

# **Types of Chemical Reactions**

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## **Objectives**

- Identify the five types of chemical rxns
- Predict the products of these rxns

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## **Reaction Types**

- Combination/synthesis
- Decomposition
- Single replacement
- Double replacement
- Combustion

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## Combination/synthesis

- Combine = put together
- $A + B \rightarrow AB$  **ONE PRODUCT**
- $2Ca + O_2 \rightarrow 2CaO$
- $SO_3 + H_2O \rightarrow H_2SO_4$
- Predict the products then balance eqn:
- $Mg + N_2 \rightarrow \underline{\hspace{2cm}}$

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- Complete the rxn and balance:
  - Calcium reacts with chlorine
  - Iron reacts with oxygen [the product contains iron (III)]
  - Potassium reacts with bromine

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## Decomposition

- Decompose = fall apart
- $AB \rightarrow A + B$  **ONE REACTANT**
- $2NaCl \xrightarrow{\text{electricity}} 2Na + Cl_2$
- $CaCO_3 \xrightarrow{\Delta} CaO + CO_2$
- Note that energy (heat, sunlight, electricity, etc) is usually required

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- You can usually predict the product if reactant is a binary cmpd (breaks apart into its two elements)

- $\text{H}_2\text{O} \rightarrow$
- $\text{HgO} \rightarrow$

- If cmpd has more than 2 elements, you will be given one product and find the other

- $\text{NiCO}_3 \rightarrow \text{CO}_2 +$
- $\text{H}_2\text{CO}_3 \rightarrow \text{CO}_2 +$

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## Single replacement

- One element replaces another in a cmpd
- $\text{E} + \text{AB} \rightarrow \text{EB} + \text{A}$  **ELEMENT+CMPO**
- Metals replace metals, nonmetals replace nonmetals
- $\text{K} + \text{NaCl} \rightarrow \text{Na} + \text{KCl}$
- $\text{F}_2 + 2\text{LiCl} \rightarrow 2\text{LiF} + \text{Cl}_2$

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## Activity series of metals

Higher Activity  
↑  
↓  
Lower Activity

- $\text{Li}^+$
- $\text{K}^+$
- $\text{Ca}^+$
- $\text{Na}^+$
- Mg
- Al
- Zn
- Fe
- Pb
- H
- Cu
- Hg
- Ag
- Pt
- Au

- Metals can replace other metals if they are higher on series
- Metals above H can replace H from acids
- Metals from Na and above (\*) can replace H from water (HOH)

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## Activity series of metals

Higher Activity  
↑  
↓  
Lower Activity

- Li<sup>+</sup>
- K<sup>+</sup>
- Ca<sup>+</sup>
- Na<sup>+</sup>
- Mg
- Al
- Zn
- Fe
- Pb
- H
- Cu
- Hg
- Ag
- Pt
- Au

Practice:

- $K + AlN \rightarrow$
- $Zn + HCl \rightarrow$
- $Mg + CaCl_2 \rightarrow$

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## Activity series of metals

Higher Activity  
↑  
↓  
Lower Activity

- Li<sup>+</sup>
- K<sup>+</sup>
- Ca<sup>+</sup>
- Na<sup>+</sup>
- Mg
- Al
- Zn
- Fe
- Pb
- H
- Cu
- Hg
- Ag
- Pt
- Au

- Think of water has HOH
  - The metal\* replaces only the first H
  - $K + HOH \rightarrow H_2 + KOH$
  - $Li + H(OH) \rightarrow$
  - $Ca + H(OH) \rightarrow$
- [Alkali metals in water](#)

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## Activity of halogens

- Halogens can replace other halogens in cmpds.
- Treat halogen column like an activity series (same rules apply)

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- Li\*
- K\*
- Ca\*
- Na\*
- Mg
- Al
- Zn
- Fe
- Pb
- H
- Cu
- Hg
- Ag
- Pt
- Au

- For the following, determine:
  - Is there a rxn? (use activity series/ halogen column)
  - If so, complete rxn and balance:
- $\text{Fe} + \text{CuSO}_4 \rightarrow$
- $\text{Pb} + \text{KCl} \rightarrow$
- $\text{Al} + \text{HCl} \rightarrow$
- $\text{K} + \text{H}_2\text{O} (\text{HOH}) \rightarrow$
- $\text{NaCl} + \text{F}_2 \rightarrow$
- $\text{MgCl}_2 + \text{Br}_2 \rightarrow$

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## Double replacement

- $\text{AB} + \text{CD} \rightarrow \text{AD} + \text{CB}$       **2 CMPDS**
- Reagents must be ionic cmpds
- $\text{NaOH} + \text{FeCl}_3 \rightarrow \text{NaCl} + \text{Fe}(\text{OH})_3$
- $\text{NaCN} + \text{H}_2\text{SO}_4 \rightarrow \text{HCN} + \text{Na}_2\text{SO}_4$

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- Double replacement rxns usually take place in aqueous solutions
- You **MUST** balance the charges!

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Complete and balance:

- $\text{CaCl}_2 + \text{NaOH} \rightarrow$
- $\text{CuCl}_2 + \text{K}_2\text{S} \rightarrow$
- $\text{KOH} + \text{Fe}(\text{NO}_3)_3 \rightarrow$
- $(\text{NH}_4)_2\text{SO}_4 + \text{BaF}_2 \rightarrow$
- $\text{HCl} + \text{NaOH} \rightarrow$
- $\text{H}_2\text{SO}_4 + \text{KOH} \rightarrow$

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## **Combustion**

- FIRE! Means add  $\text{O}_2$
- $\text{C}_x\text{H}_y + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$
- Complete combustion yields **carbon dioxide** and **water**
  - (Incomplete combustion gives carbon monoxide or just plain C like ash)
- $\text{CH}_4 + 2 \text{O}_2 \rightarrow \text{CO}_2 + 2 \text{H}_2\text{O}$

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Write the balanced equations for the complete combustion of:

- $\text{C}_4\text{H}_{10}$
- $\text{C}_6\text{H}_{12}\text{O}_6$
- $\text{C}_3\text{H}_8$
- $\text{C}_8\text{H}_8$

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