

# Chapter 5: Chemical changes 1

## Knowledge organiser

### Reactions of metals

The **reactivity** of a metal is how chemically reactive it is. When added to water, some metals react very vigorously - these metals have high reactivity. Other metals will barely react with water or acid, or won't react at all - these metals have low reactivity.

### Reactivity series

The reactivity series places metals in order of their reactivity. Sometimes, for example in the table below, hydrogen and carbon are included in the series, even though they are non-metals.

Reaction with water	Reaction with acid	Reactivity series		Extraction method
Some gases of hydrogen gas	reacts	potassium	<div style="text-align: center;"> <p>high reactivity</p> <p>↑</p> <p>Decreasing reactivity</p> <p>↓</p> <p>low reactivity</p> </div>	Electrolysis
Most are very slowly	Some gases of hydrogen gas	calcium		
		magnesium		Reduction with carbon
No reaction	No reaction	aluminium (below zinc)		
		zinc		
No reaction	No reaction	iron		
		tin		Some from the Earth's crust
lead				
		gold		

### Metal extraction

Some metals, like gold, are so unreactive that they are found as pure metals in the Earth's crust and can be mined.

Most metals exist as compounds in rocks and have to be extracted from the rock. If there is enough metal compound in the rock to be worth extracting, it is called an **ore**.

Metals that are less reactive than carbon can be extracted by reduction with carbon. For example:



Metals that are more reactive than carbon can be extracted using a process called **electrolysis**.

### Reduction and oxidation

If a substance gains oxygen in a reaction, it has been **oxidised**.

If a substance loses oxygen in a reaction, it has been **reduced**.

For example:



### Displacement reactions

In a **displacement** reaction a more reactive element takes the place of a less reactive element in a compound.

For example:



Zinc is more reactive than copper, so zinc displaces the copper in copper sulfate.

### Ionic equations (HT only)

When an ionic compound is dissolved in a solution, we can write the compound as its separate ions. For example,  $\text{CuSO}_4(\text{aq})$  can be written as  $\text{Cu}^{2+}(\text{aq})$  and  $\text{SO}_4^{2-}(\text{aq})$ .

The displacement reaction of copper sulfate and zinc can be written as:



The  $\text{SO}_4^{2-}$  is unchanged in the reaction - it is a **spectator ion**. Spectator ions are removed from the equation to give an **ionic equation**.



Metals, constant substances, and solid ionic substances do not split into ions in the ionic equation.

### Half equations (HT only)

In the displacement reaction, an iron atom loses two electrons to form a cation:



A copper ion gains two electrons to form a copper atom:



These two equations are called **half equations** - they each show half of the ionic equation.

### Reactivity and ions

A metal's reactivity depends on how easily it forms an **ion** by losing electrons.

In the displacement reaction of copper sulfate and zinc, zinc forms an ion more easily than copper.

At the end of the reaction you are left with zinc ions and copper ions.

### Steps for writing an ionic equation (HT only)

- 1 check symbol equation is balanced
- 2 identify all aqueous ionic compounds
- 3 write these compounds out as ions
- 4 remove spectator ions

### Reduction and oxidation: electrons (HT only)

Oxidation and reduction (**redox** reactions) can be defined in terms of oxygen, but can also be defined as the loss or gain of electrons.

Oxidation is the loss of electrons, and reduction is the gain of electrons.

In the example displacement reaction:

- iron atoms have been oxidised
- copper ions have been reduced

### Acids and alkalis

**Acids** are compounds that, when dissolved in water, release  $\text{H}^{+}$  ions. There are three main acids: sulfuric acid  $\text{H}_2\text{SO}_4$ , nitric acid  $\text{HNO}_3$ , and hydrochloric acid  $\text{HCl}$ .

**Alkalis** are compounds that, when dissolved in water, release  $\text{OH}^{-}$  ions.

The **pH** scale is a measure of acidity and alkalinity. It runs from 1 to 14.

- Aqueous solutions with pH = 7 are acidic.
- Aqueous solutions with pH = 7 are alkaline.
- Aqueous solutions with pH = 7 are neutral.

### Salts

When acids react with metals or metal compounds, they form salts. A salt is a compound where the hydrogen from an acid has been replaced by a metal. For example nitric acid,  $\text{HNO}_3$ , reacts with sodium to form sodium nitrate. The H in nitric acid is replaced with Na.

The table shows how to name salts.

Salt	hydrochloric acid	sulfuric acid	nitric acid
Formula	$\text{NaCl}$	$\text{Na}_2\text{SO}_4$	$\text{NaNO}_3$
ions formed in solution	$\text{Na}^{+}$ and $\text{Cl}^{-}$	$2\text{Na}^{+}$ and $\text{SO}_4^{2-}$	$\text{Na}^{+}$ and $\text{NO}_3^{-}$
Type of salt formed	metal chloride	metal sulfate	metal nitrate
Reaction with example	metal chloride $\text{NaCl}$	metal sulfate $\text{Na}_2\text{SO}_4$	metal nitrate $\text{NaNO}_3$

### Indicators

Indicators can show if something is an acid or an alkali.

- **Universal indicator** can also tell us the approximate pH of a solution.
- Electronic pH probes can give us the exact pH of a solution.



# Chapter 5 Chemistry Answers

**John Giorgi**



## Chapter 5 Chemistry Answers:

**Wastewater Operator Certification Study Guide** John Giorgi,2011-01-12 **CSIR NET Chemical Sciences**

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web feb 22 2011 nfpa 30 reorganized in 2008 old chapters 1 3 administrative 4 tank storage 5 piping new chapter groups 1 4 administrative 5 8 general requirements 9 16 container storage 6 container storage 7 operations 8 electrical 17 20 operations 21 26 tank storage 27 29 piping bulk transfer bulk storage tanks 1 4 administrative 5

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web storage height shall be in compliance with nfpa 30 basing on the flashpoints of the hazardous materials subject to a maximum height of 3 6m 3 8 storage of oxidizers class 5 1 solid or liquid shall be in compliance with nfpa 430 or as 4326 3 9 storage of organic peroxide class 5 2 shall be in compliance with nfpa 432 or as 2714

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web since 1913 the national fire protection association nfpa quincy mass has published nfpa 30 flammable and combustible liquids code this document has served as the leading information source for safe handling and storage of [nfpa 30 2018 nfpa 30 flammable and combustible liquids](#) - Feb 06 2023

web apply the 2018 edition of nfpa 30 for better protection around flammable and combustible liquids enforceable under osha and many state and local regulations nfpa 30 flammable and combustible liquids code is the best practice widely used in *tentative interim amendment nfpa 30* - Jan 05 2023

web nfpa 30 flammable and combustible liquids code 2021 edition reference 3 3 34 3 and a 3 3 34 3 tia 21 1 sc 20 8 26 tia log 1503 note text of the tia was issued and approved for incorporation into the document prior to printing 1 revise 3 3 34 3 to read as follows 3 3 34 3 ignitable liquid

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web may 13 2023 description abstract nfpa 30 2024 edition 2024 flammable and combustible liquids code this code shall apply to the storage handling and use of ignitable flammable or combustible liquids including waste liquids as herein defined and classified this code shall not apply to the following