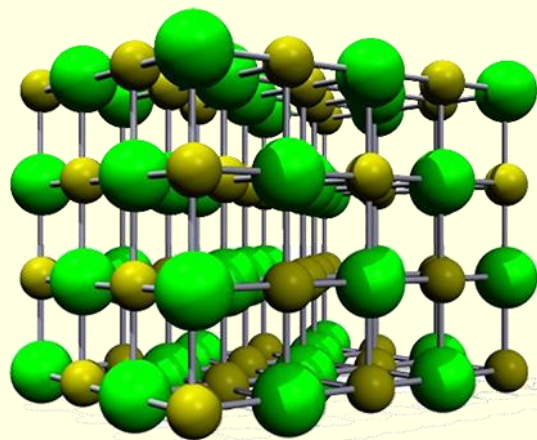


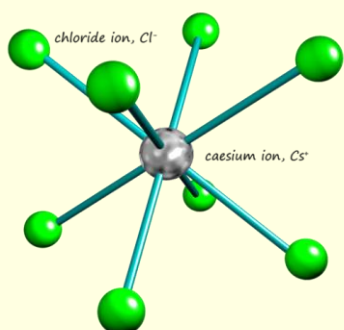
# Ionic compounds

Answer all the questions and they check your answers.

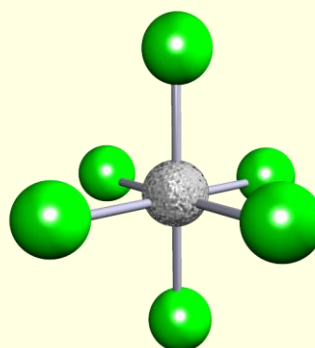
1. What charge do metal ions have? Why do they have this charge?
2. What charge do non-metal ions have? Why do they have this charge?
3. What is an ionic bond?
4. The diagram opposite shows the structure of a sodium chloride crystal.
  - a. What type of structure do ionic compounds have?
  - b. Why can this structure be described as crystalline?
  - c. Why could it also be said to be a cubic lattice?
  - d. The images below can be used to show the co-ordination numbers in the NaCl and the CsCl lattice



Caesium chloride cell



sodium chloride cell



- a. What is the co-ordination number for Cs and Na in each cell?
- b. What factors affect the coordination number?

### Formulae

Use the table below to help you answer the following questions.

Metal ion	formula	Non-metal ion	formula
Lithium	$\text{Li}^+$	fluoride	$\text{F}^-$
Sodium	$\text{Na}^+$	Chloride	$\text{Cl}^-$
Potassium	$\text{K}^+$	Bromide	$\text{Br}^-$
Magnesium	$\text{Mg}^{2+}$	Oxide	$\text{O}^{2-}$
Calcium	$\text{Ca}^{2+}$	Sulfide	$\text{S}^{2-}$
Aluminium	$\text{Al}^{3+}$	phosphide	$\text{P}^{3-}$

Ionic compounds are electrically **neutral**, this means that the overall charges from the ions need to balance and cancel each other out.

Example. What is the formula for calcium bromide?

Well calcium ions are  $\text{Ca}^{2+}$  and bromide ions are  $\text{Br}^-$ . Since the metal calcium ions have a  $2^+$  charge we will need two bromide ions to cancel out this charge. So the formula for calcium bromide will be  $\text{CaBr}_2$ .

2. Workout the formula for the following ionic compounds:

- a. calcium oxide
- b. magnesium chloride
- c. aluminium oxide
- d. lithium sulfide
- e. sodium phosphide

3. Formula of compounds containing group ions (polyatomic ions)

Use the table below to help you answer the following questions

Polyatomic ion	formula
sulfate	$SO_4^{2-}$
nitrate	$NO_3^-$
hydroxide	$OH^-$
carbonate	$CO_3^{2-}$
ammonium	$NH_4^+$
phosphate	$PO_4^{3-}$

2. Workout the formula for the following ionic compounds:

- a. calcium hydroxide      b. magnesium carbonate      c. calcium nitrate  
d. potassium sulfate      e. ammonium carbonate      f. lithium phosphate

# Ionic compounds

## Answers

1. What charge do metal ions have? Why do they have this charge?

Metal ions have a positive charge, they lose electrons when they react so end up with more positive protons than negative electrons.

2. What charge do non-metal ions have? Why do they have this charge?

Non-metal ions have a negative charge, they gain electrons when they react so end up with more negative electrons than positive protons.

3. What is an ionic bond?

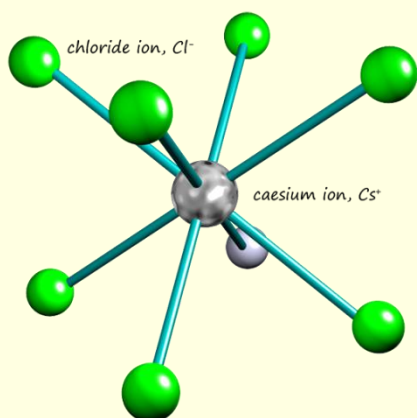
Electrostatic attraction of positive metal ions for negatively charged non-metal ions

4. The diagram opposite shows the structure of a sodium chloride crystal.

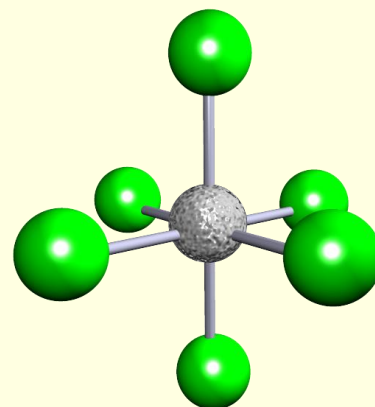
- a. What type of structure do ionic compounds have? *Giant ionic lattice*
- b. Why can this structure be described as crystalline? *Crystalline structures are ordered ones, ionic lattices are very ordered structures with the ions arranged in a regular repeating way.*
- c. Why could it also be said to be a cubic lattice? *Shape is cubic*

- d. The images below can be used to show the co-ordination numbers in the NaCl and the CsCl lattice.

Caesium chloride cell



sodium chloride cell



- a. What is the co-ordination number for Cs and Na in each cell?

8 for CsCl lattice and 6 for NaCl lattice

- b. What factors affect the coordination number?

The size and charge of the ions in the ionic lattice

### Formulae

Use the table below to help you answer the following questions.

Metal ion	formula	Non-metal ion	formula
Lithium	Li <sup>+</sup>	fluoride	F <sup>-</sup>
Sodium	Na <sup>+</sup>	Chloride	Cl <sup>-</sup>
Potassium	K <sup>+</sup>	Bromide	Br <sup>-</sup>
Magnesium	Mg <sup>2+</sup>	Oxide	O <sup>2-</sup>
Calcium	Ca <sup>2+</sup>	Sulfide	S <sup>2-</sup>
Aluminium	Al <sup>3+</sup>	phosphide	P <sup>3-</sup>

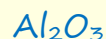
Ionic compounds are electrically neutral, this means that the overall charges from the ions need to balance and cancel each other out.

Example. What is the formula for calcium bromide?

Well calcium ions are  $\text{Ca}^{2+}$  and bromide ions are  $\text{Br}^-$ . Since the metal calcium ions have a  $2^+$  charge we will need two bromide ions to cancel out this charge. So the formula for calcium bromide will be  $\text{CaBr}_2$ .

2. Work out the formula for the following ionic compounds:

a. calcium oxide      b. magnesium chloride      c. aluminium oxide



d. lithium sulfide      e. sodium phosphide



3. Formula of compounds containing group ions (polyatomic ions)

Use the table below to help you answer the following questions

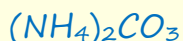
Polyatomic ion	formula
sulfate	$\text{SO}_4^{2-}$
nitrate	$\text{NO}_3^-$
hydroxide	$\text{OH}^-$
carbonate	$\text{CO}_3^{2-}$
ammonium	$\text{NH}_4^+$
phosphate	$\text{PO}_4^{3-}$

2. Work out the formula for the following ionic compounds:

a. calcium hydroxide      b. magnesium carbonate      c. calcium nitrate



d. potassium sulfate      e. ammonium carbonate      f. lithium phosphate



Note: Brackets are needed with some formula, for example  $\text{Ca}(\text{OH})_2$ , this formula tells us there is 1 calcium ion and 2 hydroxide ions. Without the bracket being present we have:

$\text{CaOH}_2$ , this formula tells us there is 1 calcium ions, 1 oxygen and 1 hydrogen, which is not what we want. This is incorrect for the formula of calcium hydroxide.