

Pre-AP Chemistry

September 4, 2011

13. Ionic Bonding II



Review

- Fill in the blanks:

1. An atom in rows 1 and 2 of the periodic table can hold no more than _____ valence electrons.
2. Ions with the same (like) charge _____ each other.
3. Ions with opposite charges _____ each other.

- Draw the Lewis structures of the following atoms and ions

Li

Al³⁺

Cl⁻

Outline

- Ionic Bonds
- Formula Units
- Properties

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 - Melting and boiling points
 - Fracturing (vs bending / denting)
 - Electrical conductivity (electrolytes)

Outline

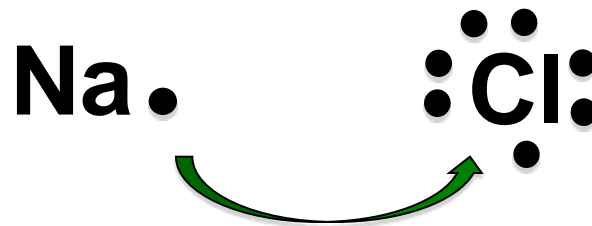
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Ionic Bonds

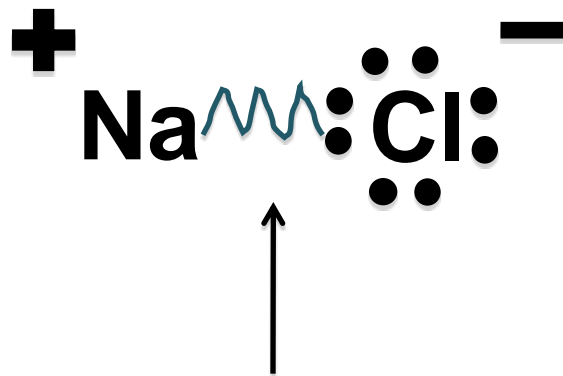
- In **ionic bonds**, one atom **transfers** an **electron** to another atom, making one **cation** and one **anion**
- The **oppositely charged** ions strongly **attract** each other forming a strong bond between them

Sodium transfers
an electron to ...



... chlorine.

Sodium cation and ...



chlorine anion ...

... make an ionic bond.

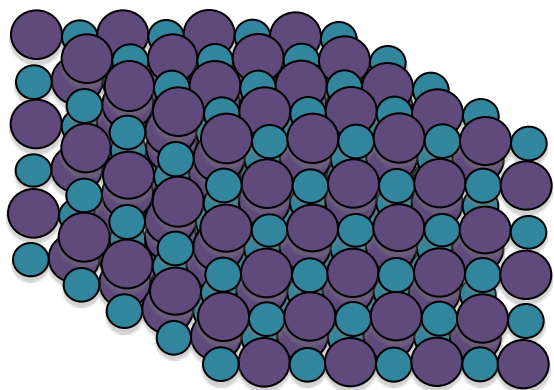
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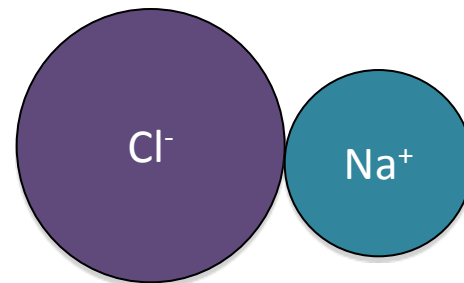
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Formula Units

- Ionic compounds form crystals of billions of billions of atoms
- We represent an ionic compound by its **formula unit**
- A **formula unit** shows a neutral combination of cations and anions



Ionic Compound

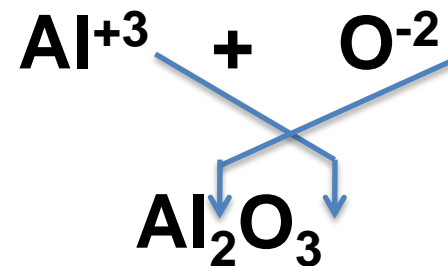
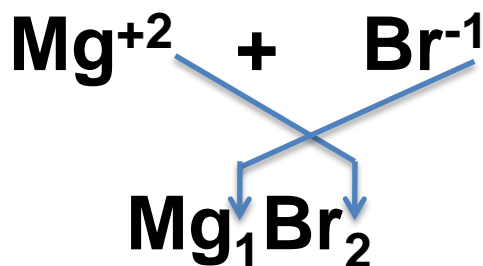
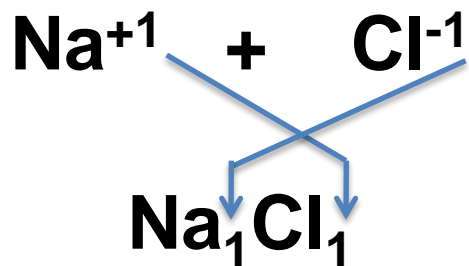


Formula Unit



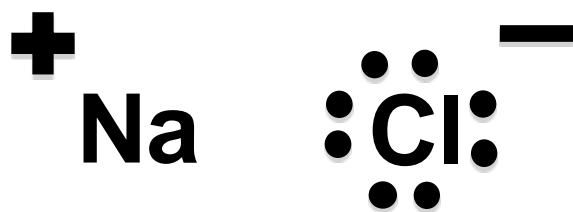
Formula Units

- The net charge on a formula unit must be zero – all negative and positive charges must be balanced!
- We can make the formula unit of binary compounds by 'crossing' their charge and their subscripts

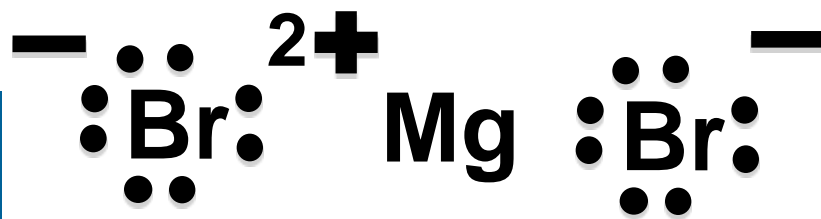


Formula Units

- Metals lose electrons and non-metals gain electrons to attain noble-gas electron configurations
- Many **ionic bonds** are between a **metal cation** and a **non-metal anion**



Sodium Chloride



Magnesium Bromide

Ionic compound naming: metal atom + non-metal atom + 'ide'

Mini Quiz

What are the formula units of the following ionic compounds?

Potassium Iodide

Calcium Chloride

Lithium Bromide

Name the compounds represented by the following formula units

MgCl₂

NaI

RbF

Give the charge on each ion in the formula units above.

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Melting and Boiling Points

Melting and boiling involve pushing atoms apart

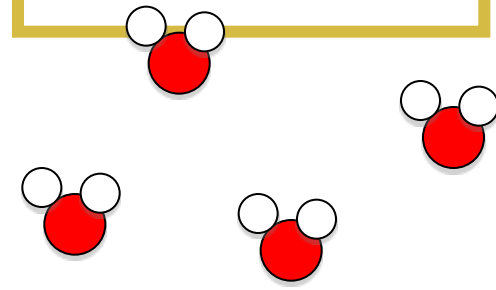
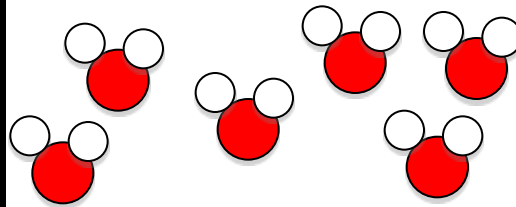
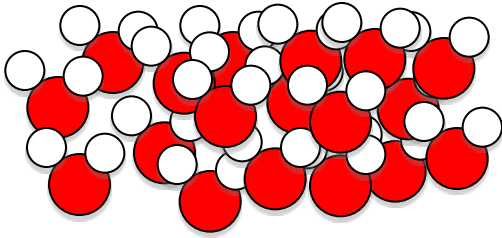
0 ° C

100 ° C

Solid

Liquid

Gas



**M
E
L
T
I
N
G**

**B
O
I
L
I
N
G**



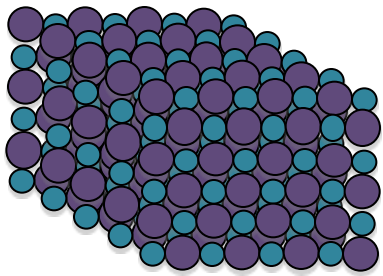
Melting and Boiling Points

Strong ionic bonds = hard to push atoms apart
= high melting and boiling points

750 ° C

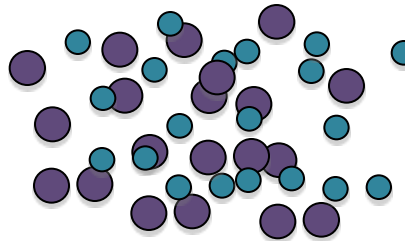
1400 ° C

Solid



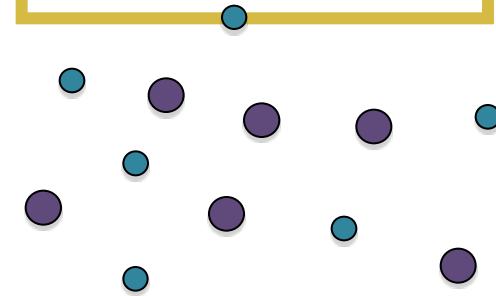
**M
E
L
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Liquid



**B
O
I
L
I
N
G**

Gas



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Deformation

Some materials are soft ...

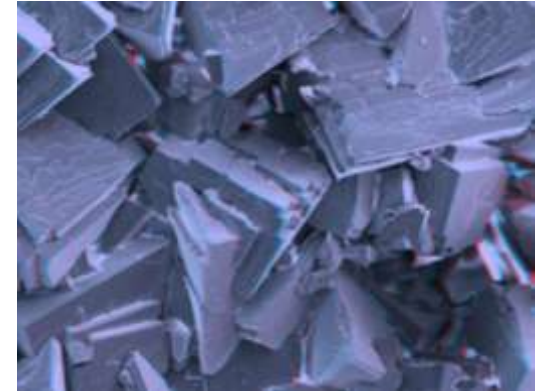


... and metals bend or dent
(more on this soon)

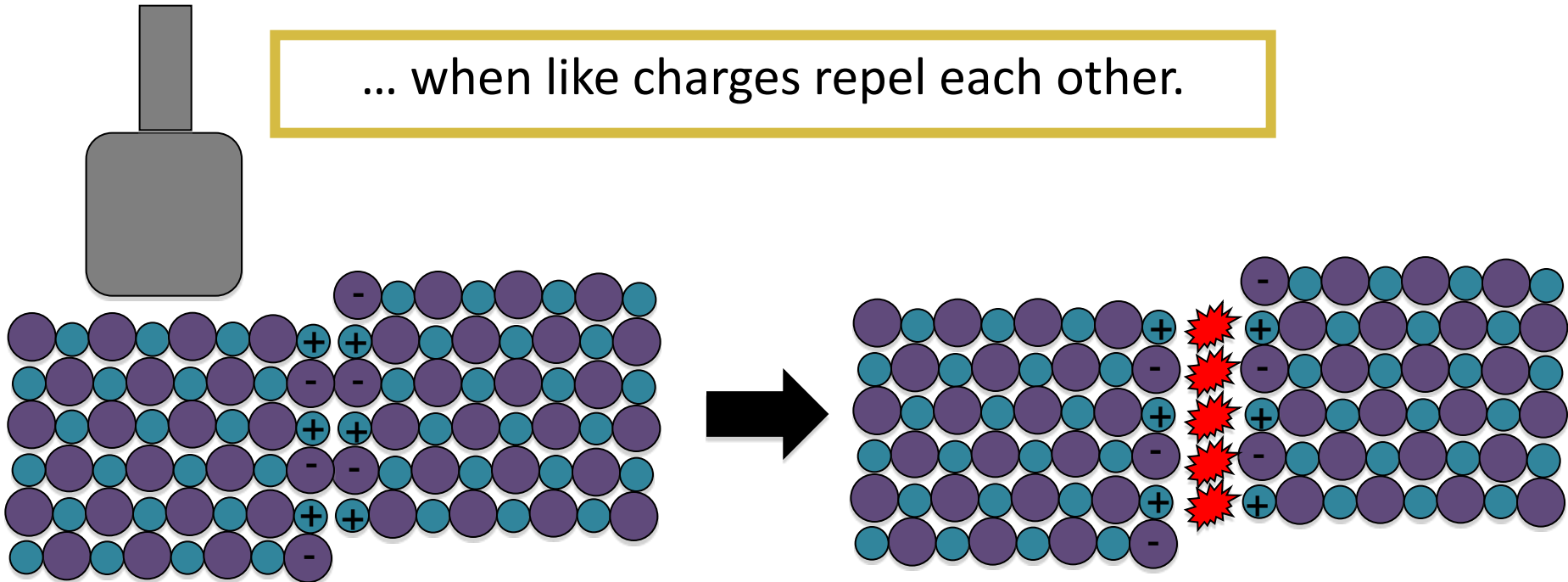


Deformation

Ionic solids **fracture** ...



... when like charges repel each other.



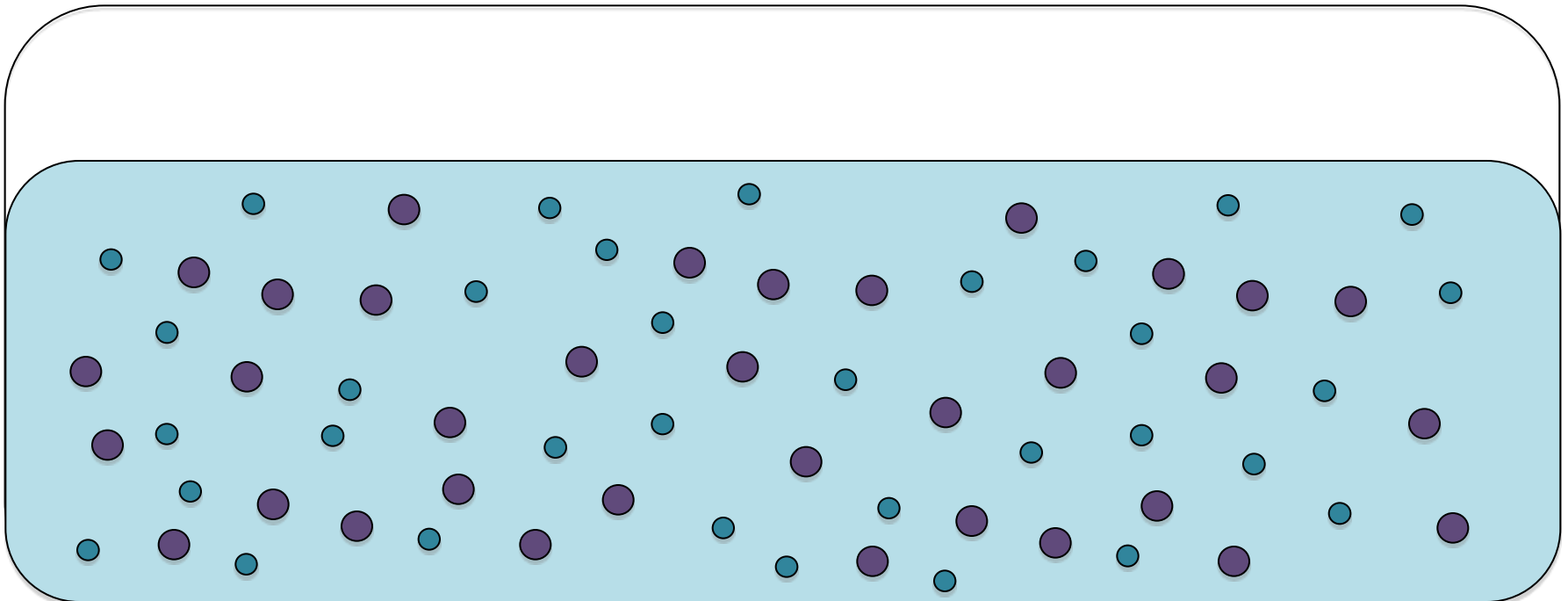
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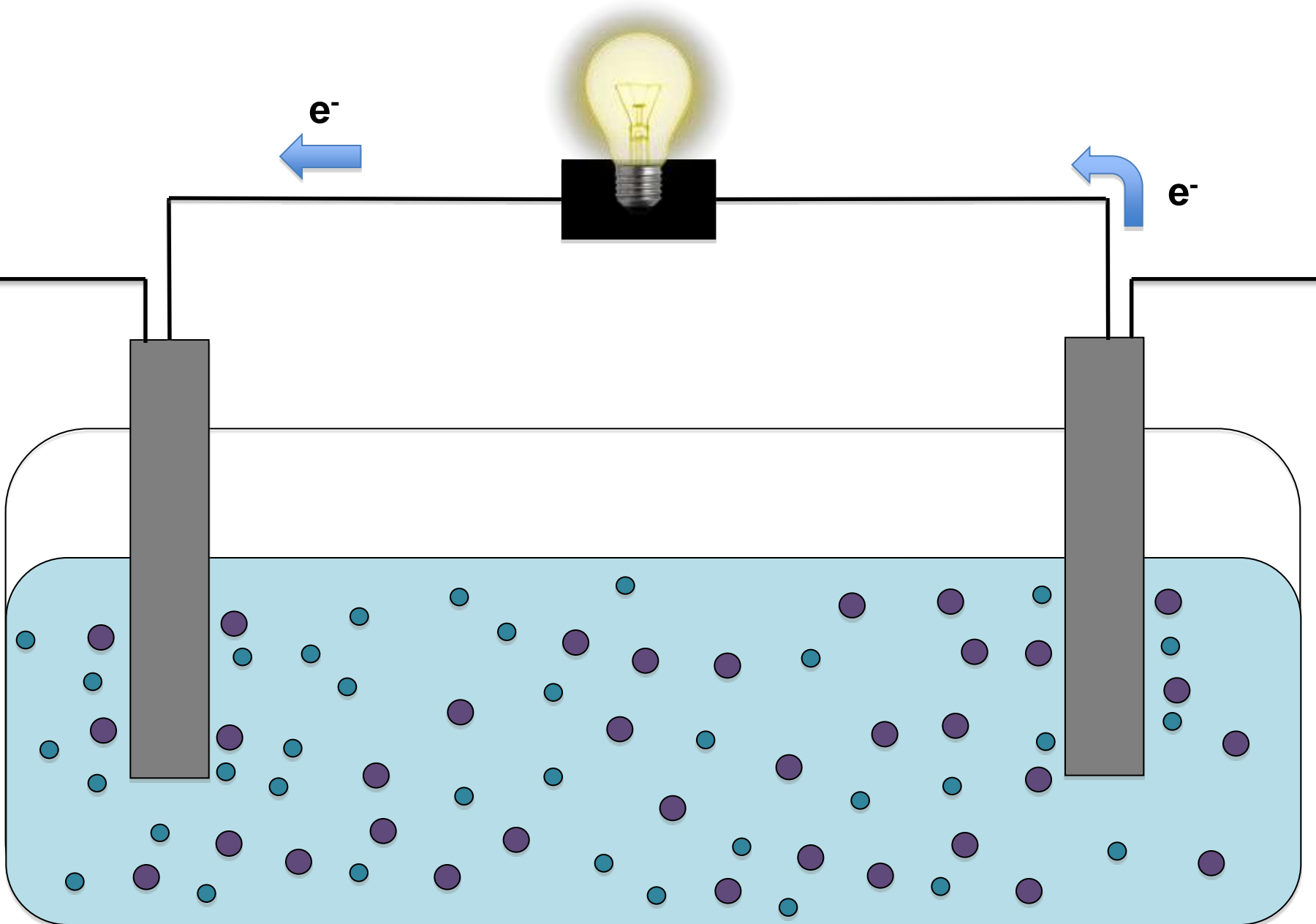
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Electrical Conductivity

- Many ionic compounds dissolve in solution
- Dissolved ions conduct electricity
- **Electrolytes** = soluble ionic compounds and conducting solutions



Electrical Conductivity



Electrical Conductivity

- What happens when we pass an electrical current through solutions of the following compounds?

- H_2SO_4
- NaCl
- $\text{CH}_3\text{CH}_2\text{OH}$
- Na_2SO_4
- CH_3COOH

Mini Quiz

Bulbs light up only if electric current passes through them

- Which solutions have 'bright' light bulbs?
- Which solutions have dark light bulbs?

Current can only be conducted by solutions containing ions

- Which solutions contain ions?

Current passes most easily through solutions with a greater concentration of ions

- Compare the concentration of ions in different solutions

Some of the solutions contain very few or no ions. Why not?

Summary

- Ionic bonds form between cations and anions.
- The smallest part of an ionic compound is a formula unit.
- Ionic compounds have high melting points, boiling points, and electrical conductivity in solution.
- Ionic compounds fracture but do not bend or dent.

Homework

- TBD