# CLASS 9 SCIENCE

# CHAPTER 5

# EXPLORING MIXTURES AND THEIR SEPARATION

# NCERT QUESTIONS & ANSWERS

**Chapter coverage:** Homogeneous and heterogeneous mixtures • solutions, suspensions and colloids • concentration • solubility • crystallization • distillation • paper chromatography • separating funnel • sublimation • centrifugation • coagulation • Tyndall effect.

**Source basis:** Prepared from the supplied NCERT Grade 9 *Exploration* Chapter 5 and its chapter-end “Revise, Reflect, Refine” questions. The chapter identifies these questions as the end-of-chapter exercise. ■filecite■turn161file0■L143-L144■

# CHAPTER-END QUESTIONS & ANSWERS

**Revise • Reflect • Refine — Chapter 5**

### 1. Which of the following mixtures are correctly classified as homogeneous (Hm) and heterogeneous (Ht)? Choose the correct option.

**Answer: (iii).** Copper sulfate solution — Hm; Salt solution — Hm; Milk — Hm; Bronze — Hm. Solutions and alloys are homogeneous mixtures. The other options contain incorrect classifications such as smoke as homogeneous or muddy water as homogeneous.

### 2. Which mixtures show the Tyndall Effect: (a) air and dust particles, (b) copper sulfate and water, (c) starch and water, (d) acetone and water?

**Answer: (iii) a and c.** Air containing dust particles and starch-water contain dispersed particles that scatter light. A transparent copper sulfate solution and acetone-water solution do not show the Tyndall effect.

### 3. Complete the table comparing solution, suspension and colloid.

**Answer:**
**Solution:** Small-sized particles (< 1 nm); particles remain evenly distributed; transparent; cannot be separated by ordinary filtration; does not settle; does not scatter light. Examples: salt solution, brass.
**Suspension:** Large-sized particles (> 1000 nm); particles settle when left undisturbed; visible; separates by filtration; scatters light. Examples: sand in water, mud.
**Colloid:** Moderate-sized particles (1–1000 nm); particles remain dispersed and do not settle; scatters light; cannot be separated by ordinary filtration. Examples: milk, smoke, butter.

### 4(i). A cake recipe uses 75 g sugar, 420 g all-purpose flour and 5 g sodium hydrogencarbonate. Express the concentration of each component in the mixture using an appropriate method.

**Total mass = 75 + 420 + 5 = 500 g.**
Mass by mass percentage = (mass of component / total mass) × 100.
**Sugar:** (75/500)×100 = **15% m/m**.
**All-purpose flour:** (420/500)×100 = **84% m/m**.
**Sodium hydrogencarbonate:** (5/500)×100 = **1% m/m**.

> **Exam Tip:** For separation questions, always state both the *method* and the *property* that makes the method suitable. For concentration numericals, write the formula before substitution.

### 4(ii). A brass alloy contains 70% copper by mass. Calculate the quantities of copper and zinc present in 120 g of brass.

**Copper = 70% of 120 g = (70/100)×120 = 84 g.**
Brass contains only copper and zinc here, so **zinc = 120** – **84 = 36 g**.

### 5. Cooking oil has a density of about 0.91 g $mL^{-1}$. If one litre of oil (910 g) is mixed with water, will it form a separate layer? Which substance is on top? How will you separate the layers?

**Answer: Yes.** Oil and water are immiscible and form separate layers. Since the oil density (0.91 g $mL^{-1}$) is less than that of water, **oil forms the upper layer** and water the lower layer. Use a **separating funnel**: allow the layers to settle, drain the lower water layer through the stopcock, then collect the oil separately.

### 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.

**Answer: (iii) A is true, but R is false.** Solutions do not show the Tyndall effect because their solute particles are extremely small (less than 1 nm), not because they are larger than 100 nm.

> **Exam Tip:** For separation questions, always state both the *method* and the *property* that makes the method suitable. For concentration numericals, write the formula before substitution.

### 7. How would you separate the following mixtures? Give the reason for selecting each method.

**Mud from muddy water:** Sedimentation followed by decantation; for fine particles, coagulation and/or centrifugation may be used.
**Plasma from other blood components:** Centrifugation, because components have different densities.
**Naphthalene and sand:** Sublimation, because naphthalene sublimes while sand does not.
**Chalk powder and common salt:** Add water to dissolve salt, filter to remove chalk, then evaporate/crystallize the salt from the filtrate.
**Common salt and water:** Evaporation if only salt is required; distillation if both salt and water are to be recovered.
**Oil from water:** Separating funnel, based on immiscibility and density difference.
**Pigments of a flower:** Paper chromatography, based on differences in movement/interactions with the solvent and paper.

### 8. Two miscible liquids A and B have boiling points of 60 °C and 90 °C. Suggest a method to separate them and draw a labelled apparatus.

**Answer: Distillation.** The boiling points differ by 30 °C, which is greater than the chapter's approximate 25 °C criterion for simple distillation. Heat the mixture; the lower-boiling liquid A vaporises first, passes into the condenser, cools and is collected as the distillate. B remains in the distillation flask.
**Labels:** distillation flask, thermometer, condenser, water inlet, water outlet, burner and receiving flask.

### 9. Compare evaporation, crystallization and distillation. When would you prefer each?

**Evaporation:** Used to obtain a dissolved solid by removing the solvent. Prefer it when recovery of the solvent is not required, e.g. obtaining salt from salt solution.
**Crystallization:** Used to obtain/purify a solid as crystals from a saturated solution, especially when purity and crystal formation are important.
**Distillation:** Used to recover a liquid from a solution or separate miscible liquids with sufficiently different boiling points. Prefer it when the solvent/liquid also needs to be recovered.

> **Exam Tip:** For separation questions, always state both the *method* and the *property* that makes the method suitable. For concentration numericals, write the formula before substitution.

### 10. Blood is a colloidal mixture. (i) What would happen if blood behaved like a true suspension inside the body? (ii) Identify the dispersed phase and dispersion medium.

**(i)** If blood behaved as a true suspension, its larger particles would tend to settle under gravity, making blood non-uniform and interfering with normal transport through the body.
**(ii)** The cellular components/particles are the **dispersed phase**, while the liquid plasma is the **dispersion medium**.

### 11. A mixture contains sand, common salt and naphthalene. Identify the correct sequence of separation techniques.

**Answer: 1. Sublimation → 2. Dissolution in water and filtration → 3. Evaporation/crystallization.**
First, heat the mixture to sublime naphthalene, leaving sand and salt. Add water so that salt dissolves while sand remains insoluble; filter to separate sand. Finally, evaporate/crystallize the filtrate to recover common salt.

### 12. Why is distillation an effective method for separating water and acetone?

**Answer:** Water and acetone are miscible liquids, but their boiling points are sufficiently different: acetone boils at about **56 °C** and water at about **100 °C**. On heating, acetone vaporises preferentially; its vapour is condensed and collected. Thus the liquids can be separated by distillation.

### 13(i). What mass of potassium nitrate is needed to prepare a saturated solution in 50 g water at 40 °C?

**Given:** Solubility of KNO■ at 40 °C = 62 g per 100 g water.
For 50 g water: mass required = (62/100)×50 = **31 g**.
**Answer: 31 g of potassium nitrate.**

> **Exam Tip:** For separation questions, always state both the *method* and the *property* that makes the method suitable. For concentration numericals, write the formula before substitution.

### 13(ii). A saturated KCl solution is prepared at 80 °C and cooled to 25 °C. What will be observed?

**Answer:** At 80 °C, KCl solubility is 54 g per 100 g water. At 25 °C it is between the 20 °C and 30 °C values (35 and 37.4 g per 100 g water), so the solubility decreases substantially on cooling. Therefore, **some KCl will crystallize/deposit out** as the solution cools.

### 13(iii). What is the effect of temperature on the solubility of the four salts? Compare their changes from 10 °C to 80 °C.

**Answer:** The solubility of all four listed salts increases as temperature rises from 10 °C to 80 °C, but by different amounts.
**KNO■:** 21 → 167 g/100 g water, increase = **146 g**.
**NaCl:** 36 → 37, increase = **1 g**.
**KCl:** 35 → 54, increase = **19 g**.
**NH■Cl:** 24 → 66, increase = **42 g**.
Thus, **KNO■ shows the greatest increase**, followed by NH■Cl, KCl and NaCl.

### 14(i). Three students prepare sugar solutions: A dissolves 20 g sugar in 80 g water; B dissolves 20 g sugar in 100 g water; C dissolves 30 g sugar in 80 g water. Calculate % m/m sugar.

**Student A:** Total mass = 100 g; % m/m = (20/100)×100 = **20%**.
**Student B:** Total mass = 120 g; % m/m = (20/120)×100 = **16.67%**.
**Student C:** Total mass = 110 g; % m/m = (30/110)×100 = **27.27%**.

### 14(ii). Whose solution is the most concentrated? Explain.

**Answer: Student C.** Concentration is compared using mass percentage. Student C has **27.27% m/m**, which is greater than Student A's 20% and Student B's 16.67%. Therefore, C's solution is the most concentrated.

# QUICK REVISION — CHAPTER 5

### High-priority concepts, formulas and separation methods

**Mixtures:** Homogeneous mixtures have uniform composition; heterogeneous mixtures are non-uniform. Solutions are homogeneous. Suspensions and colloids contain dispersed particles with different sizes and behaviours.

**Concentration:** % m/m = (mass of solute / mass of solution) × 100. % m/v = (mass of solute / volume of solution) × 100. % v/v = (volume of solute / volume of solution) × 100.

**Particle size:** Solution < 1 nm • Colloid 1–1000 nm • Suspension > 1000 nm. Suspensions settle and can be separated by filtration. Colloids do not settle and show the Tyndall effect.

**Separation methods:** Crystallization → pure solid crystals from saturated solution. Distillation → miscible liquids with sufficiently different boiling points or liquid from dissolved solid. Paper chromatography → components with different movement rates. Separating funnel → immiscible liquids. Sublimation → sublimable solid from non-sublimable material. Centrifugation → heavier particles from a suspension. Coagulation → fine suspended particles clump and settle.

**Solubility:** Maximum amount of solute that dissolves in a fixed quantity of solvent at a given temperature. For the salts in the chapter's table, solubility generally increases with temperature, with $KNO_3$ showing the largest increase from 10 °C to 80 °C.

**Tyndall effect:** Scattering of light by dispersed particles. It is seen in colloids and suspensions but not in transparent true solutions.

**Key numerical answers:** Q4(i) 15%, 84%, 1% • Q4(ii) 84 g Cu, 36 g Zn • Q13(i) 31 g $KNO_3$ • Q14(i) A = 20%, B = 16.67%, C = 27.27% • Q14(ii) Student C.