

Ions, Ionic Bonding and Deducing Ionic Formulae

Answer the questions below.

1. Name three types of bonding.

Metallic, ionic and covalent bonding

2. What type of elements does ionic bonding occur between?

Metals and non-metals

3. Write the number 132000 in standard form .

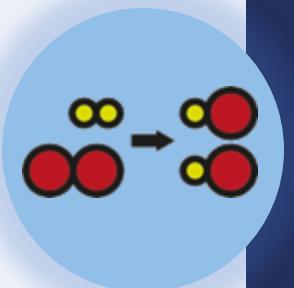
1.32×10^5

4. What is a covalent bond?

A shared pair of electrons between two non-metal atoms

5. Write down the electronic configuration of a neon atom.

2, 8



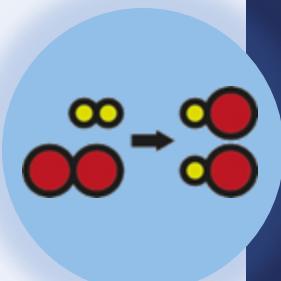
Ions, Ionic Bonding and Deducing Ionic Formulae

Do Now:

1. Name three types of bonding.
2. What type of elements does ionic bonding occur between?
3. Write the number 132000 in standard form .
4. What is a covalent bond?
5. Write down the electronic configuration of a neon atom.

Drill:

1. What word means 'a charged atom or group of atoms'?
2. What are ions able to do in a metal, which explains why metals can conduct electricity?
3. State the type of bonding in a hydrogen molecule (H_2)

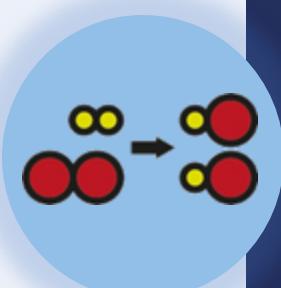


Ions, Ionic Bonding and Deducing Ionic Formulae

Read Now:

Ever since the first airplane flight (over 100 years ago), the science of flight has progressed. Now, we can fly using many different kinds of aircraft including planes, drones and helicopters. All of these methods of flight have one thing in common – they require moving parts. Now, engineers have built and flown the first ever plane that doesn't need moving parts. Instead, it uses ionic wind – a silent but mighty stream of ions. Ions are charged atoms, or groups of atoms. This ionic wind generates enough thrust to propel the plane into flight. In contrast to traditional aircraft, it requires no fossil fuels to run, and it's completely silent!

1. How long ago was the first airplane flight?
2. List three examples of aircraft.
3. What do all traditional types of aircraft have in common?
4. What is an ion?
5. Why might this new technology be better than the existing technology?



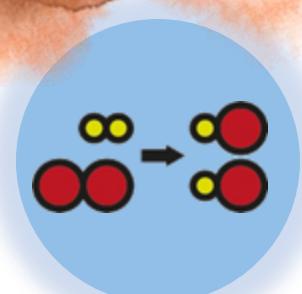
Prior Knowledge Review: Ions, Ionic Bonding and Deducing Ionic Formulae

C4.2.3

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

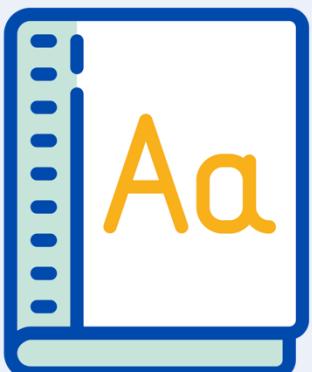
- C4.2.7 Introduction to Electrolysis
- C4.2.8 Extracting Metals by Electrolysis
- C4.2.9 Electrolysis of Molten Ionic Compounds
- C4.2.10 Electrolysis in Solutions
- C4.2.11 RP: Electrolysis of Aqueous Solutions 1
- C4.2.12 RP: Electrolysis of Aqueous Solutions 2
- C4.2.13 TIF: Corrosion and its Prevention
- 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:

- Describe how ions are formed
- Describe ionic bonding in terms of electrons
- Relate the group number of an element to the charge on its ions

Key Words:



ion

ionic

empirical formula

electron

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 describes the reaction between lithium and aluminium oxide?
 A. lithium + aluminium oxide \rightarrow lithium aluminium + oxygen
 B. lithium + aluminium oxide \rightarrow lithium oxide + aluminium
 C. lithium and aluminium oxide would not react
2. Which of the metals below would be found as a pure metal in the Earth's crust?
 A. Aluminium
 B. Gold
 C. Copper oxide (an ore)
3. The combustion of magnesium can be represented by the following equation: $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$. What type of reaction is this?
 A. A reduction reaction
 B. An oxidation reaction
 C. A neutralisation reaction

Atoms and Ions

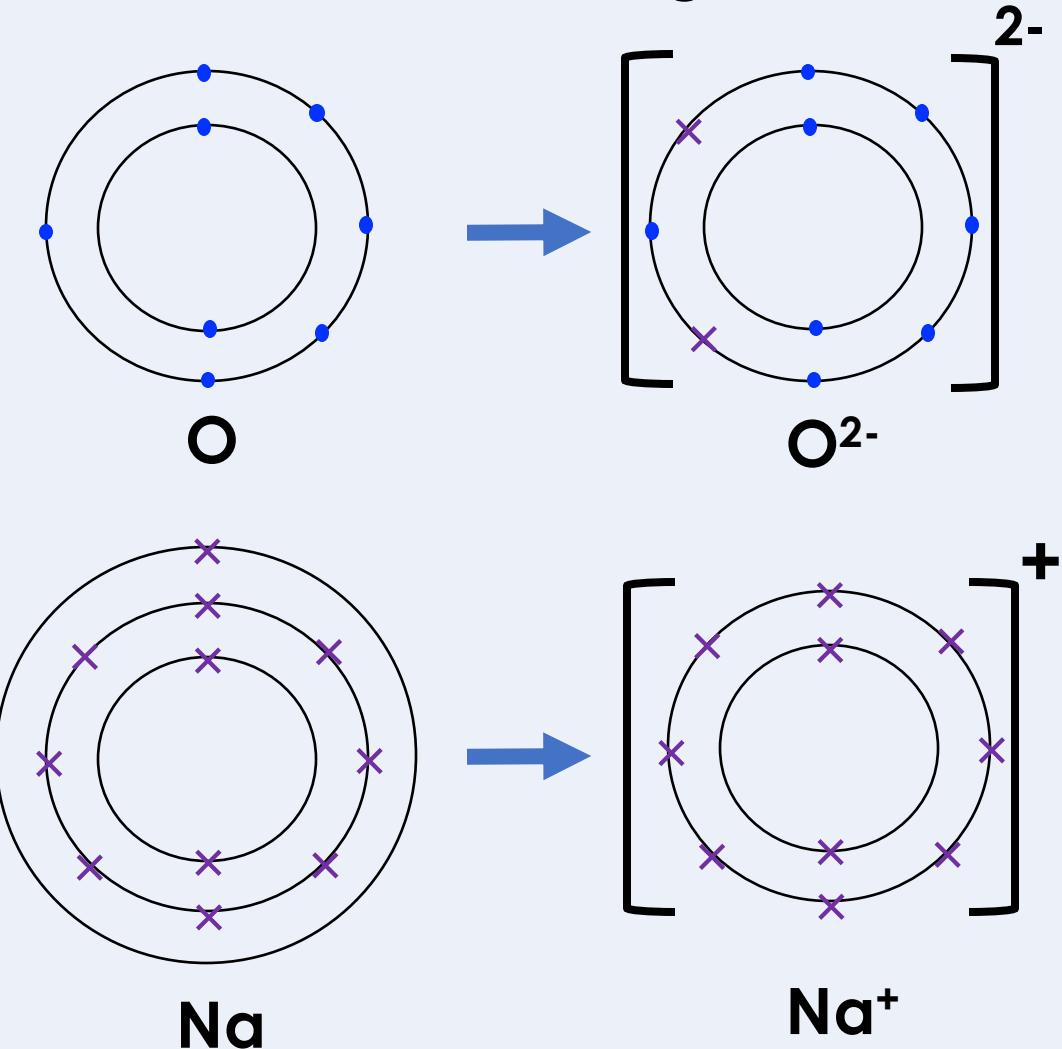
An **ion** is a charged particle, or group of particles

Atoms form ions in order to achieve a **stable electronic arrangement**

- An atom becomes a **negative ion** when it **gains electrons**.
- **Non-metals** usually form **negative ions**
- An atom becomes a **positive ion** when it **loses electrons**.
- **Metals** usually form **positive ions**

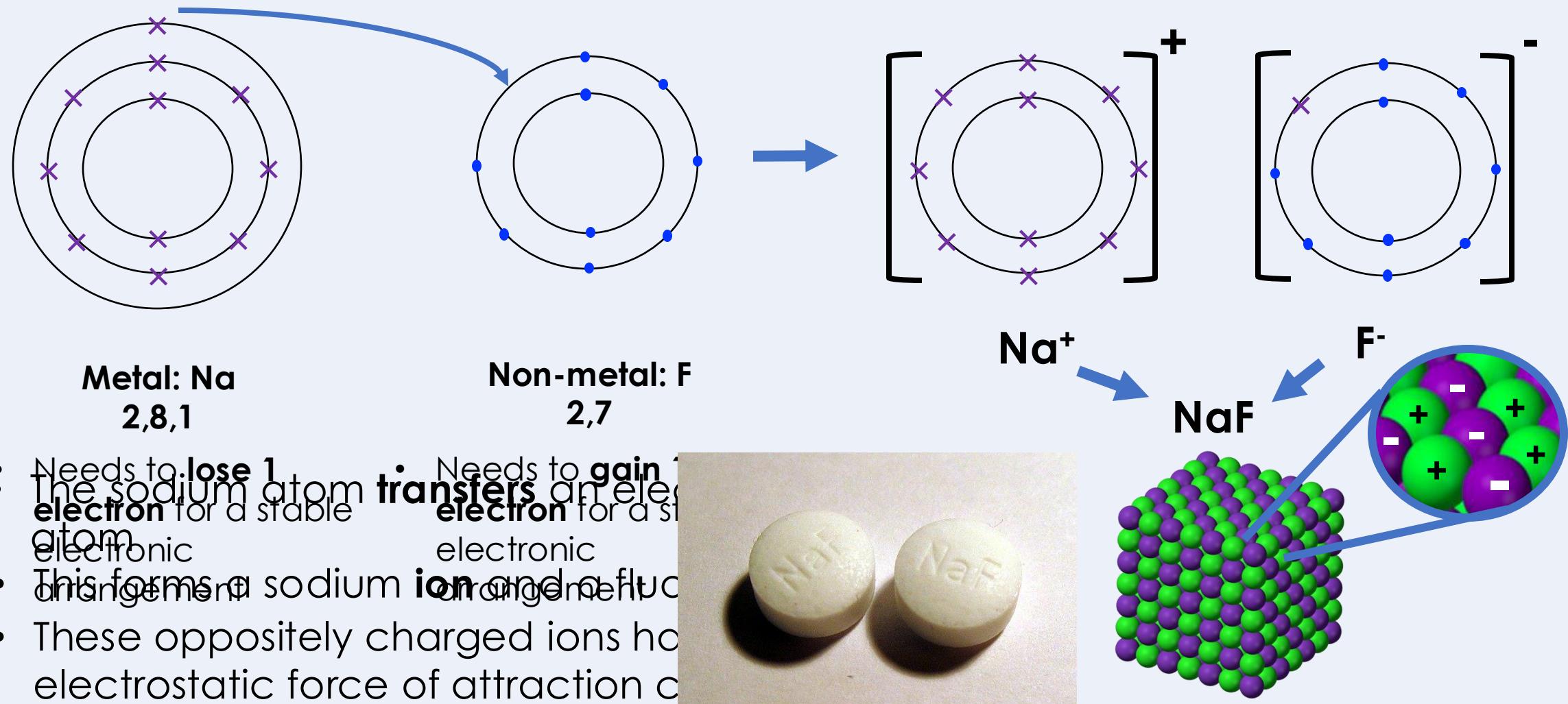
What will be the charge on..

1. a potassium ion? **+ (K⁺)**
2. a fluoride ion? **- (F⁻)**
3. a calcium ion? **2+ (Ca²⁺)**



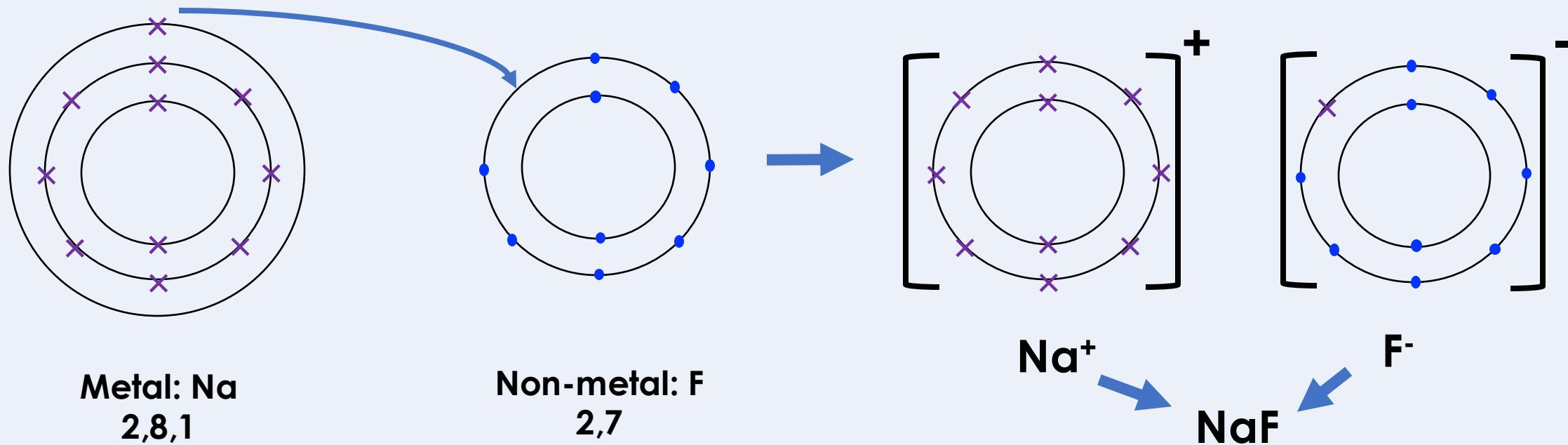
Ionic Bonding

Ionic bonding occurs in compounds formed from **metals** combined with **non-metals**.



A model of Ionic Bonding

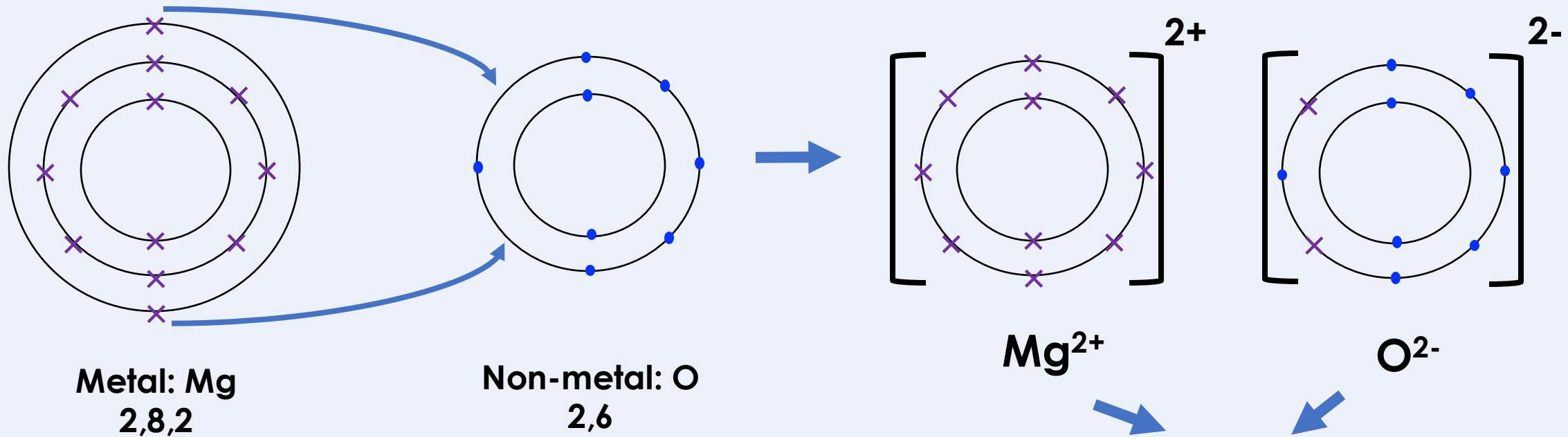
Describe the bonding in sodium fluoride.



- The sodium atom **loses** an electron and becomes a positively charged ion (Na^+)
- The fluorine atom **gains** an electron and becomes a negatively charged ion (F^-)
- The oppositely charged ions are held together by strong electrostatic forces of attraction

Introduction

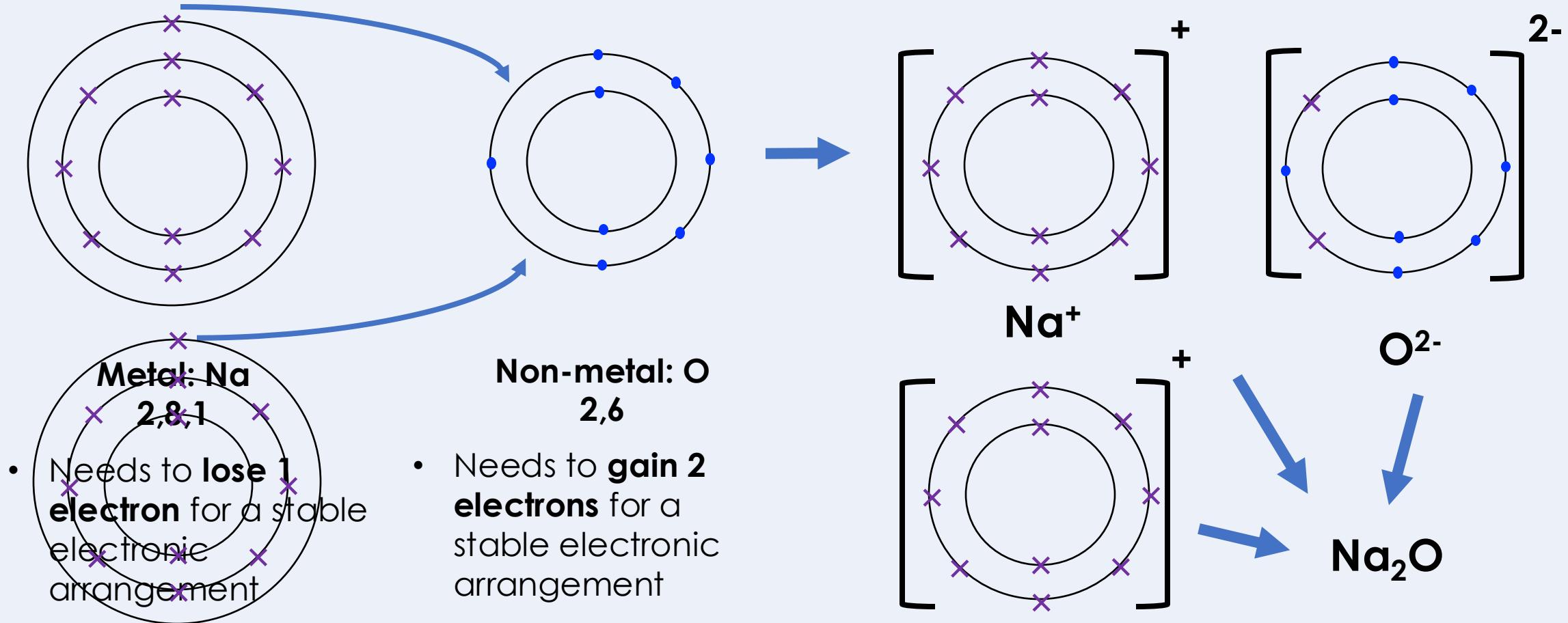
Ionic Bonding



- The ~~delocalise~~ ~~lose~~ ~~2~~ magnesium atom ~~transfers~~ ~~2~~ electrons to the ~~electrons~~ ~~from~~ ~~the~~ ~~oxygen~~ atom.
- This forms a ~~stable~~ ~~electronic~~ ~~arrangement~~ ~~ion~~ and an ~~oxide~~ ~~ion~~ arrangement.
- These oppositely charged ions have a strong electrostatic force of attraction called ionic bonding.

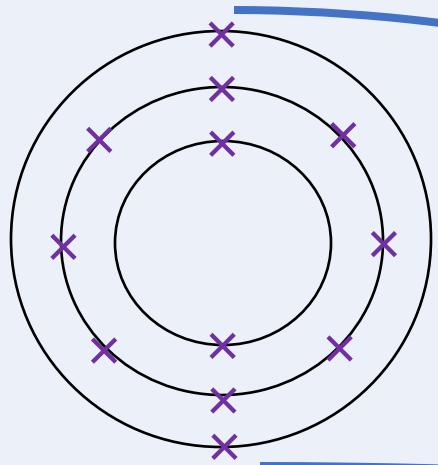


Ionic Bonding



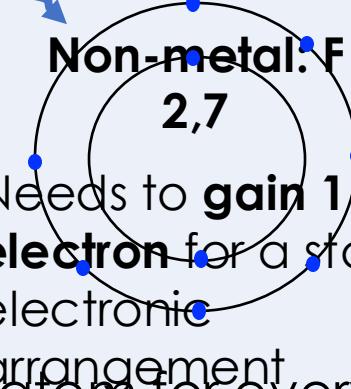
- We need 2 sodium atoms for every 1 oxygen atom
- **Each** sodium atom **transfers 1 electron** to the oxygen atom
- This forms 2 sodium **ions** and one oxide **ion**
- These oppositely charged ions have a strong electrostatic force of attraction

Ionic Bonding

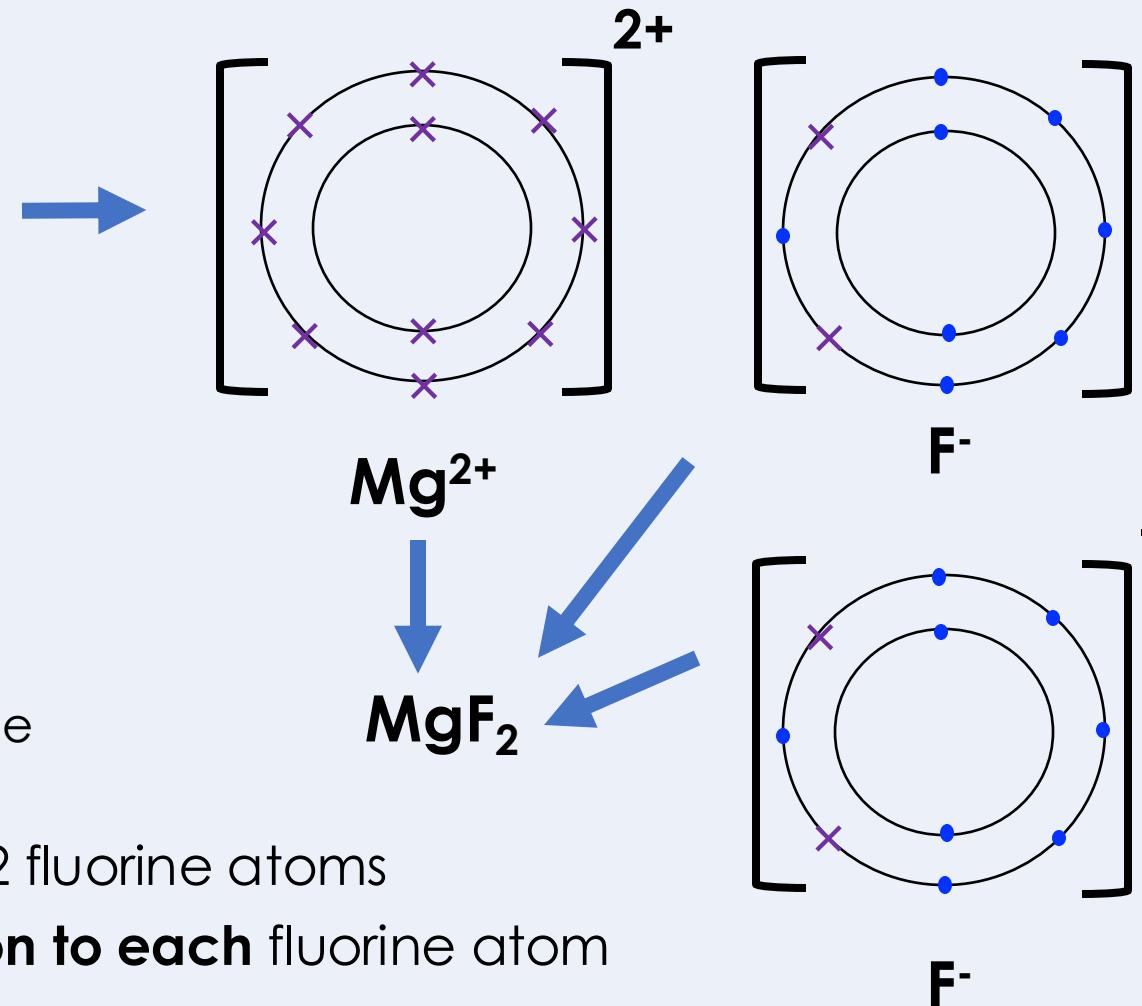


Metal: Mg
2,8,2

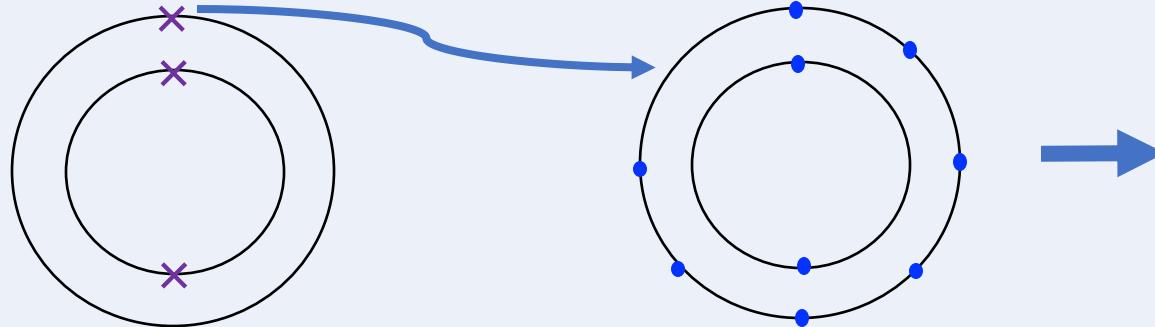
- Needs to **lose 2 electrons** for a stable electronic arrangement
- We need 1 magnesium atom for every 2 fluorine atoms
- The magnesium atom **transfers 1 electron to each** fluorine atom
- This forms 1 magnesium **ion** and 2 fluoride **ions**
- These oppositely charged ions have a strong electrostatic force of attraction called ionic bonding



Non-metal: F
2,7

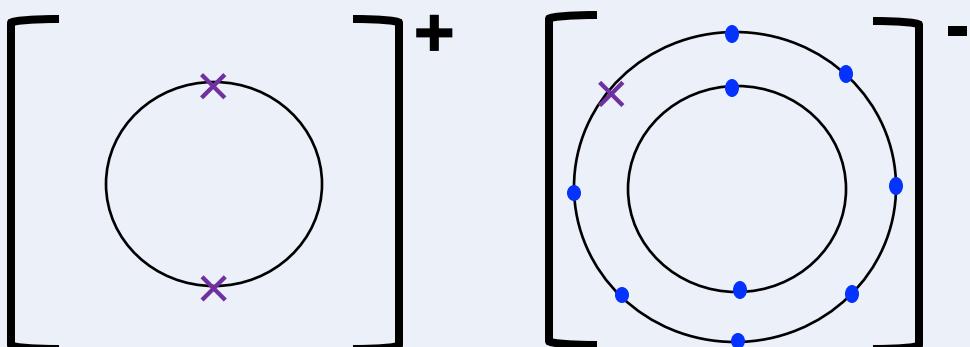


I: Describing the ionic bonding in lithium fluoride using dot-and-cross diagrams



Metal: Li
2,1

Non-metal: F
2,7



Li^+

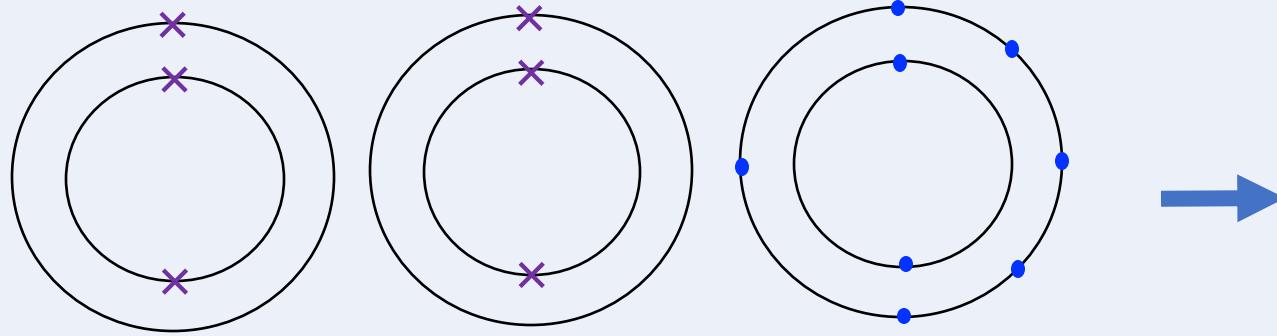
F^-

LiF

Steps to Success

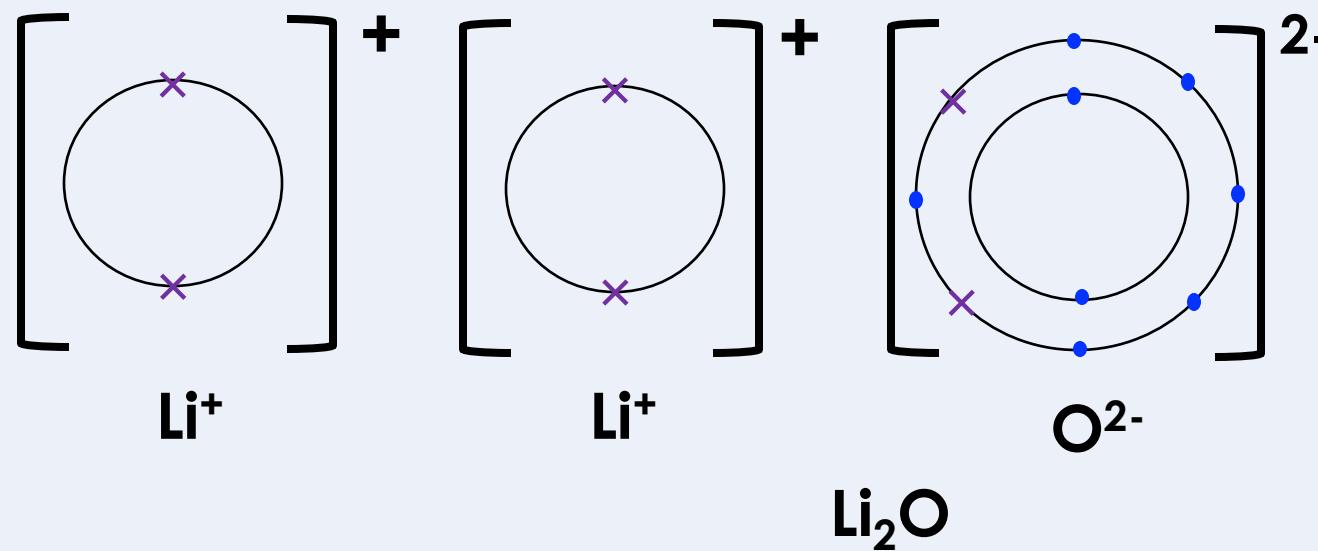
1. **Draw the electronic configuration** of both atoms using dots for one atom and crosses for the other.
2. **Draw an arrow** to show the transfer of any electrons from one atom to another.
3. **Draw the ions** formed after the electrons have moved with a square bracket
4. **Write the charge** of the ions formed at the top right of the square brackets

We: Describe the bonding in lithium oxide using dot-and cross-diagrams



Metal: Li
2,1

Non-metal: O
2,6

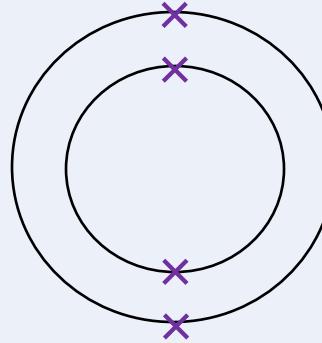


Steps to Success

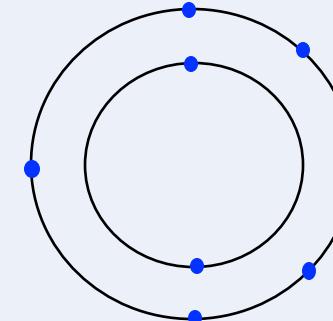
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Is this correct?

The empirical formula for beryllium oxide is Be_2O

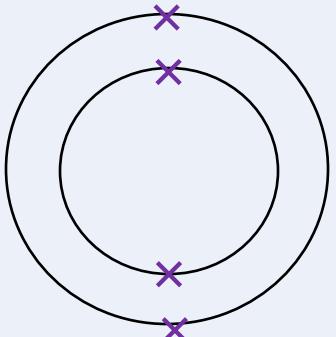


Metal: Be
2,2

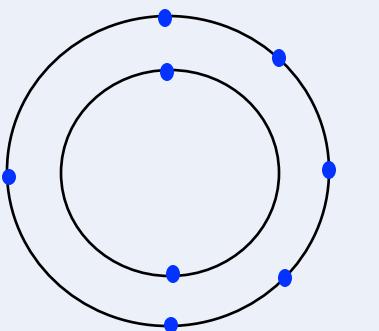


Non-metal: O
2,6

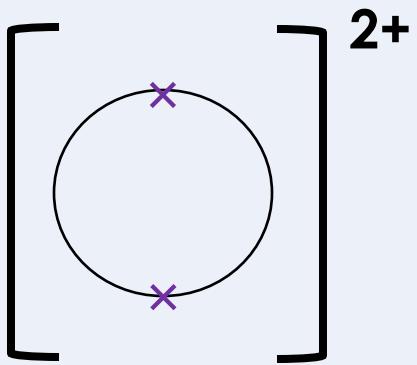
You: Describe the bonding in beryllium oxide using dot-and cross-diagrams



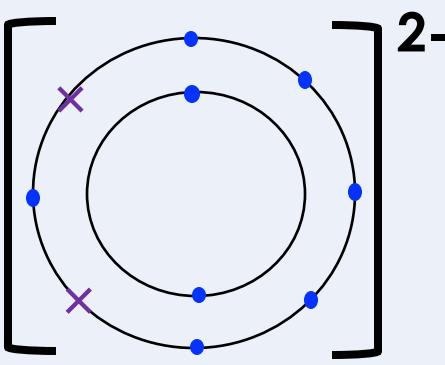
Metal: Be
2,2



Non-metal: O
2,6



Be^{2+}



O^{2-}

BeO

Steps to Success

1. **Draw the electronic configuration** of both atoms using dots for one atom and crosses for the other.
2. **Draw an arrow** to show the transfer of any electrons from one atom to another.
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Think - Pair - Share

**Which has a higher melting and boiling point:
Sodium fluoride or magnesium oxide?**

Drill

1. What is the difference between a sodium atom and a sodium ion?
2. Do metal atoms lose or gain electrons?
3. How many valence electrons does an atom of chlorine have?
4. What charge ions will atoms in group 7 of the Periodic table form?
5. For metals, what is the relationship between the group number and the charge on the ion?
6. For non-metals, what is the relationship between the group number and the charge on the ion?
7. How many atoms of sodium would react with an atom of fluorine?
8. How many atoms of sodium would react with an atom of oxygen?
9. Why are electrons drawn with different symbols for each atom?
10. Explain the answer to question 7.

Drill answers

1. A sodium atom is neutral (no charge) with the electronic configuration 2, 8, 1. A sodium ion is positively charged with the configuration 2, 8.
2. Metal atoms lose electrons.
3. An atom of chlorine has 7 valence electrons.
4. Atoms in group 7 will form ions with a charge of -1.
5. For metals, the group number equals the charge on the ion.
6. For non-metals, the group number is equal the ion \times -1.
7. One atom of sodium would react with one atom of fluorine
8. Two atoms of sodium would react with one atom of oxygen.
9. Electrons are drawn with different symbols for each atom so the transfer of electrons from one atom to another is clear.
- 10...because sodium transfers one electron to fluorine in order for both atoms to reach a stable electronic configuration.

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 calcium chloride are listed below. What is the empirical formula of calcium chloride?

- A. CaCl_2
- B. Ca_2Cl
- C. CaCl



Lesson C4.2.3

What was good about this lesson?

What can we do to improve this lesson?

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Thank you!