



# Ionic Formulae

## Topic Summary

- Ionic compounds form when metals transfer electrons to non-metals, creating positive and negative ions.
- Ions combine in ratios that balance overall charge to form a neutral compound.
- Dot-and-cross diagrams show the electron transfers to determine ion charges and empirical formulae for ionic compounds.
- The charges of some ions can be predicted from the periodic table, for example: Group 1 -  $1^+$ , Group 2 -  $2^+$  and Group 7 -  $1^-$ .
- To predict an empirical formula, match the ionic charges so positives balance out negatives (e.g.  $\text{Mg}^{2+}$  with  $\text{O}^{2-}$  lead to  $\text{MgO}$  and  $\text{Li}^+$  with  $\text{O}^{2-}$  lead to  $\text{Li}_2\text{O}$ ).
- Polyatomic anions act as single charged units (e.g.  $[\text{OH}]^{1-}$ ,  $[\text{CO}_3]^{2-}$ ,  $[\text{SO}_4]^{2-}$ ,  $[\text{NO}_3]^{1-}$ ).
- Roman numerals show the charge of metals with multiple possible ions (e.g. copper (II) oxide vs. copper (I) oxide).
- The crossover method can help find ratios quickly—but always simplify to the lowest whole number ratio to get the formula.



## Recall and basic skills

1. This question is about the empirical formula for the compound **sodium oxide**.

What is the most common charge on a sodium ion? .....  $1^+$  ..... (1 mark)

What is the most common charge on an oxide ion? .....  $2^-$  ..... (1 mark)

How many sodium ions will be required for each oxide ion, if the final compound is to be neutral overall?

..... 2 ..... (1 mark)

What is the correct empirical formula for the compound **sodium oxide**?

.....  $\text{Na}_2\text{O}$  ..... (1 mark)

2. Write the electron configurations of the following **ions**.

$\text{Na}^{1+}$  : .....  $2., \dots, \dots 8.$  ..... (1 mark)

$\text{Cl}^{1-}$  : .....  $2., \dots, \dots 8., \dots, \dots 8.$  ..... (1 mark)

$\text{Mg}^{2+}$  : .....  $2., \dots, \dots 8.$  ..... (1 mark)

$\text{O}^{2-}$  : .....  $2., \dots, \dots 8.$  ..... (1 mark)



# Ionic Formulae - Page 2



## Basic Questions

Write the empirical formula of each of these compounds

Lithium chloride: .....LiCl.....

Calcium chloride: .....CaCl<sub>2</sub>.....

Sodium fluoride: .....NaF.....

Aluminium chloride: .....AlCl<sub>3</sub>.....

Potassium bromide: .....KBr.....

Magnesium fluoride: .....MgF<sub>2</sub>.....

Magnesium oxide: .....MgO.....

Sodium oxide: .....Na<sub>2</sub>O.....

Calcium oxide: .....CaO.....

Aluminium oxide: .....Al<sub>2</sub>O<sub>3</sub>.....



## Questions with polyatomic anions

Write the empirical formula of each of these compounds

Lithium nitrate: .....LiNO<sub>3</sub>.....

Calcium carbonate: .....CaCO<sub>3</sub>.....

Sodium carbonate: .....Na<sub>2</sub>CO<sub>3</sub>.....

Sodium hydroxide: .....NaOH.....

Potassium sulphate: .....K<sub>2</sub>SO<sub>4</sub>.....

Potassium nitrate: .....KNO<sub>3</sub>.....

Magnesium nitrate: .....Mg(NO<sub>3</sub>)<sub>2</sub>.....

Magnesium hydroxide: .....Mg(OH)<sub>2</sub>.....



## Questions with other ions

Write the empirical formula of each of these compounds

Copper (II) oxide: .....CuO.....

Copper (II) sulphate: .....CuSO<sub>4</sub>.....

Iron (II) chloride: .....FeCl<sub>2</sub>.....

Lead (II) nitrate: .....Pb(NO<sub>3</sub>)<sub>2</sub>.....

Lead (II) chloride: .....PbCl<sub>2</sub>.....

Zinc (II) Oxide: .....ZnO.....



## Do this later...

Give your brain a break and come back to these questions later. Cover the rest of the sheet while you have a go. By doing this 24-48 hours after watching the video you will boost your chances of remembering the key points in an exam. If you struggle with these questions, re-watch the video and then try again.

1. Write out the electron configuration for a magnesium atom and an Mg<sup>2+</sup> ion.  
2,8 (0)
2. Write out the empirical formula of magnesium carbonate  
MgCO<sub>3</sub>
3. Write out the empirical formula of copper (II) sulphate  
CuSO<sub>4</sub>
4. Draw out a dot and cross diagram to show the bonding in sodium chloride.  
[Na]<sup>1+</sup> and a [Cl]<sup>1-</sup> with either 7 dots and one cross or 7 crosses and 1 dot inside its square bracket.

