

BioMedical Admissions Test (BMAT)

Section 2: Chemistry

Questions by Topic

C8 - Separation Techniques II

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C8: Separation Techniques II - Question by Topic

(Mark Scheme and explanations at the end)

- 1 Sodium sulfate, magnesium nitrate, lead sulfate, calcium carbonate and silver chloride are mixed with water.

Which of these salts **cannot** be extracted using a simple filtration method?

- A Sodium sulfate and magnesium nitrate
- B Sodium sulfate and lead sulfate
- C Calcium carbonate and silver chloride
- D Calcium carbonate and magnesium nitrate
- E Lead sulfate only

- 2 A student wishes to separate a mixture of sodium chloride, solid calcium carbonate and vegetable oil.

What is the best method to perform this separation?

- A Filter through filter paper, distill, and add isopropyl alcohol.
- B Filter through filter paper, add isopropyl alcohol, distill and distill/boil solutions again.
- C Filter through filter paper, add water to dissolve vegetable oil, and distill.
- D Filter through filter paper, distill, distill/boil solutions again and add isopropyl alcohol.
- E Distill mixture until separated.

- 3 Which of the following physical methods is not used to separate a solid from a liquid?

- A Decanting
- B Separating funnel
- C Centrifugation
- D Filtration
- E None of the above



4 Which of the following methods could be used to separate a mixture of ethanol and water?

- A** Separating funnel
- B** Centrifugation
- C** Fractional distillation
- D** Crystallisation
- E** Chromatography

5 Below are 3 statements about separation.

- 1** Centrifugation is only used to separate solids from liquids
- 2** The liquid in the beaker following filtration is known as the filtrate.
- 3** A solvent is the liquid in which something is dissolved.

Which of these are correct?

- A** 1 only
- B** 2 only
- C** 3 only
- D** 1 and 2
- E** 1 and 3
- F** 2 and 3
- G** All of the above
- H** None of the above





6 Below are three statements about chromatography.

- 1 The solvent front is a measure of how far the sample has travelled.
- 2 Chromatography is used to split mixtures based upon their affinity to the stationary phase in comparison to the affinity to the mobile phase.
- 3 The R_f value is a measure of only how far the sample has travelled.

Which of the above statements are correct?

- A 1 only
- B 2 only
- C 3 only
- D 1 and 2
- E 1 and 3
- F 2 and 3
- G All of the above
- H None of the above

7 Which of the following statements about testing for purity is incorrect?

- A R_f values are constant for the same solvent and substance combination across different chromatograms.
- B An impurity in a liquid will increase its boiling point.
- C Pure substances melt over a temperature range.
- D Impure substances melt over a temperature range.

8 Which of the following steps in the process of crystallisation is correct?

- A Heat until crystals begin to form at the centre of the solution.
- B Heat until the mass of the evaporating basin and solid is constant (and thus dry).
- C Once crystals have begun to form, leave until the remaining water has evaporated.
- D Collect the liquid which evaporates using distillation equipment.





9 Which line of the table correctly labels the diagram?

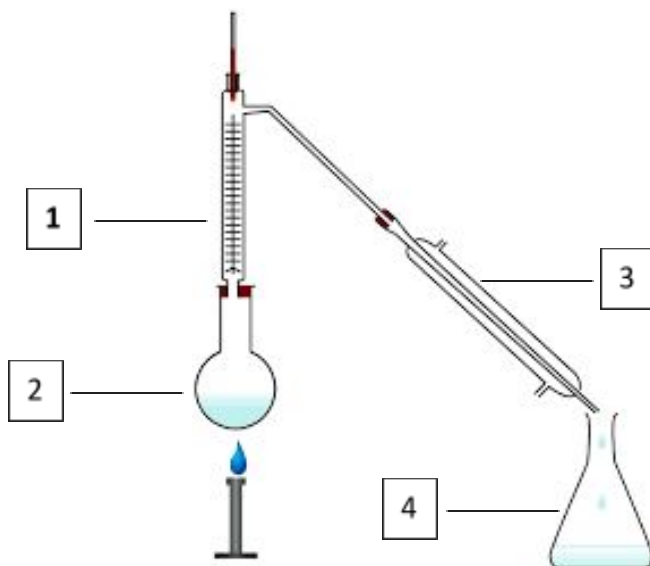
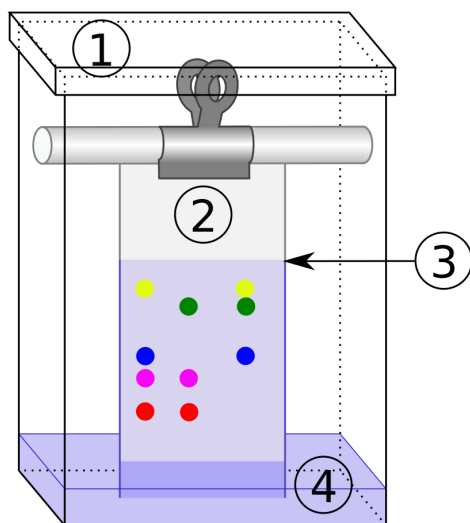


Diagram from [wikicommons](https://commons.wikimedia.org/wiki/File:Distillation_apparatus.png). Labelled for re-use.

	1	2	3	4
A	Fractionating column	Conical flask	Condenser	Round bottom flask
B	Distillation column	Condenser	Round bottom flask	Test tube
C	Distillation column	Round bottom flask	Condenser	Conical flask
D	Fractionating column	Round bottom flask	Condenser	Conical flask
E	Fractionating column	Test tube	Condenser	Round bottom flask



10 Which line of the table correctly labels the diagram?



Used from [wikicommons](https://commons.wikimedia.org/wiki/File:Thin-layer_chromatography_plate.jpg): Labelled for reuse.

	1	2	3	4
A	Lid	Stationary phase	Solvent front	Solvent
B	Lid	Mobile phase	R _f value	Stationary phase
C	Lid	Stationary Phase	Solute	Solvent
D	Lid	Solvent	Solvent front	Stationary phase
E	Lid	Solvent front	Solvent	Mobile phase





Answers and Explanations

1 The answer is A

Common sulfates, nitrates and chlorides are always soluble in water. However, carbonates, lead compounds and carbonates are always insoluble in water. Only the insoluble compounds in the list can be extracted using simple filtration.

2 The answer is D

The correct procedure is to filter the solid product (calcium carbonate) first, then proceed to deal with the other products. Vegetable oil is not soluble in water, but it is soluble in alcohol. At this point, the sodium chloride will be dissolved in the water and the oil in the alcohol. To separate these two solutions, a first distillation is required. A second distillation, or simple boiling, of each resultant solution will leave you with vegetable oil and sodium chloride. Extreme caution should be practiced here, as the vegetable oil will burn if exposed directly to a flame.

3 The answer is B

This is a simple recall question – a separating funnel is used when separating two immiscible liquids (unmixed e.g. water and oil) rather than a solid from a liquid.

4 The answer is C

This question requires the understanding that ethanol and water are two miscible (well-mixed) liquids and as such will need to be separated based on their differing physical properties. Ethanol has a lower boiling point (~78°C) than water (100°C) and so will boil at different times. The mixture should be heated up to 78 °C and the liquid which boils distilled and collected. This is your ethanol.

5 The answer is F

Centrifugation can also be used to separate gases from a mixture based on the weight of their particles though the main use is separating solids from liquids. The filtrate is the liquid in the beaker and the solid left in the filter paper is known as the residue. A solvent is a liquid in which something is dissolved with the thing dissolved known as the solute.





6 **The answer is B**

The solvent front, as the name suggests, is the distance that the solvent has travelled rather than that of the sample being tested. Statement two is correct as this is the main principle underpinning chromatography – the idea that different aspects of the sample will separate differently as a result of this property of affinity for a solvent and stationary phase (typically paper). Statement three is incorrect because the equation for R_f is:

$$R_f = \frac{\text{distance travelled by sample}}{\text{distance travelled by solvent}}$$

Thus, it is not just the distance the sample has travelled but also the distance travelled by the solvent.

7 **The answer is C**

This is because pure substances have a clear, sharp melting point. In contrast, the various impurities in an impure sample will each have their own melting points and as such the substance will melt over a temperature range. A is correct based on factual recall – R_f values are a constant. B is correct because the presence of impurities does increase boiling point – again a point to learn and recall.

8 **The answer is C**

- A is incorrect – you heat until crystals begin to form at the **edge** of the solution.
- B is incorrect – you don't heat until it is dry as this could lead some solids to decompose rather than crystallise.
- C **is correct.**
- D is incorrect – crystallisation is used when the solid is desired but the liquid is not.





9 **The answer is C**

The set-up is as follows:

- 1 – Fractionating column
- 2 – Round bottom flask
- 3 – Condenser
- 4 – Conical flask.

Distillation column is made up and a test tube is not present in the diagram.

10 **The answer is A**

The correct labels are as follows:

- 1 – lid.
- 2 – Stationary phase
- 3 – solvent front
- 4 – solvent/mobile phase (the two are synonymous)

R_f value is a value calculated from a chromatography experiment using the equation below rather than something which can be labelled on a diagram.

$$R_f = \frac{\text{distance travelled by sample}}{\text{distance travelled by solvent}}$$

