Properties of ionic compounds

Answer the questions below then check your answers.

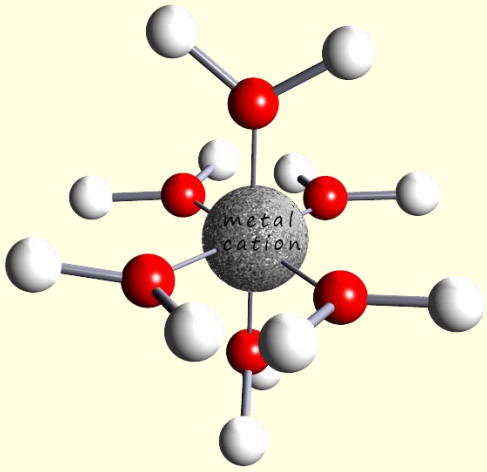
1. What are anions and cations?

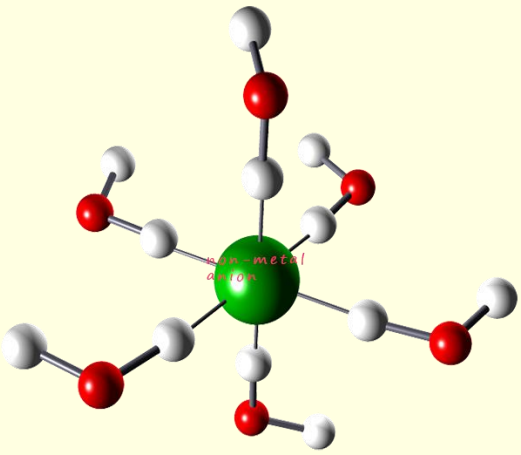
2. What type of structure do ionic compounds have?

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

4. Explain why molten lead bromide conducts electricity but solid lead bromide does not.

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





5b. Why do you think ionic compounds do not dissolve in organic solvents?

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

Ionic compound	Melting point/^{o}C
lithium oxide	1432
Sodium oxide	1132
Magnesium oxide	2852
Calcium oxide	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 aluminum oxide is higher or lower than that of calcium and magnesium oxide? Explain your decision.

Answers

1. What are anions and cations?

Anions - negatively charged ions

Cations- positively charged ions

2. What type of structure do ionic compounds have?

Giant lattice

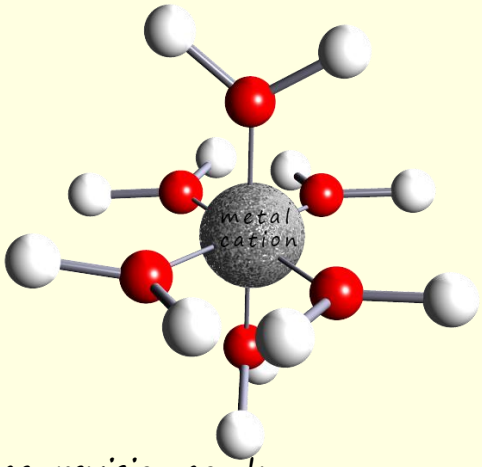
3. Do ionic compounds have high or low melting points? Explain your answer

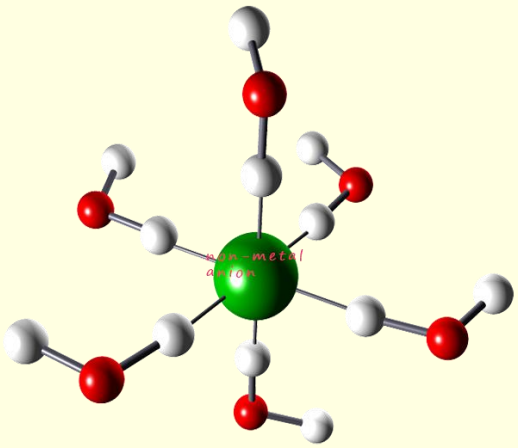
High melting points, giant structure with lots of strong bonds, requires a lot of energy to break these bonds.

4. Explain why molten lead bromide conducts electricity but solid lead bromide does not.

To conduct electricity the ions must be free to move, in solid lead bromide the ions are held in a 3d lattice structure and they are not free to move, however once melted to form a liquid the lead and bromide ions are free to move.

5. Use the image below to explain and describe what happens to an ionic compound when it dissolves in water. You should mention:





Polar water molecules are attracted to the charged ions in an ionic lattice, the water molecules contain partially negatively charged oxygen atoms which will be attracted to the sodium ions in the lattice, while the partially positively charged hydrogen atoms in the water molecules will be attracted to the negatively charged chloride ions. The water molecule will pull the metal cations and non-metals ions out of the lattice and form solvation spheres around these ions when they go into solution.

5b. Why do you think ionic compounds do not dissolve in organic solvents?

Van der Waals forces between the non-polar solvent and the ions in the lattice would not be strong enough to pull the ions from the lattice and to overcome the electrostatic attraction between the ions.

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

Ionic compound	Melting point/^{o}C
lithium oxide	1432
Sodium oxide	1132
Magnesium oxide	2852
Calcium oxide	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?

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. The magnesium and calcium ions are also smaller and the charge to size ratio is larger, the attraction to the oxide ion will therefore be stronger.

b. Based on your answer to a, do you think the melting point of aluminum 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.....!