

Worksheet 03: Mixtures Separation and Purification

Trimester school assessment - IB-style practice with SL and HL questions | Time: 50 minutes | Total: 40 marks

Name:	Class:	Date:	Total: 40 marks
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Focus: Selecting separation techniques using solubility, boiling point, magnetism, filtration, evaporation, crystallization and chromatography.

Instructions: Answer all questions. Show working where relevant. HL questions are marked with [HL]. For extended responses, use clear scientific language and link particle-level explanations to observable properties.

Section A - Multiple choice (8 marks)

Choose the best answer, A, B, C or D. Each question is worth 1 mark.

- Which method separates a solid residue from a liquid filtrate?
A. filtration
B. distillation
C. paper chromatography
D. sublimation
- Which property is used to separate water from salt water by distillation?
A. magnetism
B. boiling point
C. colour
D. particle size only
- In filtration, the liquid that passes through the filter paper is called the
A. residue
B. filtrate
C. solvent front
D. solute
- Which mixture is best separated using a magnet?
A. ethanol and water
B. salt and water
C. iron filings and sand
D. food dyes
- Which technique can show that a green dye contains several coloured pigments?
A. evaporation
B. paper chromatography
C. sedimentation
D. freezing
- What is recrystallization commonly used to improve?
A. purity of a solid
B. magnetism of a solid
C. gas pressure
D. state symbols
- Which factor should be considered when choosing a separation method?
A. only the colour of the mixture
B. a difference in physical properties of components
C. whether the sample is expensive
D. whether all substances are elements
- [HL] A high-yield purification method may still be unsuitable if
A. it gives a very impure product
B. it uses physical properties
C. the mixture is homogeneous
D. a filter is involved

Section B - Short answer (12 marks)

- Describe how to obtain dry salt crystals from a mixture of sand and salt. (4)

10. Distinguish between evaporation and distillation as methods for separating salt water. (4)

11. In chromatography, explain why different pigments move different distances up the paper. (2)

[HL] 12. Explain the trade-off between yield and purity when purifying a product from a reaction mixture. (2)

Section C - Data response / case study (10 marks)

13. A student tests four solids using water and ethanol.

Solid	Solubility in water	Solubility in ethanol	Magnetic?
A	insoluble	insoluble	yes
B	soluble	insoluble	no
C	insoluble	soluble	no
D	soluble	soluble	no

(a) Which solid could be separated from a mixture by using a magnet? (1)

(b) A mixture contains B and C. Describe how to separate them using water. (3)

(c) Which pair would be difficult to separate by solvation and filtration using either water or ethanol? Explain. (3)

(d) [HL] Design a sequence to separate A, B and C from one mixture and obtain each as a dry solid. (3)

Section D - Extended response (10 marks)

14. A reaction produces an insoluble solid product mixed with excess soluble reactants. Propose a purification method and explain the purpose of each step. Include how you would check that the product is reasonably pure. (10)

Answer Key and Marking Guidance - Worksheet 03

General marking guidance: Award marks for chemically correct answers expressed in equivalent wording. Do not award a mark twice for the same idea. For calculations, allow error carried forward if the method is correct. HL marking points may be used as extension credit where appropriate.

Section A: 1 A; 2 B; 3 B; 4 C; 5 B; 6 A; 7 B; 8 A

Section B: 9. Add water to dissolve salt (1); filter to remove sand as residue (1); collect salt solution as filtrate (1); evaporate water and dry crystals (1). 10. Evaporation leaves salt behind and does not collect pure water (2); distillation boils water, condenses vapour and collects pure water while salt remains (2). 11. Pigments have different attractions to the paper/stationary phase and solvent/mobile phase (2). 12. Extra purification steps may remove impurities but can also lose some product; maximizing yield can leave more impurities (2).

Section C: 13(a) A (1). (b) Add water so B dissolves while C remains solid (1); filter to collect C as residue (1); evaporate filtrate to obtain B (1). (c) B and D in water, or C and D in ethanol, because both substances are soluble so filtration will not separate them after dissolving (3). Accept other justified pair based on the table. (d) Use magnet to remove A (1); add water to remaining B and C, filter to collect C (1); evaporate water from filtrate to obtain B, then dry all solids (1).

Section D: Award up to 10 marks. Suggested method: filter reaction mixture to collect insoluble solid (2), wash residue with suitable solvent/water to remove soluble reactants (2), dry carefully (1), recrystallize if product is soluble in hot solvent and less soluble in cold (2), check purity by sharp melting point/chromatography/constant mass where appropriate (2), include safety and loss-of-product awareness (1).