

## 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)  $2 \text{NO}_2 \rightarrow 2 \text{O}_2 + \text{N}_2$  \_\_\_\_\_

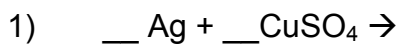
## Section 2: Practicing equation balancing

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:

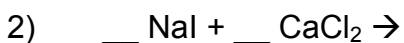
- 1)  $\_\_ \text{C}_6\text{H}_6 + \_\_ \text{O}_2 \rightarrow \_\_ \text{H}_2\text{O} + \_\_ \text{CO}_2$
- 2)  $\_\_ \text{NaI} + \_\_ \text{Pb}(\text{SO}_4)_2 \rightarrow \_\_ \text{PbI}_4 + \_\_ \text{Na}_2\text{SO}_4$
- 3)  $\_\_ \text{NH}_3 + \_\_ \text{O}_2 \rightarrow \_\_ \text{NO} + \_\_ \text{H}_2\text{O}$
- 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

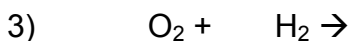
Predict the products of the following reactions:



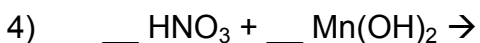
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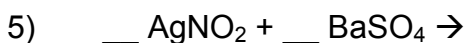
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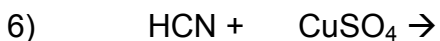
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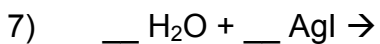
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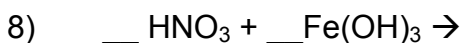
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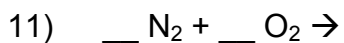
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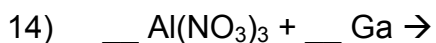
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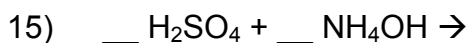
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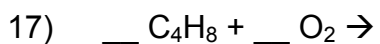
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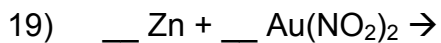
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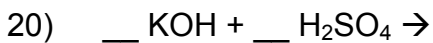
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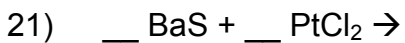
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## A Voyage through Equations ANSWER KEY

### 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)  $\text{C}_3\text{H}_6\text{O} + 4 \text{O}_2 \rightarrow 3 \text{CO}_2 + 3 \text{H}_2\text{O}$  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)  $\text{O}_3 \rightarrow \text{O} + \text{O}_2$  DECOMPOSITION
- 14)  $2 \text{NO}_2 \rightarrow 2 \text{O}_2 + \text{N}_2$  DECOMPOSITION

### Section 2: Practicing equation balancing

- 1) 2  $\text{C}_6\text{H}_6 +$  15  $\text{O}_2 \rightarrow$  6  $\text{H}_2\text{O} +$  12  $\text{CO}_2$
- 2) 4  $\text{NaI} +$  1  $\text{Pb}(\text{SO}_4)_2 \rightarrow$  1  $\text{PbI}_4 +$  2  $\text{Na}_2\text{SO}_4$
- 3) 2  $\text{NH}_3 +$  2  $\text{O}_2 \rightarrow$  1  $\text{NO} +$  3  $\text{H}_2\text{O}$
- 4) 2  $\text{Fe}(\text{OH})_3 \rightarrow$  1  $\text{Fe}_2\text{O}_3 +$  3  $\text{H}_2\text{O}$
- 5) 2  $\text{HNO}_3 +$  1  $\text{Mg}(\text{OH})_2 \rightarrow$  2  $\text{H}_2\text{O} +$  1  $\text{Mg}(\text{NO}_3)_2$
- 6) 1  $\text{H}_3\text{PO}_4 +$  3  $\text{NaBr} \rightarrow$  3  $\text{HBr} +$  1  $\text{Na}_3\text{PO}_4$
- 7) 3  $\text{C} +$  4  $\text{H}_2 \rightarrow$  1  $\text{C}_3\text{H}_8$
- 8) 2  $\text{CaO} +$  1  $\text{MnI}_4 \rightarrow$  1  $\text{MnO}_2 +$  2  $\text{CaI}_2$
- 9) 1  $\text{Fe}_2\text{O}_3 +$  3  $\text{H}_2\text{O} \rightarrow$  2  $\text{Fe}(\text{OH})_3$
- 10) 1  $\text{C}_2\text{H}_2 +$  2  $\text{H}_2 \rightarrow$  1  $\text{C}_2\text{H}_6$

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