Types of Chemical Reactions

Unit: Chemical Reactions

MA Curriculum Frameworks (2016): HS-PS1-7

Mastery Objective(s): (Students will be able to…)

- Recognize & identify the five major classes of chemical reactions.

Success Criteria:

- Reactions are correctly identified.

Tier 2 Vocabulary: reaction

Language Objectives:

- Explain what happens in each of the types of reaction.

Notes:

There are many types of chemical reactions. Five of the most common are:

synthesis: two or more reactants combine to form a single product. For example:

$$Na + Cl_2 \rightarrow NaCl$$

decomposition: one reactant disintegrates (decomposes) to form two or more products:

$$H_2CO_3 \rightarrow H_2O + CO_2$$

single replacement (sometimes called single displacement): atoms of one element replace atoms of another in a compound:

$$Al + CuCl_2 \rightarrow AlCl_3 + Cu$$

Most of the single replacement reactions you will encounter involve metals reacting with ionic compounds. In this type of single replacement reaction, a positive ion (usually a metal) replaces the other positive ion, or a negative ion (often a non-metal) replaces the other negative ion.

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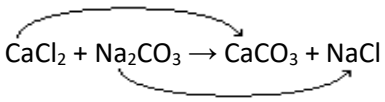
double replacement (sometimes called a double displacement or metathesis reaction): when two positive ions (or two negative ions) switch with each other to form two new compounds. For example:



Ca starts out paired with Cl, and Na is paired with CO_3. In the reaction, Ca and Na trade places so that Ca is now with CO_3 and Na is now with Cl. (Or you could think of it as Cl and CO_3 trading places—the result is the same.)

combustion: a special kind of reaction in which a hydrocarbon (a compound containing only carbon and hydrogen) reacts with O_2 (burns, or "combusts") to form CO_2 and H_2O. For example:

$$C_3H_8\ (\ell) + 5\,O_2\ (g) \rightarrow 3\,CO_2\ (g) + 4\,H_2O\ (g) + \text{heat}$$

All flames are chemical reactions. (The flame itself is the light—photons of energy—produced by the reaction.) Most flames are produced by combustion reactions involving hydrocarbons and oxygen.

The internal combustion engine in your car is a special chemical reactor, in which octane (C_8H_{18}) and other hydrocarbons combust in a chamber (cylinder), producing heat. The heat makes the gases inside the cylinder expand. The expanding gases push the piston, which makes the car go.

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Homework Problems

For each of the following chemical reactions, indicate whether the type of reaction is:

- synthesis
- decomposition
- single replacement
- double replacement
- combustion
- none of the above

1. $H_2 + O_2 \rightarrow H_2O$
2. $S_8 + O_2 \rightarrow SO_2$
3. $HgO \rightarrow Hg + O_2$
4. $Zn + HCl \rightarrow ZnCl_2 + H_2$
5. $Na + H_2O \rightarrow NaOH + H_2$
6. $C_{10}H_{16} + Cl_2 \rightarrow C + HCl$
7. $Si_2H_2 + O_2 \rightarrow SiO_2 + H_2O$
8. $Fe + O_2 \rightarrow Fe_2O_2$
9. $C_7H_6O_2 + O_2 \rightarrow CO_2 + H_2O$
10. $FeS_2 + O_2 \rightarrow Fe_2O_2 + SO_2$
11. $Fe_2O_2 + H_2 \rightarrow Fe + H_2O$
12. $K + Br_2 \rightarrow KBr$
13. $C_2H_2 + O_2 \rightarrow CO_2 + H_2O$
14. $H_2O_2 \rightarrow H_2O + O_2$
15. $C_7H_{16} + O_2 \rightarrow CO_2 + H_2O$
16. $SiO_2 + HF \rightarrow SiF_4 + H_2O$
17. $KClO_2 \rightarrow KCl + O_2$
18. $KClO_2 \rightarrow KClO_4 + KCl$
19. $P_4O_{10} + H_2O \rightarrow H_2PO_4$
20. $Sb + O_2 \rightarrow Sb_4O_6$
21. $C_2H_8 + O_2 \rightarrow CO_2 + H_2O$
22. $Fe_2O_2 + CO \rightarrow Fe + CO_2$
23. $PCl_5 + H_2O \rightarrow HCl + H_2PO_4$
24. $H_2S + Cl_2 \rightarrow S_8 + HCl$

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25. $Fe + H_2O \rightarrow Fe_2O_4 + H_2$
26. $N_2 + H_2 \rightarrow NH_2$
27. $N_2 + O_2 \rightarrow N_2O$
28. $CO_2 + H_2O \rightarrow C_6H_{12}O_6 + O_2$
29. $SiCl_4 + H_2O \rightarrow H_4SiO_4 + HCl$
30. $H_2PO_4 \rightarrow H_4P_2O_7 + H_2O$
31. $CO_2 + NH_2 \rightarrow OC(NH_2)_2 + H_2O$
32. $Al(OH)_2 + H_2SO_4 \rightarrow Al_2(SO_4)_2 + H_2O$
33. $Fe_2(SO_4)_2 + KOH \rightarrow K_2SO_4 + Fe(OH)_2$
34. $H_2SO_4 + HI \rightarrow H_2S + I_2 + H_2O$
35. $Al + FeO \rightarrow Al_2O_2 + Fe$
36. $Na_2CO_2 + HCl \rightarrow NaCl + H_2O + CO_2$
37. $P_4 + O_2 \rightarrow P_2O_5$
38. $K_2O + H_2O \rightarrow KOH$
39. $Al + O_2 \rightarrow Al_2O_3$
40. $Na_2O + H_2O \rightarrow NaOH + O_2$
41. $C + H_2O \rightarrow CO + H_2$
42. $H_3AsO_4 \rightarrow As_2O_5 + H_2O$
43. $Al_2(SO_4)_2 + Ca(OH)_2 \rightarrow Al(OH)_2 + CaSO_4$
44. $FeCl_2 + NH_4OH \rightarrow Fe(OH)_2 + NH_4Cl$
45. $Ca_3(PO_4)_2 + SiO_2 \rightarrow P_4O_{10} + CaSiO_2$
46. $N_2O_5 + H_2O \rightarrow HNO_2$
47. $Al + HCl \rightarrow AlCl_3 + H_2$
48. $H_3BO_2 \rightarrow H_4B_6O_{11} + H_2O$
49. $Mg + N_2 \rightarrow Mg_2N_2$
50. $NaOH + Cl_2 \rightarrow NaCl + NaClO + H_2O$

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