

Ionic Equations and Displacement Reactions

Answer the questions below.

1. Why do metal atoms generally form positive ions?

Metal atoms form positive ions because they tend to lose electrons.

2. What group number are the Noble Gases on the Periodic Table?

The Noble Gases are in group 0 (group 8)

3. What charge do the ions of group 1 elements have?

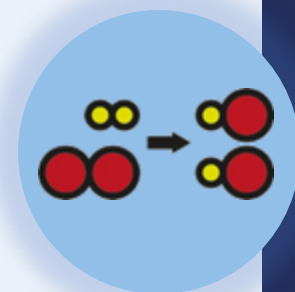
The ions of group 1 elements have a charge of +1

4. What charge do the ions of group 7 elements have?

The ions of group 7 elements have a charge of -1.

5. Sodium oxide contains the ions Na^+ and O^{2-} . What is the chemical formula for sodium oxide?

Na_2O



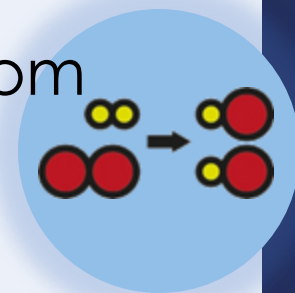
Ionic Equations and Displacement Reactions

Do Now:

1. Why do metal atoms generally form positive ions?
2. What group number are the Noble Gases on the Periodic Table?
3. What charge do the ions of group 1 elements have?
4. What charge do the ions of group 7 elements have?
5. Sodium oxide contains the ions Na^+ and O^{2-} . What is the chemical formula for sodium oxide?

Drill:

1. Draw the electronic configuration for a sodium atom.
2. Draw the electronic configuration for a chlorine atom.
3. Describe in terms of electrons what happens when a sodium atom reacts with a chlorine atom.

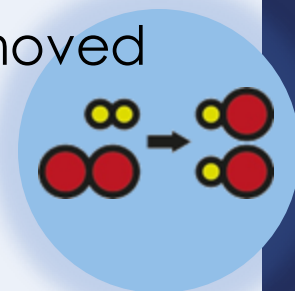


Ionic Equations and Displacement Reactions

Read Now:

Usually, atoms will only give up a small number of electrons in order to form ions. For example, a sodium atom will give up one electron from its outer shell, so that it reaches a more stable electronic arrangement. It is much more difficult to remove another electron from sodium. Scientists are, however, able to remove all of the electrons from some elements! The ions formed in this case are called highly charged ions. Examples of highly charged ions that scientists have made include U^{92+} , Xe^{40+} and Fe^{13+} . The positively charged nucleus is attracted to the negatively charged electrons, This means that it becomes harder and harder to remove each electron as the nucleus pulls the remaining electrons more strongly.

1. How many electrons will a sodium atom give up easily?
2. From which shell will a sodium atom give up an electron?
3. What name is given to the particles produced when many electrons are removed from an atom?
4. State one example of a highly charged ion.
5. Why is it more difficult to remove each additional electron from an atom?



(HT) Ionic Equations and Displacement Reactions

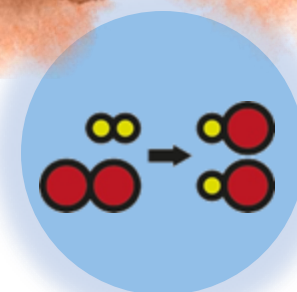
C4.2.4

Science
Mastery



- C4.2.1 PKR: Reactions of Metals
- C4.2.2 Extracting Less Reactive Metals
- C4.2.3 PKR: Ions, Ionic Bonding and Deducing Ionic Formulae
- **C4.2.4 (HT) Ionic Equations and Displacement Reactions**
- C4.2.5 (HT) Writing Half Equations
- C4.2.6 (HT) Ionic Equations for the Reactions of Acids and Metals

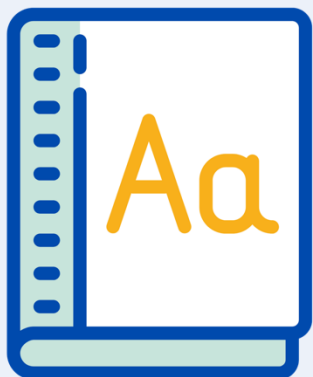
- C4.2.7 Introduction to Electrolysis
- C4.2.8 Extracting Metals by Electrolysis
- C4.2.9 Electrolysis of Molten Ionic Compounds
- C4.2.10 Electrolysis in Solutions
- C4.2.11 RP: Electrolysis of Aqueous Solutions 1
- C4.1.12 RP: Electrolysis of Aqueous Solutions 2
- C4.1.13 TIF: Corrosion and its Prevention
- C4.2.14 (HT) Obtaining Raw Materials
- C4.2.15 Recycling Metals
- C4.2.16 Feedback Lesson



Following this lesson, students will be able to:

- Write chemical equations in terms of ions
- Write ionic equations for displacement reactions
- Identify oxidised and reduced species using ionic equations

Key Words:



spectator ions

oxidation

displacement

reduction

This is the fix-it portion of the lesson

The **fix-it** is an opportunity to respond to gaps in knowledge, especially those identified by the previous lesson's exit ticket.

- The teacher should customise this slide as needed, to facilitate
 - **reteach, explanation, demonstration** or **modelling** of ideas and concepts that students have not yet grasped or have misunderstood.
 - **practise** answering specific questions or of key skills.
 - **redrafting** or **improving** previous work.

Answer the questions below.

1. Which answer correctly shows a sodium ion?

- ☐ A. Na
☒ B. Na⁺
☐ C. Na⁻

2. Which statement is true?

- ☐ A. Metal atoms gain electrons to become positive ions
☒ B. Metal atoms gain electrons to become negative ions
☒ C. Metal atoms lose electrons to become positive ions
☐ D. Metal atoms lose electrons to become negative ions

3. The ions within lithium oxide are listed below. What is the empirical formula of lithium oxide?

- ☒ A. LiCl₂
☐ B. Li₂Cl
☐ C. LiCl



Exit ticket

- (a) Identify the ions present in each of these formulae
 (b) State how many of each ion is in the formula

1. NaCl	1 Na ⁺	1 Cl ⁻	4. H ₂ SO ₄	2 H ⁺	1 SO ₄ ²⁻
2. HCl	1 H ⁺	1 Cl ⁻	5. Cu(NO ₃) ₂	1 Cu ²⁺	2 NO ₃ ⁻
3. Li ₂ O	2 Li ⁺	1 O ²⁻			

(c) Complete the table below.

A	B	Would A need to <u>gain</u> or <u>lose</u> electrons to become B?	How many electrons?
H _(g)	H ⁺ _(aq)	lose	1
Na ⁺ _(aq)	Na _(s)	gain	1
Cl _{2(g)}	2Cl ⁻ _(aq)	gain	2
Cu ²⁺ _(aq)	Cu _(s)	gain	2
Mg _(s)	Mg ²⁺ _(aq)	lose	2

Writing ionic equations

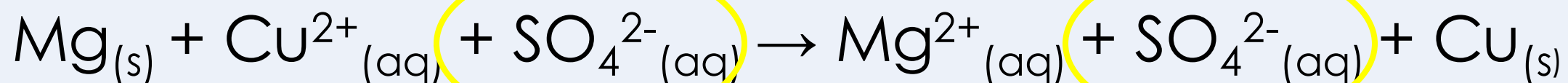
Look at this chemical equation:



Use your
list of ions
handout to
help!

We can use **2 steps** to write this as an ionic equation:

Step 1: Split up the **aqueous** (aq) substances into their ions



Step 2: Delete the **spectator** ions (the ones that appear on both sides)



What does an ionic equation show?



- Magnesium **atoms** lose 2 electrons to become positively charged **ions**
- This loss of electrons is called **oxidation**

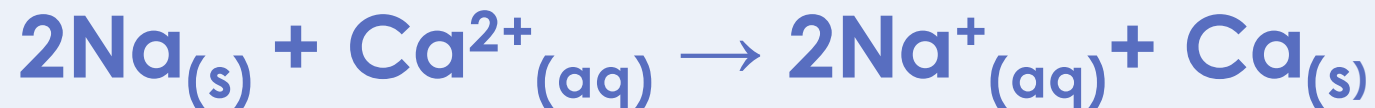
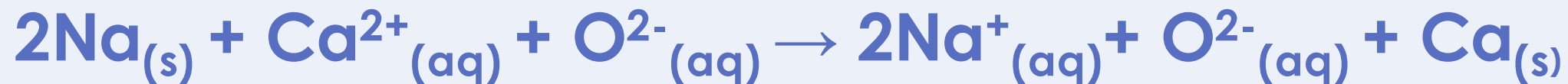
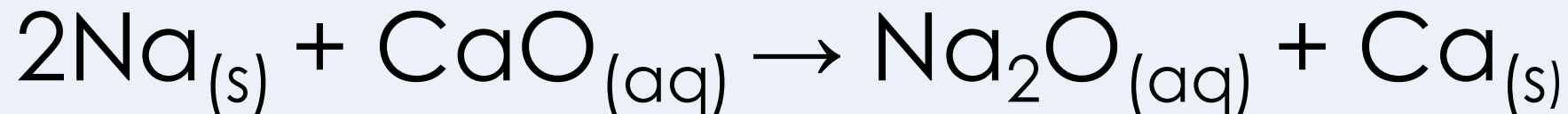
Oxidation is the loss of electrons

- Copper **ions** gain 2 electrons to become neutral **atoms**
- This gain of electrons is called **reduction**

Reduction is the gain of electrons

A redox reaction is one in which oxidation and reduction take place at the same time

With your partner, write an ionic equation for the chemical reaction below.



Discuss which species is oxidised and which is reduced.

- Sodium is oxidised because it loses electrons
- Calcium is reduced because it gains electrons

Drill

1. Define oxidation in terms of electrons
2. Define reduction in terms of electrons
3. List the ions that make up LiOH
4. List the ions that make up Na₂O
5. What must happen to Fe²⁺ to turn it into Fe?
6. What is a redox reaction?
7. Write an ionic equation for the following reaction:
$$\text{Zn}_{(s)} + \text{CuCl}_{2(aq)} \rightarrow \text{ZnCl}_{2(aq)} + \text{Cu}_{(s)}$$
8. Write the down the spectator ion in question 7
9. State which species is oxidised in question 7
10. State which species is reduced in question 7

**Use your
list of ions
handout to
help!**

Drill answers

1. Oxidation is the loss of electrons
2. Reduction is the gain of electrons
3. Li^+ OH^-
4. Na^+ O^{2-}
5. Fe^{2+} must gain 2 electrons to become Fe
6. A redox reaction is one in which oxidation and reduction take place at the same time
7. $\text{Zn}_{(s)} + \text{Cu}^{2+}_{(aq)} \rightarrow \text{Zn}^{2+}_{(aq)} + \text{Cu}_{(s)}$
8. $2\text{Cl}^-_{(aq)}$
9. Zinc is oxidised because it loses electrons
10. Copper is reduced because it gains electrons

I: Writing ionic equations

The equation for the reaction between zinc and hydrochloric acid is as follows:



1. Write an ionic equation for this reaction

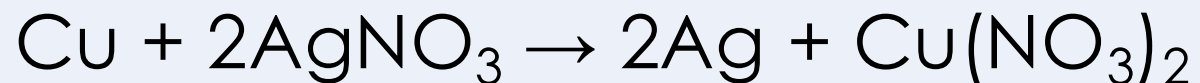


2. Explain which species is reduced in this reaction.

Hydrogen is reduced in this reaction because it gains electrons

We: Writing ionic equations

The equation for the displacement reaction between copper and silver nitrate is as follows:



1. Write an ionic equation for this reaction

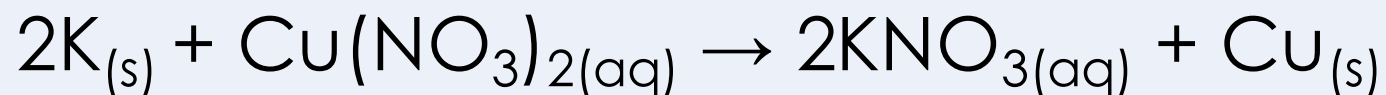


2. Explain which species is oxidised in this reaction.

Copper is oxidised because it loses electrons

You: Writing ionic equations

The equation for the displacement reaction between potassium and copper nitrate is as follows:



1. Write an ionic equation for this reaction



2. Explain which species is oxidised in this reaction.

Potassium is oxidised because it loses electrons

Answer the questions below.

1. Define reduction.

- ☒ A. Reduction is the loss of oxygen or the gain of electrons
- ☐ B. Reduction is the loss of oxygen or the loss of electrons
- ☐ C. Reduction is the gain of oxygen or the gain of electrons
- ☐ D. Reduction is the gain of oxygen or the loss of electrons.

2. Magnesium reacts with copper (II) sulfate in a displacement reaction.

The chemical equation for this reaction is $\text{Mg(s)} + \text{CuSO}_4\text{(aq)} \rightarrow \text{MgSO}_4\text{(aq)} + \text{Cu(s)}$. What is the ionic equation for this reaction?

- ☐ A. $\text{Mg(s)} + \text{Cu}^{2+}\text{(aq)} + \text{SO}_4^{2-}\text{(aq)} \rightarrow \text{Mg}^{2+}\text{(aq)} + \text{SO}_4^{2-}\text{(aq)} + \text{Cu(s)}$
- ☒ B. $\text{Mg(s)} + \text{Cu}^{2+}\text{(aq)} \rightarrow \text{Mg}^{2+}\text{(aq)} + \text{Cu(s)}$
- ☐ C. $2\text{Mg(s)} + \text{Cu}^{2+}\text{(aq)} \rightarrow \text{Mg}^{2+}\text{(aq)} + 2\text{Cu(s)}$

Answer the questions below.

3. Sodium atoms are sometimes oxidised to become positively charged sodium ions. Why is this an oxidation reaction?

- ☐ A. Because oxygen is added to the sodium atoms
- ☐ B. Because oxygen is lost from the sodium atoms
- ☒ C. Because the sodium atoms lose electrons to become positively charged
- ☐ D. Because the sodium atoms gain electrons to become positively charged

Lesson C4.2.4

What was good about this lesson?

What can we do to improve this lesson?

[Send us your feedback by clicking this link](#)
or by emailing sciencemastery@arkonline.org
Thank you!