

# Types of chemical reaction

## Target level

This probe is primarily designed for students in the 14–16 age range who have been introduced to the range of reaction types included. It may also be useful for checking the prior knowledge of students on post-16 courses.

## Topics

Types of chemical reaction: displacement, neutralisation, oxidation, reduction, thermal decomposition.

## Rationale

Students in the 14–16 year age range are expected to learn to recognise certain common types of reaction. Students are likely to come across a number of reactions in their studies. Recognising that a reaction is of a certain type can help the student fit the reaction into one of a limited number of classes. (See also the materials on Word equations for the 11–14 age range.) These ideas are discussed in Chapter 9 of the Teachers' notes.

During piloting, it was found that some students found the exercise difficult, but students recognised that it was useful and helped clarify concepts. Teachers reported that the probe was quick and simple to use, led to valuable discussion, and provided useful revision - enabling students to recognise patterns and connections 'between seemingly disparate examples'.

## Instructions

Each student requires a copy of the worksheet Types of chemical reaction. In the pilot some students found it difficult to explain the reasons for their classifications. Teachers may wish to ask some groups of students to just undertake the classification. Students may then be asked to explain the correct responses when the teacher goes through the examples.

It should be emphasised that some reactions may be classified in several categories. (Note that oxidation and reduction are shown as separate classes.)

## Resources

- Student worksheet
- Types of chemical reaction

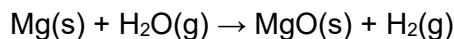
## Feedback for students

A suggested answer sheet for teachers is provided. Teachers may wish to go through the answers for the example on the first page of the worksheet before their students attempt the rest of the exercise.

## Types of chemical reaction – answers

### Example

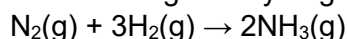
magnesium + steam → magnesium oxide + hydrogen



This is an example of an oxidation (magnesium is oxidised) and therefore also of a reduction (water is reduced).

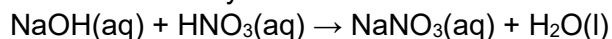
It can also be seen as magnesium displacing hydrogen from water to form the oxide.

1. nitrogen + hydrogen → ammonia



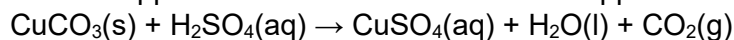
This binary synthesis reaction an example of a reduction (nitrogen is reduced) and therefore also of an oxidation (hydrogen is oxidised).

2. sodium hydroxide + nitric acid → sodium nitrate + water



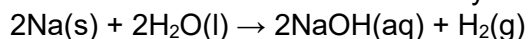
This is an example of a neutralisation reaction between an acid (nitric acid) and an alkali (sodium hydroxide).

3. copper carbonate + sulfuric acid → copper sulfate + water + carbon dioxide



This is an example of an acid-base reaction but is not normally called a neutralisation.

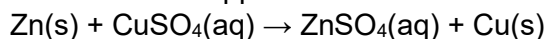
4. sodium + water → sodium hydroxide + hydrogen



This is an example of an oxidation (sodium is oxidised), and therefore also of a reduction (hydrogen from water is reduced).

This could also be considered as an example of a displacement reaction, with sodium displacing hydrogen.

5. zinc + copper sulfate → zinc sulfate + copper

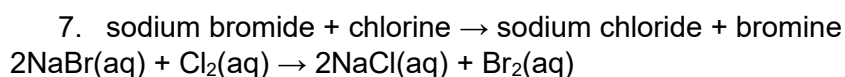


This is an example of a displacement reaction - with zinc displacing copper from the salt. This is also an example of an oxidation (zinc is oxidised) and therefore also of a reduction (copper is reduced).

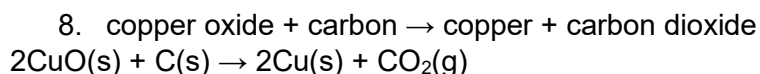
6. copper carbonate → copper oxide + carbon dioxide



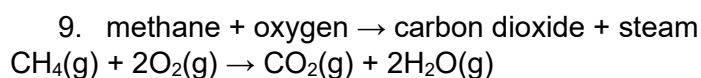
This reaction requires heating and is an example of a thermal decomposition.



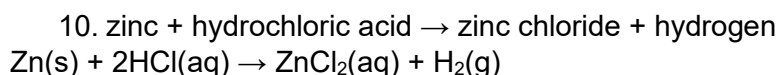
This is an example of a displacement reaction - with chlorine displacing bromine in the salt. It is also an example of an oxidation (bromide is oxidised to bromine) and a reduction (chlorine is reduced to chloride).



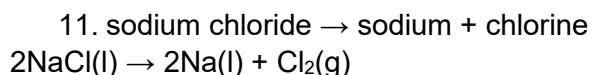
This is an example of a displacement reaction, with carbon displacing copper from the oxide. This is also an oxidation process (carbon is oxidised) and therefore a reduction (copper is reduced).



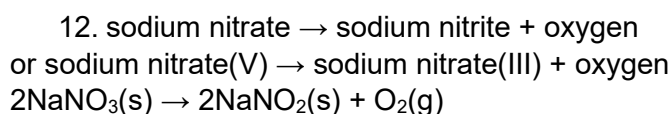
This combustion reaction is an oxidation process (carbon is oxidised) and therefore also a reduction (oxygen is reduced). Some students may feel that hydrogen is also oxidised (as it 'gains' oxygen), although from a perspective of oxidation states hydrogen is unchanged.



This reaction is an example of an oxidation (zinc is oxidised), and therefore also of a reduction (hydrogen is reduced). It may also be considered an example of a displacement reaction with zinc displacing hydrogen.



This reaction requires an input of energy, such as in electrolysis. It is an example of an oxidation process (chlorine is oxidised) and therefore also of a reduction (sodium is reduced).



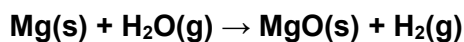
This reaction requires heating and is an example of a thermal decomposition. This is also an example of a reduction process (nitrogen is reduced), and therefore also of an oxidation process (some of the oxygen in the nitrate is oxidised to elemental oxygen). Teachers at post-16 level may wish to stress the nitrate(V) – nitrate(III) nomenclature.

## Types of chemical reaction

Scientists classify chemical reactions into different types - such as oxidation and neutralisation.

This exercises provides the equations for a number of chemical reactions. For each reaction you are given a word equation, and an equation using chemical symbols:

**magnesium + steam → magnesium oxide + hydrogen**



You should try to classify each of the examples given.

- type of reaction
- displacement
- neutralisation
- oxidation
- reduction
- thermal decomposition
- none of the above

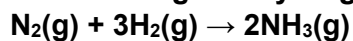
For each reaction tick (✓) the box, or boxes, that describe the type of reaction. Some of the reactions may be examples of more than one type of reaction.

Some of the reactions may only occur when energy is provided (as heat, or as electrical energy), but this is not shown in the questions.

Tick (✓) 'none of the above' if the reaction does not seem to fit any of the suggestions.

Explain why you have classified the reaction the way you have.

**1. nitrogen + hydrogen → ammonia**



type of reaction

displacement

neutralisation

oxidation

reduction

thermal decomposition

none of the above

I made this classification because:

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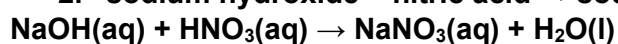
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**2. sodium hydroxide + nitric acid → sodium nitrate + water**



type of reaction

displacement

neutralisation

oxidation

reduction

thermal decomposition

none of the above

I made this classification because:

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**3. copper carbonate + sulfuric acid → copper sulfate + water + carbon dioxide**  
 **$\text{CuCO}_3(\text{s}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{CuSO}_4(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$**

type of reaction

displacement

neutralisation

oxidation

reduction

thermal decomposition

none of the above

I made this classification because:

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**4. sodium + water → sodium hydroxide + hydrogen**  
 **$2\text{Na}(\text{s}) + 2\text{H}_2\text{O}(\text{l}) \rightarrow 2\text{NaOH}(\text{aq}) + \text{H}_2(\text{g})$**

type of reaction

displacement

neutralisation

oxidation

reduction

thermal decomposition

none of the above

I made this classification because:

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**5. zinc + copper sulfate → zinc sulfate + copper**  
**Zn(s) + CuSO<sub>4</sub>(aq) → ZnSO<sub>4</sub>(aq) + Cu(s)**

type of reaction

displacement

neutralisation

oxidation

reduction

thermal decomposition

none of the above

I made this classification because:

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**6. copper carbonate → copper oxide + carbon dioxide**  
**CuCO<sub>3</sub>(s) → CuO(s) + CO<sub>2</sub>(g)**

type of reaction

displacement

neutralisation

oxidation

reduction

thermal decomposition

none of the above

I made this classification because:

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**7. sodium bromide + chlorine → sodium chloride + bromine**  
 **$2\text{NaBr}(\text{aq}) + \text{Cl}_2(\text{aq}) \rightarrow 2\text{NaCl}(\text{aq}) + \text{Br}_2(\text{aq})$**

type of reaction

displacement

neutralisation

oxidation

reduction

thermal decomposition

none of the above

I made this classification because:

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**8. copper oxide + carbon → copper + carbon dioxide**  
 **$2\text{CuO}(\text{s}) + \text{C}(\text{s}) \rightarrow 2\text{Cu}(\text{s}) + \text{CO}_2(\text{g})$**

type of reaction

displacement

neutralisation

oxidation

reduction

thermal decomposition

none of the above

I made this classification because:

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**9. methane + oxygen → carbon dioxide + steam**  
**CH<sub>4</sub>(g) + 2O<sub>2</sub>(g) → CO<sub>2</sub>(g) + 2H<sub>2</sub>O(g)**

type of reaction

displacement

neutralisation

oxidation

reduction

thermal decomposition

none of the above

I made this classification because:

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**10. zinc + hydrochloric acid → zinc chloride + hydrogen**  
**Zn(s) + 2HCl(aq) → ZnCl<sub>2</sub>(aq) + H<sub>2</sub>(g)**

type of reaction

displacement

neutralisation

oxidation

reduction

thermal decomposition

none of the above

I made this classification because:

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**11. sodium chloride → sodium + chlorine**  
 **$2\text{NaCl(l)} \rightarrow 2\text{Na(l)} + \text{Cl}_2\text{(g)}$**

type of reaction

displacement

neutralisation

oxidation

reduction

thermal decomposition

none of the above

I made this classification because:

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**12. sodium nitrate → sodium nitrite + oxygen**  
**or**  
**sodium nitrate(V) → sodium nitrate(III) + oxygen**  
 **$2\text{NaNO}_3\text{(s)} \rightarrow 2\text{NaNO}_2\text{(s)} + \text{O}_2\text{(g)}$**

type of reaction

displacement

neutralisation

oxidation

reduction

thermal decomposition

none of the above

I made this classification because:

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