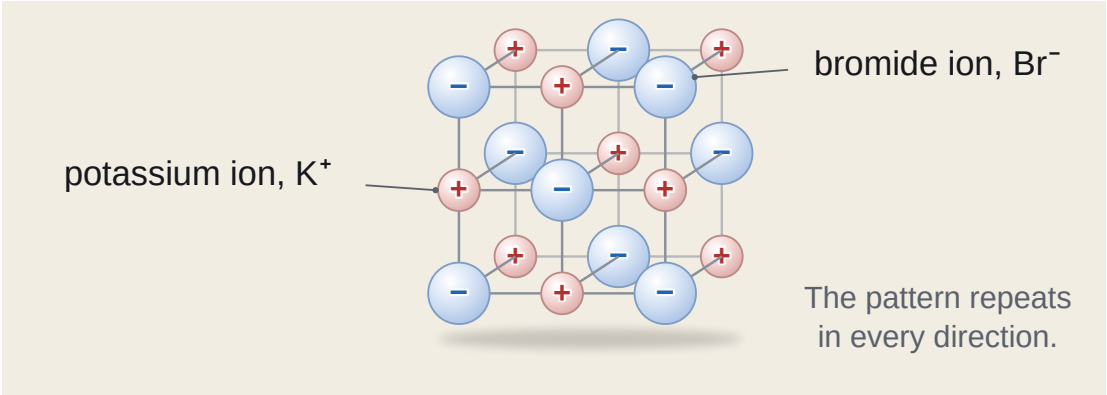
A4 · Ionic lattices and the properties they explain · Notes

Goals: Describe an ionic solid as a crystal lattice of ions. Explain why ionic compounds are hard, brittle and hard to melt, why many dissolve in water, and when they conduct electricity. Compare the melting points of two ionic compounds from the charges and sizes of their ions.

Name: _____ Date: _____

Slide 1 of 6 · An ionic solid is a lattice

In lesson A3 you drew one K^+ ion and one Br^- ion. A real crystal holds billions of each. Today you see how they fit together.



Key ideas

Ions pack together in a repeating pattern called a _____.

Each positive ion is surrounded by _____ ions.

An ionic solid has no separate _____.

So an ionic formula is a _____.

Example

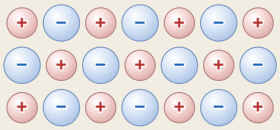
What does the formula CaF_2 tell you about a crystal of calcium fluoride?

Try it

What does the formula KBr tell you about a crystal of potassium bromide?

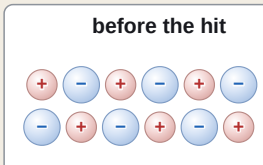
Slide 2 of 6 · Hard, brittle and hard to melt

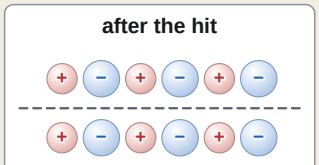
On the last slide, every ion was pulled by all its neighbours. Those pulls explain what you see when you heat or hit an ionic solid.



Strong pulls act in every direction.

Potassium bromide **melts at 734 °C.**





Key ideas

An ionic solid is _____. Its pulls are strong and act in every direction.

It has a _____. Melting means the ions break free of the pattern.

It is _____. A hard hit makes it shatter.

A hit slides one layer along. Then like charges _____ and the crystal splits.

Example

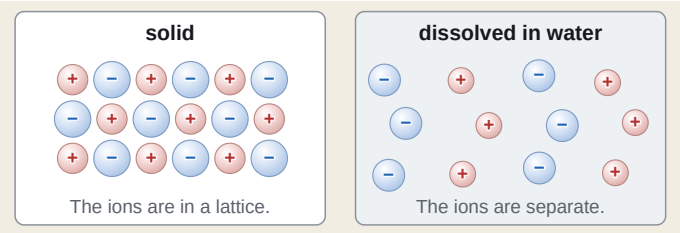
After a layer slides, why do the two layers push apart?

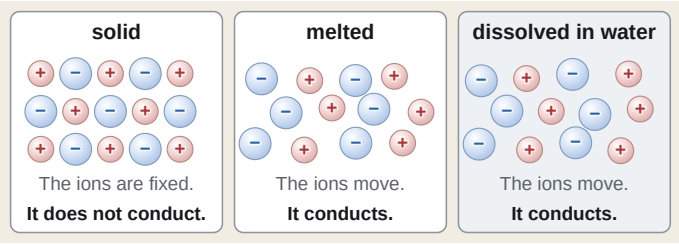
Try it

Why does an ionic solid need a high temperature to melt?

Slide 3 of 6 · Dissolving and conducting

So far the lattice stayed whole. Water can take a lattice apart. Then the ions can move, and the compound behaves in a new way.





Key ideas

Many ionic compounds _____ in water. Water pulls the ions out of the lattice.

A substance _____ electricity when charged particles can move through it.

In the solid, the ions are _____. The solid does not conduct.

A solution that conducts is called an _____.

Example

Solid potassium bromide does not conduct, but melted potassium bromide does. Why?

Try it

Will potassium bromide dissolved in water conduct? Say why.

Slide 4 of 6 · Comparing melting points

On slide 2, potassium bromide melted at 734 °C. Other ionic compounds melt higher or lower. Two things about the ions decide it.

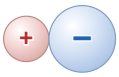
potassium fluoride



K^+ and F^- are closer together.

melts at 858 °C

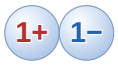
potassium bromide



K^+ and Br^- are farther apart.

melts at 734 °C

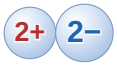
potassium fluoride



The charges are 1+ and 1−.

melts at 858 °C

calcium oxide



The charges are 2+ and 2−.

melts above 2500 °C

Key ideas

Potassium bromide melts at 734 °C. Potassium fluoride melts at 858 °C.

_____ ions sit farther apart, so they pull less strongly.

So _____ ions give a higher melting point.

Bigger _____ pull much more strongly, so they give a higher melting point.

Example

Potassium iodide has a bigger negative ion than potassium bromide. Will it melt above or below 734 °C?

Try it

Which melts higher, rubidium chloride (ions 1+ and 1−) or strontium sulfide (ions 2+ and 2−)?

Slide 5 of 6 · Method: how to compare the melting points of two ionic compounds

You just compared two pairs of compounds. Each time you looked at the charges and the sizes. Here that is as four steps.

1. **Write** the ions of each compound, with charges.
2. **Compare** the charges. Bigger charges melt higher.
3. **Compare** the sizes. Smaller ions melt higher.
4. **State** which melts higher, and why.



Check: only one thing differs between the two compounds.

Used again in: lesson A12

Key ideas

Step 1: write the _____ of each compound, with charges.

Step 2: compare the _____. Bigger charges melt higher.

Step 3: compare the _____. Smaller ions melt higher.

Step 4: _____ which melts higher, and why.

Example

Use the four steps to decide which melts higher, sodium fluoride or sodium iodide.

Try it

Use the four steps to decide which melts higher, calcium sulfide or potassium chloride.

Slide 6 of 6 · Ionic compounds around us

In this lesson, ionic compounds were hard, brittle and hard to melt. Many also dissolved in water. People choose them for jobs that suit those properties.

calcium chloride
$CaCl_2$
It melts road ice.

potassium chloride
KCl
It is a fertilizer (potash).

sodium fluoride
NaF
It is in toothpaste.

calcium carbonate
$CaCO_3$
It is chalk and antacid tablets.

Key ideas

Calcium chloride melts _____ on winter roads.

Potassium chloride is a _____.

Sodium fluoride in _____ hardens teeth.

Each ionic compound is chosen for its _____.

Example

Calcium chloride is used to melt road ice. Which property makes that possible?

Try it

Name one ionic compound you use at home, and say what it is used for.