

**Chemistry 20**  
**Solutions Unit**

In this unit we will study solutions and their properties. An aqueous solution is when one or more compounds are dissolved in water. Below are the Learning Outcomes and subtopics that we will be covering in this unit.

Each Outcome will be assessed by an assignment and a quiz. At the end of the unit, there will be a unit test.

**Outcome 1 - Aqueous Solutions**

Topic 1 -Explaining the Properties of Solutions

Topic 2 - How to Calculate Concentration of Solutions

Topic 3 -How to prepare Solutions

**Outcome 2 - Acids and Bases**

Topic 1 – Definitions of Acids and Bases

Topic 2 – Explaining and Calculating pH and pOH

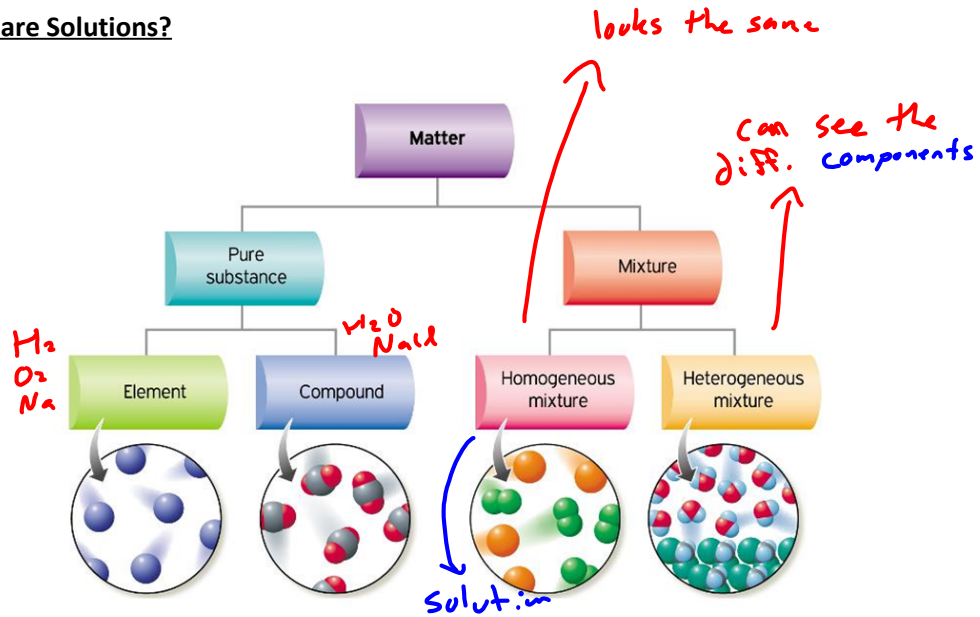
Topic 3 – How Acid Base Indicators work

Topic 4 – Modern Definitions of Acids and Bases

Topic 5 – Difference between Strong and Weak acids and Bases

## Topic 1 - Properties of Solution

### What are Solutions?



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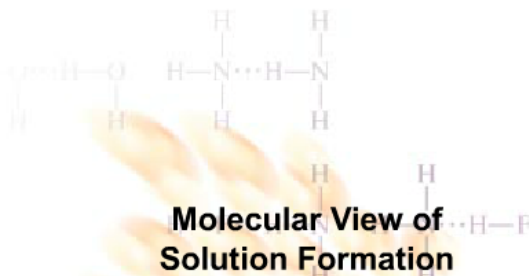
- Solutions are homogeneous mixtures composed of at least one solute and one solvent

- Solute - a substance that is dissolved  
↳ salt, sugar
- Solvent - the medium in which a solute is dissolved
  - ie. Water (aqueous solutions)

### Examples

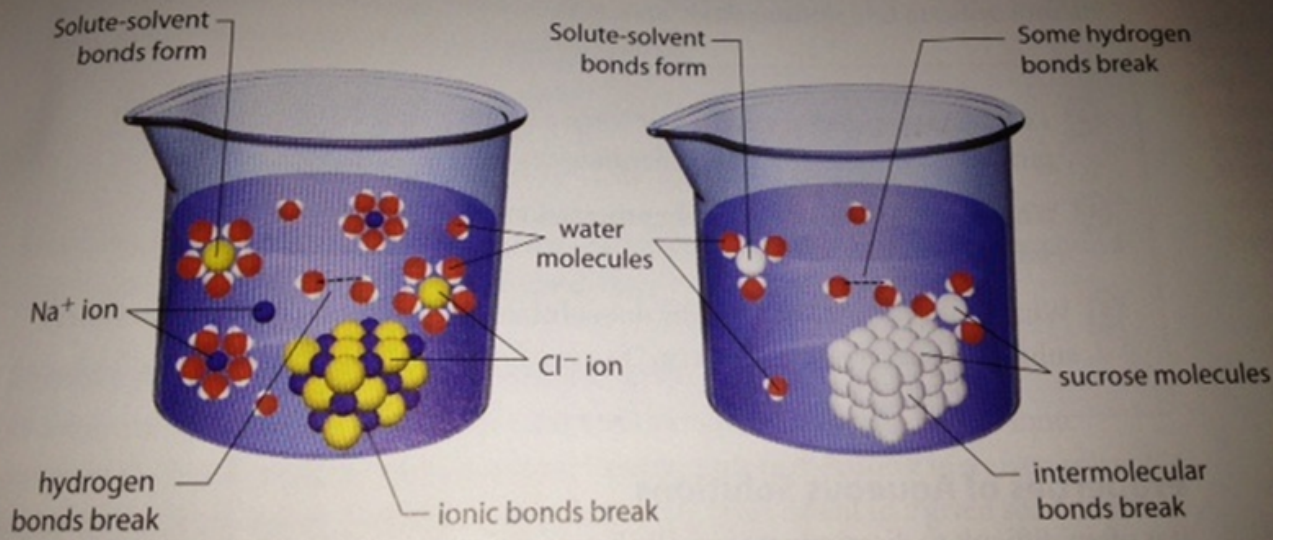
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### The dissol



**A** Sodium chloride,  $\text{NaCl(s)}$  dissolves

**B** Sucrose,  $\text{C}_{12}\text{H}_{22}\text{O}_{11(s)}$ , dissolves

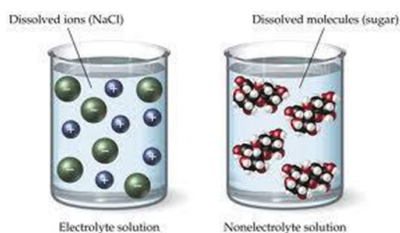


## Classifying Aqueous solutions

- Aqueous means dissolved in water

- Aqueous solutions can be classified as:

- Electrolytes or non-electrolytes or,
- Acid, base or neutral

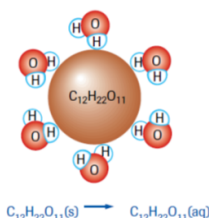


## Electrolytes vs Non-Electrolytes

- Electrolytes are compounds that conduct electricity in solution

- Non-electrolytes are compounds that don't conduct electricity in solution

Compound	Type (I,M,A,B)	Conductivity Test	Litmus Test
NaCl	I		
HCl	A		
CH <sub>3</sub> OH	M		
H <sub>2</sub> O <sub>2</sub>	M		
Cu(NO <sub>3</sub> ) <sub>2</sub>	I		
KOH	B		
H <sub>2</sub> SO <sub>4</sub>	A		
NaOH	B		

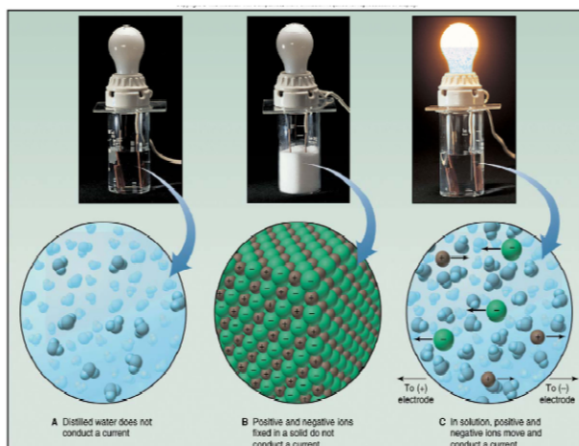


**Figure 1**  
This model illustrates sucrose dissolved in water. The model, showing electrically neutral particles in solution, agrees with the evidence that a sucrose solution does not conduct electricity.

What generalization can you make from the observations?

- In general:

- Acids, bases and ionic compounds are electrolytes
- Molecular compounds are non-electrolytes



1. Electrolytes are lost during physical activity and in hot weather through sweating. The body sweats in order to keep cool-cooling by evaporation of water. Sweating removes water and the substances dissolved in the water, such as salts and other electrolytes. We replace lost electrolytes by eating and drinking. By law, the ingredients of a food item are required to be placed on the label in decreasing order of quantity, as they are in sports drinks.

(a) Classify the ingredients of the sports drink in Figure 5 as electrolytes or nonelectrolytes. How does the number and quantity of electrolytes and nonelectrolytes compare?

(b) Which ingredients contain sodium ions? Which contain potassium ions? Are there more sodium or potassium ions in the drink? Justify your answer.

(c) Does the most energy in the drink come from proteins, carbohydrates, or fats (oils)?

(d) What three chemical needs does the drink attempt to satisfy?

2. Solve the problem in the lab exercise below.

Nutrition Facts Valeur nutritive	
Per 500 mL / par 500 mL	
Amount Teneur	% Daily Value % valeur quotidienne
Calories / Calories	130
Fat / Lipides	0 g 0 %
Sodium / Sodium	210 mg 9 %
Potassium / Potassium	55 mg 2 %
Carbohydrate / Glucides	32 g 11 %
Sugars / Sucres 30 g	
Protein / Protéines	0 g

Not a significant source of saturated fat, trans fat, cholesterol, fibre, vitamin A, vitamin C, calcium or iron.  
Source négligeable de lipides saturés, lipides trans, cholestérol, fibres, vitamine A, vitamine C, calcium et fer.

INGREDIENTS: WATER, LIQUID SUGAR, GLUCOSE-FRUCTOSE, CITRIC ACID, NATURAL AND ARTIFICIAL FLAVOUR, SALT, SODIUM CITRATE, MONOPOTASSIUM PHOSPHATE, ESTER GUM, COLOUR.  
INGRÉDIENTS : EAU, SUCRE LIQUIDE, GLUCOSE-FRUCTOSE, ACIDE CITRIQUE, ARÔME NATUREL ET ARTIFICIEL, SEL, CITRATE DE SODIUM, PHOSPHATE MONOPOTASSIQUE, GOMME ESTER, COLORANT.

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## LAB EXERCISE 5.A

### Report Checklist

- |                                  |                                 |   |
|----------------------------------|---------------------------------|---|
| <input type="radio"/> Purpose    | <input type="radio"/> Design    | <input checked="" type="radio"/> Analysis |
| <input type="radio"/> Problem    | <input type="radio"/> Materials | <input type="radio"/> Evaluation          |
| <input type="radio"/> Hypothesis | <input type="radio"/> Procedure |   |
| <input type="radio"/> Prediction | <input type="radio"/> Evidence  |   |

### Identifying Solutions

For this investigation, assume that the labels on the four containers have been removed (perhaps washed off). Your task as a laboratory technician is to match the labels to the containers to identify the solutions.

#### Purpose

The purpose of this investigation is to use diagnostic tests to identify some solutions.

#### Problem

Which of the solutions labelled 1, 2, 3, and 4 is hydrobromic acid, sodium nitrate, lithium hydroxide, and methanol?

#### Design

Each solution is tested with both red and blue litmus paper and with conductivity apparatus. The temperature and concentration of the solutions are controlled variables.

### Evidence

**Table 3** Properties of the Unidentified Solutions

Solution	Red litmus	Blue litmus	Conductivity
1	red	blue	none
2	red	red	high
3	red	blue	high
4	blue	blue	high

3. State at least two ways of classifying solutions.

4. (a) Describe an aqueous solution.

(b) Give at least five examples of aqueous solutions that you can find at home.

5. (a) What types of solutes are electrolytes?

(b) Write a definition of an electrolyte.

6. Classify each compound as an electrolyte or a nonelectrolyte:

(a) sodium fluoride (in toothpaste)

(b) sucrose (table sugar)

(c) calcium chloride (a road salt)

(d) ethanol (in wine)

## Attachments

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