2. Different solvents and their applications

At the end of this chapter, you will be competent to:

- Differentiate homogeneous mixtures from heterogeneous mixtures.

- Investigate the properties of various solvents used in day to day life.

- Preparae chemical solutions to suit our needs and explore the composition of solutions.

- Investigate factors affecting solubility.

- Explore the applications of solubility (Purification and separation).

2.1 Homogeneous and heterogeneous mixtures

Most substances that we find around us are not pure substances, but are mixtures of two or more substances. Sea water, soil, river water and air around us are such examples. The cup of tea you had in the morning and the salt water used for preparing our food also fall into this category. Matter that can physically be separated into its components are called mixtures.

Mixtures may be homogeneous or heterogeneous according to the distribution of constituents making up the mixture.

Homogeneous mixtures

In a mixture prepared by dissolving sugar in water, the constituents are sugar and water. Even on very close observation, water and sugar particles cannot be separately identified. In such a mixture the physical properties like colour, density and taste are uniform in any part of the mixture. **A mixture of this kind where the appearance, properties and composition identical throughout are is called a homogeneous mixture or a solution.**
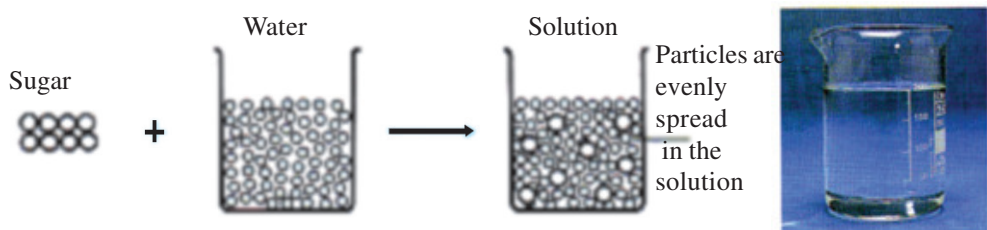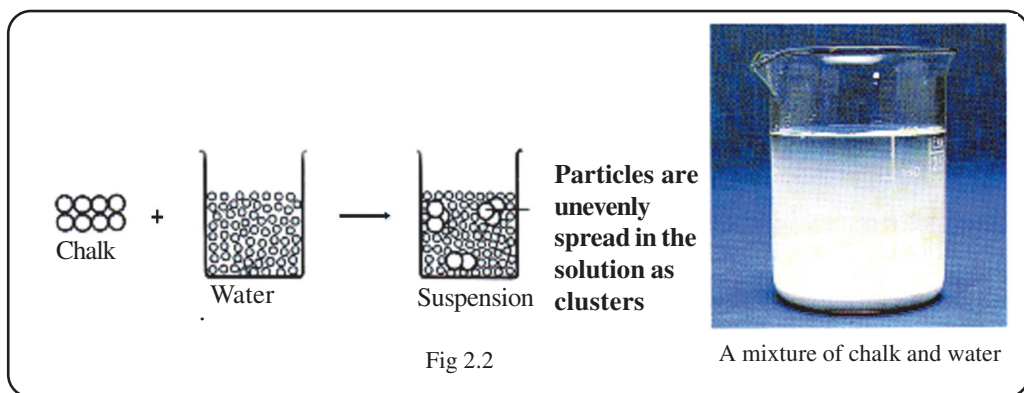

A mixture of sugar and water

A solution consists of a solvent and one or more solutes. In a solution the constituent that is in greater proportion is the solvent and the constituents that are in lesser proportions are the solutes.

Solution	=	Solute + Solvent
e.g. Sugar solution	=	Sugar + Water
Saline solution	=	Sodium chloride + Water

Heterogeneous mixtures

When finely powdered chalk is dispersed in water, white chak particles can be seen suspended in water. Some particles settle on the bottom of the vessel.

Obviously, the physical properties (colour, density) of this mixture are not uniform throughout the mixture. Its constituents can separately be identified. **Such a mixture where the physical properties, composition, and appearance are not equal in different parts of the mixture is called a heterogeneous mixture.**

Fig 2.2

A mixture of chalk and water

As such, a mixture of sugar and water forms a homogeneous mixture while a mixture of chalk powder and water forms a heterogeneous mixture.

Imitially both sugar and chalk powder that were used in the above examples were in the solid state and water was in the liquid state. Therefore sugar-water mixture could be classified as a solid-liquid homogeneous mixture, and chalk powder-water mixture as a solid-liquid heterogeneous mixture. So we see that homogeneous and heterogeneous mixtures can be further classified into different types based on the components in them.

Types of mixtures

Activity 2.1
Dissolve the substances given below in water and record observations. Salt, washing powder, copper sulphate, potassium permanganate, wheat flour, coconut oil, ethyl alcohol. Identify the different mixtures prepared as homogeneous or heterogeneous. Try to classify them further on the intial states of the components.

Solid - liquid mixtures
Let us see the results of Activity 2.1. Salt, copper sulphate, potassium permanganate, and sugar disappeared when dissolved in water, thus making solutions which are homogeneous in nature. Therefore, they are solid-liquid homogeneous mixtures.

Washing powder, washing blue, and wheat flour too dispersed in water but tiny solid particles were seen suspended in the mixture. On standing, the solid particles settled at the bottom. Therefore, they are solid-liquid heterogeneous mixtures.

Liquid-liquid mixtures
Ethyl alcohol too dissolves in water to form a homogenous solution. This is a liquid-liquid homogenous mixture.

Coconut oil too forms a mixture, When shaken vigorously with water it forms a suspension of tiny oil droplets in water. This is a liquid-liquid heterogeneous mixture.

Gas-liquid mixtures

Gases too dissolve in liquids. Bottled soda water found in the market is an example. Soda water is made by dissolving carbon dioxide in water under pressure. By examining a soda bottle you will not be able to identify the water and carbon dioxide separately. Therefore they form a gas- liquid homogeneous mixture.

But if you open the bottle, the gas bubbles rise up causing the 'fizziness' in soda. So, here we have a gas- liquid heterogeneous mixture.

Solid-solid mixtures

You already know that brass is an alloy. It is made by mixing a high percentage of copper with a low percentage of zinc. Here, zinc dissolves in copper to form a solid-solid homogeneous mixture or a solid solution. Iron powder mixed with sulphur powder gives a heterogeneous solid- solid mixture.

You can further understand about mixtures by studying the examples given in Table 2.1.

Table 2.1 - Some more example for

Solute	Solvent	Solution	Type of mixture
Water(liquid)	Salt (solid)	Salt solution	Solid - liquid
Ethanol (liquid)	Iodine (solid)	Tincture of iodine	Solid - liquid
Gold (solid)	Mercury (liquid)	Gold amalgam	Liquid - solid
Air (gas)	Water (liquid)	Mist	Liquid - gas
Gold (solid)	Copper (solid)	Gold alloy	Solid - solid
Copper (solid)	Tin (solid)	Bronze	Solid - solid
Tin (solid)	Lead (solid)	Lead solder	Solid - solid

2.2 Properties of solvents used in day to day life

When you get some jak latex stuck on your hands, you know that it cannot be washed off with water, but kerosene oil easily removes it. This is because jak latex does not dissolve in water but dissolves in solvents such as kerosene oil. This show that the same solute behaves differently in different solvents. So it is important to know what solvents should be used for a particular solute to dissolve. By now, you know that some substances dissolve in water, but some do not. What is the reason for these differences? Nature of the solute and solvent molecules is found to be an important factor in this regard.

Polar solvents and non-polar solvents

Solvent molecules can be classified as polar molecules and non-polar molecules according to the distribution of charges in the different atoms from

which the solvent molecules are made. When bonds are formed between two different atoms bond electrons get attracted more towards one atom. Then that atom gets a small negative charge and the adjoining atom gets a positive charge. Solvents consisting of such molecules are polar solvents. Such polar solvents often have groups like O-H and N-H. Water (H-OH) and ethanol (C_2H_5-OH) are examples of polar solvents.

When bond electrons do not get attracted towards any of the atoms, such molecules do not show polar properties. Solvents consisting of such molecules are non-polar solvents. Carbon tetrachloride (CCl_4) and hexane (C_6H_{14}) are examples of non-polar solvents.

According to the nature of the solvent, they can be classified as organic solvents and inorganic solvents.

Organic solvents

Organic compounds are compounds which necessarily contain carbon and often other elements like hydrogen, oxygen and halogens. When such compounds become solvents, they are called organic solvents. Organic solvents can further be classified as polar and non polar.

Organic solvents
- Polar
  e.g. Ethanol, Methanol, Acetone
- Non-polar
  e.g. Hexane, Benzene, Carbon tetrachloride
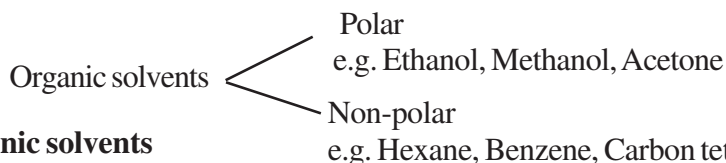
Inorganic solvents

The solvents that are not organic, are known as inorganic solvents. They also can be further divided into two classes, polar and non-polar.

Inorganic solvents
- Polar
  e.g. Water, Liquid ammonia
- Non-polar
  e.g. Carbon disulphide
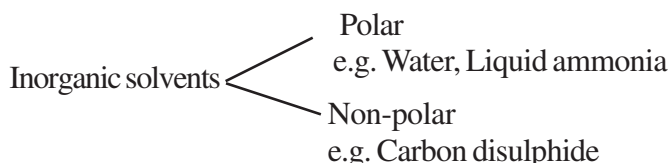
A relationship between the type of the solvent and the nature of the solutes that dissolve in them could be built up in the following manner and it could be used to find out what substances dissolve in what kind of solvents.

Solutes with polar properties dissolve in polar solvents.

Example 1: Sodium chloride is an ionic solid. In solution it consists of Na^+ and Cl^- ions. Therefore it is a solute with extreme polar properties. Water is a polar solvent. Hence sodium chloride dissolves in water.

Example 2 : Ethanol is a polar solute. Water is a polar solvent. Therefore ethanol dissolves in water.

Solutes with non-polar properties dissolve in non-polar solvents.

Example 1: Grease is a non-polar solute. Kerosene is a non-polar solvent. Therefore grease dissolves in kerosene.

Example 2 : Jak latex is a non-polar solute. Kerosene is a non-polar solvent. Therefore jak latex dissolves in kerosene.

Table 2.2 shows a few solvents, and solutes that dissolve in them. Try to identify the above mentioned relationships between the solute-solvent pairs.

Table 2.2 -Some solvents and solutes that dissolve in them

Solvent	Substances that dissolve
Water	Sugar, salt, copper sulphate
Turpentine	Enamel paint
Kerosene	Grease
Ethanol	Iodine crystals
Acetone	Nail polish
Thinner	Enamel paint

Boiling point of solvents

The relative molecular mass and the force of attraction among molecules have an effect on the boiling point of a solvent. The high molecular mass of the molecules and the strong attraction among the molecules would cause the boiling point of a solvent to rise. Since the polarity of O-H bonds in water is high, its boiling point is high (100 °C). But hexane (C_6H_{14}) consisting of C-H bonds which have a low polarity has a boiling point of 69.5 °C.

Uses of various solvents

Water is used in abundance in our day to day life as it is a good solvent for a wide range of different substances. It is an inorganic solvent. Most solutions used in our laboratories are aqueous solutions where the solvent used is water. Water is the solvent in most cellular activities taking place in living cells.

Organic solvents are frequently used as solvents for enamel paints and perfumes. You may know that the paints are classified as enamel paints and emulsion paints. Thinner (acetone) which is an organic solvent is used to dissolve enamel paints. Water is not a solvent for emulsion paints. Once mixed, emulsion paint and water form a heterogeneous mixture.

Organic solvents are used to clean motor vehicle parts and electrical appliances. They are also used in dry-cleaning of clothes.

Tincture of iodine is a germicide. Though iodine is a potential germicide, it cannot be applied alone because it is not very soluble in water. Hence it is dissolved in ethanol and used.

Solvents are also used to spread substances. An example is the use of thinner as a solvent in the application of varnish on wood. After the application, thinner evaporates leaving varnish on wood as a protective layer. The ink in ball point pens is a special mixture. The solvents used in them helps the free flow of the ink on paper. After writing the solvents quickly evaporate. In white board markers too, volatile organic solvents are used to dissolve ink. After writing, the solvent evaporates leaving the ink on the board.

Some pharmaceuticals used in medicine for treatment are available as suspensions (heterogeneous mixtures). Some drugs are dissolved in solvents such as ethanol.

It would be a pleasurable experience for you to explore more about the solvents used in various instances. Table 2.3 summarizes uses of some solvents.

Table 2.3 - A few solvents and their uses

Solvent	Uses
Tetrachloroethere	Dry cleaning
Toluene, Turpentine	Diluting (thinning) paint
Acetone, Ethyl acetate	Nail polish remover
Dichloromethane,	
Hexane, Petroleum ether	Stain remover
Ethanol	To dissolve printing ink and perfumes

Precautions to be taken when handling organic solvents

- Avoid inhaling solvent vapours. Inhaling excess chloroform and certain ethers can cause fainting.

- Never use near open flames. Most organic solvents are inflammable.

- Some may be carcinogenic. Benzene could cause cancer. Certain organic solvents cause damage to internal organs like kidneys, liver, and the brain.

- Avoid contact with the skin. Most solvents are absorbed through the skin and it tends to dry up the skin and cause sores and wounds.

Working under well ventilated conditions can minimize some of these hazards.

2.3 Preparation of solutions to suit our requirements and expressing the composition of a solution

When preparing a cup of tea for a visitor, it has become a common habit to ask how many teaspoons of sugar be added. Some would like two teaspoonfulls while some would like three and so on. The more sugar you add the sweeter the tea would become. The sweeter taste is because more solute (sugar) is contained in a unit volume of the solution. That is, the composition of the two solutions is different from each other. Very often it happens for us to express the composition of solutions both in laboratory work and day to day life. There are various ways of expressing the composition. Let us see some of them.

1. Expressing composition of a solution as a percentage by mass (w/w)

Here the composition is expressed as the mass of solute contained in 100 g of the solution.

Example : If 5g of solute is contained in 100 g of a solution, the composition can be worked out in the following manner.

$$\text{Composition of the solution (w/w)} = \frac{\text{Mass of solute}}{\text{Mass of solution}} \times 100$$

$$= \frac{5 \text{ g}}{100 \text{ g}} \times 100$$

$$= 5\%$$

The composition of the solution is expressed as 5% w/w.

Worked example: A sugar solution is prepared by dissolving 25g of sugar in 175g of water. Give the composition of this solution in w/w %.

Mass of solute $= 25 \text{ g}$

Mass of solvent $= 175 \text{ g}$

Mass of solution $= (175 + 25) = 200\text{g}$

$$\text{Compisition of the solution (w/w)} = \frac{\text{Mass of solute}}{\text{Mass of solution}} \times 100$$

$$\frac{25 \text{ g}}{200 \text{ g}} \times 100 = 12.5$$

Composition of the solution is 12.5% w/w.

2. Expressing composition of a solution as a percentage by volume (v/v)

Here the composition is expressed as volume of the solute contained in 100 cm^3 (100 ml) of the solution.

Example : If 10 cm³ of solute is contained in 100 cm³ of a solution its composition is expressed as 10% v/v.

Worked example:

A volume of 250 cm³ of acetic acid solution was prepared by dissollving 20 cm³ of concentrated acetic acid in water. Give the composition of this solution in v/v.

Volume of solute (Acetic acid)   =   20 cm³
Volume of solution   =   250 cm³
Composition of the solution   = $\underline{20\ cm^3}$ x 100   = 8% v/v
                                                                  250 cm³

3. Expressing the composition of a solution in terms of mass and volume (w/v)

Here the composition is expressed as mass of solute contained in 1 dm³ (1l) 100 cm³ of the solution.

Example: If a mass of 5 g is contained in a volume of 1 dm³ of solution, the composition is expressed as 5 g dm^{-3} w/v.

Expressing the composition of a solution using moles (n/v)

You have already learnt that the international unit used for measuring the amount of a substance is the mole and its symbol is mol'.The composition of a solution can also be expressed as the amount of moles contained in 1 dm³ (1l) of the solution.

Example : If there is 0.1 mol in 1 dm³ of a solution, the composition of the solution is as follows:

Composition   = $\underline{\text{Amount of the solute (mol)}}$
                                            Volume of solution (dm³)
                       = $\underline{0.1\ mol}$
                       =   1.0 dm³
                       =   0.1 mol dm^{-3} (moles per cubic decimetre)

When the composition of a solution is expressed in the units of mol dm^{-3}, it is specifically known as the **concentration.** When describing the composition of a solution for practical purposes, mostly in chemical activities, the unit used is mol dm^{-3}. But the international unit of measuring concentration is mol m^{-3}. However in chemical and laboratory activities the unit used is mol dm^{-3}.

1 dm³	=	1l
1 dm³	=	1000 cm³
1 dm³	=	1000 ml
1 cm³	=	1 ml

For various activities in chemistry, it becomes necessary to prepare solutions of specific concentrations. Therefore, the relationships among the units given in the above box are important for calculations.

Examples: If 4 moles of sodium hydroxide (NaOH) are contained in 2 dm^3 of solution what is the concentration of NaOH in the solution?

The amount of moles in 2 dm^3 of solution	=	4 mol
The amount of NaOH moles in l dm^3 of solution	=	4/2x mol =2 mol
Therefore concentration of NaOH	=	2 mol dm^{-3}

A solution of 2 mol dm^3 of sodium chloride solution means a solution containing 2 moles of NaCl in l dm^3 of the solution. How much of NaCl would be needed to prepare l dm^3 of such a solution?

Fig. 2.4 Preparation of a
solution

We have to find out the mass of 2 moles of NaCl.

Molar mass of NaCl	= 58.5 g mol^{-1}
Mass of 2 moles of NaCl	= 58.5x2 g
	= 117.0 g

Fig. 2.5 Volumetric
flasks

How do we prepare such a solution in the laboratory? When preparing a solution of a finite volume, accurate volume measurement is necessary. Volumetric flasks of various volumes are available in the laboratory, such as 1 dm^3, 500 cm^3, 250 cm^3 and 100 cm^3. To prepare the above solution a volumetric flask of l dm^3 must be selected. As shown in Fig 2.4 accurately weighed sodium chloride is transferred to the volumetric flask followed by addition of 2/3 the required volume of water. Dissolve the salt in water, and add water up to the mark of the flask with the help of a funnel and a wash bottle.

Worked example 1 : What is the mass of glucose ($C_6H_{12}O_6$) required to prepare l dm^3 of a 1 mol dm^{-3} glucose solution ?

Molar mass of glucose [(12x6)+(1x12)+(16x6)] g mol^{-1} =		180 g mol^{-1}
Mass of 1 mole of glucose	=	180 g

Calculate the mass of glucose required to prepare 500 cm^3 of a 1 mol dm^{-3} glucose solution?

l dm^3 = 1000 cm^3

Mass of glucose required to prepare 1000 cm^3 of the solution	=	180 g
Mass required to prepare 500 cm^3 of the solution	=	180/2 g
	=	90g

Worked example 2 : A solution of $1 \, dm^3$ is made by dissolving 40 g of sodium hydroxide in distilled water. Calculate the concentration of the solution.

Molar mass of sodium hydroxide	=	$(23 + 16 + 1) \, g \, mol^{-1}$
	=	$40 \, g \, mol^{-1}$
Amount of moles in 40 g of sodium hydroxide	=	1 mol
Amount of moles in $1 \, dm^3$ of solution	=	1 mol
Concentration of the solution	=	$1 \, mol \, dm^{-3}$

Worked example 3 : A solution of urea is made by dissolving 12 g of urea $(CO(NH_2)_2)$ and diluting the solution to $1 \, dm^3$. Calculate the concentration of this solution.

Molar mass of urea	=	$[12 + 16 + (14 \times 2) + (1 \times 4)] \, g \, mol^{-1}$
	=	$60 \, g \, mol^{-1}$
Amount of moles in 60 g of urea	=	1 mol
Amount of moles in 12 g of urea	=	$\dfrac{1 \, mol \times 12 \, g}{60 \, g} = 0.2 \, mol$
Amount of moles in $1 \, dm^3$ of solution	=	0.2 mol
Concentration of the solution	=	$0.2 \, mol \, dm^{3}$

> **Do you know?**
>
> The composition of a solution, particularly when very small amounts or trace amounts of solutes are involved is expressed in parts per million (ppm) or parts per billion (ppb). ppm and ppb are equivalent to $mg \, dm^{-3}$ and $mg \, dm^{-3}$ respectively.

Worked example 4 :   18 g of glucose were added to a volumetric flask, and a solution was prepared by adding distilled water up to $250 \, cm^3$ mark. Calculate the concentration of this solution.

Molar mass of glucose $(C_6H_{12}O_6) = [(12 \times 6) + (1 \times 12) + (16 \times 6)] \, g \, mol^{-1} = 180 \, g \, mol^{-1}$

Amount of moles in 180 g of glucose	= 1 mol
Amount of moles in 18 g of glucose	$= 1 \, mol/180 \, g \times 18 \, g = 0.1 \, mol$
Amount of moles in $250 \, cm^3$ of solution	= 0.1 mol
Amount of moles in $1000 \, cm^3$ of solution	$= 0.1 \, mol / 250 \, cm^3 \times 1000 \, cm^3$
	$= 0.4 \, mol$
Concentration of the solution	$= 0.4 \, mol \, dm^{-3}$

Reducing the concentration by adding the solvent is known as dilution, and the resulting solution is a dilute solution. Most acids brought to the science laboratory are concentrated. But what is used in laboratory experiments are often dilute solutions.

If the amount of moles of solute is n, the volume of the solution is v, and the concentration is c, then c = n/v. Here, if the unit of n is mol and v is in dm^3, concentration is given in mol dm^{-3}.

Assignment 1

Try to slove the worked examples given earlier using the equation
$$c = \frac{n}{v}$$

2.4 Factors affecting solubility

You have learned before, that when a few crystals of copper sulphate ($CuSO_4$) are added to water in a test tube, it gives rise to a clear, blue solid-liquid homogeneous mixture or a solution.

If you go on adding more and more copper sulphate to this solution with stirring, you will be able to see that, after a certain moment the copper sulphate added begins to settle down on the bottom without going into the solution.

A solution such as this, which contains the maximum amount of a solute in a given volume of a solvent is called a **saturated solution** of that solute under, the temperature concerned.

If this saturated copper sulphate solution is heated and observed, you will see that some copper sulphate already deposited on the bottom of the test tube starts to dissolve. Hence, you understand that by raising temperature, the amount of a solute that dissolves can be increased.

Solubility

Solubility is the maximum amount of solute that can dissolve in 100 g of the solvent at a given temperature.

Table 2.4 presents solubilities of some salts in water at 25 °C. From the data you will find that solubilities of different solutes in the same solvent at the same temperature are different.

Table 2.4 Solubilities of some compounds

Compound	Mass dissolving in 100 g of water at 25 ºC /g	
Silver nitrate	241.3	
Calcium nitrate	102.3	
Magnesium chloride	53.0	
Potassium nitrate	37.9	solubility decreases downwards
Potassium sulphate	12.0	
Calcium hydroxide	0.113	
Calcium carbonate	0.0013	
Silver chloride	0.0002	

Now you have some understanding about solubility. Let's now pay our attention to factors affecting solubility. For this try to do the following activities.

i) Effect of the nature solrent on solubility

> **Activity 2.2**
>
> Take nine small beakers or jam jars and equal volumes of water to three of them, kerosene oil to the other three, and ethanol to the remainning three. Add equal weights of sodium chloride, iodine and styrifoam to each of the three solvents and observe how they interact. Take care to keep the temperature constant. Your observaction would be as follows.

Substance	Water	Kerosine oil	Ethanol
Sodium chloride	Readily soluble	Insoluble	Slightly soluble
Iodine	Slightly soluble	Slightly soluble	Readily soluble
Styrifoam	Insoluble	Insoluble	Insoluble

The above activity shows that the solubility of a solute varies with different solvents. As you learnt earlier, solvents may be polar, non-polar, organic or inorganic. Their properties will determine the solubility of the solute in each of them.

ii) Effect of temperature on solubility

> **Activity 2.3**
>
> Take three test tubes and add cold water to one, water at room temperature to another, and hot water to the third. Add copper sulphate to all three while stirring with a glass rod. Observe the amounts that dissolve.

Here, you will find that the amount of copper sulphate that dissolves increases with temperature. This it can be concluded that when temperature increases, solubility of some compounds increases.

iii) Effect of the nature of the solute on solubility

Activity 2.4

Take three small beakers and add equal volumes of water to each. To maintain constant temperature, keep the beakers immersed in a vessel of water. Add equal amount of moles of sodium chloride, sugar and calcium carbonate to them separately. Stir well with a glass rod and observe.

You will find that sodium chloride and sugar dissolve well, while calcium carbonate remains almost undissolved. Hence, we can conclude that solubility depends on the nature of the solute.

The above activities show that the solubility of a substance is affected by the nature of the solvent, temperature and the nature of the solute.

Solubility of gases in water

Certain gases are highly soluble in water, even at atmospheric pressure. Some such gases are ammonia and hydrogen chloride. Some other gases are only slightly soluble in water. e.g. oxygen, carbon dioxide. We already know that the solubility of solid substances depends on the temperature. But the solubility of gases depends on the temperature as well as the pressure.

Under atmospheric pressure, solubility of carbon dioxide is very little but it can be largely increased by applying high pressure. In 'fizzy' drinks carbon dioxide is dissolved under high pressure. As you open a bottle of fizzy drinks, some carbon dioxide which was under high pressure gets released in the form of bubbles with a noise.

The effect of increasing temperature on solubility of gases is not the same as in solids. Here, solubility decreases with the increasing temperature. The solubility of oxygen in water at room temperature is greater than that in hot water.

2.5 Applications of solubility

The principle of solubility is extensively used in day to day life as well as in industries.

Crystallization

Sodium chloride crystals can be taken back by heating a sodium chloride solution or allowing it to evaporate. When the solvent evaporates, the solution becomes more concentrated. Eventually at one stage crystals will be formed. This indicates that

at a certain temperature there is a maximum amount of solute that can remain in a solution. Beyond this, the solute will get crystallized. This process is called crystallization. This is the principle used in salt and sugar industries.

Activity 2.5
Take about 200 cm³ of hot water into a beaker. Go on adding sugar to it little by little till no more dissloves. Pour the solution to another vessel and keep a paper clip susbended in the solution as shown in the diagram. Keep the vessel in a warm place and observe the formation of sugar crystals on the paper clip.
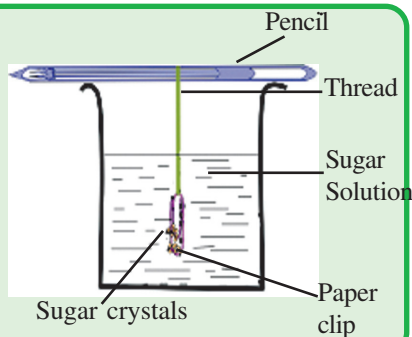
Recrystallization

This can be used in cases where small quantities of impurities are present in a solid. The solid is dissolved and allowed to crystallize again. The substance will get crystallized in the pure form.

The impure substance should be dissolved in the minimum volume of the selected solvent. This may contain other solutes with different solubilities. They can be removed by filtering. The remaining solution is allowed to crystallize.

The purity of the crystals can be found out by determining their physical properties such as melting point. Selection of the correct solvent is very important in recrystallization. The solute should not react with the solvent. Its solubility at low temperature should be minimum while it should reach maximum on heating.

Solvent extraction

Solvent extraction is the technique of separating a solute from a solution by dissolving the solute in a solvent which is immiscible with the solvent in which it is present but has the ability to dissolve it more. If cyclohexane is added to a solution of iodine and water, separate layers will be formed. The water and the cyclohexane separate into two distinct layers. When shaken thoroughly, most of the iodine which was in water goes into the cyclohexane layer. The reason for this is the greater solubility of iodine in cyclohexane than in water (Fig 2.6).

Iodine solution in water. Colour is pale straw.

Iodine solution in cycloh-exane. Dark purple is the colour.

If you shake some cyclohexane with a solution of iodine in water, iodine goes into the cycohexane layer.

Fig 2.6

> **Activity 2.6**
>
> Take some green leaves and grind them well in a motar. Put it into a beaker with little ethanol. Stir well and filter. The chlorophyll in leaves dissolve in ethanol and ethanol

becomes green in colour.

Plant extracts with medicinal properties are extracted by this method.

Importance of solubility for the survival of aquatic organisms

Gases dissolved in water are extremely important for the life of organisms living in water. Dissolved oxygen is essential for the respiration of aquatic living beings.

The oxygen concentration in some water bodies are going down rapidly due to pollution. This will pose a serious problem to aquatic organisms. Salts dissolved in water are also equally important to aquatic organisms. Organisms cannot survive in waters which have no dissolved salts and gases. At the same time, organisms cannot survive in water that has large concentrations of salts. Dead sea is and example.

Exercises

1. Explain the following scientifically.

    i) Jak gum dissolves in kerosene but not in water.

    ii) Thinner is added to varnish before applying.

2. Explain briefly how you would prepare 1 dm^3 (1 litre) of sodium hydroxide (NaOH) solution with the concentration of l mol dm^{-3}. (Na = 23, O = 16, H=l)

3. If 3 dm^3 of a nitric acid (HNO$_3$) solution contains 6 moles of the acid, what is its concentration?

4. What is the concentration of MgCl$_2$ in hits a solution containing 9.5 g of magnesium chloride in 2 dm^3 of solution? (Mg = 24, CI = 35.5)

5. Write down four precautions you have to follow when handling solvents.

6. Fill in the blanks in the paragraph using the words/ statements given below.

Note: (Some words/ statements may be used more than once while some may not be used at all).

(solution, mixture, homogeneous, heterogeneous, solute, solvent, concentration, mol dm^{-3}, g cm^{-3})

An aggregate of two or more substances which are different from one onother is called a.......................... . In such an aggregate, if the composition at any one place is the same as that of the rest, it is called a..............................., ...
while if it is not the same, it is called a................................. ....

The component present in greater proportiont in a solution is called the ....
and that present in smaller proportion is called the .... Composition of a solution can be expressed in many ways but in chemistry it is expressed in .... units.

When expressed in this unit, the composition is specifically termed ....

7.   A is a solid ionic compound. Two groups of students conducted experiments on its solubility. Results of these experiments are given below.

Experiment I)

Solvent	Water	Hexane	Kerosene
Mass of A dissolved in 100 g of solvent at room temperature / g	X	Y	Z

Experiment II)

Temperature °C	30	50	70
Mass of A dissolved in 200 g of water /g	6.4	7.2	7.8

i)   Explain the term solubility.

ii)   State three factors which affect solubility.

iii) Which might be the factor were the student are trying to find out in experiment I regarding the solubility of A?

iv)   According to experiment I which of the two values X and Y would be bigger?

v)   Which might be the factor were the student are trying to find out in experiment II regarding the solubility of A?

vi)   According to the result of experiment II, What is your conclusion regarding the solubility of A in water?

vii) Calculate the solubility of A in water at 30 °C.