

Worksheet: Writing and Balancing Chemical Reactions

1. Balance the following equations and indicate the type of reaction as formation, decomposition, single replacement, double replacement, hydrocarbon combustion, or other.

- a. $\text{Cu}_{(s)} + \text{O}_{2(g)} \rightarrow \text{CuO}_{(s)}$
- b. $\text{H}_2\text{O}_{(l)} \rightarrow \text{H}_{2(g)} + \text{O}_{2(g)}$
- c. $\text{Fe}_{(s)} + \text{H}_2\text{O}_{(g)} \rightarrow \text{H}_{2(g)} + \text{Fe}_3\text{O}_{4(s)}$
- d. $\text{AsCl}_{3(aq)} + \text{H}_2\text{S}_{(aq)} \rightarrow \text{As}_2\text{S}_{3(s)} + \text{HCl}_{(aq)}$
- e. $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}_{(s)} \rightarrow \text{CuSO}_{4(s)} + \text{H}_2\text{O}_{(g)}$
- f. $\text{Fe}_2\text{O}_{3(s)} + \text{H}_{2(g)} \rightarrow \text{Fe}_{(s)} + \text{H}_2\text{O}_{(l)}$
- g. $\text{CaCO}_{3(s)} \rightarrow \text{CaO}_{(s)} + \text{CO}_{2(g)}$
- h. $\text{Fe}_{(s)} + \text{S}_{8(s)} \rightarrow \text{FeS}_{(s)}$
- i. $\text{H}_2\text{S}_{(aq)} + \text{KOH}_{(aq)} \rightarrow \text{H}_2\text{O}_{(l)} + \text{K}_2\text{S}_{(aq)}$
- j. $\text{NaCl}_{(l)} \rightarrow \text{Na}_{(l)} + \text{Cl}_{2(g)}$
- k. $\text{Al}_{(s)} + \text{H}_2\text{SO}_{4(aq)} \rightarrow \text{H}_{2(g)} + \text{Al}_2(\text{SO}_4)_{3(aq)}$
- l. $\text{H}_3\text{PO}_{4(aq)} + \text{NH}_4\text{OH}_{(aq)} \rightarrow \text{H}_2\text{O}_{(l)} + (\text{NH}_4)_3\text{PO}_{4(aq)}$
- m. $\text{C}_3\text{H}_{8(g)} + \text{O}_{2(g)} \rightarrow \text{CO}_{2(g)} + \text{H}_2\text{O}_{(l)}$
- n. $\text{Al}_{(s)} + \text{O}_{2(g)} \rightarrow \text{Al}_2\text{O}_{3(s)}$
- o. $\text{CH}_{4(g)} + \text{O}_{2(g)} \rightarrow \text{CO}_{2(g)} + \text{H}_2\text{O}_{(l)}$
- p. $\text{K}_2\text{SO}_{4(aq)} + \text{BaCl}_{2(aq)} \rightarrow \text{KCl}_{(aq)} + \text{BaSO}_{4(s)}$
- q. $\text{C}_5\text{H}_{12(l)} + \text{O}_{2(g)} \rightarrow \text{CO}_{2(g)} + \text{H}_2\text{O}_{(g)}$
- r. $\text{Ca}(\text{OH})_{2(aq)} + \text{NH}_4\text{Cl}_{(aq)} \rightarrow \text{NH}_4\text{OH}_{(aq)} + \text{CaCl}_{2(aq)}$
- s. $\text{V}_2\text{O}_{5(s)} + \text{Ca}_{(s)} \rightarrow \text{CaO}_{(s)} + \text{V}_{(s)}$
- t. $\text{Na}_{(s)} + \text{ZnI}_{2(aq)} \rightarrow \text{NaI}_{(aq)} + \text{Zn}_{(s)}$
- u. $\text{C}_7\text{H}_6\text{O}_{3(l)} + \text{O}_{2(g)} \rightarrow \text{CO}_{2(g)} + \text{H}_2\text{O}_{(l)}$
- v. $\text{Ca}_{(s)} + \text{N}_{2(g)} \rightarrow \text{Ca}_3\text{N}_{2(s)}$
- w. $\text{Fe}_2\text{O}_{3(s)} + \text{H}_{2(g)} \rightarrow \text{Fe}_{(s)} + \text{H}_2\text{O}_{(l)}$
- x. $\text{C}_{15}\text{H}_{30(l)} + \text{O}_{2(g)} \rightarrow \text{CO}_{2(g)} + \text{H}_2\text{O}_{(g)}$
- y. $\text{BN}_{(s)} + \text{F}_{2(g)} \rightarrow \text{BF}_{3(s)} + \text{N}_{2(g)}$
- z. $\text{C}_{12}\text{H}_{26(l)} + \text{O}_{2(g)} \rightarrow \text{CO}_{2(g)} + \text{H}_2\text{O}_{(g)}$

2. Predict the product(s) along with the states, indicate the type of reaction, and balance the following chemical reactions.

- a. A solution of lead (II) nitrate is mixed with a solution of sodium iodide.
- b. Solid zinc sulfide reacts with oxygen in the air.
- c. Liquid butane ($\text{C}_4\text{H}_{10(l)}$) is used as a fuel to ignite a lighter.
- d. Barium hydroxide solution is neutralized by adding hydrochloric acid ($\text{HCl}_{(aq)}$).
- e. Copper metal is placed in a solution of silver nitrate.
- f. Sulfur burns in oxygen to make sulfur dioxide gas.
- g. A solution of aluminum sulfate is mixed with a solution of calcium hydroxide.
- h. Zinc metal is placed in sulfuric acid ($\text{H}_2\text{SO}_{4(aq)}$).
- i. Aluminum powder is placed in a container filled with chlorine gas.
- j. Sucrose undergoes cellular respiration.

Answers

Question 1

- a. $2 \text{Cu}_{(s)} + \text{O}_{2(g)} \rightarrow 2 \text{CuO}_{(s)}$ (formation)
b. $2 \text{H}_2\text{O}_{(l)} \rightarrow 2 \text{H}_{2(g)} + \text{O}_{2(g)}$ (decomposition)
c. $3 \text{Fe}_{(s)} + 4 \text{H}_2\text{O}_{(g)} \rightarrow 4 \text{H}_{2(g)} + \text{Fe}_3\text{O}_{4(s)}$ (single replacement)
d. $2 \text{AsCl}_{3(aq)} + 3 \text{H}_2\text{S}_{(aq)} \rightarrow \text{As}_2\text{S}_{3(s)} + 6 \text{HCl}_{(aq)}$ (double replacement)
e. $\text{CuSO}_4 \bullet 5 \text{H}_2\text{O}_{(s)} \rightarrow \text{CuSO}_{4(s)} + 5 \text{H}_2\text{O}_{(g)}$ (other – dehydration or decomposition)
f. $\text{Fe}_2\text{O}_{3(s)} + 3 \text{H}_{2(g)} \rightarrow 2 \text{Fe}_{(s)} + 3 \text{H}_2\text{O}_{(l)}$ (single replacement)
g. $\text{CaCO}_{3(s)} \rightarrow \text{CaO}_{(s)} + \text{CO}_{2(g)}$ (other or decomposition)
h. $8 \text{Fe}_{(s)} + \text{S}_{8(s)} \rightarrow 8 \text{FeS}_{(s)}$ (formation)
i. $\text{H}_2\text{S}_{(aq)} + 2 \text{KOH}_{(aq)} \rightarrow 2 \text{H}_2\text{O}_{(l)} + \text{K}_2\text{S}_{(aq)}$ (double replacement)
j. $2 \text{NaCl}_{(l)} \rightarrow 2 \text{Na}_{(l)} + \text{Cl}_{2(g)}$ (decomposition)
k. $2 \text{Al}_{(s)} + 3 \text{H}_2\text{SO}_{4(aq)} \rightarrow 3 \text{H}_{2(g)} + \text{Al}_2(\text{SO}_4)_3(aq)$ (single replacement)
l. $\text{H}_3\text{PO}_{4(aq)} + 3 \text{NH}_4\text{OH}_{(aq)} \rightarrow 3 \text{H}_2\text{O}_{(l)} + (\text{NH}_4)_3\text{PO}_{4(aq)}$ (double replacement)
m. $\text{C}_3\text{H}_{8(g)} + 5 \text{O}_{2(g)} \rightarrow 3 \text{CO}_{2(g)} + 4 \text{H}_2\text{O}_{(l)}$ (hydrocarbon combustion)
n. $4 \text{Al}_{(s)} + 3 \text{O}_{2(g)} \rightarrow 2 \text{Al}_2\text{O}_{3(s)}$ (formation)
o. $\text{CH}_{4(g)} + 2 \text{O}_{2(g)} \rightarrow \text{CO}_{2(g)} + 2 \text{H}_2\text{O}_{(l)}$ (hydrocarbon combustion)
p. $\text{K}_2\text{SO}_{4(aq)} + \text{BaCl}_{2(aq)} \rightarrow 2 \text{KCl}_{(aq)} + \text{BaSO}_{4(s)}$ (double replacement)
q. $\text{C}_5\text{H}_{12(l)} + 8 \text{O}_{2(g)} \rightarrow 5 \text{CO}_{2(g)} + 6 \text{H}_2\text{O}_{(g)}$ (hydrocarbon combustion)
r. $\text{Ca}(\text{OH})_{2(aq)} + 2 \text{NH}_4\text{Cl}_{(aq)} \rightarrow 2 \text{NH}_4\text{OH}_{(aq)} + \text{CaCl}_{2(aq)}$ (double replacement)
s. $\text{V}_2\text{O}_{5(s)} + 5 \text{Ca}_{(s)} \rightarrow 5 \text{CaO}_{(s)} + 2 \text{V}_{(s)}$ (single replacement)
t. $2 \text{Na}_{(s)} + \text{ZnI}_{2(aq)} \rightarrow 2 \text{NaI}_{(aq)} + \text{Zn}_{(s)}$ (single replacement)
u. $\text{C}_7\text{H}_6\text{O}_{3(l)} + 7 \text{O}_{2(g)} \rightarrow 7 \text{CO}_{2(g)} + 3 \text{H}_2\text{O}_{(l)}$ (hydrocarbon combustion)
v. $3 \text{Ca}_{(s)} + \text{N}_{2(g)} \rightarrow \text{Ca}_3\text{N}_{2(s)}$ (formation)
w. $\text{Fe}_2\text{O}_{3(s)} + 3 \text{H}_{2(g)} \rightarrow 2 \text{Fe}_{(s)} + 3 \text{H}_2\text{O}_{(l)}$ (single replacement)
x. $2 \text{C}_{15}\text{H}_{30(l)} + 45 \text{O}_{2(g)} \rightarrow 30 \text{CO}_{2(g)} + 30 \text{H}_2\text{O}_{(g)}$ (hydrocarbon combustion)
y. $2 \text{BN}_{(s)} + 3 \text{F}_{2(g)} \rightarrow 2 \text{BF}_{3(s)} + \text{N}_{2(g)}$ (single replacement)
z. $2 \text{C}_{12}\text{H}_{26(l)} + 37 \text{O}_{2(g)} \rightarrow 24 \text{CO}_{2(g)} + 26 \text{H}_2\text{O}_{(g)}$ (hydrocarbon combustion)

Question 2

- a. $\text{Pb}(\text{NO}_3)_2(aq) + 2 \text{NaI}_{(aq)} \rightarrow \text{PbI}_{2(s)} + 2 \text{NaNO}_3(aq)$ (double replacement)
b. $8 \text{ZnS}_{(s)} + 4 \text{O}_{2(g)} \rightarrow 8 \text{ZnO}_{(s)} + \text{S}_{8(s)}$ (single replacement)
c. $2 \text{C}_4\text{H}_{10(l)} + 13 \text{O}_{2(g)} \rightarrow 8 \text{CO}_{2(g)} + 10 \text{H}_2\text{O}_{(g)}$ (hydrocarbon combustion)
d. $\text{Ba}(\text{OH})_{2(aq)} + 2 \text{HCl}_{(aq)} \rightarrow \text{BaCl}_{2(aq)} + 2 \text{H}_2\text{O}_{(l)}$ (double replacement)
e. $\text{Cu}_{(s)} + 2 \text{AgNO}_{3(aq)} \rightarrow \text{Cu}(\text{NO}_3)_2(aq) + 2 \text{Ag}_{(s)}$ (single replacement)
f. $\text{S}_{8(s)} + 8 \text{O}_{2(g)} \rightarrow 8 \text{SO}_{2(g)}$ (formation)
g. $\text{Al}_2(\text{SO}_4)_3(aq) + 3 \text{Ca}(\text{OH})_{2(aq)} \rightarrow 2 \text{Al}(\text{OH})_3(s) + 3 \text{CaSO}_4(s)$ (double replacement)
h. $\text{Zn}_{(s)} + \text{H}_2\text{SO}_{4(aq)} \rightarrow \text{ZnSO}_{4(aq)} + \text{H}_{2(g)}$ (single replacement)
i. $2 \text{Al}_{(s)} + 3 \text{Cl}_{2(g)} \rightarrow 2 \text{AlCl}_{3(s)}$ (formation)
j. $\text{C}_{12}\text{H}_{22}\text{O}_{11(s)} + 12 \text{O}_{2(g)} \rightarrow 12 \text{CO}_{2(g)} + 11 \text{H}_2\text{O}_{(l)}$ (hydrocarbon combustion)