identify).
2. For each group that you identified, rewrite the reactions and then try to write a general reaction. Use 'M' to designate a metal, 'X' to designate a non-metal, 'O' to designate oxygen, and 'H' to designate hydrogen.

Student Name: _____ Pd. _____ Date: _____

Supplementary Exercises
Synthesis and Decomposition Reactions

Show all products and balance each reaction below. Also give the specific type of reaction (formation of binary acid, salt, base, ternary acid, etc.).

Synthesis Reactions

	PRODUCTS	TYPE
1. $\text{Al} + \text{Cl}_2 \rightarrow$	_____	_____
2. $\text{Sc} + \text{O}_2 \rightarrow$	_____	_____
3. $\text{H}_2\text{O} + \text{SO}_2 \rightarrow$	_____	_____
4. $\text{H}_2 + \text{I}_2 \rightarrow$	_____	_____
5. $\text{Pt} + \text{O}_2 \rightarrow$	_____	_____
6. $\text{BaO} + \text{H}_2\text{O} \rightarrow$	_____	_____
7. $\text{SO}_2 + \text{Fe}_2\text{O}_3 \rightarrow$	_____	_____
8. $\text{TiO}_2 + \text{H}_2\text{O} \rightarrow$	_____	_____
9. $\text{H}_2\text{O} + \text{Cl}_2\text{O}_7 \rightarrow$	_____	_____
10. $\text{Au}_2\text{O} + \text{H}_2\text{O} \rightarrow$	_____	_____
11. $\text{Na} + \text{Cl}_2 \rightarrow$	_____	_____
12. $\text{H}_2\text{O} + \text{SO}_3 \rightarrow$	_____	_____
13. $\text{H}_2 + \text{Br}_2 \rightarrow$	_____	_____
14. $\text{ZnO} + \text{H}_2\text{O} \rightarrow$	_____	_____
15. $\text{Na}_2\text{O} + \text{H}_2\text{O} \rightarrow$	_____	_____
16. $\text{H}_2\text{O} + \text{SO}_2 \rightarrow$	_____	_____
17. $\text{H}_2 + \text{Cl}_2 \rightarrow$	_____	_____
18. $\text{Al} + \text{Br}_2 \rightarrow$	_____	_____
19. $\text{MgO} + \text{H}_2\text{O} \rightarrow$	_____	_____
20. $\text{Mg} + \text{N}_2 \rightarrow$	_____	_____

Decomposition Reactions

Note: all the decomposition reactions require the addition of heat. Heat is omitted from the reaction for the sake of keeping everything neat and tidy.

	PRODUCTS	TYPE
21. HgO →	_____	_____
22. H ₂ CO ₃ →	_____	_____
23. K ₂ SO ₄ →	_____	_____
24. CaCO ₃ →	_____	_____
25. RbNO ₃ →	_____	_____
26. Cr(NO ₃) ₂ →	_____	_____
27. FeSO ₄ →	_____	_____
28. H ₂ SO ₄ →	_____	_____
29. Au ₂ O ₃ →	_____	_____
30. Li ₂ CO ₃ →	_____	_____
31. Cs ₂ SO ₄ →	_____	_____
32. Ba(OH) ₂ →	_____	_____
33. KOH →	_____	_____
34. CoSO ₄ →	_____	_____
35. KNO ₃ →	_____	_____
36. AgClO ₃ →	_____	_____
37. Na ₂ O →	_____	_____
38. 2KClO ₃ →	_____	_____
39. Pt(OH) ₂ →	_____	_____
40. Zn(OH) ₂ →	_____	_____