

1. WHAT ARE SOLUTIONS?

CH30S

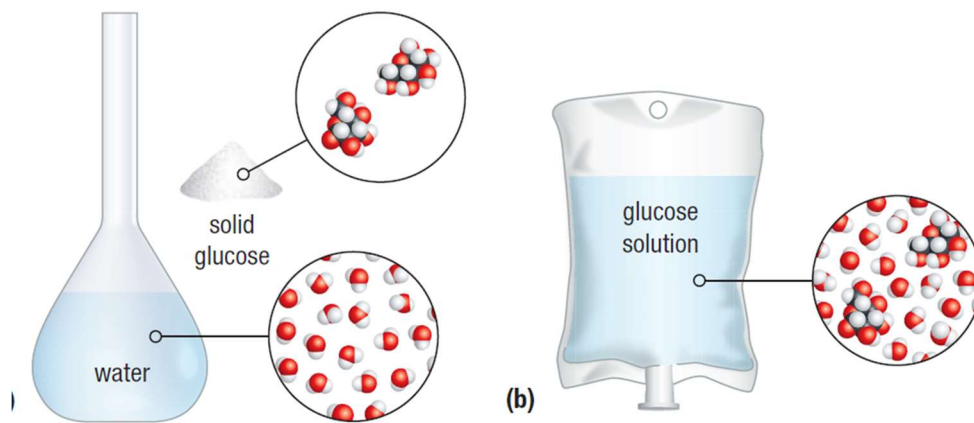
UNIT 3 - SOLUTIONS

WIEBE

1

WHAT ARE SOLUTIONS?

- A solution is a homogeneous mixture
- A solute is dissolved in a solvent.

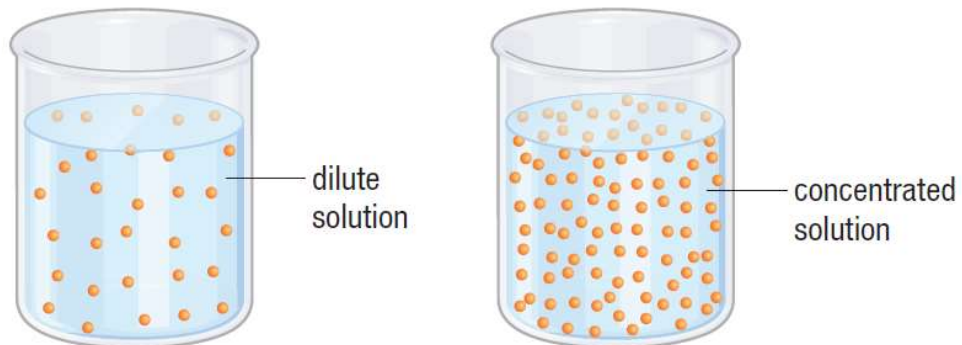


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SOLUTIONS CAN HAVE VARYING SOLUTE QUANTITY.

Concentration is the ratio of solute to solvent.

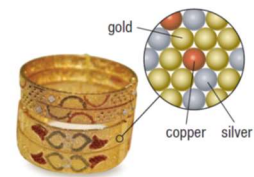
- **Concentrated** solutions have a high solute to solvent ratio.
- **Dilute** solutions have a low solute to solvent ratio.



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TYPES OF SOLUTIONS

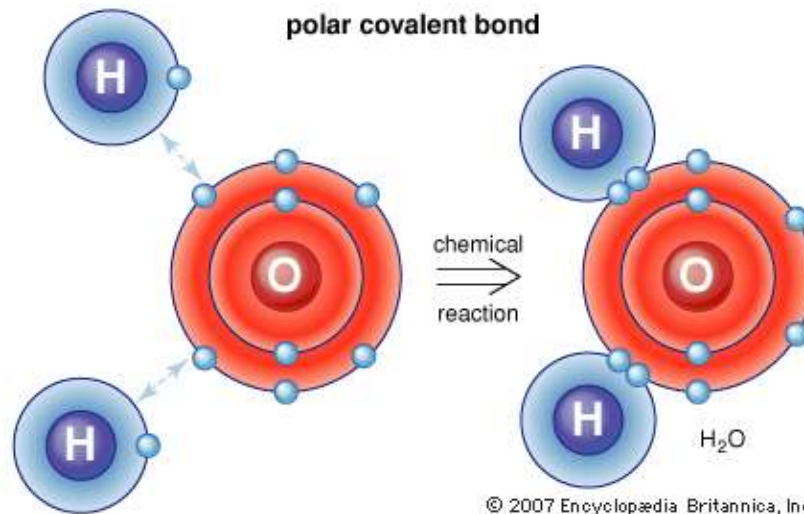
Examples	Original state of solute	State of solvent
air (oxygen, argon, carbon dioxide, and other gases in nitrogen)	gas	gas
carbonated beverages (carbon dioxide and flavour compounds in water)	gas	liquid
humidity (water molecules in air)	liquid or solid	gas
alcoholic beverages (ethanol in water)	liquid	liquid
silver-coloured dental fillings (mercury amalgams)	solid	liquid
air fresheners (vapours from scented solids in air)	solid	gas
clear apple juice (flavour compounds in water)	solid	liquid
brass (an alloy of copper and zinc)	liquid	liquid



An **aqueous** solution has **water** as solvent

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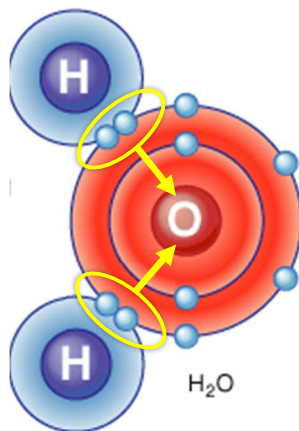
WATERS ROLE IN THE SOLUTION PROCESS



WATER IS A **POLAR COVALENT** MOLECULE.

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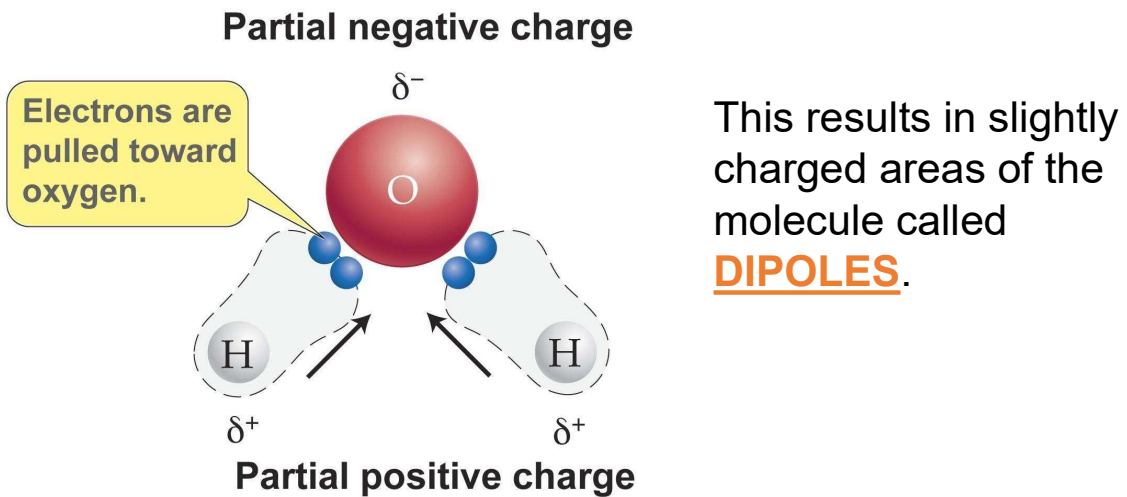
WATERS ROLE IN THE SOLUTION PROCESS



Oxygen is better at “pulling electrons” than hydrogen. As such, the shared pairs of electrons between atoms are pulled closer to the oxygen.

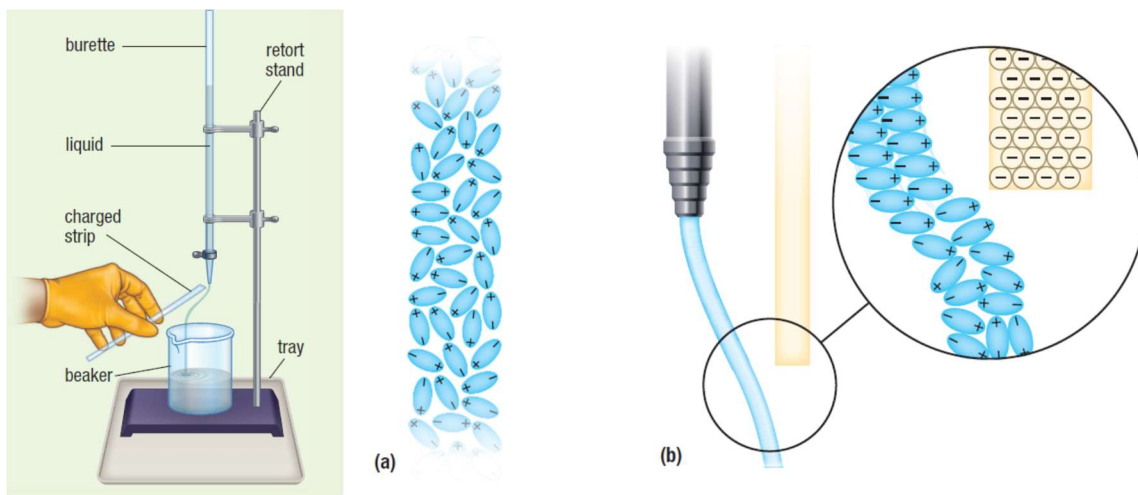
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WATERS ROLE IN THE SOLUTION PROCESS



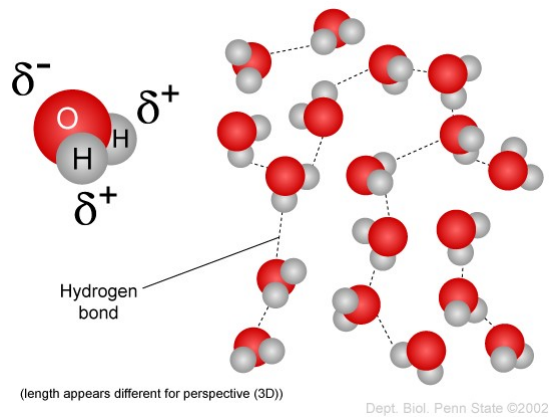
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TESTING POLARITY OF WATER



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WHEN WATER MOLECULES GET TOGETHER...



The dipoles of water molecules attract each other and **intermolecular attractions** form!

These forces explain water's high melting & boiling point, as well as its unique density and surface tension.

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WATER WITHOUT GRAVITY



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TRY THIS...



CHALLENGE: How many drops of water can you place on top of a penny before it spills over the edges?

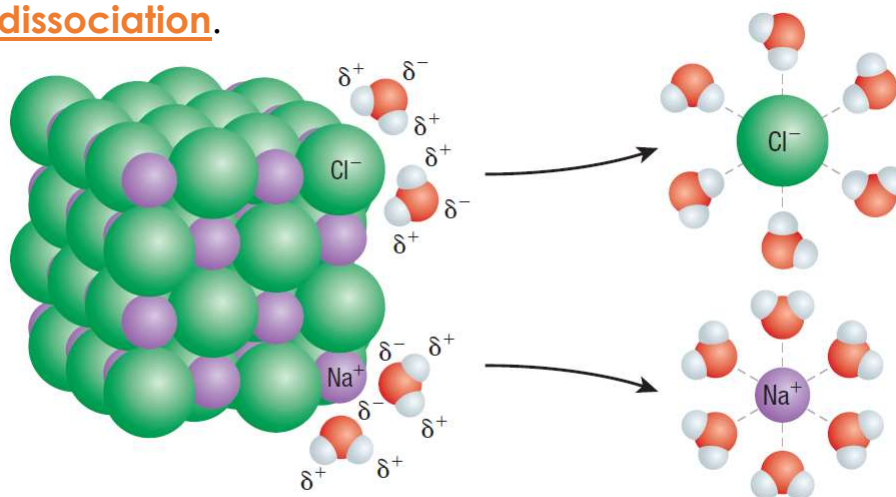
WHY do you think this happens?

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IONIC COMPOUNDS IN WATER

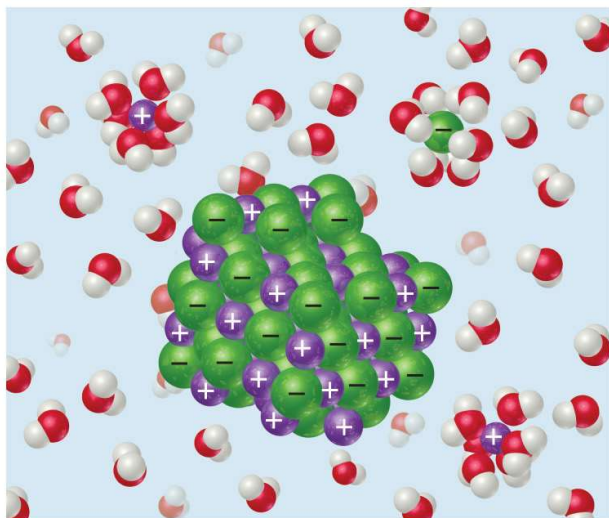
Ionic solutes dissolve in water as shown below. This process is called **dissociation**.



sodium chloride \rightarrow sodium cations + chloride anions

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IONIC COMPOUNDS IN WATER



The positive poles of a water molecule attract to a negative ion in the crystal and removes it.

The negative pole of a water molecule attracts to a positive ion in the crystal and removes it.

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SOLUBILITY OF COMMON COMPOUNDS IN WATER
The term soluble here means > 0.1 mol/L at 25°C.

Negative Ions (Anions)	Positive Ions (Cations)	Solubility of Compounds
All	Alkali ions: Li ⁺ , Na ⁺ , K ⁺ , Rb ⁺ , Cs ⁺ , Fr ⁺	Soluble
All	Hydrogen ion: H ⁺	Soluble
All	Ammonium ion: NH ₄ ⁺	Soluble
Nitrate, NO ₃ ⁻	All	Soluble
Chloride, Cl ⁻ or Bromide, Br ⁻ or Iodide, I ⁻	All others	Soluble
	Ag ⁺ , Pb ²⁺ , Cu ⁺	Low Solubility
Sulphate, SO ₄ ²⁻	All others	Soluble
	Ag ⁺ , Ca ²⁺ , Sr ²⁺ , Ba ²⁺ , Pb ²⁺	Low Solubility
Sulphide, S ²⁻	Alkali ions, H ⁺ , NH ₄ ⁺ , Be ²⁺ , Mg ²⁺ , Ca ²⁺ , Sr ²⁺ , Ba ²⁺	Soluble
	All others	Low Solubility
Hydroxide, OH ⁻	Alkali ions, H ⁺ , NH ₄ ⁺ , Sr ²⁺	Soluble
	All others	Low Solubility
Phosphate, PO ₄ ³⁻ or Carbonate, CO ₃ ²⁻ or Sulphite, SO ₃ ²⁻	Alkali ions, H ⁺ , NH ₄ ⁺	Soluble
	All others	Low Solubility

Some ionic solutes dissolve better in water than others.

- HIGH SOLUBILITY = dissolves readily (**aq**)
- LOW SOLUBILITY = doesn't appear to dissolve to any extent (even though it does a bit). (**s**)

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Chloride, Cl ⁻ or Bromide, Br ⁻ or Iodide, I ⁻	All others	Soluble
	Ag ⁺ , Pb ²⁺ , Cu ⁺	Low Solubility
Sulphate, SO ₄ ²⁻	All others	Soluble
	Ag ⁺ , Ca ²⁺ , Sr ²⁺ , Ba ²⁺ , Pb ²⁺	Low Solubility
Sulphide, S ²⁻	Alkali ions, H ⁺ , NH ₄ ⁺ , Be ²⁺ , Mg ²⁺ , Ca ²⁺ , Sr ²⁺ , Ba ²⁺	Soluble
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Hydroxide, OH ⁻	Alkali ions, H ⁺ , NH ₄ ⁺ , Sr ²⁺	Soluble
	All others	Low Solubility
Phosphate, PO ₄ ³⁻ or Carbonate, CO ₃ ²⁻ or Sulphite, SO ₃ ²⁻	Alkali ions, H ⁺ , NH ₄ ⁺	Soluble
	All others	Low Solubility

Determine the general solubility of the following solutes:

sodium chloride

calcium sulphate

lithium hydroxide

zinc hydroxide

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Sample Problem 1: Writing a Dissociation Equation

Write a chemical equation for the dissociation of potassium phosphate, K₃PO₄(s).

WE WRITE DISSOCIATION EQUATIONS FOR HIGHLY SOLUBLE IONIC SOLUTES ONLY!

STEP 1: Check general solubility.

STEP 2: If highly soluble, write equation. If low solubility, write "Does not dissociate to any significant extent."

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USING THE SOLUBILITY TABLE

For each of the following ionic solutes:

1. Determine if it would be highly soluble in water (aq) or low solubility in water (s).
2. Write a dissociation equation for the highly soluble solutes.

Calcium nitrate

Iron(III) chloride

Silver nitrate

Ammonium nitrite

Barium sulphate

Nickel(II) hydroxide

Aluminum sulphate

Sodium sulphide

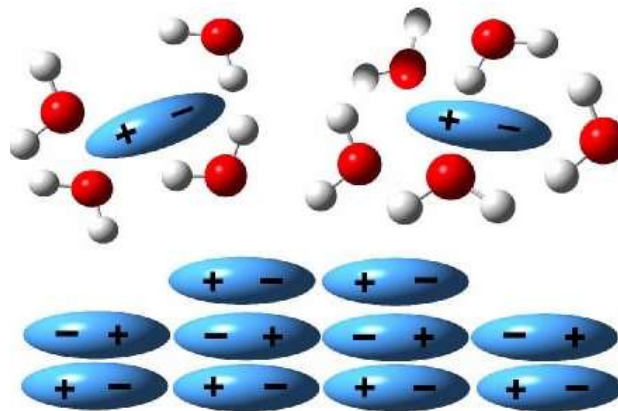
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ANSWERS

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COVALENT COMPOUNDS IN WATER

- When a **polar covalent compound** dissolves in water, the polar water molecules attract to the poles of each solute molecule and pull them apart.
- Non-polar molecules **DON'T DISSOLVE** in water.



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COVALENT COMPOUNDS IN WATER

Remember “Like Dissolves Like”

- Polar solutes dissolve in polar solvents (ie. sugar in water)
- Non-polar solutes dissolve in non-polar solvents (ie. oil in gasoline)
- All other combo's don't happen (ie. oil in water, sugar in gasoline)

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