Properties of Ionic Compounds

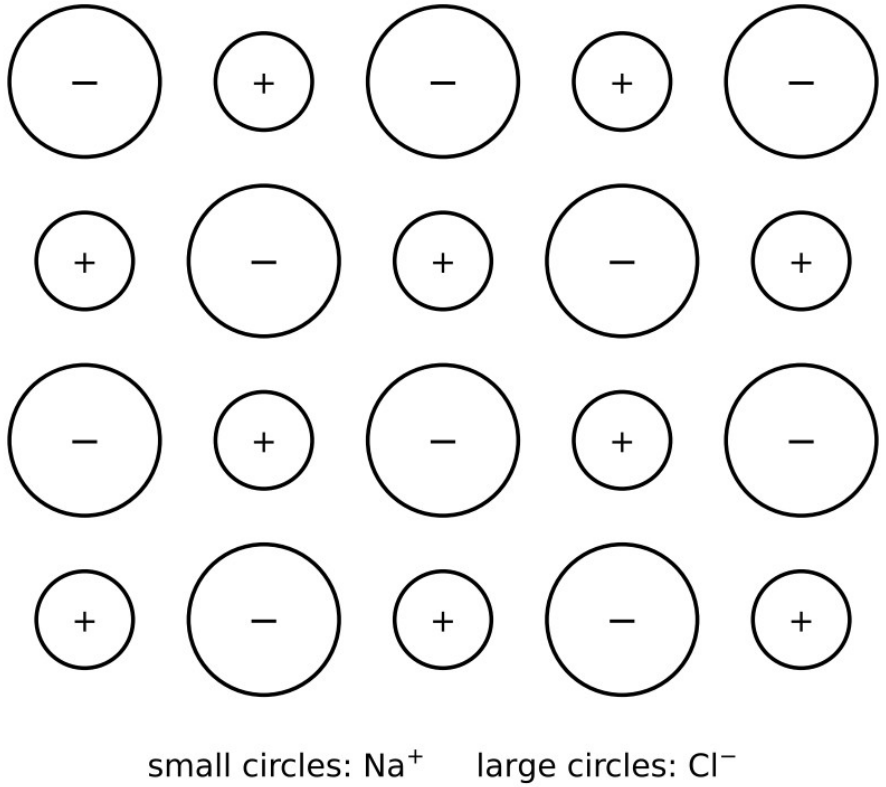
Essential Question

What gives ionic compounds their properties?

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The Crystal Lattice

- Cations (+) and anions (−) stack in a repeating 3-D pattern
- Each ion is surrounded by opposite charges
- Strong attractions in every direction



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Properties of Ionic Compounds

High Melting Points

- To melt, ions must break free of the lattice
- Many strong attractions → lots of energy needed
- Ionic compounds are solids at room temperature

Substance	Ionic?	Melting point
ice	no	0 °C
sugar	no	about 186 °C
table salt (NaCl)	yes	801 °C

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Bigger Charges, Higher Melting Point

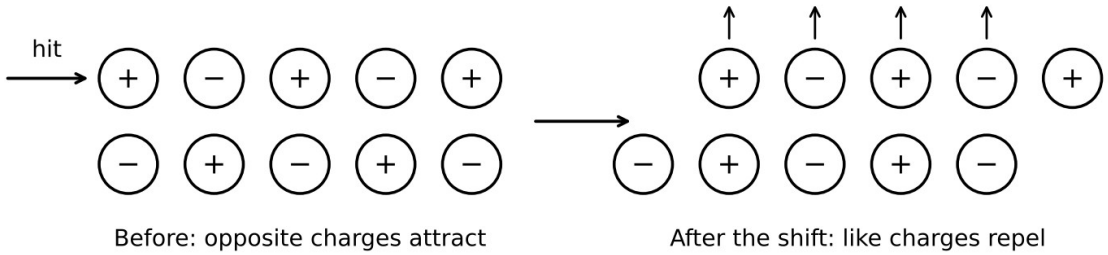
- Larger ion charges → stronger attraction (Coulomb's law)
- Stronger attraction → higher melting point
- Compare charges first, then size

Compound	Ion charges	Melting point
NaCl	+1 and −1	801 °C
MgO	+2 and −2	2852 °C

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Hard but Brittle

- Hard: strong attractions hold ions in place
- A sharp hit shifts a layer of ions
- Like charges line up and repel → it shatters



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Conductivity: Solids

- Current needs charged particles that can move
- In a solid, the ions are locked in the lattice
- Solid ionic compounds do not conduct

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Conductivity: Melted or Dissolved

- Melted or dissolved: the ions are free to move
- Moving ions carry the current

Sample	Ions move?	Conducts?
solid	no	no
melted (molten)	yes	yes
dissolved in water	yes	yes

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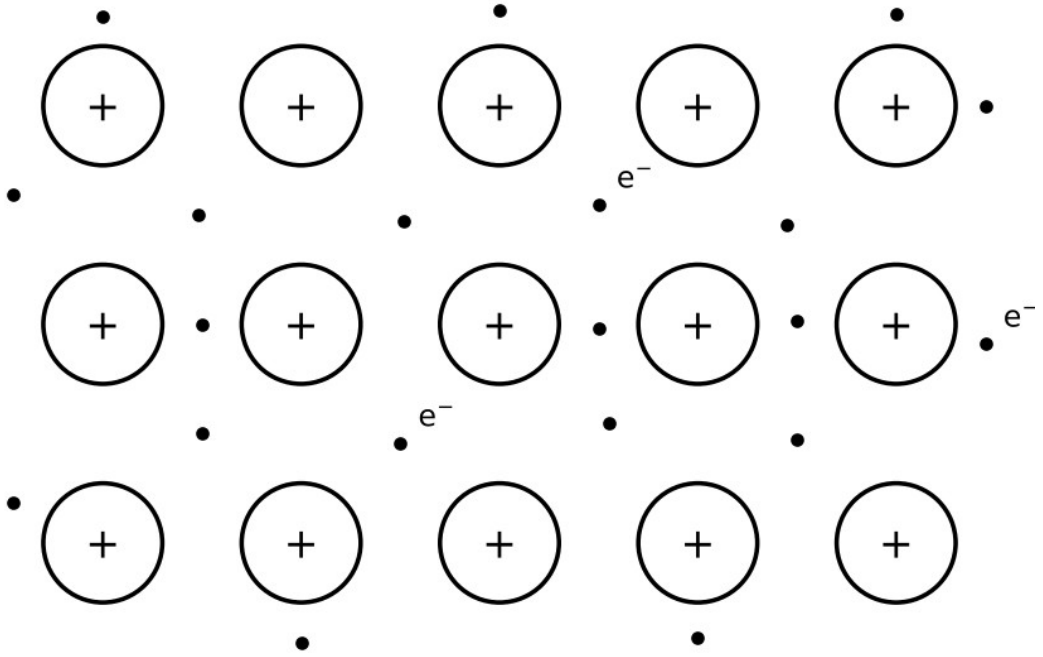
Dissolving in Water

- Water pulls ions out of the lattice
- The ions separate (dissociate)
- $NaCl(s) \rightarrow Na^{+}(aq) + Cl^{-}(aq)$
- Oxygen ends face Na^{+}; hydrogen ends face Cl^{-}

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Compare: Metallic Bonding

- Chemical bond: a strong attraction that holds atoms or ions together
- Metallic bond: metal cations in a sea of shared electrons
- Free electrons → metals conduct and shine (luster)

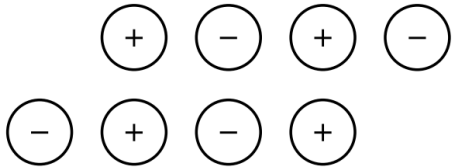


metal cations (+) in a sea of electrons (•)

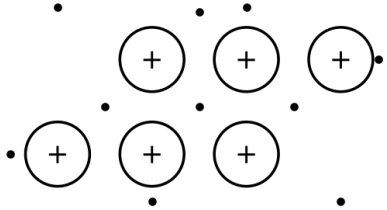
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Ionic vs Metallic: Hit with a Hammer

- Ionic: like charges meet → brittle
- Metal: electrons still surround the cations → malleable



Ionic: like charges meet → shatters



Metal: electrons still surround cations → bends

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Example: Comparing Melting Points

Which compound has the higher melting point, NaF or CaO? Explain your answer.

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Example: Identify the Solid

An unknown white solid was tested in lab. Is it an ionic compound? Use the data as evidence.

Test	Result
Melting point	770 °C
Conducts as a solid?	no
Conducts when dissolved in water?	yes

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Example: Which Samples Conduct?

Which samples of KBr conduct electricity? Explain your answer. A: solid KBr. B: melted KBr. C: KBr dissolved in water.

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Example: Explaining Brittleness

A student hits a crystal of table salt with a hammer, and it shatters into pieces. Explain why, using the arrangement of ions.

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Properties of Ionic Compounds

Big Ideas

- Strong attractions hold ions in a lattice
- High melting points (higher with bigger charges)
- Hard but brittle
- Conduct only when melted or dissolved
- Metals: cations in a sea of electrons, so they conduct, bend and shine

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