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CHAPTER NOTES

Exploring Mixtures and their Separation Class 9 Notes | CBSE Science Chapter 2

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Your teacher for Exploring Mixtures ...



Hi, I am **Ira**. I teach this syllabus all day, so **Exploring Mixtures and their Separation** is very much my home ground.

Ask me anything from this chapter. A concept, a numerical, or that one doubt you did not want to raise in class. Pick one to start:

Explain Exploring Mixtures and their Separation simply

What can the board exam ask?

Most important formulas

Quiz me on this chapter

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Exploring Mixtures and their Separation Class 9 Notes | CBSE Science Chapter 5

Exploring Mixtures and their Separation is Chapter 5 of CBSE Class 9 Science in the new 2026-27 NCERT book. It builds on what you learnt about mixtures in Grades 6 and 8 and goes deeper: homogeneous and heterogeneous mixtures, how to express the concentration of a solution as a percentage, solubility and saturated solutions, and the main techniques used to separate mixtures, from crystallization and distillation to chromatography, sublimation, centrifugation and coagulation.

The chapter ends by sorting mixtures into solutions, suspensions and colloids by particle size, and by explaining the Tyndall effect. For exams it gives you three kinds of questions: short percentage calculations (% m/m, % m/v, % v/v), reasoning about which separation method suits a given mixture and why, and comparisons of solutions, suspensions and colloids. It is also the base for the chemistry you will meet in Class 10.

Quick Answer - Exploring Mixtures

A homogeneous mixture (a solution) has uniform composition throughout. A heterogeneous mixture does not. Concentration (amount of solute ÷ amount of solution, or of solvent can dissolve at a given temperature, at least about 25 °C apart) and paper chromatography, separating funnel, sublimation, centrifugation, etc. Particle size decides the type: solutions have particles less than 1000 nm. Colloids and suspensions have larger particles.



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All Key Terms at a Glance

Term	Meaning or formula	Example
Homogeneous mixture	Uniform composition throughout; also called a solution	Sugar in water, vinegar, soda, air, brass
Heterogeneous mixture	Composition is not uniform	Sand in water, oil and water, smoke, fog
Mass by mass percentage	$(\text{Mass of solute} / \text{Mass of solution}) \times 100$	10 g salt in 90 g water = 10% m/m
Mass by volume percentage	$(\text{Mass of solute} / \text{Volume of solution}) \times 100$	5% glucose solution, 0.9% saline
Volume by volume percentage	$(\text{Volume of solute} / \text{Volume of solution}) \times 100$	
Solubility	Maximum solute that can dissolve in a fixed amount of solvent at a given temperature	
Crystallization	Forming pure solid from a saturated solution	
Distillation	Heating to vaporize a liquid, then condensing it	
Paper chromatography	Separation by differential movement on a stationary phase	
Sublimation	Solid to vapor transition without melting point	
Centrifugation and coagulation	Fast spinning to separate components with a coagulant	
Tyndall effect	Scattering of light by colloidal particles	



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Key Concepts

1. Homogeneous and Heterogeneous Mixtures

A well-stirred mixture of sugar and water is equally sweet in the first sip and the last sip. Its composition is uniform throughout, so it is a **homogeneous mixture**, also called a **solution**. A solution always remains homogeneous. Vinegar (acetic acid in water) and soda (carbon dioxide in water) are other examples.

A stirred mixture of sand and water is not uniform: the sand particles are easily visible and settle with time. This is a **heterogeneous mixture**. Oil and water, which form two separate layers, are heterogeneous too.

Mixtures with a gas: gas particles move freely in all directions, so they mix uniformly with other gases. Most gas mixtures are therefore homogeneous, such as hydrogen and oxygen used as a rocket fuel. Smoke (solid particles suspended in air), fog (tiny water droplets in air) and dust in the air are heterogeneous mixtures with a

Solid-solid mixtures: most are heterogeneous by a property of one solid: a magnet pulls camphor from sand.

Alloys: metals do not dissolve into each other to form a solution that cools into a mixture of two or more metals, or of a metal and a non-metal. Alloys cannot separate its components. Alloys are resistant.

Alloy	Approximate composition
Brass	About 80% copper and 20% zinc
Bronze	About 80% copper and 20% tin
Stainless steel	Iron with carbon (about 0.02-0.03%) and molybdenum (about 2-3%)

Activity 5.1: three beakers, three ki



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Salt (A), chalk powder (B) and a few drops of milk (C) are each stirred into 50 mL of water. A laser beam is shone through each beaker and viewed from the side. (Never look directly into a laser beam.)

Observation	A: salt in water	B: chalk in water	C: milk in water
Particles visible?	No	Yes	No, looks uniform
Path of laser beam	Not visible	Visible (particles scatter light)	Visible (particles scatter light)
On standing	Nothing settles	Chalk settles	Nothing settles
Residue on filter paper	None		
Type of mixture	Solution		

2. Concentration of a Solution as

A solution has a **solute** (the substance that dissolves the solute). In sugar water, sugar is the solute.

The proportion matters. ORS need specific amounts of salt and sugar in water. A spray with too little pesticide may not protect the environment. (Dilip Mahalanabis, an Indian physician, and the World Health Organization popularised worldwide use of ORS.)

The **concentration of a solution** is the amount of solute in a given amount of solution. This chapter expresses it as a percentage.

A. Mass by mass percentage (% m/m)

Grams of solute in 100 g of the total solution

Mass by mass percentage = (Mass of solute / Mass of solution) × 100



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It is used for homogeneous mixtures and for heterogeneous ones such as milk powder and spice mixtures, and on packaged food labels. Industries write % w/w; numerically, % m/m and % w/w are equal.

NCERT Example 5.1: 10 g of salt in 90 g of water. Mass of solution = 10 + 90 = 100 g, so the concentration = $(10 / 100) \times 100 = 10\% \text{ m/m}$. The denominator is the mass of the **solution**, never the 90 g of water alone.

B. Mass by volume percentage (% m/v or % w/v)

Grams of solute in 100 mL of solution. It is used where measuring a liquid's volume is easier than weighing it, as in medicines and laboratories.

Mass by volume percentage = (Mass of solute / Volume of solution) $\times$ 100

NCERT Example 5.2: 5 g of glucose is dissolved in water to make 100 mL of solution. Mass by volume percentage = $(5 \text{ g} / 100 \text{ mL}) \times 100 = 5\%$. This is the same as 5% m/v solution.

Saline drip: usually 0.9% m/v sodium chloride. It is safe for blood and replaces lost body

C. Volume by volume percentage (% v/v)

Millilitres of solute in 100 mL of solution. It is used for perfumes, cosmetics and vinegar.

Volume by volume percentage = (Volume of solute / Volume of solution) $\times$ 100

NCERT Example 5.3: 1 mL of a liquid pesticide in 100 mL of water. Volume by volume percentage = $(1 \text{ mL} / 100 \text{ mL}) \times 100 = 1\%$.

Choosing the right method



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Solute	Solution measured by	Method	Example
Solid (weighed)	Mass	% m/m	Milk powder label, spice mix, alloy
Solid (weighed)	Volume	% m/v	5% glucose, 0.9% saline
Liquid (measured)	Volume	% v/v	Vinegar, perfume, pesticide spray

Making vinegar (NCERT Pause and Ponder 3): vinegar is 5% v/v acetic acid; glacial acetic acid is 100% acetic acid. Add 5 mL of glacial acetic acid to some water, then add water until the total volume is 100 mL.

3. Solubility, Saturated Solutions

The **solubility** of a substance is the maximum amount of solute that can dissolve in 100 mL of the solvent (100 mL or 100 g) at a given temperature. A solution containing the maximum amount of solute at that temperature is a **saturated solution**.

The temperature must always be stated. Temperature affects solubility; the solubility of a **gas in a liquid** decreases with temperature; the solubility of a **solid in a liquid** increases with temperature.

Solubility curve: a graph of solubility (g per 100 g of solvent) against temperature (°C). In NCERT Activity 5.2, compound 'B' has a solubility of 241 g at 40 °C. On such a graph the horizontal line represents the solubility of compound 'B', and the steeper curve is the solubility curve of compound 'A'.

Cooling a hot saturated solution: dissolve a substance in a solvent at a high temperature, then gradually cool the solution to a lower temperature. Only the amount of solute that is soluble at the lower temperature can stay dissolved; the rest will crystallise out of the solution as crystals.

A **crystal** is a solid made up of particles arranged in a regular pattern. Sugar (mishri), snowflakes and frost are examples of crystals.

Crystallization is the process of forming crystals from a solution. It is used to purify solids when one is present in small quantities.



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solids, such as a newly prepared compound mixed with impurities. Its **principle** is the difference in the solubility of a substance at different temperatures.

Activity 5.3: growing copper sulfate crystals, step by step

1. Place 1 g of copper sulfate (blue vitriol) in a 100 mL beaker with 25 mL of water. The teacher adds a drop of dilute sulfuric acid, which helps make pure crystals by preventing unwanted reactions (only some salts need it).
2. Heat the mixture gently in a water bath while stirring constantly.
3. Add more copper sulfate gradually until the solution becomes saturated.
4. Filter the hot solution to remove insoluble impurities; cover the filtrate with a watch glass.
5. Let it cool slowly without disturbance. The particles have time to come together into large, shiny, well-shaped blue crystals.
6. Filter out the crystals, rinse them with cold water, and dry them on a watch glass.

Copper sulfate is toxic: do not touch it with

Testing the cooling rate: NCERT's hypothesis predicts smaller, less well-formed crystals than slow cooling. A hot saturated solution into two equal parts to compare crystals.

Salt from seawater (Activity 5.4): seawater when water evaporates. Coastal Indian communities use brines and **karkatch salt** by evaporating salt. It loses the solvent; to recover it, you need to

4. Distillation and Paper Chromatography

Distillation

Distillation separates a homogeneous mixture. The lower boiling point vaporises, then condensed. It works for boiling points that differ by **at least about 25°C**. Example: a solid, such as water from salt water; the solvent

The set-up in words: the mixture sits in a round-bottom flask over a burner, held by a laboratory stand. A thermometer is placed in the neck. The vapour passes into a water condenser, cooled by water flowing in through a water inlet and



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out through a water outlet (usually in at the lower end, out at the upper end), and condenses into a conical flask.

Acetone and water: acetone boils at about 56 °C and water at 100 °C, a difference of 44 °C. Acetone vaporises before water vapour forms in significant amount, so acetone collects in the conical flask and water stays in the distillation flask.

In Kannauj, Uttar Pradesh, the perfume capital of India, the earthy smell of the first rain is captured as **Mitti ka Ittar** by the traditional **Deg-Bhapka** distillation method.

Fractional distillation separates components whose boiling points differ by relatively small amounts (less than 25 °C). A petroleum refinery uses it to separate crude oil into petroleum gas, petrol, aviation fuel (kerosene), diesel, lubricating oil and bitumen. The gaseous fraction, filled into steel cylinders under high pressure, liquefies and is used as domestic fuel (LPG).

Paper chromatography

From the Greek *chroma* (colour) and *graphein* (to write), paper chromatography is used to separate coloured substances such as dyes and inks.

Activity 5.5 set-up:

1. Take a 3 cm wide strip of chromatography paper and draw a straight horizontal line 2 cm from the bottom edge.
2. Put a spot of black sketch-pen ink at the intersection of the line and the strip.
3. Pour enough water to make a thin layer in the beaker.
4. Hang the strip vertically so its lower end is just below the ink spot. A watch glass covers the jar.
5. As the water rises through the paper, the components of the ink are separated.

Principle: the components interact differently with the solvent and are carried up at different rates. A black pencil line is used because it does not run in the solvent. The solvent is carried up the paper instead of dissolving the ink.

The method also separates pigments in spinach extract using alcohol or a mixture of solvents instead of water. It can also be used to separate ions in a salt solution.



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5. Separating Heterogeneous Mixtures: Separating Funnel and Sublimation

Two immiscible liquids: the separating funnel

Immiscible liquids, such as oil and water, do not mix and form separate layers. A **separating funnel** separates them by their different densities.

Activity 5.6 (mustard oil and water):

1. Pour 5 mL mustard oil and 20 mL water into a 50 mL separating funnel on a laboratory stand (glass stopper on top, stopcock at the bottom).
2. Let it stand. Yellow mustard oil forms the upper layer and water the lower layer, because the less dense liquid floats.
3. Open the stopcock slowly to drain the water; close it when the water is almost fully drained.
4. Discard the next small portion, which may contain both liquids, then collect the oil separately.

Sublimation

Activity 5.7 (camphor and sand): put a spoonful of camphor in a china dish on a wire gauze over a tripod stand. The funnel nozzle is plugged with cotton. Heat gently from below. The inner wall of the funnel, and sand remains at the bottom.

- **Sublimation:** camphor, on heating below its boiling point, changes into vapour without passing through the liquid state.
- **Deposition:** on cooling, the vapour changes back into solid. This happens on the cooler funnel wall.

Camphor separates because sand does not. Similarly, iodine and dry ice (solid carbon dioxide) also sublime on heating and deposit on cooling.

6. Suspensions, Centrifugation and Colloids

A **suspension** is a heterogeneous mixture in which solid particles are suspended throughout the bulk of the medium. They are visible to the naked eye, settle when left undisturbed, and can be separated by filtration. Examples: chalk powder, sawdust or tea leaves in water.



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Cleaning muddy water: left undisturbed, the heavier mud settles but the water may stay cloudy, and filtering through cloth or filter paper often leaves it cloudy too. Tiny particles need centrifugation and/or coagulation.

A. Centrifugation

Spin with a partner holding crossed hands (the folk game phugadi in Marathi, kikli in Punjabi) and you feel pulled outwards. In **centrifugation** a mixture in a tube is spun at high speed. The tubes become horizontal, and the **centrifugal force** (the outward force on a body moving in circular motion) moves the heavier particles outwards, so they settle at the bottom of the tube while the lighter liquid stays on top.

Laboratories use it to separate blood into plasma (top), platelets and white blood cells (middle band) and red blood cells (bottom); many chemical industries use it too. The **paperfuge**, a hand-powered cardboard disc spun on strings, does the same job without electricity and helps detect malaria and anaemia in remote areas.

B. Coagulation

Powdered alum (fitkari), a white crystalline suspended particles in muddy water **clump** **coagulant**. The clumps settle by gravity (s) **decantation** or **filtration**. Paneer making is the milk proteins. Sewage treatment uses

7. Colloids and the Tyndall Effect

Blood can be centrifuged and it coagulate neither a solution nor a true suspension: it

The three types differ mainly in **particle size** colloid particles 1 to 1000 nm, and suspension particles not settle over time; they stay uniformly dispersed uniform. NCERT's exercise classes milk and

Tyndall effect

In Activity 5.1 the beam was invisible in the in the milk mixture, although the milk mixture particles is the **Tyndall effect**, named after colloids and suspensions, and not in a trans,



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room through a small hole (dust and smoke scatter it), stadium floodlight beams, and sunbeams between the leaves of a dense tree. Smoky, dusty cities look hazy for the same reason.

Dispersed phase, dispersion medium and emulsions

The solute-like dispersed particles of a colloid form the **dispersed phase**; the component they are suspended in is the **dispersion medium**. In blood, the cells are the dispersed phase and plasma is the medium. A colloid with both components liquid is an **emulsion**:

Type	Dispersed phase in medium	Examples (NCERT)
Oil-in-water	Oil droplets spread in water	Milk, vanishing cream
Water-in-oil	Water droplets spread in oil	Butter, body lotions, cold cream

Emulsifying agents, such as the proteins in milk and butter stabilise emulsions. Shaking a few drops of cooking oil with water containing

Solution, suspension and colloid co



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Property	Solution	Suspension	Colloid
Nature	Homogeneous	Heterogeneous	Heterogeneous (looks homogeneous)
Particle size	Less than 1 nm	More than 1000 nm	1 to 1000 nm
Visibility of particles	Not visible; transparent	Visible to the naked eye	Not visible to the naked eye
Separation by filtration	Cannot be separated	Separates by filtration	Cannot be separated by filtration
Settling	Does not settle	Settles when left undisturbed	Does not settle; particles remain evenly distributed
Tyndall effect	Not shown		
Examples	Salt solution, sugar solution, vinegar, brass		

Separation relies on properties such as size (kidneys remove waste from blood), and s
composting is a separation task at home.



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Formula and Reaction Sheet

Quantity or rule	Formula or statement	Unit or note
Mass by mass percentage	$(\text{Mass of solute} / \text{Mass of solution}) \times 100$	% m/m (= % w/w)
Mass by volume percentage	$(\text{Mass of solute} / \text{Volume of solution}) \times 100$	% m/v; solute in g, solution in mL
Volume by volume percentage	$(\text{Volume of solute} / \text{Volume of solution}) \times 100$	% v/v; both in mL
Mass of solute from a percentage	$\text{Mass of solute} = (\% \text{ m/m} \times \text{Mass of solution}) / 100$	4% of 300 g = 12 g
Solute in a saturated solution	$\text{Solute} = \text{Solubility} \times (\text{Mass of solvent} / 100 \text{ g})$	
Solid deposited on cooling	$\text{Solubility at } T_2 - \text{Solubility at } T_1$	
Simple distillation	Boiling point about 25 °C	
Particle size	Solution < 1 m suspension > 1 m	



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Important Definitions

- **Homogeneous mixture (solution):** a mixture in which the composition is uniform throughout. A solution always remains homogeneous.
- **Heterogeneous mixture:** a mixture where the composition is not uniform throughout. Examples include oil and water.
- **Concentration of a solution:** the amount of solute present in a given amount of solution.
- **Mass by mass percentage:** grams of solute per 100 grams of solution.

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- **Mass by volume percentage:** grams of solute present in 100 mL of solution.
- **Volume by volume percentage:** millilitres of solute present in 100 mL of solution.
- **Solubility:** the maximum amount of solute that dissolves in a fixed quantity of solvent (100 mL or 100 g) at a given temperature.
- **Saturated solution:** a solution that cannot dissolve any more solute at that temperature.
- **Crystallization:** the process of forming crystals from a saturated solution.
- **Distillation:** heating a mixture until the liquid with the lower boiling point vaporises, then cooling the vapour back into liquid.
- **Paper chromatography:** separating components by their different rates of movement up the paper, caused by different interactions with the solvent and the paper.
- **Sublimation:** the change of a solid directly into vapour, below its melting point, without passing through the liquid state.
- **Deposition:** the change of a vapour directly back into a solid on cooling, without becoming a liquid.
- **Alloy:** a homogeneous mixture of two or more metals.
- **Suspension:** a heterogeneous mixture in which solid particles are suspended throughout the bulk of the liquid.
- **Centrifugation:** spinning a mixture in a centrifuge so that the solid particles move outwards and settle at the bottom of the tube.
- **Coagulation:** adding a substance (a coagulant) to a suspension so that the solid particles settle down.
- **Colloid:** a mixture with particles 1 to 100 nm in size that do not settle.
- **Tyndall effect:** the scattering of light by the particles in a colloid.
- **Dispersed phase and dispersion medium:** the solid or liquid component they are suspended in.
- **Emulsion:** a colloid in which both the dispersed phase and the dispersion medium are liquids.



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Solved Examples (NCERT-Based)

Example 1: Zinc oxide in talcum powder (NCERT Pause and Ponder 1)

A common talcum powder contains 4% m/m zinc oxide, which acts as an antiseptic. How much zinc oxide is present in 300 g of the talcum powder?

Solution: 4% m/m means 4 g of zinc oxide in every 100 g of powder.

Mass of zinc oxide = $(4 \times 300) / 100 = 1200 / 100 = 12 \text{ g}$.

Example 2: Orange juice concentrate (NCERT Pause and Ponder 2)

You mix two tablespoons of orange juice concentrate with water in a glass tumbler. Each tablespoon measures 15 mL, and you make 150 mL of juice per person. What is the % v/v of orange juice concentrate in the mixture you prepared?

Solution: Volume of concentrate (solute) = 30 mL.

% v/v = $(30 / 150) \times 100 = 20\% \text{ v/v}$.

Example 3: Three students, three solutions

Student A dissolves 20 g of sugar in 80 g of water. Student B dissolves 20 g of sugar in 100 g of water. Student C dissolves 30 g of sugar in 80 g of water. Calculate the (m/m) concentration of sugar in each student's solution. Which is the most concentrated? Explain why.

Solution:

- A: mass of solution = $20 + 80 = 100 \text{ g}$. % m/m = $(20 / 100) \times 100 = 20\%$ (2 significant places).
- B: mass of solution = $20 + 100 = 120 \text{ g}$. % m/m = $(20 / 120) \times 100 = 16.7\%$ (3 significant places).
- C: mass of solution = $30 + 80 = 110 \text{ g}$. % m/m = $(30 / 110) \times 100 = 27.3\%$ (3 significant places).

(ii) **Student C's solution is the most concentrated** because it has the highest mass of sugar per 100 g of solution.



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Example 4: Dry cake mix (NCERT Exercise 4 i)

A cake recipe uses dry ingredients, namely 75 g of sugar for 420 g of all-purpose flour and 5 g of sodium hydrogencarbonate. Express the concentration of each component in the mixture using an appropriate method.

Solution: All three are solids that are weighed, so use **mass by mass percentage**. Total mass of mixture = $75 + 420 + 5 = 500$ g.

- Sugar = $(75 / 500) \times 100 = 15\% \text{ m/m}$
- Flour = $(420 / 500) \times 100 = 84\% \text{ m/m}$
- Sodium hydrogencarbonate = $(5 / 500) \times 100 = 1\% \text{ m/m}$

Check: $15 + 84 + 1 = 100\%$.

Example 5: Copper and zinc in brass (NCERT Exercise 4 ii)

A brass alloy contains 70% copper by mass in 120 g of brass.

Solution: Copper = $(70 \times 120) / 100 = 84$ g

Brass here is copper and zinc, so zinc = 12 g

Example 6: Choosing a method for separation

How would you separate the mixtures given below? Choose a suitable method. If a mixture cannot be separated, state the reason.



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Mixture	Method of separation	Reason for selection
Mud from muddy water	Coagulation with alum, then sedimentation and decantation or filtration (centrifugation also works)	Fine mud particles are too small to remove by filtration alone; alum clumps them so they settle
Plasma from other components in the blood sample	Centrifugation	Spinning moves the heavier cells to the bottom; the lighter plasma stays on top
Naphthalene and sand	Sublimation	Naphthalene sublimates on heating; sand does not
Chalk powder and common salt	Add water, filter, then evaporate or crystallize the filtrate	Salt dissolves in water and chalk does not, so chalk
Common salt and water	Evaporation (to get salt) or distillation (to get water)	
Oil from water	Separating funnel	
Pigments of the flower	Paper chromatography	

Example 7: Sand, common salt and naphthalene

You are given a mixture of sand, common salt and naphthalene. Suggest separation techniques.

Solution:

- Sublimation:** heat the dry mixture in a closed container with a plugged nozzle. Naphthalene sublimates and leaves sand and salt remain.



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2. **Dissolving and filtration:** add water to the remaining solid and stir. Salt dissolves, sand does not. Filter: sand stays on the filter paper as the residue.
3. **Evaporation or crystallization:** heat the filtrate (salt solution) to remove the water and obtain the salt.

Sublimation comes first, while the mixture is still dry.

Example 8: Which pairs can simple distillation separate? (NCERT Table 5.5 data)

Boiling points: water 100 °C, acetone 56 °C, alcohol 78 °C, chloroform 61 °C, benzene 80 °C. Which of these mixtures can be separated by distillation: (a) water and acetone, (b) water and salt, (c) acetone and alcohol, (d) sand and salt, (e) alcohol and chloroform, (f) alcohol and benzene?

Solution: Miscible liquids need a gap of at least about 25 °C.

Mixture	Difference in boiling points (°C)
(a) Water and acetone	$100 - 56 = 44$
(b) Water and salt	Solid dissolves in liquid
(c) Acetone and alcohol	$78 - 56 = 22$
(d) Sand and salt	Two solids
(e) Alcohol and chloroform	$78 - 61 = 17$
(f) Alcohol and benzene	$80 - 78 = 2$

Answer: **(a) and (b).**



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Competency-Based Questions (with answers)

1. Case-based: The hospital saline drip

A nurse prepares saline drips. The standard drip is 0.9% m/v sodium chloride in water. It is safe for blood and replaces lost fluids. A patient also needs 5% glucose solution.

(a) How much salt is present in a 250 mL drip? 0.9 g per 100 mL, so $0.9 \times 250 / 100 = 2.25$ g.

(b) Why is concentration written as % m/v here and not % m/m? The solute (salt or glucose) is weighed, and the solution is a liquid whose volume is easier to measure than its mass. NCERT notes that % m/v is used in medicines and laboratories for this reason.

2. Case-based: Salt pans on the coast

Workers let seawater into shallow pans. As the sun heats the pans, the water level falls. After some days the liquid becomes saturated and

(a) Name the stages in the order they occur to form crystals.

(b) Why do crystals appear only after some time? The solution becomes saturated. Until enough water has evaporated, the solution is not saturated.

3. Source-based: Solubility data (NCERT)

Solubility in g per 100 g of water:

Salt	10 °C	20 °C
Potassium nitrate	21	31
Sodium chloride	36	36
Potassium chloride	35	40
Ammonium chloride	24	37

(a) A student makes a saturated solution of potassium chloride in water and then cools the solution to cool at room temperature. What happens? Explain. Crystals of potassium chloride appear. Its solubility falls from 54 g per 100 g of



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water at 80 °C to between 35 and 37.4 g at 25 °C (the table gives 20 °C and 30 °C). The extra salt, about 16.6 to 19 g for every 100 g of water (54 - 37.4 to 54 - 35), can no longer stay dissolved and crystallizes out.

(b) What is the effect of a change in temperature on the solubility of salts? Compare the four salts from 10 °C to 80 °C. The solubility of all four increases with temperature, by very different amounts. Potassium nitrate rises from 21 to 167 g (an increase of 146 g), ammonium chloride from 24 to 66 g (42 g), potassium chloride from 35 to 54 g (19 g), and sodium chloride only from 36 to 37 g (1 g).

4. Assertion-Reason (NCERT Exercise 6)

Assertion (A): Solutions do not exhibit the Tyndall effect. **Reason (R):** The particles in solutions are larger than 100 nm, so they cannot scatter light.

(i) Both A and R are true, and R is the correct explanation of A. (ii) Both A and R are true, but R is not the correct explanation of A. (iii) A is true and R is false. (iv) A is false and R is true.

Answer: (iii). A is true: a transparent solution and a solution are the smallest, less than 1 nm, the real reason.

A screenshot of a chat application. At the top, there is a dark blue header bar. On the left of this bar is a circular profile picture of a woman with long dark hair, smiling. To the right of the profile picture, the name 'Ira' is written in white, bold font. Below the name, the text 'Your teacher for Exploring Mixtures ...' is written in a smaller white font. The main area of the chat is white. On the left side of this area, there is a smaller version of the same profile picture. To its right, there is a message bubble with a light blue border. The message inside the bubble reads: 'Hi, I am Ira. I teach this syllabus all day, so **Exploring Mixtures and their Separation** is very much my home ground. Ask me anything from this chapter. A concept, a numerical, or that one doubt you did not want to raise in class. Pick one to start:'. At the bottom of the screen, there is a white footer bar. It contains the text 'Free questions, no login needed' in a medium-sized black font. Below this, in a smaller black font, it says 'AI generated, can make mistakes. Cross-check with NCERT.'

5. Assertion-Reason

Assertion (A): A mixture of acetone and w

(R): Acetone boils at about 56 °C and water

Answer: Both A and R are true, and R is the correct explanation of A. The boiling point of water is 100 °C at 1 atm. At 1.44 atm, the boiling point is raised by 44 °C, more than the minimum of about 30 °C. Hence, water will form in significant amount.

6. Assertion-Reason

Assertion (A): The components of brass can be separated by filtration. **Reason (R):** Brass is a heterogeneous mixture.

Answer: A is true, but R is false. Brass is a physical method cannot separate the components of brass.

7. Case-based: The paperfuge in a village clinic

A health worker in a remote village has no electricity. She places a blood sample in a thin tube, tapes it to a cardboard disc threaded with string, and pulls the handles so that the disc spins very fast.

(a) Name the separation technique. Centrifugation.

(b) Where do the red blood cells collect and why? At the bottom of the tube. They are the heavier components, and the outward (centrifugal) force during spinning moves them outwards, which is the bottom of the tube. The lighter plasma stays at the top.

8. Case-based: Water for a small town

A town treats river water in three tanks. In the first, muddy water stands still for a day. In the second, alum is added. In the third, the water passes through layers of sand.

(a) Name the process in each tank. Tank 1: sedimentation (or flocculation with coagulant). Tank 2: flocculation (or sedimentation with coagulant). Tank 3: filtration.

(b) Why is the second tank needed if the water settles in tank 1, but the finest particles still remain? These fine particles clump together into larger particles in the second tank.

Important Questions for

1-Mark Questions

Q1. Which of the following mixtures are heterogeneous (Ht)? (i) Air - Hm, Milk - Hm, Fog - Ht, Vinegar - Ht, Muddy water - Hm, (ii) Smoke - Ht, Milk - Hm, Bronze - Hm (iv) Muddy water - Hm, Smoke - Ht

Answer: (iv). Smoke and milk are heterogeneous mixtures. Muddy water is heterogeneous.

Q2. Which among the following mixtures are homogeneous (Hm)? (i) dust particles (b) copper sulfate and water (c) air and water (d) b and d (iii) a and c (iv) c and d

Answer: (iii) a and c. Dust in air and starch in water are homogeneous mixtures. Copper sulfate and acetone form true solutions in water.



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Q3. State the particle size range of a colloid.

Answer: 1 to 1000 nm in diameter.

2-Mark Questions

Q4. Why is distillation an effective method for separating a mixture of water and acetone?

Answer: The two are miscible liquids whose boiling points differ by 44 °C (acetone about 56 °C, water 100 °C), which is more than the minimum of about 25 °C. On heating, acetone vaporises first, before water vapour forms in significant amount. Its vapour is condensed and collected separately, while water stays in the flask.

Q5. Why do immiscible liquids form two separate layers in a separating funnel?

Answer: Immiscible liquids do not mix with each other. They have different densities, so the less dense liquid floats as the upper layer and the denser liquid forms the lower layer. For mustard oil and water, oil forms the upper layer.

Q6. Is sublimation different from evaporation?

Answer: Yes. In sublimation a solid changes directly into vapour, passing through the liquid state (camphor, iodine).

3-Mark Questions

Q7. The label on a cooking oil pack says 'oil and water form a separate layer'. If so, which substance forms the upper layer?

Answer: Yes, oil and water are immiscible. The density of oil is 0.91 g / 1000 mL = 0.91 g/mL, less than water (1.0 g/mL). In a separating funnel: let the mixture stand, oil will rise to the top. When water is almost drained, discard the water. Then, pour the oil into another container. Finally, wash the separating funnel on a stand, glass stopper, and keep it upside down underneath.

Q8. Two miscible liquids, A and B, are present in a mixture. The boiling point of B is 90 °C. Suggest a method to separate them.

Answer: Distillation. The difference in boiling points is more than 25 °C. Heat the mixture in a distillation flask; the vapour of B passes through a condenser, condenses, and is collected in a receiver flask. The residue A remains in the distillation flask. Apparatus: burner, wire gauze, distillation flask, thermometer, condenser, receiver flask.



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Q9. Describe how you would obtain pure copper sulfate crystals from an impure sample.

Answer: Dissolve the sample in water with a drop of dilute sulfuric acid, heating in a water bath and stirring, and keep adding the solid until the solution is saturated. Filter the hot solution to remove insoluble impurities, cover the filtrate with a watch glass, and let it cool slowly without disturbance. Large blue crystals form. Filter them, rinse with cold water and dry on a watch glass. The soluble impurities, present in small amount, stay in the solution.

Q10. Blood is an example of a colloidal mixture. (i) What would happen if blood behaved like a true suspension inside the body? (ii) In a blood sample, identify the dispersed phase and the dispersion medium.

Answer: (i) Suspension particles settle when left undisturbed. The blood cells would settle out of the plasma instead of staying evenly spread, so blood could not carry nutrients, gases and hormones evenly to all parts of the body. (ii) Dispersed phase: the blood cells (and platelets). Dispersion medium: the plasma.

Q11. Compare evaporation, crystallization and distillation. In which situation would you prefer each of these over the others?

Answer:

Method	What it does
Evaporation	Removes the solvent completely and leaves solid; the solvent is lost
Crystallization	Forms pure crystals from a saturated solution, leaving soluble impurities in solution
Distillation	Vaporises and condenses the liquid, so the liquid is purified

5-Mark Questions

Q12. Differentiate between a solution, a suspension, and a colloid in terms of particle size, visibility, filtration, settling.

Answer: Solution: homogeneous; particles are not visible; cannot be separated by filtration; does not settle; no Tyndall effect. Suspension: heterogeneous; particles are visible; can be separated by filtration; settle on standing; show Tyndall effect. Colloid: heterogeneous; particles are not visible; cannot be separated by filtration; do not settle; show Tyndall effect.



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filtration; settles when left undisturbed; shows the Tyndall effect. Examples: sand in water, mud in water. Colloid: heterogeneous though it looks uniform; particles 1 to 1000 nm; not visible to the naked eye; cannot be separated by filtration; does not settle, particles remain evenly distributed; shows the Tyndall effect. Examples: milk, blood.

Common Mistakes and Examiner Tips

1. **Dividing by the mass of solvent.** 20 g sugar in 100 g water is $20/120 \times 100 = 16.67\%$, not 20%.
2. **Mixing up the three percentages.** Solid in a measured liquid volume is % m/v; two liquids is % v/v; everything weighed is % m/m. Always write the unit, such as 10% m/m.
3. **Saying all solubilities rise with temperature.** Solids in liquids generally become more soluble when heated; gases in liquids generally become less soluble.
4. **Treating evaporation and crystallization as the same.** Evaporation removes impurities completely; crystallization grows pure crystals and leaves impurities behind.
5. **Using distillation for liquids with close boiling points.** Distillation works best at least about 25 °C. For less than 25 °C, use fractional distillation.
6. **Chromatography set-up errors.** The solvent front must be below the spot at the start.
7. **Calling milk or blood a solution.** They are colloids, not solutions. Milk and blood are heterogeneous, and so are alloys.
8. **Calling an alloy heterogeneous or "separated".** Alloys like brass and stainless steel are homogeneous mixtures of different components.
9. **Writing that the heavier liquid rises in a separating funnel.** The heavier liquid sinks. Drain the lower layer first.
10. **Defining sublimation without "directly".** Sublimation is the direct transition from solid to gas, directly, below its melting point, no liquid phase.



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Quick Revision Points

- Homogeneous mixture = uniform composition

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- Heterogeneous mixture = composition not uniform: sand in water, oil and water, smoke, fog.
- Alloy = homogeneous mixture of metals, or a metal and a non-metal; brass about 80% Cu + 20% Zn, bronze about 80% Cu + 20% Sn.
- % m/m = (mass of solute / mass of solution) $\times$ 100; % m/m and % w/w are numerically equal.
- % m/v = (mass of solute / volume of solution) $\times$ 100; used in medicines, for example 0.9% saline and 5% glucose.
- % v/v = (volume of solute / volume of solution) $\times$ 100; used for two miscible liquids, for example vinegar at 5% v/v acetic acid.
- Solubility = maximum solute in 100 g (or 100 mL) of solvent at a given temperature; saturated solution holds no more.
- Crystallization works on the difference in solubility at different temperatures.
- Distillation: boiling point difference at least about 25 °C; acetone (56 °C) from water (100 °C).
- Fractional distillation: difference less than 25 °C: crude oil into petroleum gas, petrol, kerosene, diesel, lubricating oil, bitumen.
- Paper chromatography: pencil line, spots, R_f values.
- Separating funnel: immiscible liquids separate.
- Sublimation: solid directly to vapour below 100 °C; Camphor, naphthalene, dry ice.
- Suspension: particles more than 1000 nm, do not settle; muddy water.
- Centrifugation: fast spinning; heavier particles settle; blood components and cells; paperfuge works without electricity.
- Coagulation: alum makes fine particles settle; used in water treatment to make paneer.
- Colloid: particles 1 to 1000 nm, do not settle; milk, ink, smoke, fog, tomato sauce, ice cream.
- Tyndall effect = scattering of light by particles in colloids, not in true solutions.



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Weightage and Exam Pattern

Class 9 has no board exam. This chapter is important for internal assessments (half-yearly and annual papers), and the NCERT source gives no fixed mark allocation for it. It is the

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foundation for Class 10 chemistry.

Question type	What this chapter typically supplies
MCQ and one-word	Homogeneous or heterogeneous, which mixtures show the Tyndall effect, particle size ranges, naming a process (sublimation, deposition, coagulation)
Assertion-Reason	Tyndall effect in solutions, boiling point gap for distillation, alloys as homogeneous mixtures
Short answer	% m/m, % m/v and % v/v calculations, sublimation versus evaporation, why oil floats, choosing a method with a reason
Data and case-based	Reading solubility tables and curves, saline and ORS, water treatment, blood centrifugation
Long answer	Solution, suspension, distillation with a lab mixture



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