

ScE7.3.2 : Solutions and Concentrations

Outline and Study Guide



1. Solution, solvent, solute (p.2-3)
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3. Concentrated, dilute (p.5)
4. Measuring concentration – definition, different units, and calculating g/L. (p.6-8)
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6. **Core Lab** : *Effect of Temperature on Solubility of Salt in Water.*
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Concentration	Insoluble	Solubility	Solute
Concentrated	Unsaturated	Soluble	Solvent
Dilute	Saturated	Solution	

Definitions

1. _____ : a homogeneous mixture composed of a solvent and one or more solute.
2. _____ : the substance that dissolves the solute; the substance that is in greater amount in the solution.
3. _____ : the substance that is dissolved in the solvent
4. _____ substance : a substance that CAN dissolve in a particular solvent.
5. _____ substance : a substance that CANNOT dissolve in a particular solvent.
6. _____ solution: a solution that contains less solute for the amount of solvent.
7. _____ solution: a solution that contains more solute for the amount of solvent.
8. _____ : a measurement of the amount of solute for the amount of solvent in a solution
9. _____ : the maximum concentration of a solute that is capable of dissolving in that solvent
10. _____ solution: a solution that contains the MAXIMUM concentration possible of that solute.
11. _____ solution: a solution that contains LESS THAN THE MAXIMUM concentration possible of that solute.

Solution, Solvent, Solute

Use a labelled drawing to represent the relationship between the solvent, the solute, and a solution.

Define each term and give an example:

Solvent:

Solute:

Solution:

For each example below, identify the name of the solution, the solvent, and the solute.

Example	Solution	Solvent	Solute
Vinegar contains 5% acetic acid and 95% water			
Windshield wiper fluid contains propylene glycol dissolved in water			
Dental amalgam is a metal alloy that can be used to fill cavities in people's teeth. It is made of tin dissolved in mercury.			
You can make Kool Aid from powder at home by mixing the powder with water.			
Seawater (use your own knowledge!)			
A trumpet is made of brass, an alloy of zinc dissolved in copper.			
Air contains about 21% oxygen, 78% nitrogen, 0.04% carbon dioxide, 1% argon, and the rest is water vapor and traces of other gases.			

Soluble / Insoluble

Listen to the SmartBoard activity and complete the examples of soluble and insoluble substances

Soluble in Water	Insoluble in Water

Define soluble and insoluble.

Why do you have to specify the solvent when you say if a substance is soluble or insoluble?

What happens to the particles of a substance when it dissolves in water?

How does particle theory explain why some substances are soluble in a certain solvent but others are not?

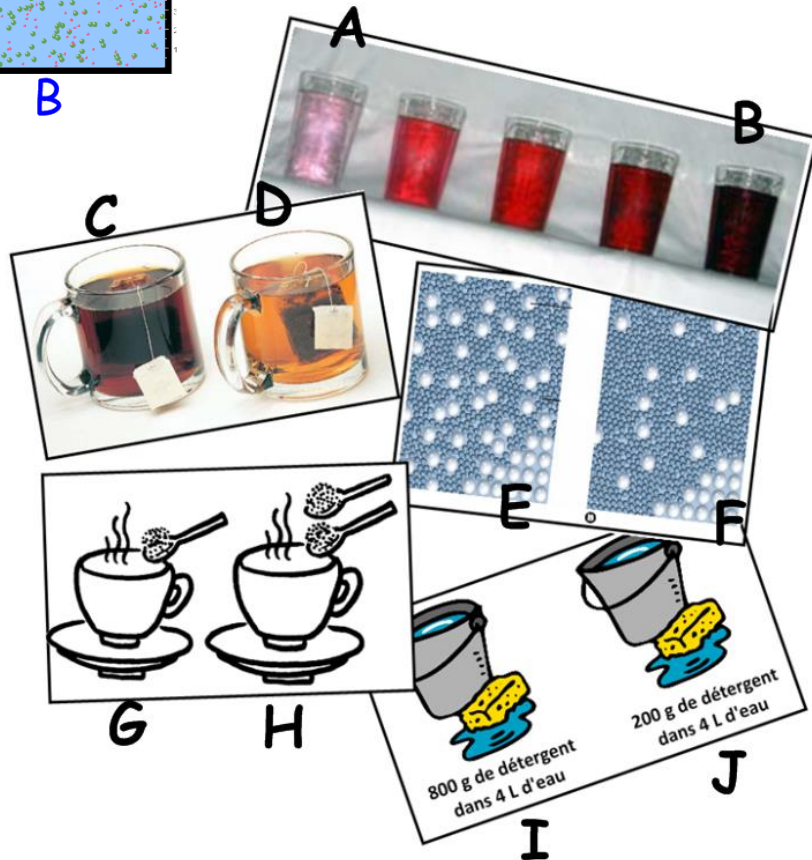
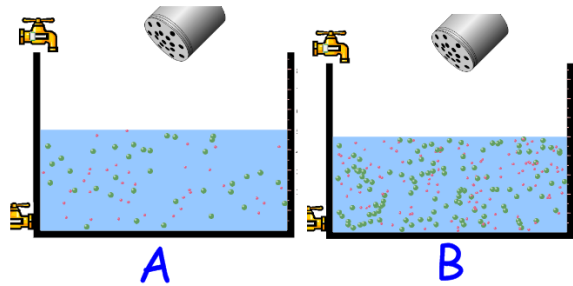
Concentrated / Dilute

Listen to your teacher showing the activities on the SmartBoard, then explain the difference between a concentrated and a dilute solution.

Concentrated solution : _____

Dilute solution : _____

In each example below, indicate the most concentrated solution with **C**, and the most dilute with **D**.



Measuring Concentration

Define **concentration**.

Examples of concentration of different products:

Name of Product	Solute	Label concentration

How to Calculate Concentration in g/L

Formula :

Note: you are ALLOWED to use a calculator for this section! 😊

In science, the way to SHOW YOUR WORKINGS is to include the formula and the units as in the following examples!

Calculating Concentration - Examples

1. What is the concentration in g/L of a sugar solution made from 45 g of sugar in 1 litre of water ?
2. If I dissolve 150 g of salt in 0.5 L of water, what is the concentration ?
3. Calculate the Kool-Aid concentration of 600 g of crystals in a 3 L pitcher of water.
4. Hydrogen peroxyde is a chemical used to bleach hair before dyeing. If a 0.25 L bottle contains 10 g of hydrogen peroxyde, what is its concentration?

Individual Practice

1. If you dissolve 5 g of instant coffee crystals in a small cup (0.2 L) of boiling water, what is the concentration ?

2. A small swimming pool contains 1000 L of water. If 1.2 g of chlorine is added to disinfect the water, what is the concentration in g/L?



3. Honey contains mostly sugar and water. If 100 mL (0.1 L) of honey contains 60 g of sugar, what is its concentration in g/L?

4. Benadryl is a medication often used to help people having allergic reactions. According to the information on the label, liquid Benadryl contains 0.0125 g of medicine in each 5 mL dose (0.005 L). What is the concentration of Benadryl in g/mL ?



5. An epipen is a special needle that can be used to give a medication called epinephrin to someone who is having a life-threatening anaphylactic reaction to something they are allergic to. According to the information on the label, each dose contains 0.0005 g of epinephrin in 10 mL (0.01 L) of liquid. What is the concentration in g/L?



Solubility : Saturated and Unsaturated Solutions.

So, salt is soluble in water, but is there a limit?

Explain the difference between a saturated and an unsaturated solution.

Define solubility.

Would you expect the solubility of salt to be affected by the temperature? In other words, do you think you can dissolve more salt in hot water or cold? Explain your answer.

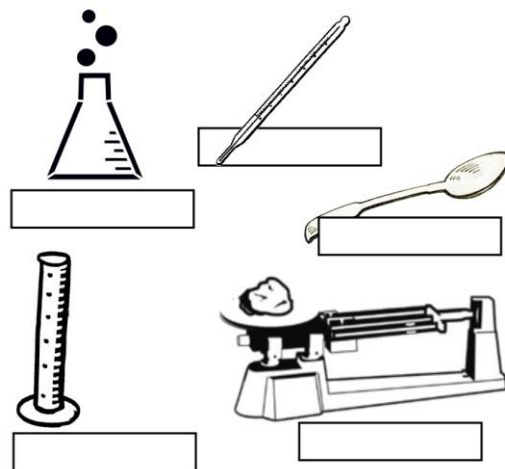
Conclusion of Lab Activity :

Effect of Temperature on the Solubility of Salt in Water.

Considering the results of all the groups in the class, what can we conclude about the effect of temperature on the solubility of salt?

Label the following lab equipment :

Scale, graduate cylinder, thermometer, spoon, erlenmeyer.



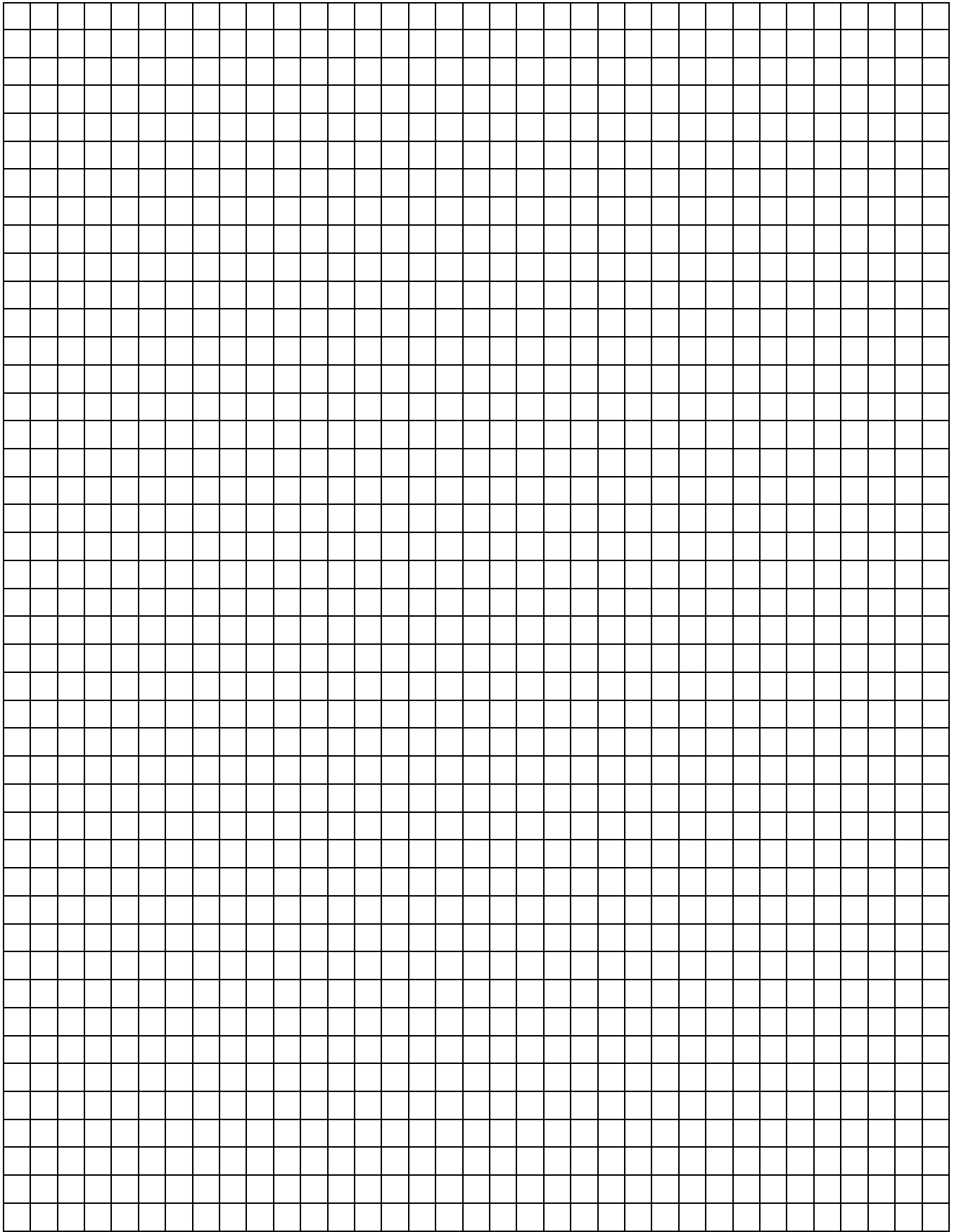
Graphing Practice : The Effect of Temperature on the Solubility of Three Solids

It turns out that salt is very slightly more soluble in hot water than cold. For different substances, the effect of temperature on solubility can be different. Consider the three solids in the table below.

Temperature (°C)	Solubility in water (g/L)		
	Solid A: Sugar	Solid B : Potassium Chlorate	Solid C : Lithium Sulfate
10	1910	50	370
20	2040	70	360
30	2200	110	350
40	2390	150	340
50	2610	210	330
60	2870	270	320
70	3200	340	310

- Based on these results
 - Which solid is most soluble overall? _____
 - Which solid has a solubility that increases the most with temperature? _____
 - Which solid has a solubility that decreases with temperature? _____
- Graph these results using a THREE LINE graph on the following page. Use a legend to identify each line. Don't forget to label your axes and to give a title to your graph.
- In your graph, what is the independent variable? _____
 What is the dependent variable? _____
- In this data, what is the unit for temperature? _____
 What is the unit for solubility? _____
- Estimate the solubility of each substance at 55 °C and 80 °C:

	Estimated solubility at 55 °C	Estimated solubility at 80 °C
Sugar		
Potassium Chlorate		
Lithium Sulfate		



The Solubility of Various Substances

Consider the following table of solubilities

Solute	Solubility in Water at 0 °C
Baking soda (solid)	69
Bluestone (solid)	316
Calcium hydroxide (solid)	1,9
Carbon dioxide (gas)	3,4
Epson salts (solid)	700
Ethanol (liquid)	unlimited
Limestone (solid)	0,007
Nitrogen (gas)	0,03
Oxygen (gas)	0,07
Salt (solid)	357
Sugar (solid)	1792

- In what solvent were these solubilities measured?
- At what temperature?
- Why is it necessary for the chart to indicate the temperature?
- What states of matter are the solutes in this chart?
- List these substances in order from the least to the most soluble.
- Use particle theory to explain why some substances like limestone have a very low solubility in water while others like sugar are much more soluble. (HINT : the difference is in the attraction between particles. See p.4 in this booklet.)

Dissolving Gases

Watch a [youtube video](#) on how soda fountains work, and the demonstration on the effect of temperature on soda water. Then complete the notes below.

1. Name two examples of gases that can dissolve in water.
2. What is the effect of pressure on the solubility of a gas in water?
3. Why do you hear a “pssshhhht!” when you crack open a soft drink?
4. How does the solubility of carbon dioxide in water change with temperature ? Explain why, using particle theory.
5. Fish depend on oxygen dissolved in water to breathe, because they have no lungs and cannot use the oxygen from the air. Why could fish have trouble breathing in the summer if the water gets too warm?

Review

1. Explain the relationship between the three following terms : a **solution**, a **solvent**, a **solute**.

2. Complete the following table :

Solution	Which substance is the solvent? How do you know?	Which substance is the solute? How do you know?
Bronze is an alloy containing 88% copper and 12% tin.		
Apple juice contains 30 g of sugar per 250 mL of juice.		
Antifreeze contains ethylene glycol and coloring dissolved in water.		
Air contains about 21% oxygen, 78% nitrogen, 0.04% carbon dioxide, 1% argon, and the rest is water vapor and traces of other gases.		

3. Name two substances that are insoluble in water : _____, _____
4. Name two substances that are soluble in water : _____, _____
5. Describe what happens to the sugar molecules when a sugar cristal dissolves in water.

6. In each of the following pictures, write C for the most concentrated solution, and D for the most dilute.



7. Rosalind Franklin gradually adds sugar to 1 litre of water, 100 g at a time. At first the sugar crystals dissolve, but after 3200 g, no more sugar dissolves.
- At what point does the solution become saturated ?
 - During what time is the solution unsaturated?

