

Class – IX (Science)

Chapter – Exploring Mixtures and their Separation

Back Exercise Solution

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

(i) Air — Hm, Milk — Ht, Sugar solution — Hm, Smoke — Hm

(ii) Brass — Ht, Fog — Ht, Vinegar — Ht, Muddy water — Hm

(iii) Copper sulfate solution — Hm, Salt solution — Hm, Milk — Hm, Bronze — Hm

(iv) Muddy water — Ht, Milk — Ht, Blood — Ht, Brass — Hm

Solution:

Correct option: (iv) Muddy water - Ht, Milk - Ht, Blood - Ht, Brass - Hm.

Mixture	Correct class	Reason
Muddy water	Heterogeneous	Suspended mud particles are not uniformly distributed and may settle on standing.
Milk	Heterogeneous colloid	Fat/protein droplets are dispersed in water; it looks uniform but is microscopically heterogeneous.
Blood	Heterogeneous colloid/suspension-like mixture	Cells and plasma components are dispersed in a liquid medium.
Brass	Homogeneous	Brass is a solid solution alloy of copper and zinc.

2. Choose the correct options, and explain the reason for the correct and incorrect options.

Which among the following mixtures show the Tyndall Effect?

(a) air and dust particles

(b) copper sulfate and water

(c) starch and water

(d) acetone and water

(i) a and b

(ii) b and d

(iii) a and c

(iv) c and d



Solution:

Correct option: (iii) a and c.

Option	Mixture	Shows Tyndall effect?	Reason
a	Air and dust particles	Yes	Dust particles scatter a beam of light, so the path becomes visible.
b	Copper sulphate and water	No	It forms a true solution; particles are too small to scatter light.
c	Starch and water	Yes	Starch in water forms a colloidal mixture and scatters light.
d	Acetone and water	No	They form a homogeneous true solution.

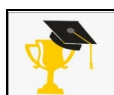
3. A mixture can be categorised as a solution, a suspension, or a colloid, each possessing distinct properties. Utilise the words or phrases provided in the box to fill in Table 5.2. Complete Table 5.2.

Solution:

Solution	Suspension	Colloid
Properties: small-sized particles, less than 1 nm; particles remain evenly distributed; transparent; cannot be separated by filtration.	Properties: large-sized particles, more than 1000 nm; settles down when left undisturbed; separates by filtration; heterogeneous mixture; scatters light.	Properties: moderate-sized particles, 1-1000 nm; particles do not settle down; scatters light; cannot be separated by ordinary filtration; heterogeneous mixture.
Examples: salt solution; brass.	Examples: sand in water; muddy water.	Examples: milk; smoke; butter.

4. Solve the following problems:

(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.

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

Solution:

(i) Total mass of dry mixture = 75 g + 420 g + 5 g = 500 g.

Component	Mass (g)	Mass percentage formula	Answer
Sugar	75	$(75/500) \times 100$	15%
All-purpose flour	420	$(420/500) \times 100$	84%
Sodium hydrogencarbonate	5	$(5/500) \times 100$	1%

Therefore, the cake mixture contains sugar = 15%, flour = 84% and sodium hydrogencarbonate = 1% by mass.

(ii) Brass contains 70% copper by mass. Mass of brass = 120 g.

Copper = $70/100 \times 120 = 84$ g. Zinc = $120 - 84 = 36$ g.

5. The label on a cooking oil pack says one litre (910 g). If this oil is mixed with water, will it form a separate layer? If so, which substance will be on top? How will you separate the two layers? Also, draw the diagram of the apparatus used.

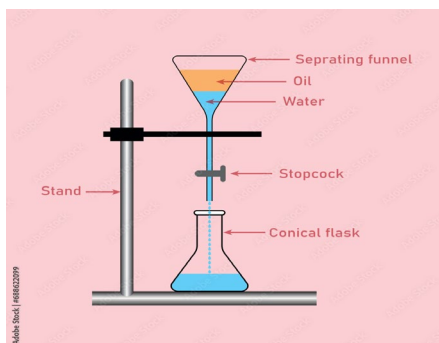
Solution:

One litre of oil has mass 910 g, so its density is 0.91 g/mL. Water has density about 1.00 g/mL. Since oil is less dense and immiscible with water, it forms a separate upper layer while water remains below.

Separation method: separating funnel

- Pour the oil-water mixture into a separating funnel and allow the layers to settle.
- Open the stopcock to drain the lower water layer first.
- Close the stopcock before the oil layer enters the stem, then collect 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.

Choose the correct option:

- (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, but R is false.
- (iv) A is false, but R is true.

Solution:

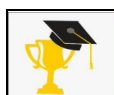
Correct option: (iii) A is true, but R is false.

Assertion is true because true solutions do not show the Tyndall effect. Their solute particles are extremely small and do not scatter a beam of light. Reason is false because particles in true solutions are smaller than 1 nm, not larger than 100 nm.

7. **How would you separate the mixtures given in Table 5.3? Mention the reason for choosing your method. If a mixture cannot be separated, explain why.**

Solution:

Mixture	Method of separation	Reason for selection
Mud from muddy water	Sedimentation followed by decantation or filtration	Mud is insoluble and heavier than water; it settles or is retained on filter paper.
Plasma from other components in blood sample	Centrifugation	Components of blood have different densities; fast spinning separates plasma from cells.
Naphthalene and sand	Sublimation	Naphthalene sublimes on heating; sand does not sublime.
Chalk powder and common salt	Dissolution in water, filtration, then evaporation/crystallization	Salt dissolves in water; chalk is insoluble and remains as residue.



Common salt and water	Evaporation/crystallization; distillation if water is also required	Salt is non-volatile whereas water evaporates.
Oil from water	Separating funnel/decantation	Oil and water are immiscible and have different densities.
Pigments of the flower	Paper chromatography	Different pigments have different solubilities and rates of movement on paper.

8. Two miscible liquids, A and B, are present in a mixture. The boiling point of A is 60°C and the boiling point of B is 90°C. Suggest a method to separate them. Also, draw a labelled diagram of the method suggested.

Solution:

Suggested method simple distillation. Liquid A boils at 60 deg C and liquid B boils at 90 deg C. The boiling point difference is 30 deg C, which is sufficient for simple distillation in school-level separation.

Labelled diagram to draw

- Distillation flask containing A + B.
- Thermometer at the mouth of the flask.
- Liebig condenser with water inlet and outlet.
- Receiver to collect the more volatile liquid A first.

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

Basis	Evaporation	Crystallization	Distillation
Principle	Solvent changes into vapour from the surface.	Solubility decreases on cooling or on concentrating a hot saturated solution.	Liquid vapourises and then condenses back to liquid.
Main use	To obtain dissolved solids quickly.	To obtain pure crystals of a solid.	To separate a liquid from a solution or separate miscible liquids with different boiling points.
Product obtained	Usually solid residue; solvent is lost.	Pure crystalline solid.	Distillate liquid is collected; residue remains in flask.



Preferred when	Solvent need not recover, e.g., salt from salt water.	Solid decomposes strong heating or pure crystals are needed, e.g., copper sulphate crystals.	Solvent must be recovered or liquids have sufficiently different boiling points, e.g., acetone and water.
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10. 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.

Solution :

(i) If blood behaved like a true suspension, the heavier blood cells would settle down quickly on standing, forming a sediment at the bottom and leaving clearer liquid above. It would not remain uniformly dispersed for long.

(ii) In a blood sample, the dispersed phase is mainly blood cells and colloidal plasma proteins. The dispersion medium is plasma, which is the liquid part of blood.

11. You are given a mixture of sand, common salt and naphthalene. The figure depicts various steps used to separate the components of this mixture. Identify and write down the correct sequence of separation techniques.



Fig. 5.25: (a)



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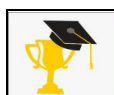
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Fig. 5.25: (b)

Solution:

Correct sequence of techniques: Sublimation -> Dissolution in water -> Filtration -> Evaporation/crystallization.

Step	Figure/technique	What happens
1	Fig. 5.25(b)-1: Sublimation	Naphthalene sublimates and is collected on the cooler surface of the inverted funnel. Sand and salt remain.



2	Add water to residue	Common salt dissolves in water; sand remains insoluble.
3	Fig. 5.25(b)-3: Filtration	Sand is collected as residue on filter paper; salt solution passes as filtrate.
4	Fig. 5.25(b)-2: Evaporation	Water evaporates and common salt is obtained as residue/crystals.

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

Solution:

Water and acetone are miscible liquids, but their boiling points are very different: acetone boils at about 56 deg C and water at 100 deg C. On heating, acetone vapourises first. Its vapours pass through the condenser and change back into liquid acetone. Water remains mostly in the flask. This makes distillation effective.

13. Answer the following questions with the help of the data given in Table 5.4.

(i) What mass of potassium nitrate would be needed to prepare its saturated solution in 50 g of water at 40°C?

(ii) A student makes a saturated solution of potassium chloride in water at 80°C and leaves the solution to cool at room temperature (25°C). What would she observe as the solution cools? Explain.

(iii) What is the effect of a change in temperature on the solubility of salts?

(i) At 40 deg C, potassium nitrate has solubility 62 g per 100 g water. For 50 g water, mass required = $62/100 \times 50 = 31$ g. Therefore, 31 g of potassium nitrate is needed.

(ii) At 80 deg C, potassium chloride solubility = 54 g per 100 g water. At about 25 deg C, its solubility is approximately 36 g per 100 g water. Therefore, about $54 - 36 = 18$ g of potassium chloride crystallizes out per 100 g water. The student will observe crystals separating as the solution cools.

(iii) Solubility generally increases with increase in temperature. The increase from 10 deg C to 80 deg C is:

Salt	Solubility at 10 deg C	Solubility at 80 deg C	Increase	Conclusion
Potassium nitrate	21	167	146	Maximum increase; very



				temperature sensitive.
Sodium chloride	36	37	1	Very small change.
Potassium chloride	35	54	19	Moderate increase.
Ammonium chloride	24	66	42	Large increase.

14. Three students, A, B and C, are preparing sugar solutions for an experiment.

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.

(i) Calculate the mass percentage (% m/m) concentration of sugar in each student's solution.

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

Solution:

Student	Sugar (g)	Water (g)	Total solution (g)	Mass percent = solute/solution x 100
A	20	80	100	$20/100 \times 100 = 20\%$
B	20	100	120	$20/120 \times 100 = 16.67\%$
C	30	80	110	$30/110 \times 100 = 27.27\%$

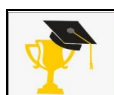
(ii) Student C has the most concentrated solution because it has the highest mass percentage of sugar, 27.27%.

15. Examine Fig. 5.26.

(i) Identify the separation technique marked as 'S'.

(ii) Label the apparatus A, B and C.

(iii) Which mixtures can be separated by the technique identified above?



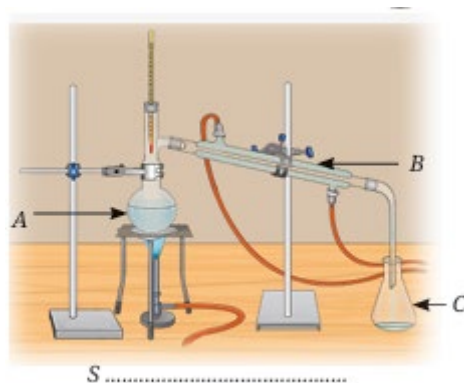


Fig. 5.26

Boiling points of some compounds Solvent Water, Acetone, Alcohol, Chloroform, Benzene Temperature (°C) 100 °C, 56 °C, 78 °C, 61 °C, 80 °C respectively

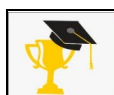
Solution:

(i) The technique marked S is simple distillation.

(ii) Apparatus labels: A = distillation flask/round-bottom flask; B = Liebig condenser; C = receiver/conical flask for collecting distillate.

(iii) Simple distillation is suitable when a volatile liquid can be separated from a non-volatile solute, or when two miscible liquids have a large boiling point difference, generally about 25 deg C or more.

Mixture	Can be separated by simple distillation?	Reason
Water - acetone	Yes	Boiling points are 100 deg C and 56 deg C; difference = 44 deg C. Acetone distils first.
Water - salt	Yes	Water is volatile and salt is non-volatile; water distils, salt remains.
Acetone - alcohol	No; fractional distillation is better	Boiling points 56 deg C and 78 deg C; difference = 22 deg C, too close for simple distillation.
Sand - salt	No, not directly	Both are solid; use dissolution, filtration and evaporation instead.
Alcohol - chloroform	No; fractional distillation is better	Boiling points 78 deg C and 61 deg C; difference = 17 deg C.



Alcohol - benzene	No	Boiling points 78 deg C and 80 deg C; difference = only 2 deg C.
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Final Revision Points

- True solutions: particles below 1 nm; no Tyndall effect; cannot be separated by filtration.
- Suspensions: large particles; settle on standing; can be filtered.
- Colloids: intermediate particles; show Tyndall effect; do not settle easily.
- Choose separation method by checking solubility, density, particle size, volatility and boiling point difference.

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