

A Voyage through Equations

After working on this worksheet, you should be able to do the following:

- 1) Given an equation, you should be able to tell what kind of reaction it is.
- 2) Predict the products of a reaction when given the reactants.

Section 1: Identify the type of reaction

For the following reactions, indicate whether the following are examples of synthesis, decomposition, combustion, single displacement, double displacement, or acid-base reactions:

- 1) $\text{Na}_3\text{PO}_4 + 3 \text{KOH} \rightarrow 3 \text{NaOH} + \text{K}_3\text{PO}_4$ _____
- 2) $\text{MgCl}_2 + \text{Li}_2\text{CO}_3 \rightarrow \text{MgCO}_3 + 2 \text{LiCl}$ _____
- 3) $\text{C}_6\text{H}_{12} + 9 \text{O}_2 \rightarrow 6 \text{CO}_2 + 6 \text{H}_2\text{O}$ _____
- 4) $\text{Pb} + \text{FeSO}_4 \rightarrow \text{PbSO}_4 + \text{Fe}$ _____
- 5) $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$ _____
- 6) $\text{P}_4 + 3 \text{O}_2 \rightarrow 2 \text{P}_2\text{O}_3$ _____
- 7) $2 \text{RbNO}_3 + \text{BeF}_2 \rightarrow \text{Be}(\text{NO}_3)_2 + 2 \text{RbF}$ _____
- 8) $2 \text{AgNO}_3 + \text{Cu} \rightarrow \text{Cu}(\text{NO}_3)_2 + 2 \text{Ag}$ _____
- 9) $\text{C}_3\text{H}_6\text{O} + 4 \text{O}_2 \rightarrow 3 \text{CO}_2 + 3 \text{H}_2\text{O}$ _____
- 10) $2 \text{C}_5\text{H}_5 + \text{Fe} \rightarrow \text{Fe}(\text{C}_5\text{H}_5)_2$ _____
- 11) $\text{SeCl}_6 + \text{O}_2 \rightarrow \text{SeO}_2 + 3 \text{Cl}_2$ _____
- 12) $2 \text{MgI}_2 + \text{Mn}(\text{SO}_3)_2 \rightarrow 2 \text{MgSO}_3 + \text{MnI}_4$ _____
- 13) $\text{O}_3 \rightarrow \text{O} \cdot + \text{O}_2$ _____
- 14) $2 \text{NO}_2 \rightarrow 2 \text{O}_2 + \text{N}_2$ _____

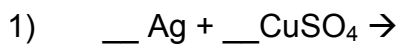
Section 2: Practicing equation balancing

Before you can write a balanced equation for a problem which asks you to predict the products of a reaction, you need to know how to balance an equation. Because some of you may not fully remember how to balance an equation, here are some practice problems:

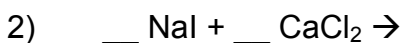
- 1) $__ \text{C}_6\text{H}_6 + __ \text{O}_2 \rightarrow __ \text{H}_2\text{O} + __ \text{CO}_2$
- 2) $__ \text{NaI} + __ \text{Pb}(\text{SO}_4)_2 \rightarrow __ \text{PbI}_4 + __ \text{Na}_2\text{SO}_4$
- 3) $__ \text{NH}_3 + __ \text{O}_2 \rightarrow __ \text{NO} + __ \text{H}_2\text{O}$
- 4) $__ \text{Fe}(\text{OH})_3 \rightarrow __ \text{Fe}_2\text{O}_3 + __ \text{H}_2\text{O}$
- 5) $__ \text{HNO}_3 + __ \text{Mg}(\text{OH})_2 \rightarrow __ \text{H}_2\text{O} + __ \text{Mg}(\text{NO}_3)_2$
- 6) $__ \text{H}_3\text{PO}_4 + __ \text{NaBr} \rightarrow __ \text{HBr} + __ \text{Na}_3\text{PO}_4$
- 7) $__ \text{C} + __ \text{H}_2 \rightarrow __ \text{C}_3\text{H}_8$
- 8) $__ \text{CaO} + __ \text{MnI}_4 \rightarrow __ \text{MnO}_2 + __ \text{CaI}_2$
- 9) $__ \text{Fe}_2\text{O}_3 + __ \text{H}_2\text{O} \rightarrow __ \text{Fe}(\text{OH})_3$
- 10) $__ \text{C}_2\text{H}_2 + __ \text{H}_2 \rightarrow __ \text{C}_2\text{H}_6$
- 11) $__ \text{VF}_5 + __ \text{HI} \rightarrow __ \text{V}_2\text{I}_{10} + __ \text{HF}$
- 12) $__ \text{OsO}_4 + __ \text{PtCl}_4 \rightarrow __ \text{PtO}_2 + __ \text{OsCl}_8$
- 13) $__ \text{CF}_4 + __ \text{Br}_2 \rightarrow __ \text{CBr}_4 + __ \text{F}_2$
- 14) $__ \text{Hg}_2\text{I}_2 + __ \text{O}_2 \rightarrow __ \text{Hg}_2\text{O} + __ \text{I}_2$
- 15) $__ \text{Y}(\text{NO}_3)_2 + __ \text{GaPO}_4 \rightarrow __ \text{YPO}_4 + __ \text{Ga}(\text{NO}_3)_2$

Section 3: Predicting the products of chemical reactions

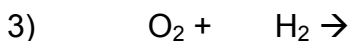
Predict the products of the following reactions:



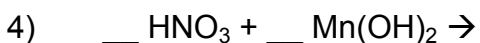
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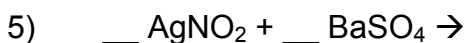
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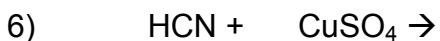
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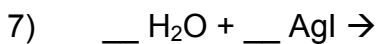
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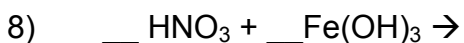
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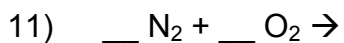
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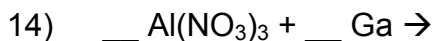
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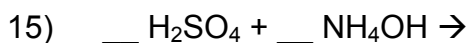
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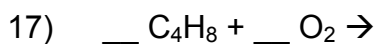
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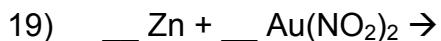
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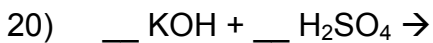
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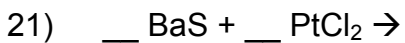
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A Voyage through Equations ANSWER KEY

Section 1: Identify the type of reaction

- 1) $\text{Na}_3\text{PO}_4 + 3 \text{KOH} \rightarrow 3 \text{NaOH} + \text{K}_3\text{PO}_4$ DOUBLE DISPLACEMENT
- 2) $\text{MgCl}_2 + \text{Li}_2\text{CO}_3 \rightarrow \text{MgCO}_3 + 2 \text{LiCl}$ DOUBLE DISPLACEMENT
- 3) $\text{C}_6\text{H}_{12} + 9 \text{O}_2 \rightarrow 6 \text{CO}_2 + 6 \text{H}_2\text{O}$ COMBUSTION
- 4) $\text{Pb} + \text{FeSO}_4 \rightarrow \text{PbSO}_4 + \text{Fe}$ SINGLE DISPLACEMENT
- 5) $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$ DECOMPOSITION
- 6) $\text{P}_4 + 3 \text{O}_2 \rightarrow 2 \text{P}_2\text{O}_3$ SYNTHESIS
- 7) $2 \text{RbNO}_3 + \text{BeF}_2 \rightarrow \text{Be}(\text{NO}_3)_2 + 2 \text{RbF}$ DOUBLE DISPLACEMENT
- 8) $2 \text{AgNO}_3 + \text{Cu} \rightarrow \text{Cu}(\text{NO}_3)_2 + 2 \text{Ag}$ SINGLE DISPLACEMENT
- 9) $\text{C}_3\text{H}_8\text{O} + 4 \text{O}_2 \rightarrow 3 \text{CO}_2 + 3 \text{H}_2\text{O}$ COMBUSTION
- 10) $2 \text{C}_5\text{H}_5 + \text{Fe} \rightarrow \text{Fe}(\text{C}_5\text{H}_5)_2$ SYNTHESIS
- 11) $\text{SeCl}_6 + \text{O}_2 \rightarrow \text{SeO}_2 + 3 \text{Cl}_2$ SINGLE DISPLACEMENT
- 12) $2 \text{MgI}_2 + \text{Mn}(\text{SO}_3)_2 \rightarrow 2 \text{MgSO}_3 + \text{MnI}_4$ DOUBLE DISPLACEMENT
- 13) $\text{O}_3 \rightarrow \text{O} \cdot + \text{O}_2$ DECOMPOSITION
- 14) $2 \text{NO}_2 \rightarrow 2 \text{O}_2 + \text{N}_2$ DECOMPOSITION

Section 2: Practicing equation balancing

- 1) 2 $\text{C}_6\text{H}_6 + \text{15} $\text{O}_2 \rightarrow \text{6}$ $\text{H}_2\text{O} + \text{12}$ $\text{CO}_2$$
- 2) 4 $\text{NaI} + \text{1}$ $\text{Pb}(\text{SO}_4)_2 \rightarrow \text{1}$ $\text{PbI}_4 + \text{2}$ Na_2SO_4
- 3) 2 $\text{NH}_3 + \text{2}$ $\text{O}_2 \rightarrow \text{1}$ $\text{NO} + \text{3}$ H_2O
- 4) 2 $\text{Fe}(\text{OH})_3 \rightarrow \text{1}$ $\text{Fe}_2\text{O}_3 + \text{3}$ H_2O
- 5) 2 $\text{HNO}_3 + \text{1}$ $\text{Mg}(\text{OH})_2 \rightarrow \text{2}$ $\text{H}_2\text{O} + \text{1}$ $\text{Mg}(\text{NO}_3)_2$
- 6) 1 $\text{H}_3\text{PO}_4 + \text{3}$ $\text{NaBr} \rightarrow \text{3}$ $\text{HBr} + \text{1}$ Na_3PO_4
- 7) 3 $\text{C} + \text{4}$ $\text{H}_2 \rightarrow \text{1}$ C_3H_8
- 8) 2 $\text{CaO} + \text{1}$ $\text{MnI}_4 \rightarrow \text{1}$ $\text{MnO}_2 + \text{2}$ CaI_2
- 9) 1 $\text{Fe}_2\text{O}_3 + \text{3}$ $\text{H}_2\text{O} \rightarrow \text{2}$ $\text{Fe}(\text{OH})_3$
- 10) 1 $\text{C}_2\text{H}_2 + \text{2}$ $\text{H}_2 \rightarrow \text{1}$ C_2H_6

- 11) $2 \text{VF}_5 + 10 \text{HI} \rightarrow 1 \text{V}_2\text{I}_{10} + 10 \text{HF}$
- 12) $1 \text{OsO}_4 + 2 \text{PtCl}_4 \rightarrow 2 \text{PtO}_2 + 1 \text{OsCl}_8$
- 13) $1 \text{CF}_4 + 2 \text{Br}_2 \rightarrow 1 \text{CBr}_4 + 2 \text{F}_2$
- 14) $2 \text{Hg}_2\text{I}_2 + 1 \text{O}_2 \rightarrow 2 \text{Hg}_2\text{O} + 2 \text{I}_2$
- 15) $1 \text{Y}(\text{NO}_3)_2 + 1 \text{GaPO}_4 \rightarrow 1 \text{YPO}_4 + 1 \text{Ga}(\text{NO}_3)_2$

Section 3: Predicting the products of chemical reactions

- | | |
|--|----------------------------------|
| 1) $2 \text{Ag} + 1 \text{CuSO}_4 \rightarrow 1 \text{Ag}_2\text{SO}_4 + 1 \text{Cu}$ | Type: <u>Single Displacement</u> |
| 2) $2 \text{NaI} + 1 \text{CaCl}_2 \rightarrow 2 \text{NaCl} + 1 \text{CaI}_2$ | Type: <u>Double Displacement</u> |
| 3) $1 \text{O}_2 + 1 \text{H}_2 \rightarrow 2 \text{H}_2\text{O}$ | Type: <u>Synthesis</u> |
| 4) $2 \text{HNO}_3 + 1 \text{Mn}(\text{OH})_2 \rightarrow 2 \text{H}_2\text{O} + 1 \text{Mn}(\text{NO}_3)_2$ | Type: <u>Acid-Base</u> |
| 5) $2 \text{AgNO}_2 + 1 \text{BaSO}_4 \rightarrow 1 \text{Ag}_2\text{SO}_4 + 1 \text{Ba}(\text{NO}_2)_2$ | Type: <u>Double Displacement</u> |
| 6) $2 \text{HCN} + 1 \text{CuSO}_4 \rightarrow 1 \text{H}_2\text{SO}_4 + 1 \text{Cu}(\text{CN})_2$ | Type: <u>Double Displacement</u> |
| 7) $1 \text{H}_2\text{O} + 1 \text{AgI} \rightarrow 1 \text{HI} + 1 \text{AgOH}$ | Type: <u>Double Displacement</u> |
| 8) $3 \text{HNO}_3 + 1 \text{Fe}(\text{OH})_3 \rightarrow 3 \text{H}_2\text{O} + 1 \text{Fe}(\text{NO}_3)_3$ | Type: <u>Acid-Base</u> |
| 9) $4 \text{LiBr} + 1 \text{Co}(\text{SO}_3)_2 \rightarrow 2 \text{Li}_2\text{SO}_3 + 1 \text{CoBr}_4$ | Type: <u>Double Displacement</u> |
| 10) $1 \text{LiNO}_3 + 1 \text{Ag} \rightarrow 1 \text{AgNO}_3 + 1 \text{Li}$ | Type: <u>Single Displacement</u> |
| 11) $1 \text{N}_2 + 2 \text{O}_2 \rightarrow 2 \text{NO}_2$ | Type: <u>Synthesis</u> |
| 12) $1 \text{H}_2\text{CO}_3 \rightarrow 1 \text{CO}_2 + 1 \text{H}_2\text{O}$ | Type: <u>Decomposition</u> |
| 13) $1 \text{AlCl}_3 + 3 \text{Cs} \rightarrow 3 \text{CsCl} + 1 \text{Al}$ | Type: <u>Single Displacement</u> |
| 14) $1 \text{Al}(\text{NO}_3)_3 + 1 \text{Ga} \rightarrow 1 \text{Ga}(\text{NO}_3)_3 + 1 \text{Al}$ | Type: <u>Single Displacement</u> |
| 15) $1 \text{H}_2\text{SO}_4 + 2 \text{NH}_4\text{OH} \rightarrow 2 \text{H}_2\text{O} + 1 (\text{NH}_4)_2\text{SO}_4$ | Type: <u>Acid-Base</u> |
| 16) $1 \text{CH}_3\text{COOH} + 1 \text{O}_2 \rightarrow 1 \text{CO}_2 + 2 \text{H}_2\text{O}$ | Type: <u>Combustion</u> |
| 17) $1 \text{C}_4\text{H}_8 + 6 \text{O}_2 \rightarrow 4 \text{CO}_2 + 4 \text{H}_2\text{O}$ | Type: <u>Combustion</u> |
| 18) $2 \text{KCl} + 1 \text{Mg}(\text{OH})_2 \rightarrow 2 \text{KOH} + 1 \text{MgCl}_2$ | Type: <u>Double Displacement</u> |
| 19) $1 \text{Zn} + 1 \text{Au}(\text{NO}_2)_2 \rightarrow 1 \text{Zn}(\text{NO}_2)_2 + 1 \text{Au}$ | Type: <u>Single Displacement</u> |
| 20) $2 \text{KOH} + 1 \text{H}_2\text{SO}_4 \rightarrow 1 \text{K}_2\text{SO}_4 + 2 \text{H}_2\text{O}$ | Type: <u>Acid-Base</u> |
| 21) $1 \text{BaS} + 1 \text{PtCl}_2 \rightarrow 1 \text{BaCl}_2 + 1 \text{PtS}$ | Type: <u>Double Displacement</u> |
| 22) $2 \text{Na}_2\text{O} \rightarrow 4 \text{Na} + 1 \text{O}_2$ | Type: <u>Decomposition</u> |