



CLASS 9 SCIENCE — CHAPTER 5

EXPLORING MIXTURES AND THEIR SEPARATION



New *Exploration* Science Textbook | 2026–27

This chapter covers **homogeneous and heterogeneous mixtures, solutions, suspensions, colloids, concentration, solubility and different separation techniques.**



Formula note: All formulas are written in simple **text format**, as requested.



1. What Is a Mixture?

We encounter mixtures everywhere in our daily life. 🌍

Examples:



Milk



Salt water



Lemonade



Air



Soil



Food



Rocks



Definition

A **mixture** is formed when two or more substances are combined physically in any proportion.

The substances present in a mixture are called its:

Components

For example:

 Salt +  Water = Salt solution

Here:

- Salt → Solute
 - Water → Solvent
 - Salt solution → Mixture
-



2. Types of Mixtures

Mixtures can be classified as:

1 Homogeneous mixtures

2 Heterogeneous mixtures

They can also be discussed as:

 **Solutions**

 **Suspensions**

 **Colloids**

3. Homogeneous Mixture

A homogeneous mixture has:

Uniform composition throughout

Its components are evenly distributed.

Examples:

 Salt solution

 Sugar solution

 Air

 Alcohol-water mixture

You cannot normally distinguish the different components by simply looking at the mixture.

4. Heterogeneous Mixture

A heterogeneous mixture does **not** have a uniform composition throughout.

Its components may be visibly different.

Examples:

 Sand + water

 Oil + water

 Salad

 Soil

Different parts of the mixture can have different compositions.

5. Homogeneous vs Heterogeneous Mixture

Homogeneous

Uniform composition

Components evenly distributed

Usually appears as one phase

Components generally not separately visible

Heterogeneous

Non-uniform composition

Components unevenly distributed

Often has more than one phase

Components may be visible

Salt solution

Sand + water



6. Solution

A **solution** is a homogeneous mixture of two or more substances.

A solution contains:



Solute

and



Solvent



7. Solute

The substance that gets dissolved is called the:

Solute

Example:

In salt water:



Salt = Solute



8. Solvent

The substance that dissolves the solute is called the:

Solvent

Example:

In salt water:

 Water = Solvent

9. Solution

The homogeneous mixture formed by the solute and solvent is called the:

Solution

Therefore:

Solute + Solvent = Solution

Example:

Salt + Water = Salt solution

10. Examples of Solutions

Solution	Solute	Solvent
 Salt water	Salt	Water
 Sugar solution	Sugar	Water
 Soda	Carbon dioxide	Water
 Air	Different gases	Mainly nitrogen
 Alcohol-water	Alcohol	Water

11. Concentration of a Solution

The amount of solute present in a given amount of solution determines its:

Concentration

A solution can be:

● Dilute → Less solute

● Concentrated → More solute



12. Mass by Mass Percentage

Mass by mass percentage tells us the mass of solute present in **100 g of solution**.

Formula:

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

The textbook uses this method to express the concentration of solutions and other mixtures such as some packaged food products.



13. Example — Mass by Mass Percentage

10 g salt is dissolved in 90 g water.

Mass of solution:

$$10 + 90 = 100 \text{ g}$$

Therefore:

$$\text{Mass by mass percentage} = (10 / 100) \times 100$$

$$= 10\%$$

So, the solution is:

10% m/m



14. Mass by Volume Percentage

Mass by volume percentage tells us the mass of solute present in:

100 mL of solution

Formula:

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

It is commonly useful when measuring the volume of a liquid is easier than weighing it, such as in medicines and laboratories.



15. Example — Mass by Volume Percentage

5 g glucose is dissolved to make 100 mL of solution.

Mass by volume percentage = (5 / 100) × 100

= 5%

Therefore:

5% m/v glucose solution



16. Volume by Volume Percentage

For liquid solutes and solvents, concentration can also be expressed as:

Volume by volume percentage

Formula:

Volume by volume percentage = (Volume of solute / Volume of solution) × 100



17. Example — Volume by Volume Percentage

10 mL alcohol is present in 100 mL of solution.

Volume by volume percentage = $(10 / 100) \times 100$

= 10% v/v



18. Concentration Formula Sheet

Mass by mass:

% m/m = $(\text{Mass of solute} / \text{Mass of solution}) \times 100$

Mass by volume:

% m/v = $(\text{Mass of solute} / \text{Volume of solution}) \times 100$

Volume by volume:

% v/v = $(\text{Volume of solute} / \text{Volume of solution}) \times 100$



19. Solubility



Definition

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

For example:

If we keep adding sugar to water, initially it dissolves.

After a certain point, no more sugar dissolves.

The solution has then reached:

Saturation



20. Saturated Solution

A solution that contains the maximum amount of solute that can dissolve at a particular temperature is called a:

Saturated solution

Any additional solute remains:

Undissolved



21. Unsaturated Solution

A solution that can still dissolve more solute at a particular temperature is called:

Unsaturated solution

Example:

If a glass of water can still dissolve more sugar, it is unsaturated.



22. Effect of Temperature on Solubility

For many solid substances:



Increase in temperature → Increase in solubility

However, the exact relationship depends on the substance.

23. Solubility of Gases

The solubility of gases generally:

 **Decreases when temperature increases.**

For example, warm water holds less dissolved oxygen than cooler water.

24. Carbonated Drinks

Carbon dioxide is dissolved in soft drinks under pressure.

When the bottle is opened:

↓ Pressure decreases

↓ CO₂ becomes less soluble

↓ Gas escapes

 Bubbles are produced.

25. Suspension

A suspension is a heterogeneous mixture in which relatively large insoluble particles are dispersed in a fluid.

Examples:

 Muddy water

 Sand in water

Some medicines

Characteristics:

- Particles are relatively large.
 - Particles may be visible.
 - Particles settle on standing.
 - Can generally be separated by filtration.
 - They scatter light.
-

26. Colloid

A colloid is a heterogeneous mixture in which very small particles are dispersed throughout another substance.

The particles are:

Larger than solution particles

but

Smaller than suspension particles.

Examples:

 Milk

 Fog

 Clouds

 Some emulsions

27. Tyndall Effect

When light passes through a colloid, its dispersed particles scatter the light.

This is called:

Tyndall effect

Examples:

☀️ Sunlight passing through a dusty room

🌳 Sunlight passing through gaps between leaves

💡 A beam of light visible in fog

The chapter specifically describes light scattering by colloidal or suspended particles as the Tyndall effect.



28. Solution vs Suspension vs Colloid

Feature	● Solution	● Suspension	● Colloid
Type	Homogeneous	Heterogeneous	Heterogeneous
Particle size	Very small	Large	Intermediate
Particles visible?	No	Often	Usually not individually
Settling	No	Yes	Generally no
Filtration	Not by ordinary filtration	Yes	Not by ordinary filtration
Tyndall effect	No	Yes	Yes



29. Why Do We Separate Mixtures?

We separate mixtures to:

🧴 Remove unwanted substances

🧴 Obtain pure substances

🍲 Obtain useful components

🏭 Process materials industrially

Perform medical procedures

Examples include:

 Sugar production

 Water purification

 Separation of blood components

 Obtaining salt

The chapter highlights separation as important in everyday life, industry, medicine and environmental management.

30. Basis of Separation

Different separation methods depend on differences in properties such as:

 Particle size

 Density

 Solubility

 Boiling point

 Melting point

 Sublimation behaviour

The textbook specifically notes **size, density and solubility** as important properties used in separation.

31. Filtration

Principle:

Difference in:

Particle size

Filtration separates an insoluble solid from a liquid using a filter.

Example:

 Sand + Water

Sand remains on the filter paper.

Water passes through.

Uses:

 Water purification

 Laboratory separation

32. Evaporation

Evaporation is used to separate:

Dissolved solid from a solution

The solvent is allowed to escape as vapour.

Example:

 Obtaining salt from salt water.

Water evaporates.

Salt remains behind.

33. Crystallization

Crystallization is used to obtain:

Pure solid crystals

from a suitable solution.

It is particularly useful when the solid contains impurities.

Basic steps:

 Prepare solution



 Concentrate it



 Cool it slowly



 Crystals form



 Separate and dry crystals

The textbook describes crystallization as a method for obtaining a pure solid from a saturated solution.

34. Why Is Crystallization Better Than Simple Evaporation?

Evaporation mainly removes the solvent.

Crystallization can produce:

Purified crystals

Slow cooling generally helps produce larger and better-formed crystals.

35. Centrifugation

Centrifugation uses:

Rapid spinning

to separate components based on differences in density or settling behaviour.

Examples:

 Separating components of blood

 Separating cream from milk

The denser particles move outward/downward more rapidly during spinning.

36. Paper Chromatography

Paper chromatography is used to separate:

Different dissolved components

based on differences in how quickly they move through paper with a solvent.

Example:

 Separating colours present in ink.

37. How Does Chromatography Work?

A small spot of the mixture is placed on chromatography paper.

Then:

 Solvent moves through the paper.

Different components move at different rates.

Therefore:

🎨 Different components appear as separate spots.

Why?

Because different substances interact differently with the paper and solvent.

38. Applications of Chromatography

Paper chromatography can be used to:

🎨 Separate colours in ink

🌿 Investigate pigments in leaves

🍷 Analyse food colours

🔬 Identify components of mixtures

The textbook even suggests investigating whether red leaves contain green pigments using paper chromatography.

39. Sublimation

Some solids change directly into vapour when heated without becoming liquid first.

This process is called:

Sublimation

Solid → Vapour

Examples of substances that can sublime include:

- Camphor
 - Some other sublimable solids
-



40. Deposition

The reverse process is:

Deposition

Vapour → Solid

without passing through the liquid state.

Example:

Camphor vapour cools and forms solid camphor on a cooler surface.



41. Separating Sublimable Substances

Suppose we have:

Camphor + Sand

On heating:



Camphor → Vapour



Sand → Remains solid

The camphor vapour cools and deposits as solid on a cooler surface.

Therefore:

Camphor and sand can be separated by sublimation.



42. Separating Funnel

A separating funnel is used to separate:

Two immiscible liquids

Immiscible liquids do not mix with each other.

Example:

 Oil + Water

They form separate layers.

The liquid with greater density settles at the bottom.

The lower layer can be drained out through the stopcock.

The textbook identifies the separating funnel as a method based on differences in density of immiscible liquids.



43. Distillation

Distillation can be used to separate:

Two miscible liquids with sufficiently different boiling points

It can also be used to obtain a liquid from a mixture of a liquid and a dissolved solid.

Basic process:

 Heating



Liquid with lower boiling point vaporises



 Vapour passes into condenser



 Vapour cools



 Liquid is collected

The new textbook states that simple distillation is used for two miscible liquids with a minimum boiling-point difference of about **25°C**, and can also recover a liquid from a liquid-solid mixture.



44. Boiling Point

The **boiling point** is the temperature at which a liquid boils under a given pressure.

Examples from the chapter include:

Substance	Approx. Boiling Point
 Water	100°C
 Acetone	56°C
 Alcohol	78°C
 Chloroform	61°C
 Benzene	80°C



45. Distillation of Salt Water

Salt water contains:



Water



Dissolved salt

On heating:



Water → Vapour



Salt → Remains behind

The water vapour is then cooled in a condenser.

Result:

 Pure/distilled water is collected.

46. Coagulation

Coagulation involves adding a substance called a:

Coagulant

The coagulant causes small particles to:

Clump together

The larger clumps then settle more easily.

Example:

Coagulation is used as one step in treating water and sewage.

The chapter specifically mentions sedimentation, coagulation and filtration in sewage treatment.

47. Separation in Blood

Blood contains different components.

 Plasma

 Red blood cells

 White blood cells

 Platelets

Centrifugation can help separate blood components because they differ in density.

48. Separation of Cream from Milk

Milk is a complex mixture.

Centrifugation can be used to separate:

 **Cream from milk**

because the components differ in density.

49. Separation in Waste Management

Separation is also important for protecting our environment. 

Dry waste:

 Plastic

 Paper

 Glass

 Metal

These can often be recycled.

Wet waste:

 Food scraps

 Vegetable peels

These can be composted.

Proper waste segregation helps recycling and reduces environmental pollution.

50. Separation in Water Treatment

Sewage and wastewater may undergo several processes:

1 Sedimentation

Large/heavier particles settle.

2 Coagulation

Small particles clump together.

3 Filtration

Remaining suspended particles are removed.

This helps produce cleaner water that can sometimes be reused for purposes such as flushing or watering plants.



51. Separation Techniques — Quick Chart

Method	Principle	Example
 Filtration	Particle size	Sand + water
 Evaporation	Volatility	Salt from salt solution
 Crystallization	Solubility	Pure crystals
 Centrifugation	Density/settling	Blood components
 Chromatography	Different movement rates	Ink colours
 Sublimation	Sublimation property	Camphor + sand
 Separating funnel	Density + immiscibility	Oil + water
 Distillation	Boiling point	Water + acetone
 Coagulation	Clumping of particles	Water treatment

52. Choosing the Correct Separation Method

 **Insoluble solid + liquid**

👉 **Filtration**

Example:

Sand + water

 **Dissolved solid + liquid**

👉 **Evaporation / Crystallization**

Example:

Salt + water

 **Immiscible liquids**

👉 **Separating funnel**

Example:

Oil + water

 **Miscible liquids with sufficiently different boiling points**

👉 **Distillation**

Example:

Suitable liquid-liquid mixtures

 **Coloured components**

👉 Paper chromatography

Example:

Ink

👉 Sublimable solid + non-sublimable solid

👉 Sublimation

Example:

Camphor + sand

💧 Components with different densities

👉 Centrifugation

Example:

Blood



53. Important Definitions

Mixture

A physical combination of two or more substances.

Homogeneous mixture

A mixture with uniform composition throughout.

Heterogeneous mixture

A mixture with non-uniform composition.

Solute

The substance that dissolves.

Solvent

The substance that dissolves the solute.

Solution

A homogeneous mixture of solute and solvent.

Solubility

Maximum amount of solute that can dissolve in a given amount of solvent at a specified temperature.

Suspension

A heterogeneous mixture containing relatively large insoluble particles that can settle.

Colloid

A mixture containing intermediate-sized dispersed particles that generally do not settle readily.

Tyndall effect

Scattering of light by dispersed particles in a colloid or suspension.

Crystallization

A method used to obtain relatively pure solid crystals from a suitable solution.

Sublimation

Direct conversion of a solid into vapour without passing through the liquid state.

Deposition

Direct conversion of vapour into solid.



54. Important Exam Questions

Q1. What is a mixture?

A mixture is a physical combination of two or more substances in which the components retain their individual properties.

Q2. Differentiate between homogeneous and heterogeneous mixtures.

A homogeneous mixture has a uniform composition, whereas a heterogeneous mixture has a non-uniform composition.

Q3. What is a solution?

A solution is a homogeneous mixture of a solute and a solvent.

Q4. What is a solute?

A solute is the substance that dissolves in a solvent.

Q5. What is a solvent?

A solvent is the substance that dissolves the solute.

Q6. What is concentration?

Concentration indicates the amount of solute present in a given amount of solution.

Q7. What is a saturated solution?

A saturated solution contains the maximum amount of solute that can dissolve at a particular temperature.

Q8. What is a suspension?

A suspension is a heterogeneous mixture containing relatively large insoluble particles that settle on standing.

Q9. What is a colloid?

A colloid contains intermediate-sized dispersed particles that generally do not settle readily.

Q10. What is the Tyndall effect?

The Tyndall effect is the scattering of light by dispersed particles in a colloid or suspension.

Q11. Why is filtration used?

Filtration is used to separate an insoluble solid from a liquid based mainly on particle size.

Q12. What is crystallization?

Crystallization is a method of obtaining relatively pure solid crystals from a suitable solution.

Q13. What is sublimation?

Sublimation is the direct conversion of a solid into vapour without passing through the liquid state.

Q14. What is a separating funnel used for?

It is used to separate immiscible liquids having different densities.

Q15. What is distillation?

Distillation involves vaporising and then condensing a component, and is used to separate suitable liquid mixtures based on differences in boiling points.



55. Important Numerical Problems

Example 1

A solution contains 10 g salt and 90 g water. Find its mass by mass percentage.

Solution:

Mass of solution:

$$10 + 90 = 100 \text{ g}$$

Mass by mass percentage:

$$\% \text{ m/m} = (10 / 100) \times 100$$

Answer = 10%

Example 2

4 g of a substance is dissolved to make 200 mL of solution. Find the mass by volume percentage.

$$\% \text{ m/v} = (\text{Mass of solute} / \text{Volume of solution}) \times 100$$

$$\% \text{ m/v} = (4 / 200) \times 100$$

Answer = 2%

Example 3

15 mL of alcohol is present in 150 mL of solution. Find the volume by volume percentage.

$$\% \text{ v/v} = (15 / 150) \times 100$$

Answer = 10%

56. Competency-Based Question

Situation

A student has a mixture of:

Sand + Salt + Water

How can the student separate all three components?

Step 1

Use:

Filtration

Sand remains on the filter paper.

The salt solution passes through.

Step 2

Use:

Evaporation or crystallization

Water is removed and salt is obtained.

Answer:

Filtration → Evaporation/Crystallization

57. Competency-Based Question

A mixture contains:

Oil + Water

Which method should be used?

👉 **Separating funnel**

Why?

Oil and water:

- Are immiscible.
 - Have different densities.
 - Form separate layers.
-

58. Competency-Based Question

A student wants to separate different colours present in black ink.

Which technique should be used?

👉 **Paper chromatography** 

Why?

Different components move at different rates through the paper with the solvent.

Therefore, they separate into different spots.

59. Competency-Based Question

A mixture contains:

 **Sand + Camphor**

Which method should be used?

👉 **Sublimation**

Camphor changes:

Solid → Vapour

while sand remains solid.

The camphor vapour then cools and undergoes:

Vapour → Solid

This is deposition.

60. Competency-Based Question

Why can milk show the Tyndall effect?

Milk contains dispersed particles that scatter light.

Therefore:

Milk is a colloid and can show the Tyndall effect.

61. Common Mistakes to Avoid

Mistake 1

Calling salt water a heterogeneous mixture.

Correct:

Salt water is a:

Homogeneous mixture / solution

Mistake 2

Using filtration to separate dissolved salt from water.

✓ **Correct:**

Use:

Evaporation or crystallization

✗ **Mistake 3**

Thinking all mixtures can be separated by filtration.

✓ **Correct:**

Filtration works mainly for an **insoluble solid + liquid** mixture.

✗ **Mistake 4**

Confusing sublimation and evaporation.

✓ **Correct:**

Sublimation: Solid → Vapour

Evaporation: Liquid → Vapour

✗ **Mistake 5**

Confusing tendon-like terminology from previous chapters—this chapter is about mixtures and separation, so focus on the **property used for separation**.

62. QUICK REVISION

★ Mixture = Physical combination of substances.

★ Homogeneous mixture = Uniform composition.

★ Heterogeneous mixture = Non-uniform composition.

- ★ Solute = Substance that dissolves.
 - ★ Solvent = Substance that dissolves the solute.
 - ★ Solution = Solute + Solvent.
 - ★ Concentration = Amount of solute in a given amount of solution.
 - ★ Saturated solution = Maximum solute dissolved at a given temperature.
 - ★ Suspension = Large particles that settle.
 - ★ Colloid = Intermediate particles that generally do not settle readily.
 - ★ Tyndall effect = Scattering of light.
 - ★ Filtration = Insoluble solid + liquid.
 - ★ Evaporation = Recover dissolved solid.
 - ★ Crystallization = Obtain purer crystals.
 - ★ Centrifugation = Separation by rapid spinning.
 - ★ Chromatography = Separation based on different movement rates.
 - ★ Sublimation = Solid $\rightarrow$ Vapour.
 - ★ Deposition = Vapour $\rightarrow$ Solid.
 - ★ Separating funnel = Immiscible liquids.
 - ★ Distillation = Separation based on boiling points.
 - ★ Coagulation = Particles clump together.
-

63. MEMORY TRICKS

Solution

S + S = Solution

Solute + Solvent = Solution

Types

Solution → Small particles

Colloid → Medium particles

Suspension → Large particles

Separation Methods

F → Filtration → Solid + liquid

E → Evaporation → Dissolved solid

C → Crystallization → Pure crystals

C → Centrifugation → Spinning

C → Chromatography → Colours

S → Sublimation → Solid to vapour

S → Separating funnel → Separate liquids

D → Distillation → Difference in boiling points

64. COMPLETE CHAPTER FORMULA SHEET

Mass by Mass Percentage

$$\% \text{ m/m} = (\text{Mass of solute} / \text{Mass of solution}) \times 100$$

Mass by Volume Percentage

$$\% \text{ m/v} = (\text{Mass of solute} / \text{Volume of solution}) \times 100$$

Volume by Volume Percentage

$$\% \text{ v/v} = (\text{Volume of solute} / \text{Volume of solution}) \times 100$$

Mass of Solution

$$\text{Mass of solution} = \text{Mass of solute} + \text{Mass of solvent}$$

★ 65. CHAPTER 5 — FINAL TAKEAWAY

Mixtures are a part of our everyday life. 

Science helps us understand:

 What mixtures contain

 How their components behave

 How concentration is measured

 How solubility changes

 How mixtures can be separated

Different separation techniques work because different substances have different physical properties.

★ The key idea is:

Different property → Different separation method

For example:

 Particle size → **Filtration**

 Density → **Separating funnel / Centrifugation**

 Boiling point → **Distillation**

 Solubility → **Crystallization**

 Movement through paper → **Chromatography**

☁ Sublimation ability → **Sublimation**

The textbook's chapter summary highlights these same separation principles and techniques.