COMPLETE CHAPTER 5 NOTES - EXPLORING MIXTURES AND THEIR SEPARATION

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PART 1: UNDERSTANDING MIXTURES

WHAT IS A MIXTURE?

Definition: A mixture is a combination of two or more substances that are NOT chemically combined together. Each substance keeps its own individual properties. The components can be separated by physical methods.

Key Points:

· No chemical reaction occurs when making a mixture
· Each component retains its own properties
· Components can be separated using physical methods
· The composition can vary (unlike compounds)

TYPES OF MIXTURES

1. HOMOGENEOUS MIXTURE (SOLUTION)

Definition: A mixture with uniform composition throughout. Every part of the mixture looks exactly the same.

Characteristics:

· Cannot see individual components with naked eye
· Particles are very small (less than 1 nm)
· Do not settle on standing
· Cannot be separated by filtration
· Do not show Tyndall effect (do not scatter light)
· Completely transparent

Examples:

· Sugar dissolved in water
· Salt dissolved in water
· Vinegar (acetic acid in water)
· Aerated drinks (soda)
· Air
· Brass (alloy)
· Bronze (alloy)
· Stainless steel (alloy)

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2. HETEROGENEOUS MIXTURE

Definition: A mixture where the components are NOT uniformly distributed. Different parts have different compositions.

Characteristics:

· Can see different components
· Particles are large
· May settle on standing
· Can be separated by filtration
· Show Tyndall effect (scatter light)
· Not transparent

Examples:

· Sand and water
· Oil and water
· Muddy water
· Smoke
· Fog
· Dust in air

ACTIVITY 5.1: COMPARISON OF MIXTURES

Procedure:

· Group A: Salt + Water (stir well)
· Group B: Chalk powder + Water (stir well)
· Group C: Milk + Water (stir well)

Observations:

Property	Group A (Salt + Water)	Group B (Chalk + Water)	Group C (Milk + Water)
Particles Visible?	No	Yes	No
Laser Light Visible?	No	Yes	Yes
Filtration Residue?	No	Yes	No
Settling on Standing?	No	Yes	No
Type of Mixture	Solution	Suspension	Colloid

PART 2: SOLUTIONS IN DEPTH

5.2 SOLUTIONS

Key Terms

Solute: The substance that gets dissolved in a solution.

· Example: In sugar water, sugar is the solute

Solvent: The substance that dissolves the solute.

· Example: In sugar water, water is the solvent

Solution: The homogeneous mixture formed when solute dissolves in solvent.

Important: A solution always remains homogeneous. The composition is uniform throughout.

5.2.1 CONCENTRATION OF A SOLUTION

Definition: The amount of solute dissolved in a given amount of solvent or solution.

Why Concentration Matters

Medicine:

· ORS (Oral Rehydration Solution) requires specific amounts of salt and sugar
· Wrong concentration won't work as medicine
· Developed by Dr. Dilip Mahalanabis (Indian paediatrician)
· Saved millions of lives worldwide

Agriculture:

· Too little pesticide → crops not protected
· Too much pesticide → damages crops, soil, and environment

Food:

· Recipes require precise proportions
· Taste, texture, and quality depend on correct concentration

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5.2.2 WAYS TO EXPRESS CONCENTRATION

A. MASS BY MASS PERCENTAGE (% m/m or % w/w)

Definition: Number of grams of solute present in 100 grams of total solution.

Formula:

```
% m/m = (Mass of solute / Mass of solution) × 100
```

Where:

· Mass of solution = Mass of solute + Mass of solvent

Example 5.1:
If 10g of salt is dissolved in 90g of water:

· Mass of solution = 10g + 90g = 100g
· % m/m = (10/100) × 100 = 10% m/m

Uses:

· Packaged foods
· Milk powder
· Spice mixtures
· Cosmetics

B. MASS BY VOLUME PERCENTAGE (% m/v or % w/v)

Definition: Number of grams of solute present in 100 millilitres of solution.

Formula:

```
% m/v = (Mass of solute / Volume of solution) × 100
```

Example 5.2:
If 5g of glucose is dissolved in water to make 100mL of solution:

· % m/v = (5/100) × 100 = 5% m/v

Uses:

· Medicines
· Laboratory solutions
· When measuring volume is easier than weighing

C. VOLUME BY VOLUME PERCENTAGE (% v/v)

Definition: Number of millilitres of solute present in 100 millilitres of solution.

Formula:

```
% v/v = (Volume of solute / Volume of solution) × 100
```

Example 5.3:
If 1mL of liquid pesticide is mixed to make 100mL of solution:

· % v/v = (1/100) × 100 = 1% v/v

Uses:

· Perfumes
· Cosmetics
· Vinegar (acetic acid solution)

· Mixing two liquids

5.2.3 SOLUBILITY

Definition: The maximum amount of solute that dissolves in a fixed quantity of solvent (100mL or 100g) at a given temperature.

Saturated Solution: A solution that cannot dissolve any more solute at that temperature.

Effect of Temperature on Solubility

Solid Solutes:

· Solubility generally INCREASES with temperature
· More solid dissolves in hot water than cold water

Gas Solutes:

· Solubility generally DECREASES with temperature
· Less gas dissolves in hot water than cold water

Solubility Curve

A graph showing how solubility changes with temperature.

· X-axis: Temperature (°C)
· Y-axis: Solubility (g per 100g of water)

PART 3: SEPARATION OF HOMOGENEOUS MIXTURES

5.3.1 CRYSTALLIZATION

Definition: The process of forming pure solid crystals from a saturated solution by cooling it slowly.

Principle

Different substances have different solubilities at different temperatures. When a saturated solution is cooled, the excess solute cannot remain dissolved and comes out as pure crystals.

Procedure for Crystallization

Step 1: Take the substance (e.g., copper sulfate) in a beaker

· 1g copper sulfate + 25mL water + drop of dilute sulfuric acid
· Sulfuric acid prevents unwanted reactions

Step 2: Heat the mixture in a water bath

· Stir constantly
· Add more substance until solution becomes saturated

Step 3: Filter the hot solution

· Removes insoluble impurities
· Collect in clean beaker

Step 4: Cover with watch glass

· Allow to cool SLOWLY without disturbing

Step 5: Crystals form

· Large, shiny, well-shaped crystals develop

Step 6: Filter and dry

· Rinse with cold water
· Dry on watch glass

Why Slow Cooling?

Cooling Method	Result
Slow cooling at room temperature	Large, well-formed, shiny crystals
Rapid cooling in ice water	Small, poorly-formed crystals

Reason: Slow cooling gives particles enough time to arrange in proper crystal pattern.

Uses of Crystallization

1. Separating two solids (when one is in small quantity)
2. Purifying solids
3. Obtaining salt from seawater
4. Making sugar crystals (mishri/candy sugar)
5. Purifying chemicals in laboratories

Examples of Crystals in Daily Life

· Rock salt crystals
· Sugar crystals (mishri)

· Snowflakes
· Frost on windows
· Quartz crystals in nature
· Cave crystal formations (Mawsmai Cave, Cherrapunji)

5.3.2 DISTILLATION

Definition: Separating a homogeneous mixture of miscible liquids by heating - the liquid with the lower boiling point vaporizes first, then is cooled and condensed back to liquid.

Requirements

· Liquids must be miscible (mix completely)
· Difference in boiling points must be at least 25°C
· Lower boiling point liquid vaporizes first

Example: Acetone and Water

Liquid Boiling Point
Acetone 56°C
Water 100°C
Difference 44°C (can be separated)

Distillation Apparatus

Parts:

1. Distillation flask: Contains the mixture to be separated
2. Thermometer: Measures temperature
3. Condenser: Cools the vapour (water circulates through it)

4. Collecting flask: Collects the pure liquid

Process

1. Heat the mixture in distillation flask
2. Lower boiling liquid vaporizes first
3. Vapours pass through condenser
4. Cold water in condenser cools the vapour
5. Vapour condenses to liquid
6. Pure liquid collected in separate flask
7. Other component remains in distillation flask

Uses of Distillation

1. Separating miscible liquids
2. Obtaining pure solvent from a solution
3. Making perfumes (Deg-Bhapka method)
4. Water purification
5. Petroleum refining

Deg-Bhapka Method

· Traditional distillation method from Kannauj, Uttar Pradesh
· Known as "Perfume Capital of India"
· Used to make Mitti ka Ittar (earthy fragrance)
· Captures fragrance from flowers and earth after first rain
· Passed down through generations
· Fragrance and Flavour Development Centre in Kannauj supports this

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FRACTIONAL DISTILLATION

Definition: Used when boiling points differ by LESS than 25°C.

Example: Petroleum Refining

· Crude oil from Earth's crust
· Processed in petroleum refinery
· Separated into different fractions

Products from Fractional Distillation:

Fraction	Boiling Point	Use
Petroleum gas	Very low	LPG (domestic fuel)
Petrol	Low	Vehicle fuel
Kerosene	Medium	Lamp fuel, jet fuel
Diesel	Higher	Vehicle fuel
Lubricating oil	High	Lubrication

LPG (Liquefied Petroleum Gas):

· Gaseous fraction filled in steel cylinders under high pressure
· Liquefied under pressure
· Used as domestic fuel for cooking

5.3.3 PAPER CHROMATOGRAPHY

Definition: Separating components of a mixture based on differences in their movement on paper when carried by a solvent.

Principle

Different components interact differently with:

· The paper (stationary phase)
· The solvent (mobile phase)

Components that interact less with paper move faster. Components that interact more with paper move slower.

Procedure

Step 1: Cut a strip of chromatographic paper (or filter paper)

· 3 cm wide
· Draw a pencil line 2 cm from bottom (PENCIL, not pen)

Step 2: Place a spot of mixture on the pencil line

· Use black sketch pen or food color
· A small spot is sufficient

Step 3: Add solvent to a container

· Enough to make a thin layer at bottom
· Water, alcohol, or mixture of solvents

Step 4: Place paper strip in container

· Lower end dips in solvent
· Spot is ABOVE solvent level
· Solvent level must NOT touch the spot

Step 5: Observe as solvent rises

· Solvent moves up the paper by capillary action

· Components separate into different color spots

Important Rule

Solvent level must ALWAYS be BELOW the sample spot.

Why? If solvent touches the spot directly, the mixture will dissolve in the solvent instead of being carried up the paper. The separation will not happen.

Observations

· Black ink often separates into multiple colors (blue, red, yellow, etc.)
· Different components travel at different speeds
· Each component forms a spot at a different height

Uses of Paper Chromatography

1. Separating ink colors
2. Separating pigments from leaves (chlorophyll, carotenoids)
3. Testing food colors
4. Identifying components in mixtures
5. Forensic analysis
6. Detecting impurities

Other Applications

Spinach leaves: Extract green pigments

· Chlorophyll (green)
· Carotenoids (yellow/orange)
· Xanthophylls (yellow)

Flower petals: Extract colored pigments

· Anthocyanins (red, blue, purple)
· Carotenoids (yellow, orange)

Note: Water may not work for all mixtures. Sometimes alcohol or other solvents are needed.

PART 4: SEPARATION OF HETEROGENEOUS MIXTURES

5.4.1 SEPARATION OF IMMISCIBLE LIQUIDS

Definition

Immiscible liquids: Liquids that do NOT mix together.

· Example: Oil and water
· They form separate layers

Why They Separate

Different Densities:

· Denser liquid settles at the bottom
· Less dense liquid floats on top

Apparatus: Separating Funnel

Structure:

· Pear-shaped glass funnel
· Has a stopcock at the bottom
· Allows controlled drainage

Procedure

1. Pour mixture into separating funnel
2. Let it stand undisturbed
3. Layers form (oil on top, water at bottom)
4. Open stopcock slowly
5. Collect bottom layer in a container
6. Close stopcock when bottom layer is drained
7. Discard small portion that may contain both liquids
8. Collect top layer separately

Example: Mustard Oil and Water

· Mustard oil: Upper layer (less dense)
· Water: Lower layer (more dense)

Limitations

Problem: What if two immiscible liquids have the same density?

· Layers will NOT form
· Cannot use separating funnel

Gas in Heterogeneous Mixtures

Gases in mixtures:

· Gases mix freely with other gases (homogeneous)
· But can form heterogeneous mixtures with solids or liquids

Examples:

· Smoke (solid particles in air)
· Fog (liquid droplets in air)
· Dust in air

5.4.2 SUBLIMATION

Definitions

Sublimation: Direct change of a solid to vapour WITHOUT passing through liquid state.

Deposition: Direct change of vapour to solid WITHOUT passing through liquid state.

Activity: Separation of Camphor and Sand

Procedure:

1. Take mixture of crushed camphor and sand in a china dish
2. Place on tripod stand with wire gauze
3. Invert a funnel over the dish
4. Plug funnel nozzle with cotton
5. Heat gently
6. Observe inner wall of funnel

Observations:

· White solid deposits on funnel wall (camphor)
· Sand remains in china dish

Explanation:

· Camphor sublimes on heating (solid → vapour)
· Vapour rises and cools on funnel wall
· Camphor deposits back to solid (deposition)
· Sand does NOT sublime

Sublimable Substances

1. Camphor
2. Naphthalene (mothballs)
3. Dry ice (solid CO_2)
4. Iodine

Uses of Sublimation

· Separating sublimable substances from non-sublimable ones
· Purifying substances
· Dry ice for ice cream storage

ALLOYS

Definition: A homogeneous mixture of two or more metals, or a metal and a non-metal.

How Alloys Are Made

1. Metals are melted at high temperatures
2. Mixed together
3. Mixture cools and solidifies

4. Forms a single metal-like material

Properties of Alloys

· Stronger than pure metals
· More rigid
· More corrosion-resistant
· Physical methods cannot separate components

Examples of Alloys

Alloy Composition Uses
Brass 80% Copper + 20% Zinc Musical instruments, fittings
Bronze 80% Copper + 20% Tin Statues, coins, bells
Stainless Steel Iron + Carbon (0.03-0.8%) + Chromium (16-18%) + Nickel (10-14%) + Molybdenum (2-3%) Utensils, surgical instruments

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5.4.3 SUSPENSIONS

Definition: A heterogeneous mixture where solid particles do NOT dissolve but remain suspended throughout the liquid.

Characteristics

Property Description
Particle Size More than 1000 nm diameter
Visibility Visible to naked eye
Settling Settles over time
Filtration Can be separated by filtration
Tyndall Effect Shows Tyndall effect
Nature Heterogeneous

Examples

· Muddy water (sand in water)
· Sawdust in water
· Tea leaves in water
· Chalk powder in water

A. CENTRIFUGATION

Definition: Using rapid spinning (centrifugal force) to separate heavier particles from lighter ones in a mixture.

Principle

Centrifugal Force:

· Outward force acting on a body moving in circular motion
· Heavier particles experience more force
· They move outward and settle at bottom

How It Works

1. Mixture placed in tubes
2. Tubes spun at high speed
3. Tubes become horizontal during spinning
4. Heavier particles move outward
5. Heavier particles settle at bottom
6. Lighter liquid remains at top

Uses of Centrifugation

1. Blood separation:
   · Red blood cells (heavier) → bottom
   · Plasma (lighter) → top
   · White blood cells and platelets → middle
2. Chemical industries
3. Testing for diseases (malaria, anaemia)
4. Separating cream from milk

The Paperfuge

What is it?

· Hand-powered centrifuge made from paper
· Inspired by a common toy
· Works without electricity

Advantages:

· Low cost
· Can be used in remote areas
· No electricity needed
· Can detect diseases like malaria and anaemia

Concept:

· By spinning blood samples at very high speed
· Separates heavier components from lighter ones
· Like a laboratory centrifuge

B. COAGULATION

Definition: Adding a substance (coagulant) that causes fine suspended particles to clump together and settle.

Principle

· Tiny particles have a charge (usually negative)
· They repel each other and stay suspended
· Coagulant neutralizes the charge
· Particles stick together
· Form larger clumps (flocs)
· Clumps are heavy and settle

Process

1. Add coagulant to the suspension
2. Particles clump together
3. Larger clumps form
4. Clumps settle by gravity (sedimentation)
5. Clear liquid on top
6. Separate by decantation or filtration

Coagulants

Alum (Fitkari):

· White crystalline substance
· Used in water purification
· Causes suspended particles to clump

Examples of Coagulation

1. Water Purification:

· Add alum to muddy water
· Particles clump and settle
· Clear water obtained

2. Making Paneer (Cheese):

· Add acid (lemon juice or vinegar) to milk
· Milk proteins coagulate
· Form cheese (paneer)

5.4.4 COLLOIDS

Definition: A mixture where particles are intermediate in size between solutions and suspensions.

Characteristics

Property	Description
Particle Size	1 to 1000 nm
Visibility	Not visible to naked eye
Settling	Does NOT settle on standing
Filtration	Cannot be separated by filtration
Tyndall Effect	Shows Tyndall effect
Appearance	Appears homogeneous but is actually heterogeneous

Components of Colloids

Dispersed Phase:

· The solute-like component

· The dispersed particles
· Example: Milk fat in milk

Dispersion Medium:

· The component in which particles are suspended
· Example: Water in milk

Examples of Colloids

Colloid Dispersed Phase Dispersion Medium Type
Milk Milk fat Water Oil-in-water
Butter Water Milk fat Water-in-oil
Blood Blood cells Plasma Solid-in-liquid
Clouds Water droplets Air Liquid-in-gas
Smoke Solid particles Air Solid-in-gas
Fog Water droplets Air Liquid-in-gas
Ice cream Ice crystals, fat Milk, sugar -

EMULSIONS

Definition: A colloid where both the dispersed phase and dispersion medium are liquids.

Types of Emulsions

1. Oil-in-Water (O/W):

· Oil is dispersed in water
· Examples: Milk, Vanishing creams

2. Water-in-Oil (W/O):

· Water is dispersed in oil
· Examples: Butter, Body lotions, Cold cream

Emulsifying Agents

Definition: Substances that stabilize emulsions.

Examples:

· Proteins in milk
· Proteins in butter
· Soap solution

Why Needed:

· Prevent separation of the two liquids
· Keep emulsion stable

Making an Emulsion

· Mix cooking oil with water
· Add soap solution
· Shake thoroughly
· Emulsion forms

Uses of Emulsions

· Medicines (easier to swallow, less greasy)
· Cosmetics
· Food products
· Paints

PART 5: TYNDALL EFFECT

5.5 TYNDALL EFFECT

Definition: The scattering of light by particles in a colloid or suspension.

Named After

John Tyndall: Scientist who first explained the scattering of light by particles.

Why It Happens

Solutions:

· Particles are very small (<1 nm)
· Light passes straight through
· Beam not visible

Colloids and Suspensions:

· Particles are larger (1-1000 nm or more)
· Particles scatter light in all directions
· Beam becomes visible

Observations

Experiment (Activity 5.1):

· Salt + Water: No beam visible (solution)
· Chalk + Water: Beam visible (suspension)
· Milk + Water: Beam visible (colloid)

Real-Life Examples

1. Sunlight through tree gaps:
   · Light scatters from dust particles in air
   · Bright rays visible
2. Dark room with small hole:
   · Light beam visible due to dust particles
   · Tyndall effect
3. Sports stadium floodlights:
   · Light beams visible on foggy days
4. Hazy cities:
   · Smoke and dust scatter light
   · City looks hazy
5. Headlights in fog:
   · Beam visible due to water droplets
   · Reduced visibility

SUMMARY TABLE: COMPARING MIXTURES

Table 5.1: Properties of Different Mixtures

Property	Solution	Suspension	Colloid
Nature	Homogeneous	Heterogeneous	Heterogeneous (appears homogeneous)
Particle Size	Less than 1 nm	More than 1000 nm	1 to 1000 nm
Visibility	Not visible	Visible to naked eye	Not visible
Filtration	Cannot be filtered	Can be filtered	Cannot be filtered
Settling	Does not settle	Settles on standing	Does not settle

Tyndall Effect No Yes Yes

Examples Salt water, sugar water Muddy water, chalk in water Milk, blood, smoke

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IMPORTANT DEFINITIONS

Term Definition

Mixture Two or more substances not chemically combined

Homogeneous Uniform composition throughout

Heterogeneous Non-uniform composition

Solution Homogeneous mixture of solute and solvent

Solute Substance that gets dissolved

Solvent Substance that dissolves the solute

Concentration Amount of solute in given amount of solution

Solubility Maximum solute that dissolves at given temperature

Saturated solution Cannot dissolve more solute

Crystallization Forming pure crystals from saturated solution

Distillation Separating liquids by boiling point difference

Fractional distillation Separating with <25°C boiling point difference

Chromatography Separating by different movement rates

Sublimation Solid → Vapour (no liquid)

Deposition Vapour → Solid (no liquid)

Immiscible Liquids that don't mix

Centrifugation Spinning to separate by density

Coagulation Adding substance to clump particles

Colloid Particles 1-1000 nm, don't settle

Tyndall effect Light scattering by particles

Alloy Homogeneous mixture of metals

Emulsion Colloid with both phases as liquids

IMPORTANT FORMULAS

Concentration Formulas

1. Mass by Mass Percentage

```
% m/m = (Mass of solute / Mass of solution) × 100
```

2. Mass by Volume Percentage

```
% m/v = (Mass of solute / Volume of solution) × 100
```

3. Volume by Volume Percentage

```
% v/v = (Volume of solute / Volume of solution) × 100
```

APPLICATION IN DAILY LIFE

1. Blood Donation and Storage

· Blood is a colloid
· Centrifugation separates components
· Plasma, platelets, RBCs, WBCs separated
· Stored in blood banks
· Used when needed

2. Water Purification

· Sedimentation
· Coagulation (alum)
· Filtration
· Clean water obtained
· Sewage treatment

3. Waste Management

· Segregation of waste
· Dry waste: plastic, paper, glass, metal
· Wet waste: food scraps, vegetable peels
· Recycling and composting

4. Sugar Production

· Crystallization from sugarcane
· Pure sugar crystals obtained

5. Perfume Making

· Distillation (Deg-Bhapka method)
· Fragrance from flowers captured
· Mitti ka Ittar produced

6. Petroleum Refining

· Fractional distillation
· Various products obtained
· LPG for domestic use

PAUSE AND PONDER SOLUTIONS

Question 1:

Talcum powder has 4% m/m zinc oxide.

· 4% means 4g in 100g
· In 300g: (4/100) × 300 = 12g
  Answer: 12g zinc oxide

Question 2:

· Concentrate = 2 tablespoons × 15mL = 30mL
· Total juice = 150mL
· % v/v = (30/150) × 100 = 20%
  Answer: 20% v/v

Question 3:

To make vinegar from glacial acetic acid:

· Vinegar is 5% v/v acetic acid
· Need 5mL acetic acid in 100mL solution
· Take 5mL glacial acetic acid (100% acetic acid)
· Add 95mL water
· Total = 100mL vinegar

Question 4:

Solubility curves:

· Compound A: 80°C (65g), 60°C (50g) → drops 15g
· Compound B: 80°C (155g), 60°C (120g) → drops 35g
Answer: Compound B deposits more solid

Question 5:

Effect of evaporation rate:

· Slow evaporation: Large, well-formed crystals
· Fast evaporation: Small, poorly-formed crystals
· Reason: More time allows proper crystal arrangement

Question 6: True/False

(i) Salt can be separated from salt solution by evaporation or distillation.
Answer: TRUE

· Evaporation: salt remains, water disappears
· Distillation: both salt and water recovered

(ii) Distillation can be used for two liquids with same boiling point.
Answer: FALSE

· Correction: Need minimum 25°C difference

(iii) In paper chromatography, solvent level should be above sample spot.
Answer: FALSE

· Correction: Solvent level must be BELOW the spot

(iv) Evaporation and crystallization are same.
Answer: FALSE

· Evaporation: removes solvent completely
· Crystallization: forms pure crystals from saturated solution

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Question 7:

Why do immiscible liquids form two layers?

· Different densities
· Denser liquid sinks to bottom
· Less dense liquid floats on top
· They don't mix due to different molecular structures

Question 8:

Is sublimation different from evaporation?
Answer: YES

· Sublimation: Solid → Vapour (no liquid state)
· Evaporation: Liquid → Vapour (involves liquid state)

Question 9:

Clouds are colloids. Why?

· Tiny water droplets/ice crystals (1-1000 nm) suspended in air
· Particles don't settle (float)
· Show Tyndall effect (sunlight scattering)
· Cannot be filtered

Question 10:

Why do smoky/dusty cities look hazy?

· Smoke and dust particles scatter light
· This is the Tyndall effect
· Particles suspended in air (colloid or suspension)
· Scattered light makes everything appear hazy

SOLVED EXERCISES - COMPLETE ANSWERS

Question 1: Correct Classification

Answer: Option (iv)

Mixture Classification
Muddy water Heterogeneous ✓
Milk Heterogeneous ✓ (colloid)
Blood Heterogeneous ✓ (colloid)
Brass Homogeneous ✓ (alloy)

Question 2: Tyndall Effect

Answer: Option (iii) - a and c

Mixture Tyndall Effect? Reason
(a) Air + dust particles Yes Suspension/colloid
(b) Copper sulfate + water No Solution
(c) Starch + water Yes Colloid
(d) Acetone + water No Solution

Question 3: Table Completion

Solution

Properties:

· Small-sized particles (less than 1 nm)
· Particles remain evenly distributed
· Does not settle down
· Transparent
· Cannot be separated by filtration
· Homogeneous mixture

Examples:

· Salt solution
· Sugar solution

Suspension

Properties:

· Large-sized particles (more than 1000 nm)
· Settles down when left undisturbed
· Scatters light
· Separates by filtration
· Heterogeneous mixture

Examples:

· Sand in water
· Mud
· Muddy water

Colloid

Properties:

· Moderate-sized particles (1-1000 nm)
· Particles remain evenly distributed
· Does not settle down
· Scatters light
· Cannot be separated by filtration
· Heterogeneous mixture

Examples:

· Milk

· Smoke

· Butter

Question 4: Problems

(i) Cake Recipe

Total mixture = 75g + 420g + 5g = 500g

Component Mass Percentage
Sugar 75g (75/500) × 100 = 15% m/m
All-purpose flour 420g (420/500) × 100 = 84% m/m
Sodium hydrogencarbonate 5g (5/500) × 100 = 1% m/m

(ii) Brass Alloy

Brass = 70% copper, 30% zinc

Metal Calculation Mass
Copper (70/100) × 120g 84g
Zinc 120g - 84g 36g

Question 5: Oil and Water

Will it form separate layers? YES

Which on top? Oil is on top

· Reason: Oil density = 910g/L, Water = 1000g/L

· Oil is less dense than water

Apparatus: Separating funnel

Diagram:

```
   ______
  |     |
  | OIL | ← Top layer (less dense)
  |_____|
  |     |
  |WATER| ← Bottom layer (more dense)
  |_____|
    ||
   [Stopcock]
```

Procedure:

1. Pour mixture into separating funnel
2. Let stand until layers separate
3. Open stopcock to drain water (bottom layer)
4. Close stopcock when water is drained
5. Collect oil from top

Question 6: Assertion-Reason

Answer: Option (iii)

· Assertion (A): Solutions do not exhibit Tyndall effect → TRUE
· Reason (R): Particles in solutions are larger than 100 nm → FALSE

Correct Reason: Particles in solutions are smaller than 1 nm, so they cannot scatter light.

Question 7: Separation Methods

Mixture Method Reason
Mud from muddy water Filtration Mud particles are large, trapped by filter
Plasma from blood Centrifugation Different densities, spinning separates
Naphthalene and sand Sublimation Naphthalene sublimes, sand doesn't
Chalk powder and common salt Filtration + Evaporation Chalk doesn't dissolve (filter), salt dissolves (evaporate)
Common salt and water Evaporation or Distillation Heat to evaporate water
Oil from water Separating funnel Immiscible, different densities
Pigments of flower Paper chromatography Different pigments move at different speeds

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Question 8: Separating Liquids A and B

Given: A boils at 60°C, B boils at 90°C
Difference: 30°C (>25°C) → Distillation works

Diagram:

```
      [Thermometer]
```

```
          |
   [Distillation Flask]-----+ [Condenser]
          |             |    |
      (Heat)            [Water out]
          |             |    |
      [Mixture A+B]      [Water in]
          |             |    |
          +---------------> [Collecting Flask]
                        (Pure A collected)
```

Procedure:

1. Heat mixture in distillation flask
2. A vaporizes at 60°C
3. Vapours enter condenser
4. Condenser cools (circulating cold water)
5. A condenses to liquid
6. Pure A collected in collecting flask
7. B remains in distillation flask

Question 9: Comparison

Evaporation

· Liquid → Vapour (solid remains)
· Used when only solid needed
· Solvent is wasted
· Example: Salt from seawater

Crystallization

· Forms pure crystals from saturated solution
· Used when pure crystals needed
· Both components can be recovered
· Example: Sugar crystals, purifying chemicals

Distillation

· Heating mixture, collecting vapour
· Used when both components needed
· Both components recovered
· Example: Separating acetone and water

When to use each:

· Evaporation: Only need solid, solvent is cheap
· Crystallization: Need pure, well-formed crystals
· Distillation: Need both components or pure solvent

Question 10: Blood as Colloid

(i) If blood behaved as true suspension:

· Red blood cells would settle
· Circulation would stop
· Oxygen transport would fail
· Body tissues would die
· Person would die

(ii) Components:

· Dispersed phase: Blood cells (RBCs, WBCs, platelets)
· Dispersion medium: Plasma

Question 11: Separation Sequence

Mixture: Sand + Salt + Naphthalene

Step	Process	Removes
1	Sublimation	Naphthalene
2	Dissolve in water	Salt dissolves
3	Filtration	Sand
4	Evaporation/Crystallization	Salt

Answer: Sublimation → Dissolution → Filtration → Evaporation/Crystallization

---

Question 12: Distillation for Acetone-Water

Boiling points:

· Acetone = 56°C
· Water = 100°C
· Difference = 44°C (>25°C)

Why effective:

1. Large difference in boiling points
2. Acetone vaporizes first at 56°C
3. Water remains liquid (boils at 100°C)
4. Acetone vapours condensed and collected

5. Both liquids recovered separately

Question 13: Solubility Table

(i) Potassium nitrate at 40°C

· Solubility at 40°C = 62g per 100g water
· For 50g water: (62/100) × 50 = 31g
Answer: 31g KNO_3

(ii) Potassium chloride cooling

· At 80°C: Solubility = 54g per 100g water
· At 25°C: Solubility ≈ 36g per 100g water
· Excess = 54 - 36 = 18g crystallizes
Observation: Crystals will form as solution cools

(iii) Effect of temperature

Salt 10°C 80°C Increase
Potassium nitrate 21g 167g +146g (largest)
Sodium chloride 36g 37g +1g (smallest)
Potassium chloride 35g 54g +19g
Ammonium chloride 24g 66g +42g

Conclusion: All salts show increased solubility with temperature. Potassium nitrate shows most dramatic increase. Sodium chloride shows very little change.

Question 14: Sugar Solutions

Student A:

· Sugar = 20g, Water = 80g
· Solution mass = 100g
· % m/m = (20/100) × 100 = 20%

Student B:

· Sugar = 20g, Water = 100g
· Solution mass = 120g
· % m/m = (20/120) × 100 = 16.67%

Student C:

· Sugar = 30g, Water = 80g
· Solution mass = 110g
· % m/m = (30/110) × 100 = 27.27%

Most concentrated: Student C (27.27%)
Why? Highest sugar-to-solution ratio

Question 15: Distillation

(i) Separation technique 'S': Distillation

(ii) Labelling:

· A: Thermometer
· B: Condenser
· C: Collecting flask/Distillate

(iii) Which mixtures can be separated?

Mixture BP Difference Separable?

Water-Acetone 100-56 = 44°C ✓ YES

Water-Salt - ✗ NO (solid)

Acetone-Alcohol 78-56 = 22°C ✗ NO (<25°C)

Sand-Salt - ✗ NO (both solids)

Alcohol-Chloroform 78-61 = 17°C ✗ NO (<25°C)

Alcohol-Benzene 80-78 = 2°C ✗ NO (<25°C)

Only water-acetone can be separated by distillation.

COMPARISON TABLE: ALL SEPARATION METHODS

Method Used For Principle

Crystallization Pure solids from solution Different solubility at different temperatures

Distillation Miscible liquids Different boiling points (>25°C)

Fractional Distillation Miscible liquids Different boiling points (<25°C)

Paper Chromatography Colored mixtures Different movement rates

Separating Funnel Immiscible liquids Different densities

Sublimation Sublimable solids Direct solid→vapour transition

Centrifugation Solid-liquid mixtures Different densities (spinning)

Coagulation Suspensions Clumping particles together

Filtration Solid-liquid mixtures Different particle sizes

Evaporation Solid from solution Liquid→vapour (solid remains)

KEY TAKEAWAYS

1. Mixtures are classified as homogeneous or heterogeneous
2. Solutions are homogeneous, suspensions and colloids are heterogeneous
3. Concentration can be expressed in three ways: % m/m, % m/v, % v/v
4. Solubility depends on temperature
5. Crystallization separates pure solids from solutions
6. Distillation separates liquids with different boiling points
7. Chromatography separates based on different movement rates
8. Immiscible liquids are separated using a separating funnel
9. Sublimation separates sublimable substances
10. Centrifugation uses spinning to separate by density
11. Coagulation causes particles to clump and settle
12. Colloids have particle size between solutions and suspensions
13. Tyndall effect is light scattering by particles in colloids and suspensions
14. Alloys are homogeneous mixtures of metals

END OF NOTES

These notes cover the entire chapter with all definitions, explanations, examples, and solved exercises. Copy and paste to create your PDF.