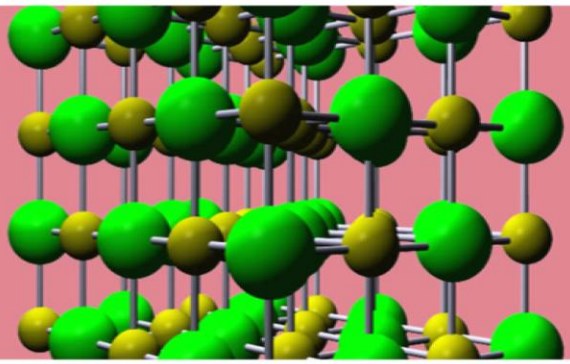
The Properties of Ionic Compounds



Answer the questions below then check your answers.

1. What is an ionic compound? What are anions and cations?

2. What type of structure do ionic compounds have?

3. Do ionic compounds have high or low melting points? Explain your answer.

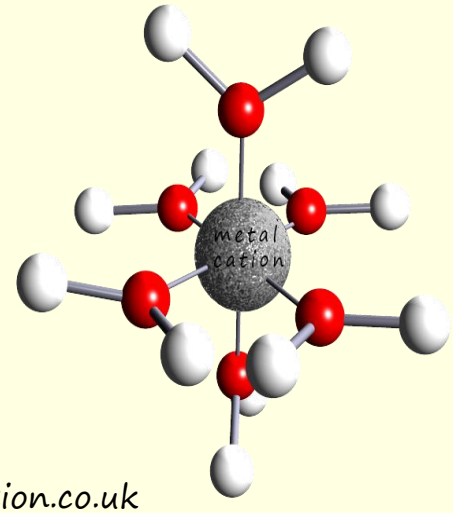
b. Name the two factors that primarily affect the melting point of an ionic compound.

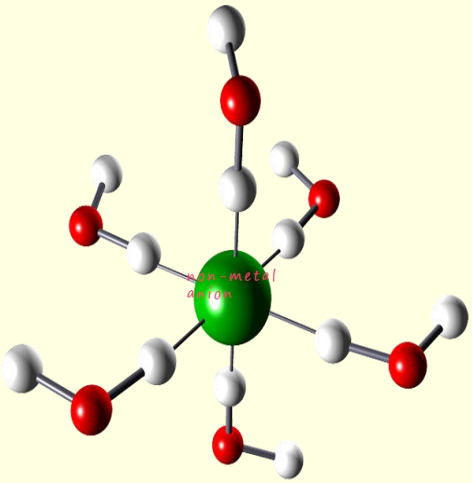
4. What must be done to an ionic compound to make it conduct electricity?

5. Why do solid ionic compounds not conduct electricity?

b. Explain why ionic compounds conduct electricity when molten but not when solid.

6. Use the image below to explain and describe what happens to an ionic compound when it dissolves in water.





7. Why do molten and solutions of ionic compound conduct electricity?

8. The table below shows the melting points of 4 ionic compounds.

Ionic compound	Melting point/°C
lithium oxide ($Li_2^+O^{2-}$)	1432
Sodium oxide ($Na_2^+ O^{2-}$)	1132
Magnesium oxide ($Mg^{2+}O^{2-}$)	2852
Calcium oxide ($Ca^{2+}O^{2-}$)	2572

a. Why do you think the melting points of magnesium oxide and calcium oxide are much higher than that of lithium and sodium oxide?

b. Based on your answer to a, do you think the melting point of aluminium oxide is higher or lower than that of calcium and magnesium oxide? Explain your decision.

c. Why are ionic compounds often brittle?

9. Explain the following properties of ionic compounds in terms of their structure and bonding:

High melting and boiling points

Solubility in polar solvents (like water)

Conductivity when molten or dissolved in a solvent

Brittleness

Properties of ionic compounds

Answers

1. What is an ionic compound? Compound made up positively charged metal ions and negatively charged non-metal ions. Anions are negatively charged ions, cations are positively charged ions.

2. What type of structure do ionic compounds have? Giant ionic lattice.

3. Do ionic compounds have high or low melting points. Explain your answer

   High melting points due to the fact they have giant structures with lots of strong bonds present, so lots of energy is required to break these bonds so that the ions can move freely and enter the liquid state.

b. Name the two factors that primarily affect the melting point of an ionic compound.

Charge of the ions (greater charge = higher melting point)

Size of the ions (smaller ions = higher melting point)

4. What must be done to an ionic compound to make it conduct electricity?

   Must be dissolved or melted, in both cases the lattice structure breaks down and the ions are free to move. It will now conduct an electric current.

5. Why do solid ionic compounds not conduct electricity?

   The ions are not free to move, held in place within a giant ionic lattice. As in any solid they only vibrate about fixed positions.

b. Explain why ionic compounds conduct electricity when molten but not when solid.

In the solid state, ions are fixed in the lattice and cannot move.

When molten, the lattice breaks down, and the ions are free to move, allowing them to carry an electrical current.

6. Use the image below to explain and describe what happens to an ionic compound when it dissolves in water.

The water molecules pull apart the giant ionic lattice and separate the ions out evenly throughout the water to form a solution of ions that are free to move. This solution is called an electrolyte and it will conduct electricity.

7. Why do molten and solutions of ionic compound conduct electricity?

The ions present are free to move, giant lattice structure has been broken down.

8. The table below shows the melting points of 4 ionic compounds.

Ionic compound	Melting point/°C
lithium oxide ($Li_2^+O^{2-}$)	1432
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a. Why do you think the melting points of magnesium oxide and calcium oxide are much higher than that of lithium and sodium oxide?

Magnesium and calcium are in group 2 of the periodic table, they form ions with a 2^+ charge, Mg^{2+} and Ca^{2+}. Li and Na are in group 1 of the periodic table so form ions with a 1^+ charge. Oxide ions are O^{2-}. So magnesium and calcium ions will be more strongly attracted to the O^{2-}, oxide ion due to the fact they both have a charge of 2. Sodium and lithium will be less strongly attracted as these ions only have a 1^+ charge. Larger charges means stronger bonds, which means more energy required to break up the lattice, so higher melting point.

b. Based on your answer to a, do you think the melting point of aluminium oxide is higher or lower than that of calcium and magnesium oxide? Explain your decision.

Aluminium is in group 3 of the periodic table, so ions will be Al^{3+}, these ions should form very strong bonds to the oxide ions, O^{2-}, so melting point should be higher due to attraction of a 3^+ charge to a 2^- charge would be stronger than that of a 2^+ charge to a 2^-

Note: if you goggle the melting point of aluminium oxide you will see it is 2072°C. Lower that you probably expected, obviously there are other factors at play here.....!

c. Why are ionic compounds often brittle?

When stress shifts the lattice, ions with the same charge get closer. Their repulsion causes the crystal to break apart.

9. Explain the following properties of ionic compounds in terms of their structure and bonding:

High melting and boiling points

Solubility in polar solvents (like water)

Conductivity when molten or dissolved in a solvent

Brittleness

High melting and boiling points: Ionic compounds form giant lattices with strong electrostatic forces between oppositely charged ions. Overcoming these forces requires a lot of energy, hence the high temperatures needed.

Solubility in polar solvents: Polar water molecules are attracted to the positive and negative ions, disrupting the lattice and surrounding the ions in solution.

Conductivity when molten or dissolved: When molten or dissolved, the lattice breaks down, freeing ions to carry electrical charge.

Brittleness: When an ionic lattice is distorted, ions of like charge align. Their repulsion causes the lattice to shatter.