

Name:

Target Grade:

Actual Grade:



SEPARATIONS TECHNIQUES MCQ and STRUCTURED QUESTIONS

READ THESE INSTRUCTIONS FIRST

INSTRUCTIONS TO CANDIDATES

1. Find a quiet, comfortable spot free place from distractions.
2. Spend one minute on each mark.
3. Time yourself for every single question.
4. Every chapter has their own question types. Ensure that you know the different question type for each chapter.
5. Make a conscientious effort to remember your mistakes, especially in terms of answering techniques. E.g Take a picture for the mistakes that you made, keep it in a photo album, and revise it over and over again.
6. Highlight question types that you tend to keep making mistakes and review them nearing exams.
7. Always review the common questions and question type that you tend to make mistakes nearing exams.
8. During exams, classify the question type and recall what you have learnt, how you need to analyse the questions for the different question type, what you need to take note of and answer with the correct answering techniques!

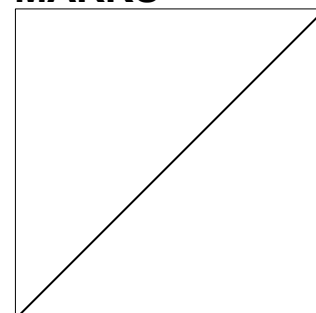
🌟 Wishing you all the best for this test!

You've got this!

💡 With lots of love,
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If you are struggling in this paper, means you need to work harder!

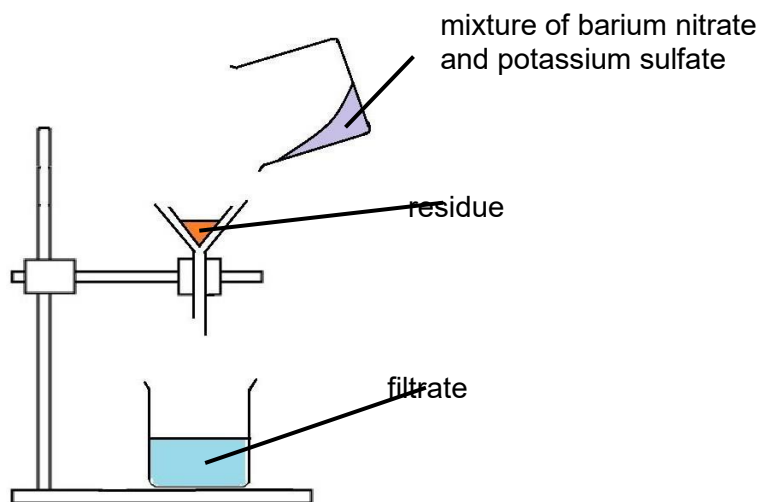
If you need any professional guidance and further advice on how to advance, feel free to WhatsApp us at 91870820 or find us at www.bright-culture.com/. We are committed to connect you to your future to reach your goals.

MARKS

SEPARATION TECHNIQUES MCQ

- 1 Which statement does **not** show that a salt solution is a mixture?
- A Both the salt and the salt solution consist of 2 or more elements.
 - B Salt and water can be mixed in any proportion.
 - C Salt and water can be separated by physical methods.
 - D The salt and water are not chemically combined.
- 2 Which of the following can evaporation to dryness be applied?
- A extraction of iron in a scrapyard
 - B preservation of food such as herbs and spices
 - C production of NEWater
 - D separation of tea leaves from tea
- 3 Which mixture can be separated into its components by magnetic attraction?
- A chalk and mud
 - B mixture of dyes
 - C salt solution
 - D steel and sawdust
- 4 In Singapore, desalination is carried out using reverse osmosis instead of distillation.
- Which of the following is the key reason for this preference?
- A Reverse osmosis does not have any impact on the environment, unlike water distillation.
 - B Reverse osmosis is able to remove microscopic organisms while fractional distillation cannot.
 - C Reverse osmosis is less tedious to carry out than distillation.
 - D Unlike reverse osmosis, distillation requires a lot of energy to heat up a large of volume of water and hence is unsustainable.
- 5 Which of the following explains why crystallisation is used to obtain sugar from sugar solution instead of evaporation to dryness?
- A Sugar decomposes into carbon and water upon prolonged heating.
 - B Sugar obtained by crystallisation has a higher level of purity than the sugar obtained by evaporation to dryness.
 - C The mass of sugar obtained by crystallisation is more than the amount of sugar obtained by evaporation to dryness.
 - D It takes longer to obtain sugar by crystallisation than evaporation to dryness.
-

- 6 A colourless solution of barium nitrate is added to a colourless solution of potassium sulfate. All the barium nitrate and potassium sulfate reacted. The resultant mixture, which consists of a white precipitate (insoluble solid) of barium sulfate suspended in a colourless solution of potassium nitrate, is then filtered.



Which of the following shows the correct residue and filtrate obtained?

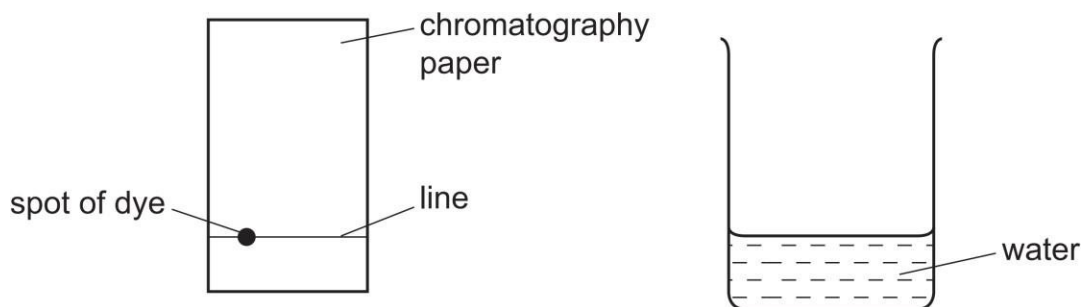
	residue	filtrate
A	barium sulfate	potassium sulfate
B	barium sulfate	potassium nitrate
C	potassium sulfate	barium nitrate
D	potassium nitrate	barium sulfate

- 7 A small spatula of salt was added to 500 cm³ of water and stirred thoroughly.

At which temperature will the solution start to boil?

- A** 96 °C
- B** 98 °C
- C** 100 °C
- D** 102 °C

- 8 A sample of a dye is investigated by chromatography. A line is drawn across a piece of chromatography paper, and a spot of the dye is placed on it. The paper is then placed in water.



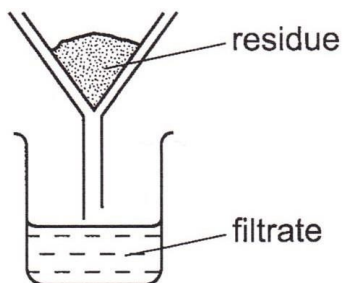
Which option is correct?

	what is used to draw the line	position of spot
A	ink	above the level of the water
B	ink	below the level of the water
C	pencil	above the level of the water
D	pencil	below the level of the water

- 9 The table shows the colours and solubilities in water of four solids.

solid	colour	solubility in water
W	blue	insoluble
X	blue	soluble
Y	white	insoluble
Z	white	soluble

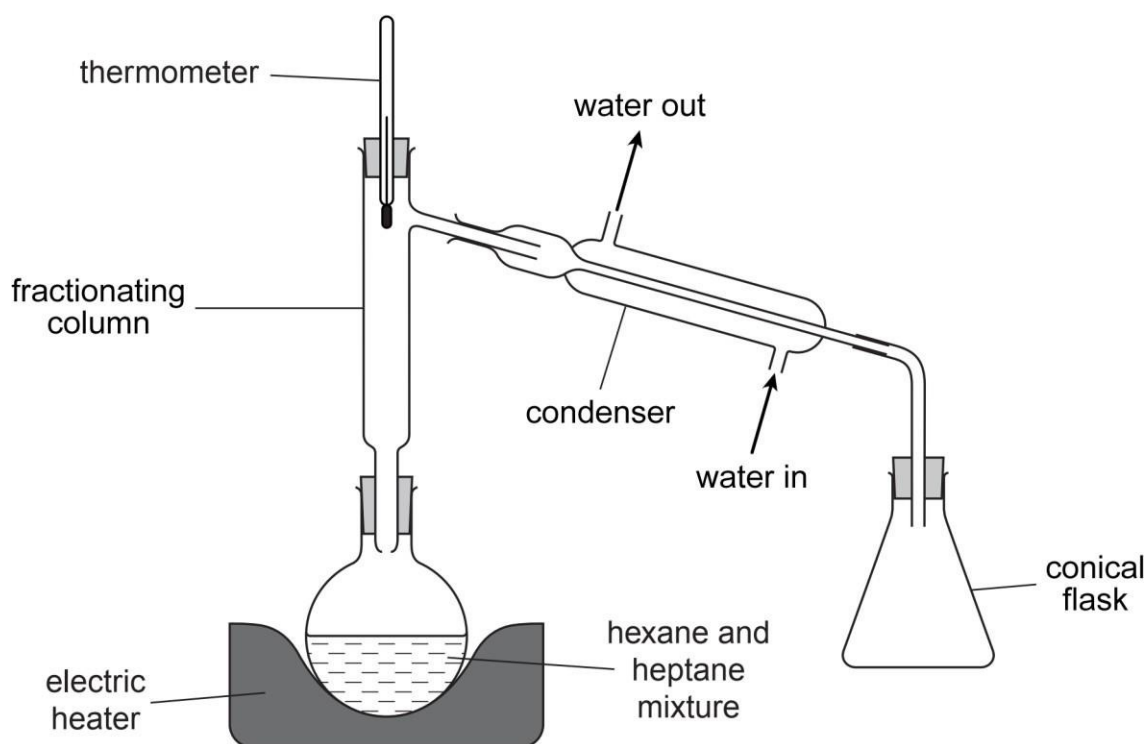
A mixture containing two of the solids is added to excess water, stirred and filtered. A blue filtrate and white residue are obtained.



Which solids are present in the mixture?

- A** W and X **B** W and Y **C** X and Y **D** X and Z

- 10 A student wanted to separate a mixture of hexane and heptane by fractional distillation. They set up the apparatus as shown below.



What **errors** are there in the way that this fractional distillation has been set-up?

- I The water is flowing through the condenser in the wrong direction.
 - II The bulb of the thermometer is in the wrong location.
 - III The fractionating column should be packed with glass beads.
 - IV The top of the conical flask should be left open.
- A** I and III only **B** I and IV only
C II and III only **D** III and IV only

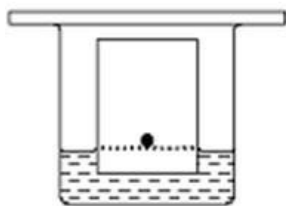
- 11 Which of the following substances is a **liquid** at room temperature (25°C)?

Substance	melting point / °C	boiling point / °C
A	35	79
B	-56	73
C	-134	12
D	-138	1

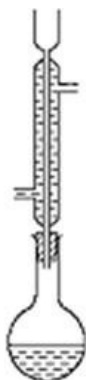
12 An unknown compound **P** is known to have the following properties.

- It is insoluble in water.
- It melts at 10 °C and boils at 134 °C.
- It decomposes on heating.

Which of the following apparatus should be used to obtain pure **P** from a mixture of **P** and water?



A



B



C



D

13 The following steps were carried out to extract water from a solution containing sand and sugar. Which of the following steps is **not** necessary in obtaining pure water?

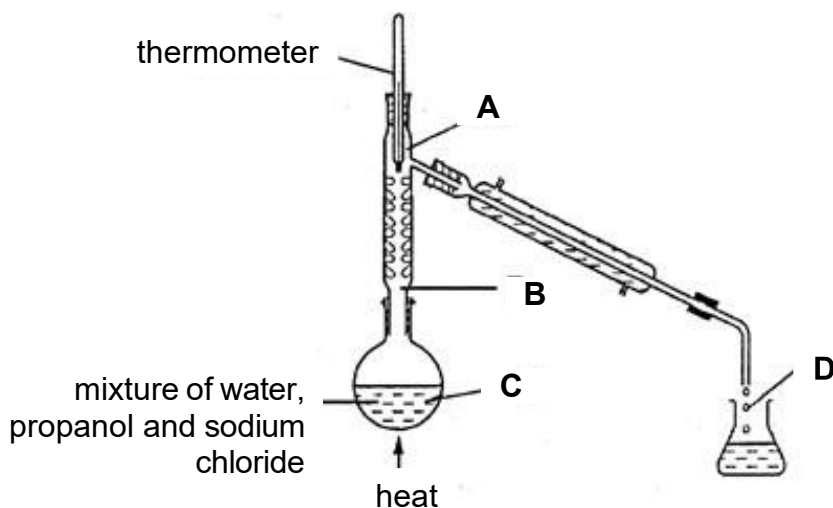
- 1 Pass the mixture through filter paper and filter funnel.
- 2 Dry the residue with pieces of filter paper.
- 3 Heat the filtrate until solution is saturated and cool.
- 4 Heat the solution in a distillation flask and collect the distillate.

A 2 only
C 3 only

B 2 and 3 only
D 2 and 4 only

Refer to the following set-up for Question 8 and 9.

The set-up below shows a mixture of 50 cm³ water, 50 cm³ propanol and some sodium chloride fractionally distilled. Propanol is soluble in water and has a boiling point of 97 °C.



14 At which point will there be a greater proportion of water, when the thermometer first shows a steady reading?

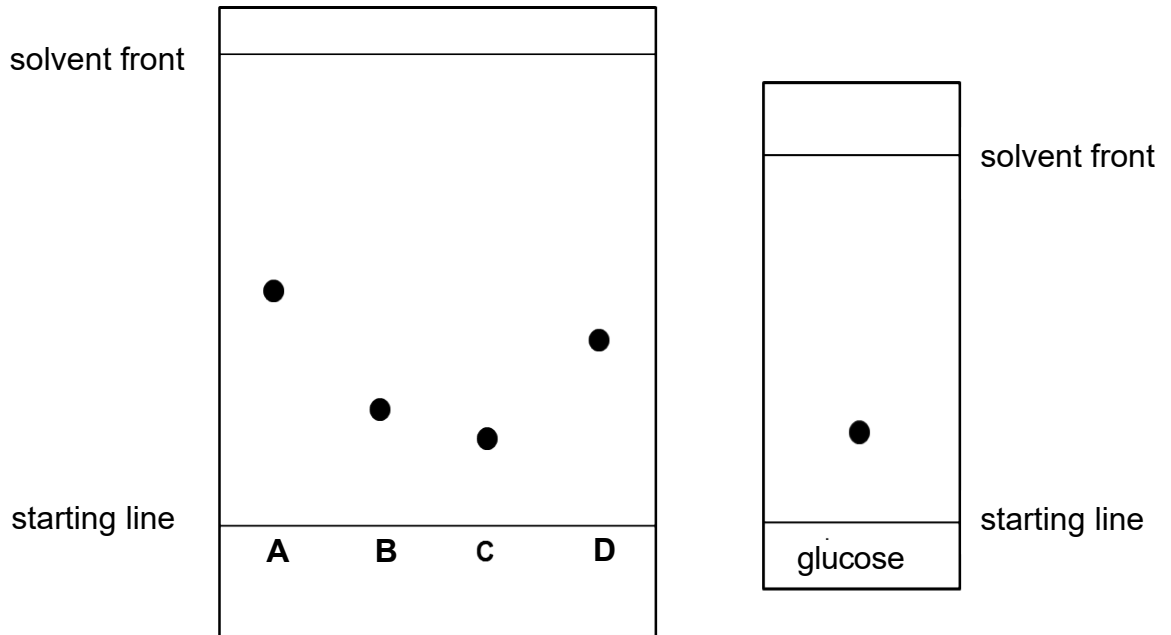
15 What is the temperature shown by the thermometer and what is left in C at the end of distillation?

	thermometer reading/ °C	final contents left in C
A	97	no residue
B	100	white residue
C	103	no residue
D	106	white residue

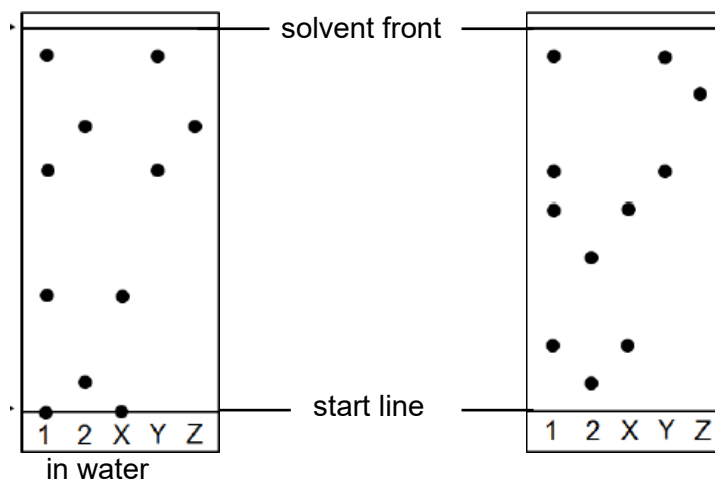
- 16 The diagram below shows two separate chromatograms and both chromatograms used the same solvent.

The chromatogram on the left shows four unknown sugars: **A**, **B**, **C** and **D**. The chromatogram on the right shows glucose.

Which sugar (**A**, **B**, **C** or **D**) is glucose?



- 17 Food dyes **1** and **2** are known to contain one or more of three substances **X**, **Y** and **Z**. Two chromatograms are developed under the same conditions. One used water as the solvent, and the other used ethanol. The results are shown in the diagram below.



Which of the following statement(s) is/are correct?

- 1 There is a component in Dye **1** that is insoluble in water but soluble in ethanol.
- 2 The component in **Z** is more soluble in water than in ethanol.
- 3 Substance **Z** is likely to be pure.

- | | | | |
|----------|----------------------------|----------|----------------------------|
| A | 1 only | B | 2 only |
| C | 1 and 3 only | D | 2 and 3 only |

- 18 In an experiment, white crystalline solid **X** is found to melt at 121.0 °C, the same temperature as the melting point of benzoic acid (white crystalline solid).

To identify the solid, some of it was mixed with pure benzoic acid and the melting point of the mixture was found to be 114.5 °C.

What can be deduced about **X**?

- A** **X** is a mixture.
- B** **X** is a pure compound.
- C** **X** is impure benzoic acid.
- D** **X** is not benzoic acid.

19 Some information about three solids is given below.

solid	solubility in water	solubility in ethanol	action of heat
P	soluble	insoluble	no effect
Q	insoluble	soluble	no effect
R	soluble	soluble	sublimes

Which of the following procedures could be carried out to obtain a pure sample of P from a dry mixture of the three solids?

- A Add ethanol to the mixture, filter and collect the residue.
- B Add water to the mixture, filter and collect the residue.
- C Add ethanol to the mixture, filter and evaporate the filtrate.
- D Heat the mixture and, cool and condense the gas.

20 When a saturated blue solution of copper(II) sulfate is allowed to cool from 85 °C to 10 °C, blue crystals separate out (precipitate) from the solution.

A saturated solution contains the maximum mass of dissolved copper(II) sulfate in the water (at a specific temperature).

Which of the following statement(s) made about crystallisation is/are correct?

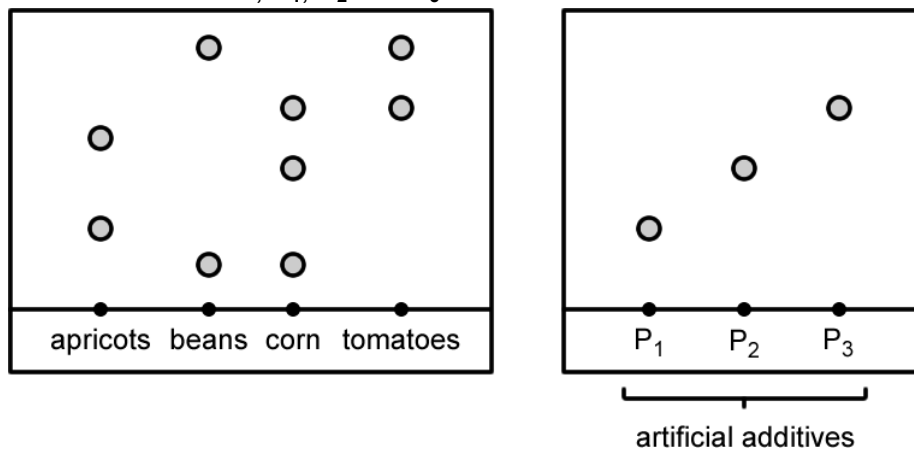
- 1 The mass of the dissolved copper(II) sulfate in the solution remains constant.
- 2 The mass of the dissolved copper(II) sulfate in the solution changes.
- 3 The mass of the solvent (water) in the solution remains the same.
- 4 The solubility of copper(II) sulfate decreases as the temperature falls.

- A 1 only
 - B 1 and 3 only
 - C 2, 3 and 4
 - D 4 only
-

21 Yii Wenn added a small amount of salt to some water that she is going to boil to cook rice. Which one of the following is most likely to be the boiling point of the salt water?

- A 96.0 °C
- B 98.0 °C
- C 100 °C
- D 104 °C

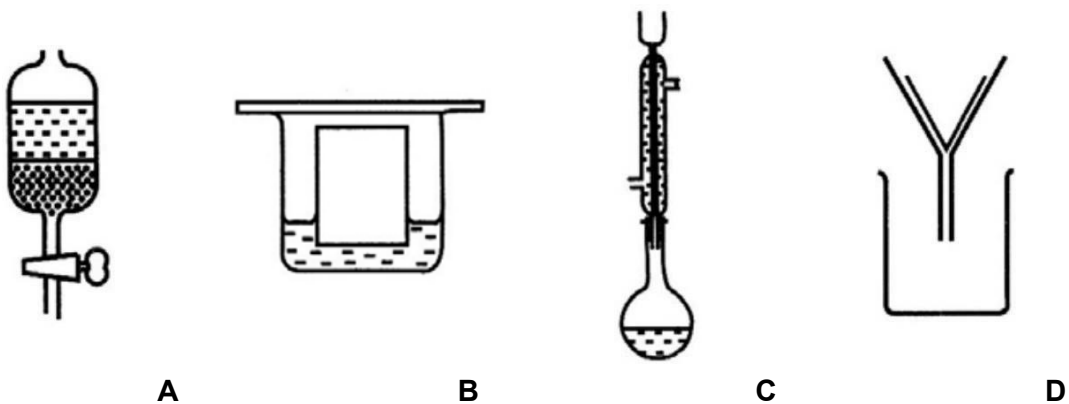
12 Samples of tinned apricots, beans, corn and tomatoes were tested for additives using chromatography. The chromatograms were compared with those of three artificial additives, P₁, P₂ and P₃. The results were as follows.



Which tinned food does **not** contain any artificial additives?

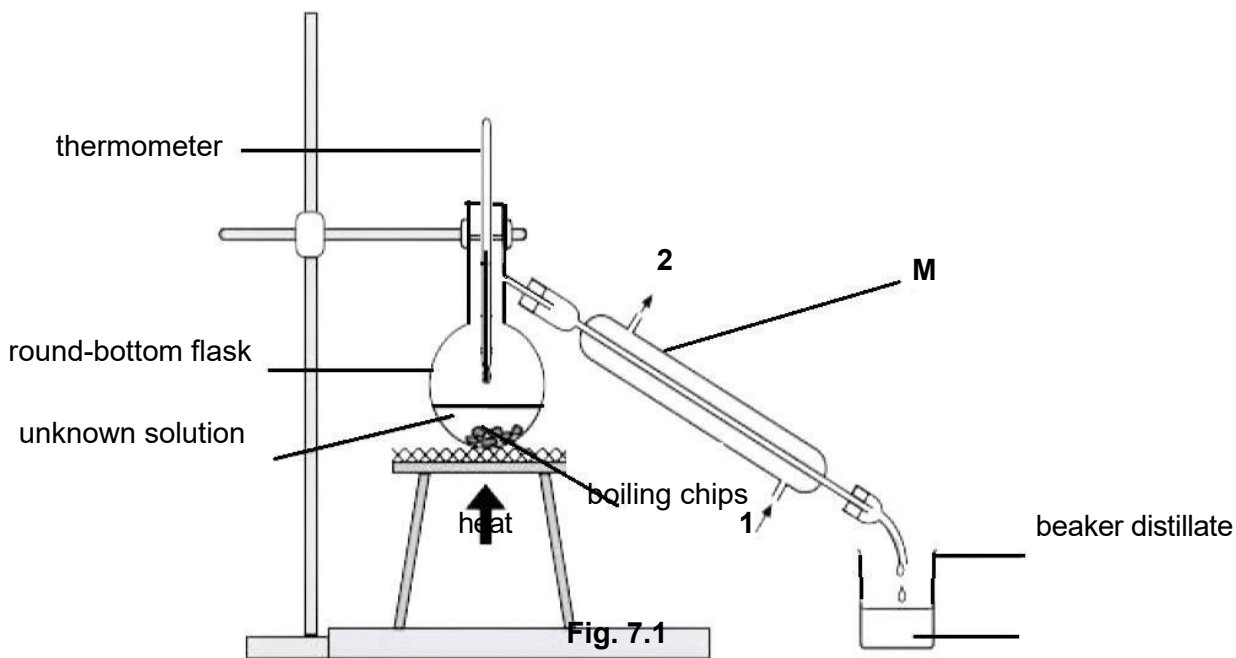
- A apricots
- B beans
- C corn
- D tomatoes

22 Substance X melts at 8 °C and boils at 98 °C. It does not dissolve in water and it does not react with water. Which diagram shows the method **most suitable** for separating X from a mixture of X and water?



SEPARATION TECHNIQUES STRUCTURED QUESTIONS

1 Fig. 7.1 shows the set up used to separate the contents of an unknown solution.



a. State the physical property that allows the constituents of the unknown solution to be separated.

..... [1]

b. Describe the purpose of having cold water enter from position 1 rather than 2 of apparatus M.

.....
 [1]

c. There is an error in the setup. Explain the consequence of this error and suggest how it should be corrected.

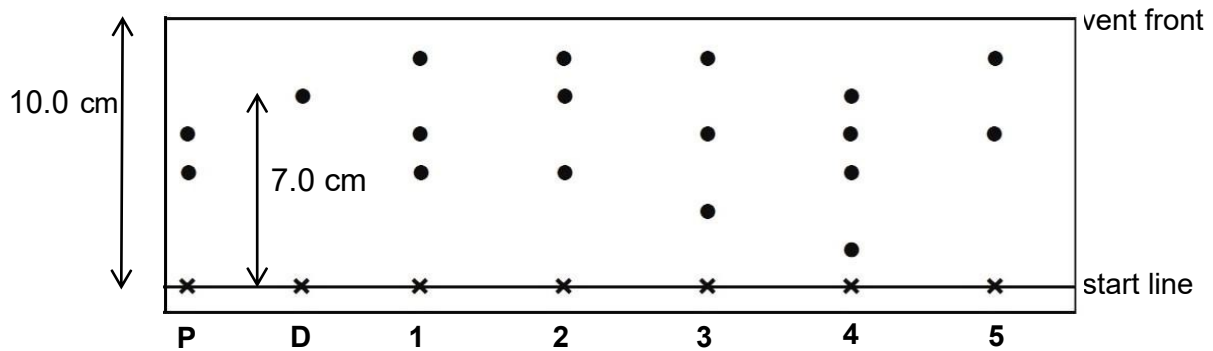
.....

 [2]

d. Suggest an alternative method of separation that can be used if the student only needs to recover the solute, given that it does not decompose upon heating.

..... [1]

2 Five athletes have been suspected of taking banned drugs, pseudoephedrine and darbepoetin, to enhance their performance in the SEA Games. During the investigation, chromatography was conducted on their urine samples to detect whether the banned drugs were present. Fig 8.1 shows the chromatogram for the two drugs and the five urine samples.



Legend:

P	pseudoephedrine
D	darbepoetin
1 to 5	corresponding urine samples of athletes 1 to 5

Fig. 8.1

(a) Describe the function of the locating agent.

[1]

(b) State the R_f value of darbepoetin.

[1]

(c) State the full name of the drug that is an impure substance.

[1]

(d) During the testing process, the urine sample of athlete 3 was accidentally contaminated with one of the other four athletes' urine sample.

Identify the urine sample that contaminated the urine sample of athlete 3.

[1]

(e) Explain why the start line **cannot** be drawn with a pen.

[2]

3 Ephedrine and insulin are both drugs that are banned for use by athletes.

One way that athletes can be tested for banned drugs is by chromatography of their urine samples.

Fig. 5.1 shows a chromatogram for ephedrine and insulin and the urine samples from four athletes.

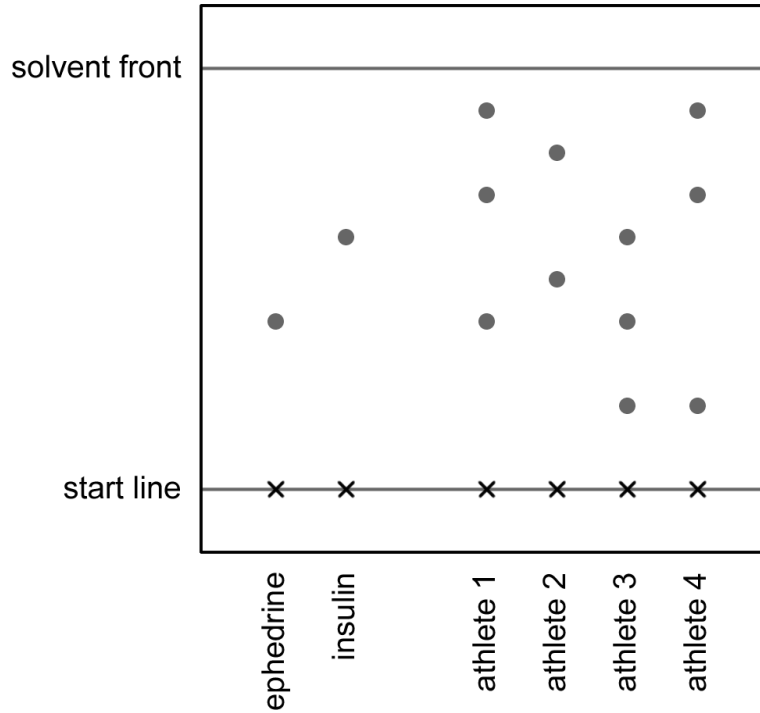


Fig. 5.1

- Describe what the chromatogram shows about the drug(s) use by each of the four athletes. [2]

.....

.....

.....

.....

- The ephedrine, insulin and urine samples are all colourless. Explain how the spots can be seen so that their *R_f* values can be calculated. [1]

.....

.....

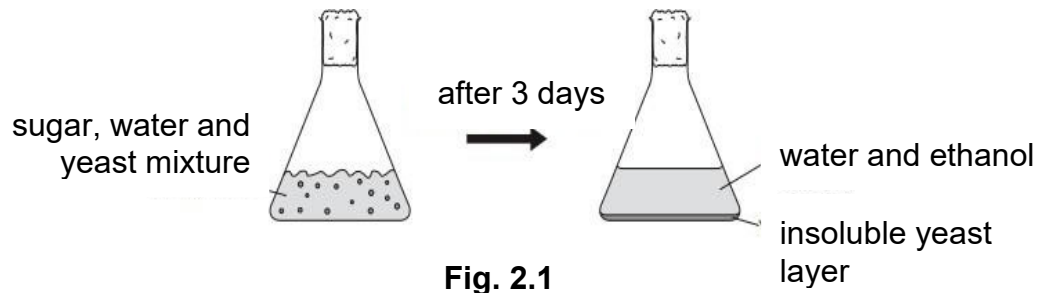
- Calculate the *R_f* value of ephedrine. Show your working. Give your final answer to one decimal place. [1]

R_f value =

[Total = 4 marks]

4 Fig. 2.1 below shows how ethanol is produced by fermentation in the laboratory.

A sugar solution is mixed with yeast and the mixture is kept at a temperature of 37 °C for three days. After three days, a mixture of water, ethanol and yeast is obtained.



- (a) Ethanol has a chemical formula of C_2H_5OH . State the type of elements and the number of atoms per each type of element in ethanol.

[2]

- (b) Describe the method(s) of separation that you will use in the laboratory to obtain a pure sample of ethanol from the mixture produced. [2]

.....

.....

.....

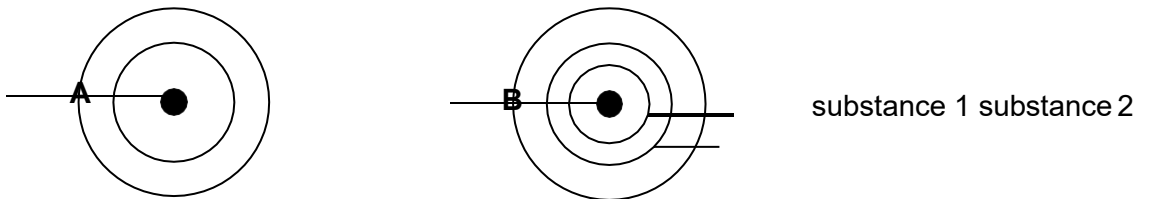
- (c) Describe a test that you would perform to ensure that the ethanol obtained in (a) is pure and the expected observation or results obtained if ethanol is pure. [2]

.....

.....

Total [6]

5 Two black pigments, **A** and **B** were subjected to a paper chromatography separation. In each case, a small amount of the pigment was placed at the centre of a filter paper and allowed to dry. Drops of pure ethanol were slowly added to the centre of the filter papers. After some time, the appearances of the filter papers were shown as below:



- (a) What information does the experiment give about the nature of [2]

(i) pigment **A**?

.....

(ii) pigment **B**?

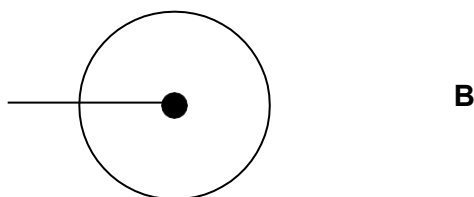
.....

- (b) It was found that substance **2** has an R_f value of 0.60. If the distance moved by the solvent is 0.33 cm, calculate the distance moved by the sample spot.
Show your working clearly and leave your answer in 2 significant figures.

[1]

distance moved by sample:
cm

- (c) A second chromatography was conducted using water instead of ethanol on pigment **B**. The diagram below shows the chromatogram obtained.



Suggest a reason for the results obtained.

[1]

.....

.....

.....

Total [4]

6 Figure 3.1 shows a simple approach by students to purify contaminated run-off water from the drains in Singapore.

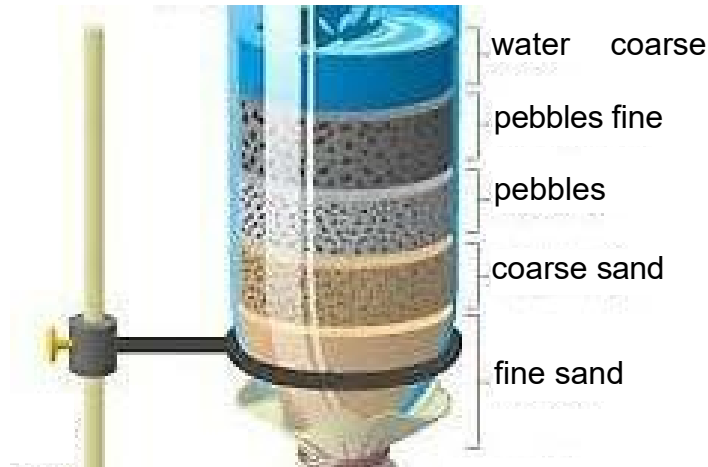


Figure 3.1

Source:

https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcSMd6PS0zIS1gOlv2GuY9bWuKqmtAnB-UoXoYIYZBU_3YGcpJzL

- (i) Explain how the method of filtration works and why the layers are arranged in this order.

[3]

.....

.....

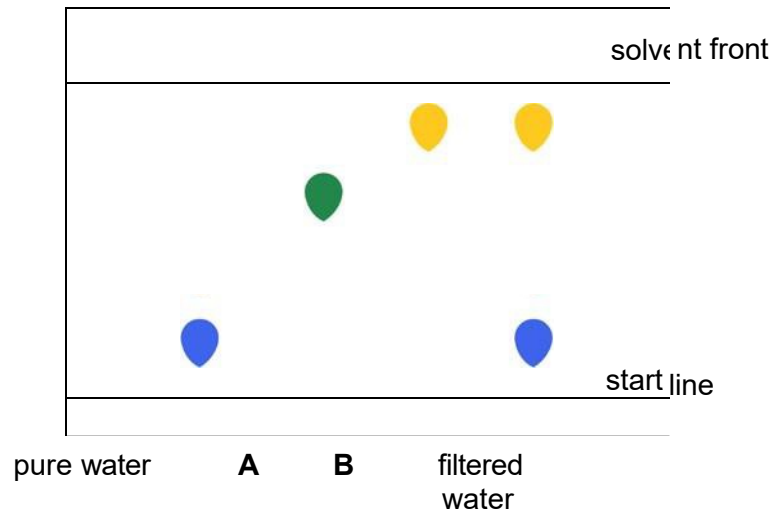
.....

- (ii) Suggest a reason why the filtered water is likely to be unsafe to drink.

[1]

.....

- Paper chromatography is used to check if the filtered water is pure. The diagram below shows the chromatogram obtained.



Calculate the R_f value of the contaminant that filtered water contains, showing your working clearly.

[2]

- Singapore imports water from Malaysia and uses desalination to purify it. Figure 3.2 below shows how desalination is carried out in a desalination plant.

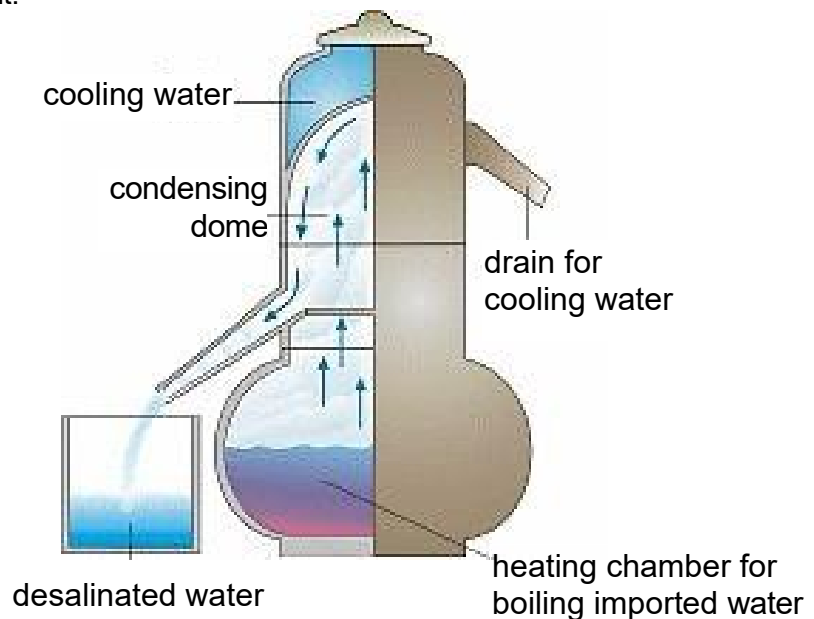


Figure 3.2

Source: <https://water.usgs.gov/edu/graphics/desalinationprocess.gif>

- (i) Suggest the separation technique that is used in desalination.

[1]

.....

- (ii) Suggest what change could be made to the set-up to check that the water obtained from desalination is pure water.

[1]

- The method used to obtain NeWater is known as reverse osmosis.

Figure

3.3 shows how reverse osmosis occurs.

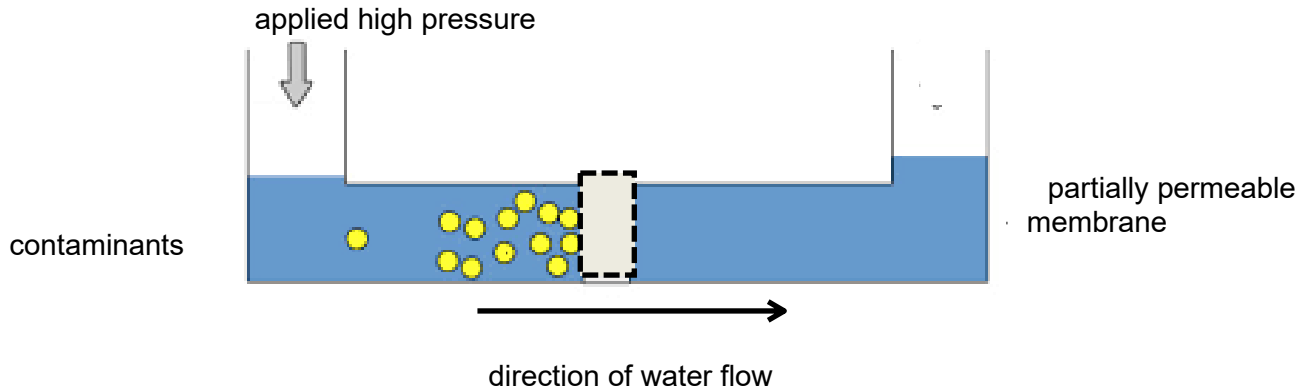


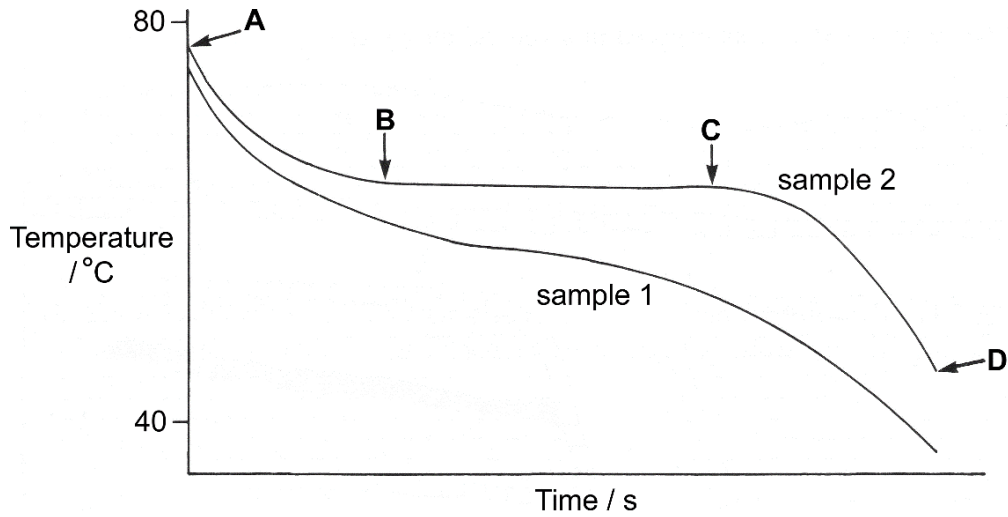
Figure 3.3

Suggest a disadvantage of using reverse osmosis.

[1]

Total [9]

- 7 Soap is manufactured from fats. Two samples of the same fat from different suppliers were tested for purity. Both samples were heated until they completely melted, and then allowed to cool down to room temperature. The cooling curves obtained for the two samples are given below.



- (a) State which of the two samples is **pure**.

[1]

- (b) With reference to the data presented in the graph, state what effect an impurity has on the melting point of a pure substance.

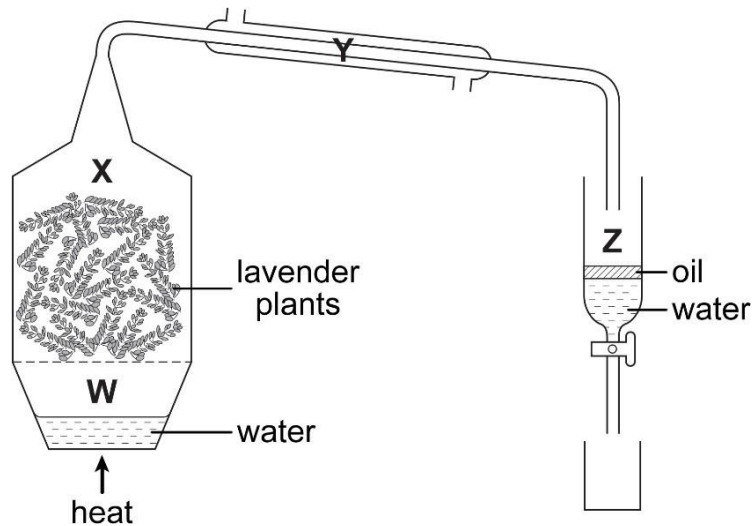
[1]

- (c) With reference to the cooling curve given for sample 2, describe how the movement of the particles changes between point **B** and point **C**.

[2]

[Total: 4m]

- 8 Lavender oil is used in perfumery. It is composed of a mixture of relatively delicate organic molecules called *monoterpenes*. Lavender oil can be extracted from lavender plants using the process of *steam distillation*. The apparatus used for the steam distillation of lavender is shown below.



- (a) Suggest a reason why the lavender is heated using steam, and is not heated directly by a flame.

.....
 [1]

- (b) The temperature of the steam produced at **W** is 100°C. The chemicals in lavender oil boil at approximately 200°C. Name the process by which lavender oil is changing from a liquid to a gas at **X**.

..... [1]

- (c) State the function of the apparatus labelled **Y**.

..... [1]

- (d) Explain why lavender oil and water can be separated by the process shown at **Z**.

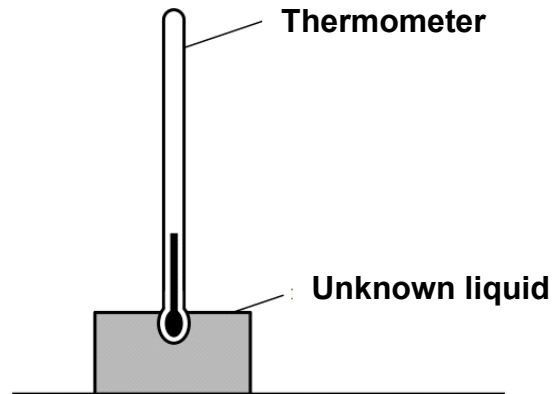
.....
 [1]

[Total: 4m]

- 9 A student is measuring the melting point of an unknown liquid using a mercury thermometer without calibration.

The lengths of the mercury column indicating the ice point and steam point are found to be 3.2 cm and 36.1 cm respectively.

She leaves a block of frozen unknown liquid on the table and measures the length of a mercury column while the block melts.



The length of the mercury column indicating the melting point of the unknown liquid is 0.2 cm.

Calculate the melting point of the unknown liquid.

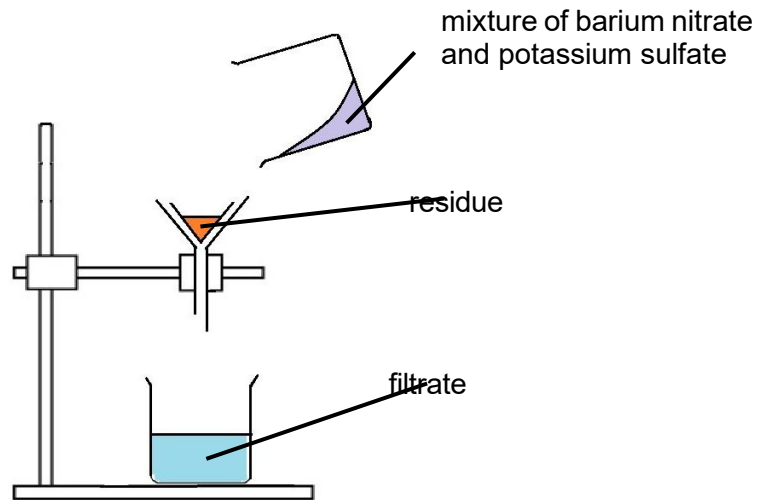
melting point of the unknown liquid = _____ [2]

[Total: 2m]

ANSWER FOR SEPARATION TECHNIQUES MCQ

- 1 Which of the following can evaporation to dryness be applied?
- A extraction of iron in a scrapyard
 - B preservation of food such as herbs and spices**
 - C production of NEWater
 - D separation of tea leaves from tea
- 2 Which mixture can be separated into its components by magnetic attraction?
- A chalk and mud
 - B mixture of dyes
 - C salt solution
 - D steel and sawdust**
- 3 In Singapore, desalination is carried out using reverse osmosis instead of distillation.
- Which of the following is the key reason for this preference?
- A Reverse osmosis does not have any impact on the environment, unlike water distillation.
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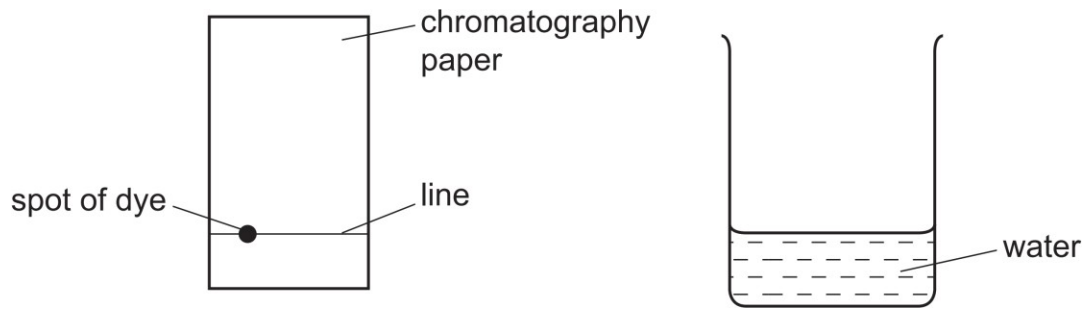
- 5 A colourless solution of barium nitrate is added to a colourless solution of potassium sulfate. All the barium nitrate and potassium sulfate reacted. The resultant mixture, which consists of a white precipitate (insoluble solid) of barium sulfate suspended in a colourless solution of potassium nitrate, is then filtered.



Which of the following shows the correct residue and filtrate obtained?

	residue	filtrate
A	barium sulfate	potassium sulfate
B	barium sulfate	potassium nitrate
C	potassium sulfate	barium nitrate
D	potassium nitrate	barium sulfate

- 6 A sample of a dye is investigated by chromatography. A line is drawn across a piece of chromatography paper, and a spot of the dye is placed on it. The paper is then placed in water.



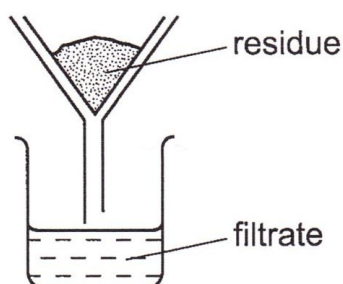
Which option is correct?

	what is used to draw the line	position of spot
A	ink	above the level of the water
B	ink	below the level of the water
C	pencil	above the level of the water
D	pencil	below the level of the water

- 7 The table shows the colours and solubilities in water of four solids.

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Z	white	soluble

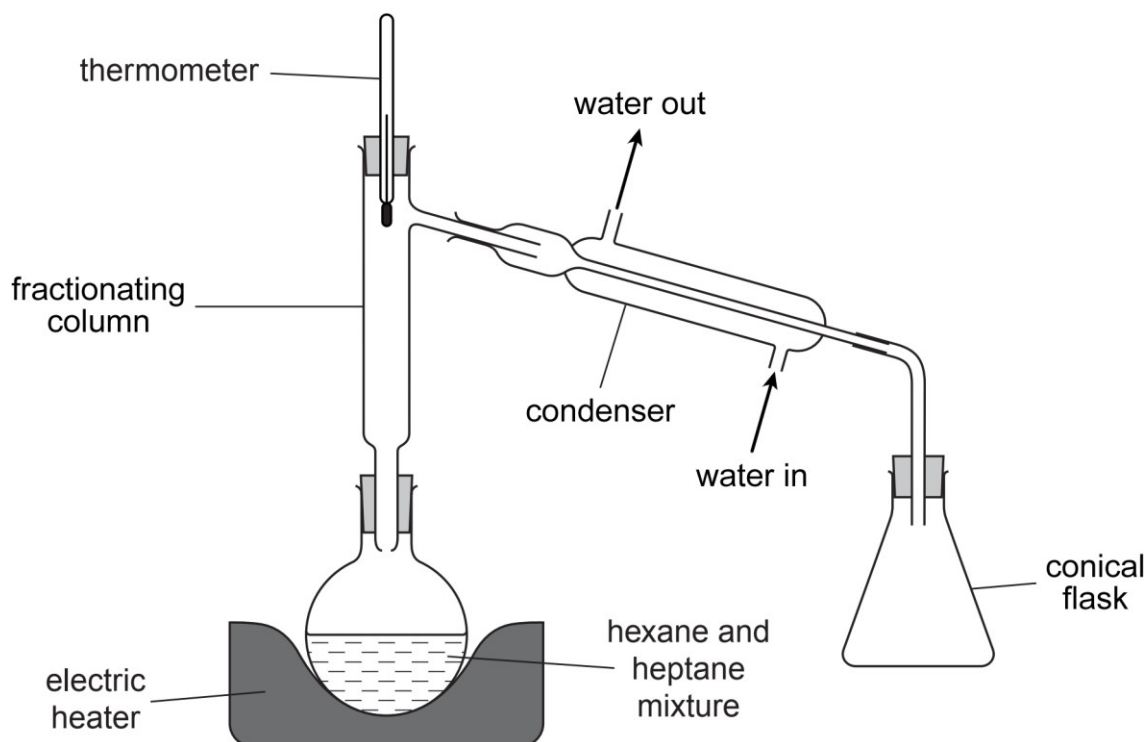
A mixture containing two of the solids is added to excess water, stirred and filtered. A blue filtrate and white residue are obtained.



Which solids are present in the mixture?

- A** W and X **B** W and Y **C** X and Y **D** X and Z

- 8 A student wanted to separate a mixture of hexane and heptane by fractional distillation. They set up the apparatus as shown below.



What **errors** are there in the way that this fractional distillation has been set-up?

- I The water is flowing through the condenser in the wrong direction.
 - II The bulb of the thermometer is in the wrong location.
 - III The fractionating column should be packed with glass beads.
 - IV The top of the conical flask should be left open.
- A I and III only B I and IV only
 C II and III only D III and IV only

- 9 Which of the following substances is a **liquid** at room temperature (25°C)?

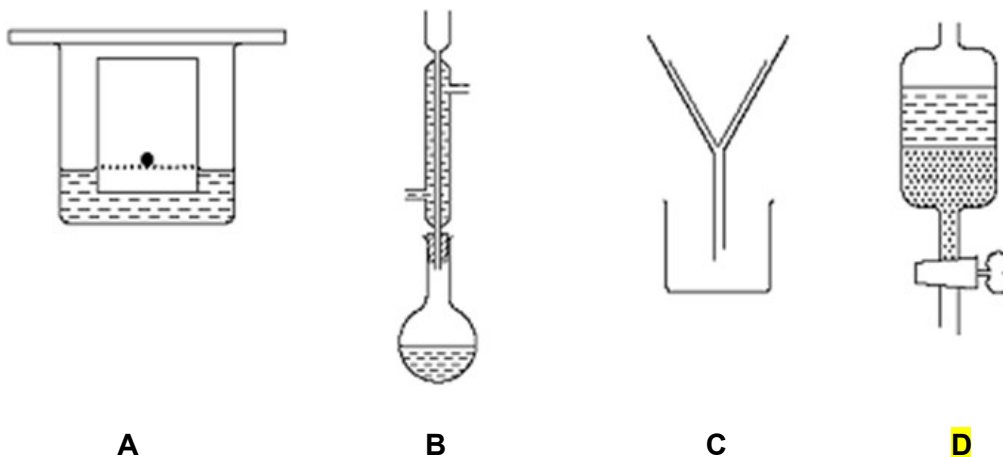
Substance	melting point / °C	boiling point / °C
A	35	79
B	-56	73
C	-134	12
D	-138	1

Ans : B

10 An unknown compound **P** is known to have the following properties.

- It is insoluble in water.
- It melts at 10 °C and boils at 134 °C.
- It decomposes on heating.

Which of the following apparatus should be used to obtain pure **P** from a mixture of **P** and water?



11 The following steps were carried out to extract water from a solution containing sand and sugar. Which of the following steps is **not** necessary in obtaining pure water?

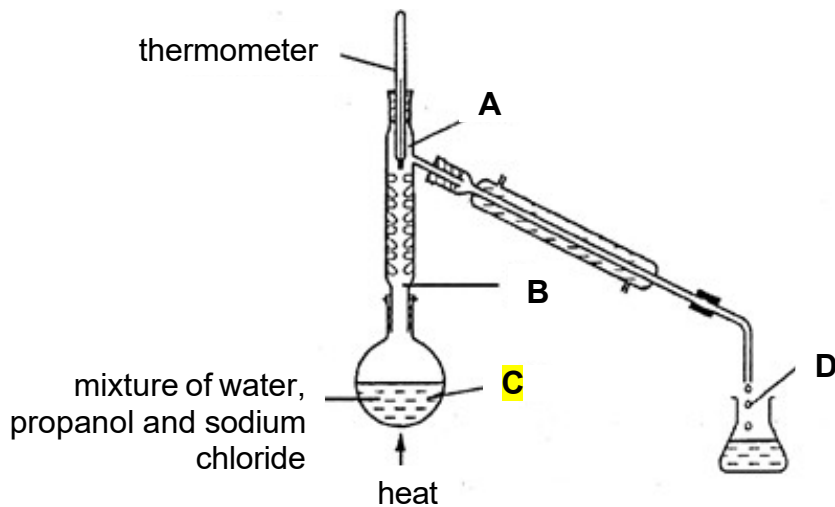
- 1 Pass the mixture through filter paper and filter funnel.
- 2 Dry the residue with pieces of filter paper.
- 3 Heat the filtrate until solution is saturated and cool.
- 4 Heat the solution in a distillation flask and collect the distillate.

- A** 2 only
C 3 only

- B** 2 and 3 only
D 2 and 4 only

Refer to the following set-up for Question 8 and 9.

The set-up below shows a mixture of 50 cm³ water, 50 cm³ propanol and some sodium chloride fractionally distilled. Propanol is soluble in water and has a boiling point of 97 °C.



12 At which point will there be a greater proportion of water, when the thermometer first shows a steady reading?

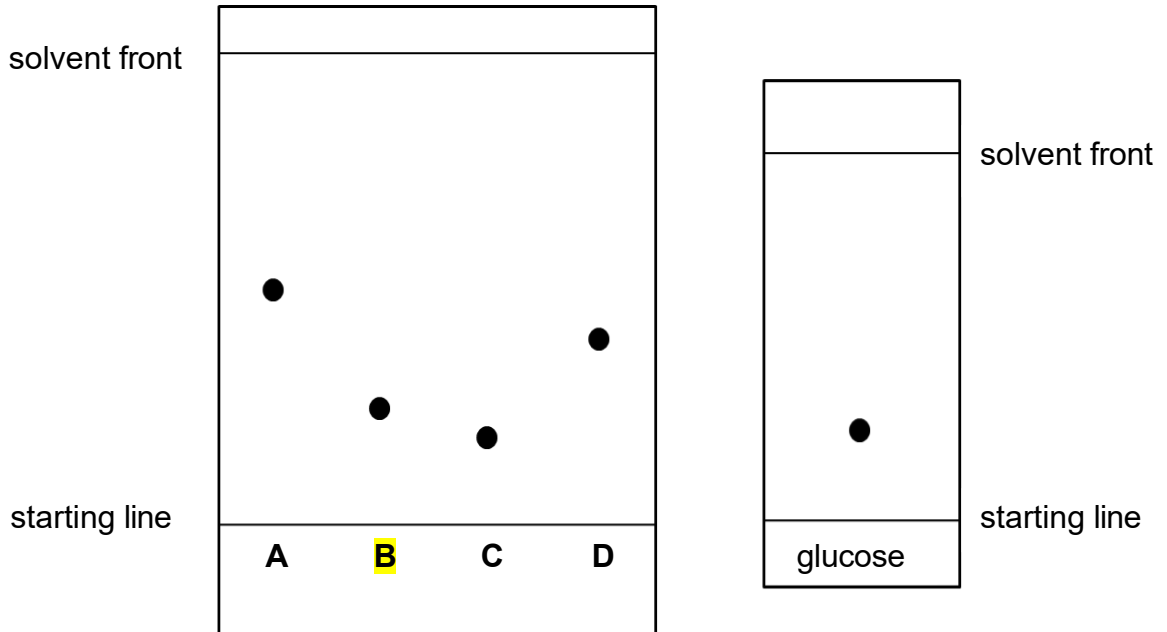
13 What is the temperature shown by the thermometer and what is left in C at the end of distillation?

	thermometer reading/ °C	final contents left in C
A	97	no residue
B	100	white residue
C	103	no residue
D	106	white residue

14 The diagram below shows two separate chromatograms and both chromatograms used the same solvent.

The chromatogram on the left shows four unknown sugars: **A**, **B**, **C** and **D**. The chromatogram on the right shows glucose.

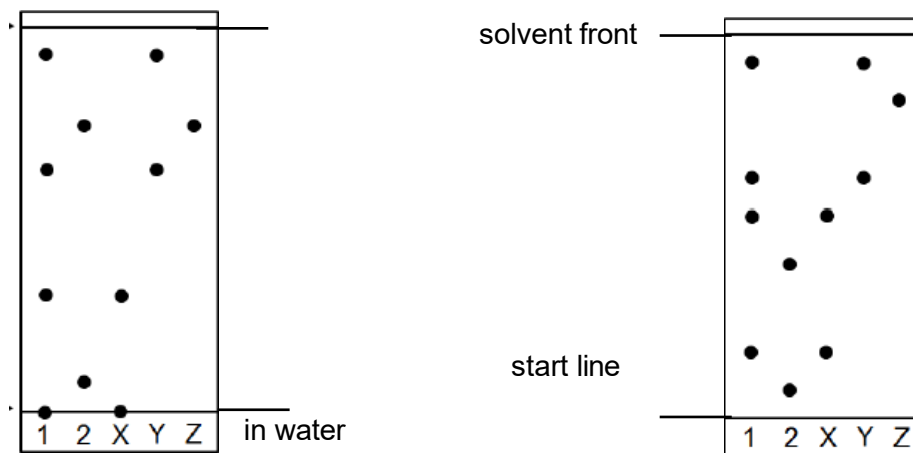
Which sugar (**A**, **B**, **C** or **D**) is glucose?



15 Which of the following is a correct definition of classification?

- A Classification is the method of dividing things into groups according to different properties.
- B Classification is the method of dividing things into groups according to the same property.**
- C Classification is the method of dividing things into groups according to similar properties.
- D Classification is the method of dividing things into groups according to two similar properties

- 16 Food dyes 1 and 2 are known to contain one or more of three substances X, Y and Z. Two chromatograms are developed under the same conditions. One used water as the solvent, and the other used ethanol. The results are shown in the diagram below.



Which of the following statement(s) is/are correct?

- 1 There is a component in Dye 1 that is insoluble in water but soluble in ethanol.
- 2 The component in Z is more soluble in water than in ethanol.
- 3 Substance Z is likely to be pure.

- | | | | |
|----------|--------------|----------|--------------|
| A | 1 only | B | 2 only |
| C | 1 and 3 only | D | 2 and 3 only |

- 17 In an experiment, white crystalline solid X is found to melt at 121.0 °C, the same temperature as the melting point of benzoic acid (white crystalline solid).

To identify the solid, some of it was mixed with pure benzoic acid and the melting point of the mixture was found to be 114.5 °C.

What can be deduced about X?

- A X is a mixture.
- B X is a pure compound.
- C X is impure benzoic acid.
- D X is not benzoic acid.

18 Some information about three solids is given below.

solid	solubility in water	solubility in ethanol	action of heat
P	soluble	insoluble	no effect
Q	insoluble	soluble	no effect
R	soluble	soluble	sublimes

Which of the following procedures could be carried out to obtain a pure sample of P from a dry mixture of the three solids?

- A** Add ethanol to the mixture, filter and collect the residue.
- B** Add water to the mixture, filter and collect the residue.
- C** Add ethanol to the mixture, filter and evaporate the filtrate.
- D** Heat the mixture and, cool and condense the gas.

19 When a saturated blue solution of copper(II) sulfate is allowed to cool from 85 °C to 10 °C, blue crystals separate out (precipitate) from the solution.

A saturated solution contains the maximum mass of dissolved copper(II) sulfate in the water (at a specific temperature).

Which of the following statement(s) made about crystallisation is/are correct?

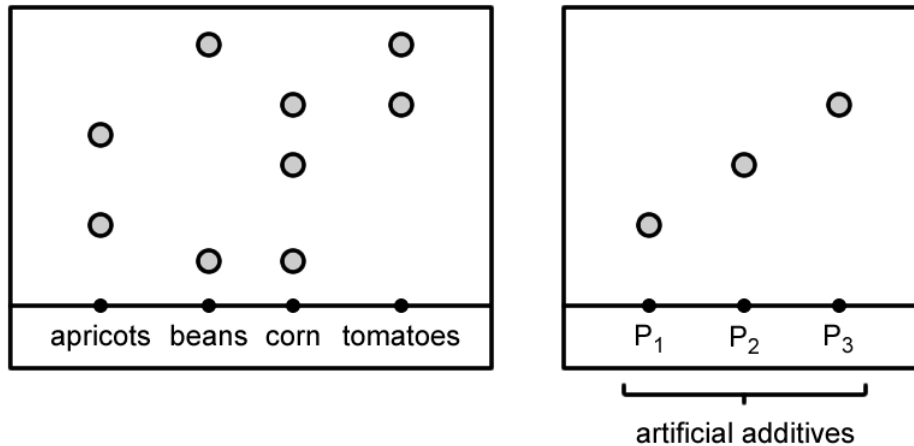
- 1 The mass of the dissolved copper(II) sulfate in the solution remains constant.
- 2 The mass of the dissolved copper(II) sulfate in the solution changes.
- 3 The mass of the solvent (water) in the solution remains the same.
- 4 The solubility of copper(II) sulfate decreases as the temperature falls.

- A** 1 only
- B** 1 and 3 only
- C** 2, 3 and 4
- D** 4 only

20 Yii Wenn added a small amount of salt to some water that she is going to boil to cook rice. Which one of the following is most likely to be the boiling point of the salt water?

- A 96.0°C
- B 98.0°C
- C 100°C
- D 104°C**

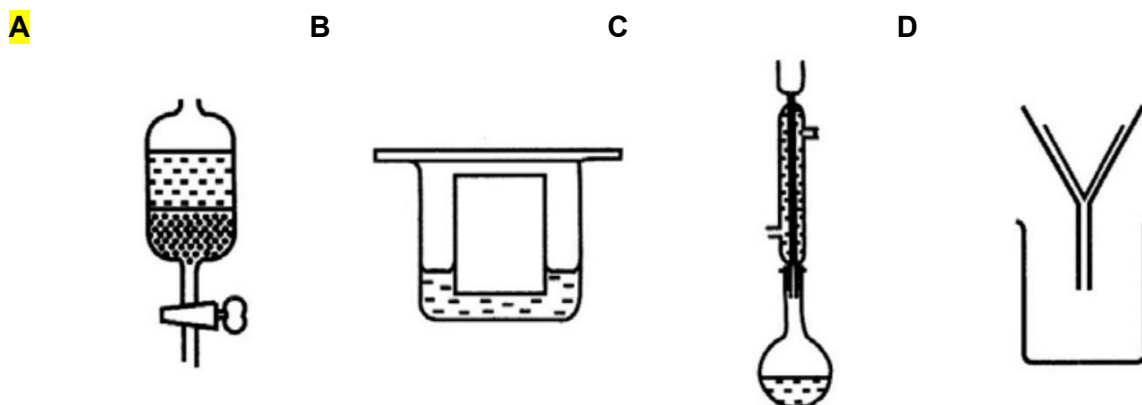
21 Samples of tinned apricots, beans, corn and tomatoes were tested for additives using chromatography. The chromatograms were compared with those of three artificial additives, P₁, P₂ and P₃. The results were as follows.



Which tinned food does **not** contain any artificial additives?

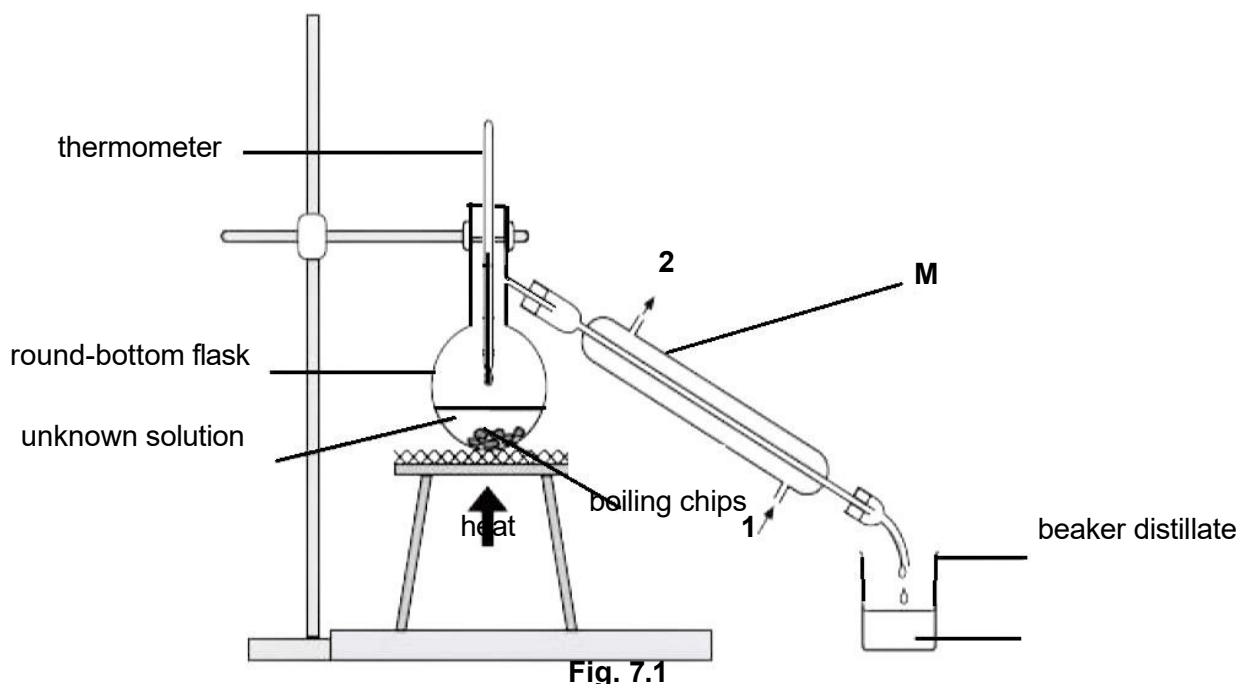
- A apricots
- B beans**
- C corn
- D tomatoes

22 Substance X melts at 8°C and boils at 98°C. It does not dissolve in water and it does not react with water. Which diagram shows the method **most suitable** for separating X from a mixture of X and water?



ANSWERS FOR SEPARATION TECHNIQUES STRUCTURED QUESTIONS

1 Fig. 7.1 shows the set up used to separate the contents of an unknown solution.



A State the physical property that allows the constituents of the unknown solution to be separated.

Boiling point / different boiling points [1]

B Describe the purpose of having cold water enter from position 1 rather than 2 of apparatus M.

**It increases the efficiency of the condensation of the solvent.
OR It allows efficient cooling / condensation of the solvent.
OR It provides a temperature gradient for the condensation of the solvent.**

[1]

C There is an error in the setup. Explain the consequence of this error and suggest how it should be corrected.

**The thermometer reading may not be the accurate boiling point of the solvent/distillate. [1]
Position the thermometer bulb at / near the entrance / mouth / opening of the condenser. [1]**

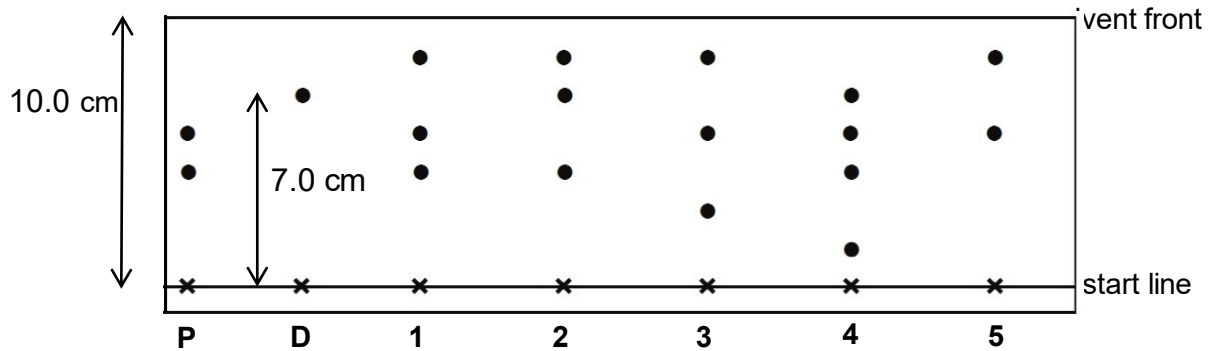
[2]

D Suggest an alternative method of separation that can be used if the student only needs to recover the solute, given that it does not decompose upon heating.

evaporation (to dryness)

[1]

- 2 Five athletes have been suspected of taking banned drugs, pseudoephedrine and darbepoetin, to enhance their performance in the SEA Games. During the investigation, chromatography was conducted on their urine samples to detect whether the banned drugs were present. Fig 8.1 shows the chromatogram for the two drugs and the five urine samples.



Legend:

P	pseudoephedrine
D	darbepoetin
1 to 5	corresponding urine samples of athletes 1 to 5

Fig. 8.1

- (a) Describe the function of the locating agent.

It forms coloured spots for easy identification. [1]

- (b) State the R_f value of darbepoetin.

0.70 (2 dp) [1]

- (c) State the full name of the drug that is an impure substance.

Pseudoephedrine [1]

- (d) During the testing process, the urine sample of athlete 3 was accidentally contaminated with one of the other four athletes' urine sample.

Identify the urine sample that contaminated the urine sample of athlete 3.

urine sample of athlete 5 [1]

- (e) Explain why the start line **cannot** be drawn with a pen.

**The pen ink may be soluble / dissolve in the solvent used [1]
And interfere with / affect the chromatography / separation / results. [1]**

[2]

3 Ephedrine and insulin are both drugs that are banned for use by athletes.

One way that athletes can be tested for banned drugs is by chromatography of their urine samples.

Fig. 5.1 shows a chromatogram for ephedrine and insulin and the urine samples from four athletes.

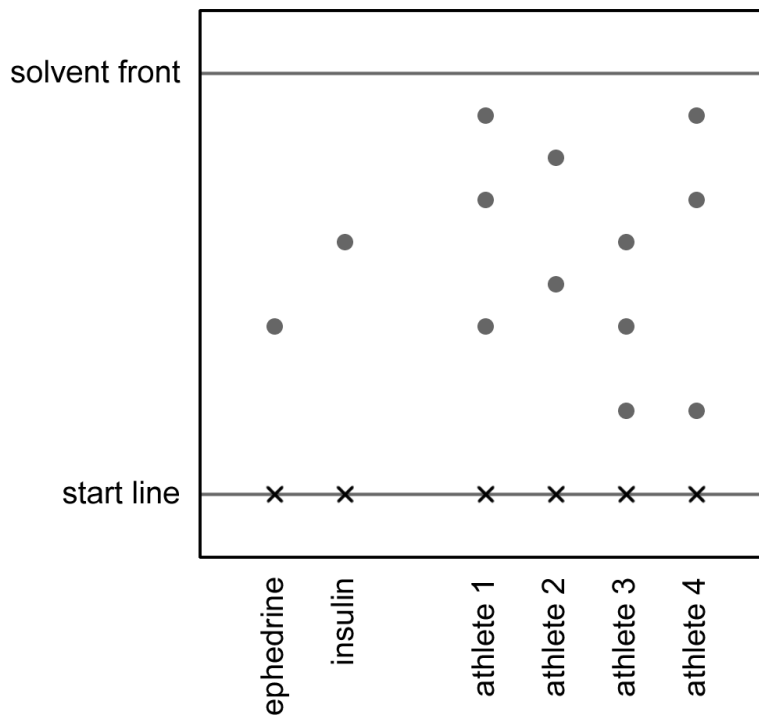


Fig. 5.1

A Describe what the chromatogram shows about the drug(s) use by each of the four athletes.
[2]

Athlete 1 has taken ephedrine AND Athlete 3 has taken ephedrine and insulin [1]

2 and 4 have not taken any banned substances [1]

B The ephedrine, insulin and urine samples are all colourless. Explain how the spots can be seen so that their *R_f* values can be calculated.
[1]

Use a locating agent to make the colourless spots visible. [1]

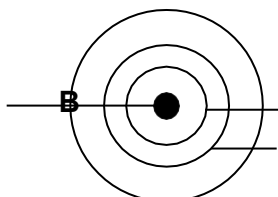
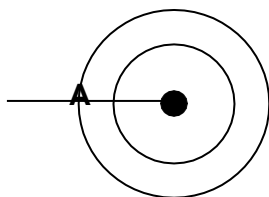
Accepted alternative answers - use iodine, use ultraviolet light.

C Calculate the *R_f* value of ephedrine. Show your working. Give your final answer to one decimal place.
[1]

$$R_f \text{ value} = 2.2 \text{ cm} / 5.5 \text{ cm} = 0.4 \text{ (no units) accept measurements } +/1 \text{ 0.1 cm}$$

[Total = 4 marks]

- 4 Two black pigments, **A** and **B** were subjected to a paper chromatography separation. In each case, a small amount of the pigment was placed at the centre of a filter paper and allowed to dry. Drops of pure ethanol were slowly added to the centre of the filter papers. After some time, the appearances of the filter papers were shown as below:



substance 1
substance 2

- (a) What information does the experiment give about the nature of [2]

- (i) pigment **A**?

Pigment **A** is a pure substance;

- (ii) pigment **B**?

Pigment **B** is a mixture with 2 substances present;

- (b) It was found that substance **2** has an R_f value of 0.60. If the distance moved by the solvent is 0.33 cm, calculate the distance moved by the sample spot. Show your working clearly and leave your answer in 2 significant figures.

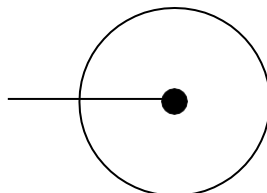
[1]

$R_f = \frac{\text{distance moved by solute(substance)}}{\text{distance moved by solvent}}$

Distance moved by substance = $0.60 \times 0.33 = 0.20 \text{ cm}$ (2sf)

- (c) A second chromatography was conducted using water instead of ethanol on pigment **B**. The diagram below shows the chromatogram obtained.

B



Suggest a reason for the results obtained.

[1]

The substances in pigment **B** are insoluble in water.

Total [4]

- 5 Figure 3.1 shows a simple approach by students to purify contaminated run-off water from the drains in Singapore.

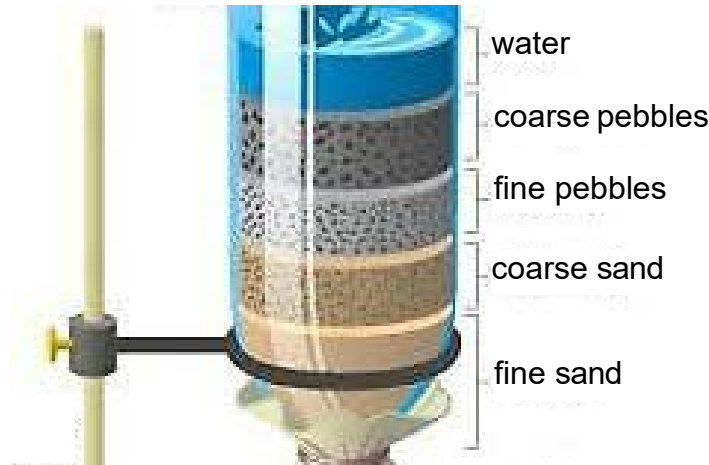


Figure 3.1

Source:

https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcSMd6PS0zIS1gOlv2GuY9bWuKqmtAnB-UoXoYIYZBU_3YGcpJzL

- (a) (i) Explain how the method of filtration works and why the layers are arranged in this order.

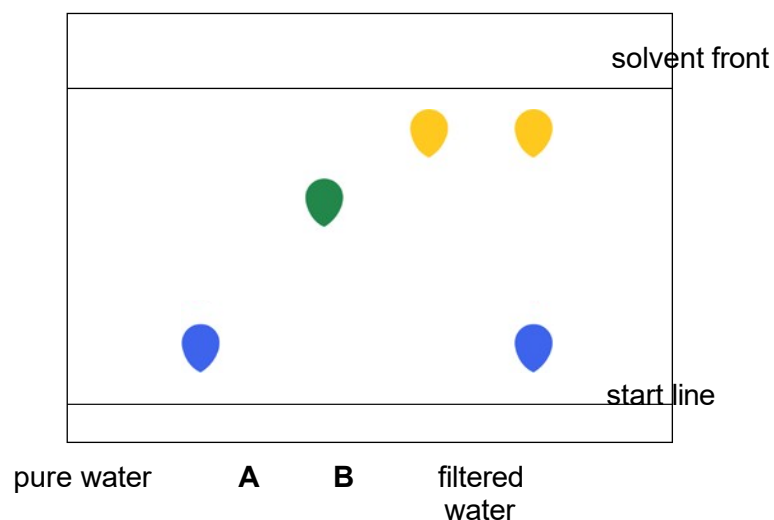
[3]

Filtration works when the spaces between particles in a layer, are small enough to prevent other larger particles to pass through. As the water seeps further down the filter, the spaces in a layer **become progressively smaller**, making the trapping of the **smaller particles more effective**.

- (ii) Suggest a reason why the filtered water is likely to be unsafe to drink.
[1]

Presence of bacteria/viruses/harmful soluble chemicals

- (b) Paper chromatography is used to check if the filtered water is pure. The diagram below shows the chromatogram obtained.



Calculate the R_f value of the contaminant that filtered water contains, showing your working clearly. [2]

$R_f = 3.6 \text{ cm} \div 4.1 \text{ cm} = 0.878$ (no units)

- (c) Singapore imports water from Malaysia and uses desalination to purify it. Figure 3.2 below shows how desalination is carried out in a desalination plant.

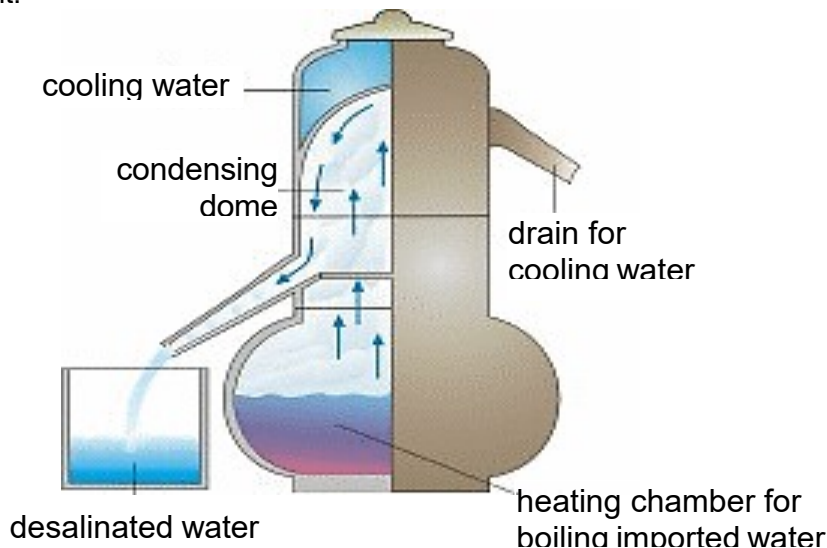


Figure 3.2

Source: <https://water.usgs.gov/edu/graphics/desalinationprocess.gif>

- (i) Suggest the separation technique that is used in desalination. [1]
- Distillation**
- (ii) Suggest what change could be made to the set-up to check that the water obtained from desalination is pure water. [1]

Add a thermometer to measure temperature of water vapour

- (d) The method used to obtain NeWater is known as reverse osmosis. Figure 3.3 shows how reverse osmosis occurs.

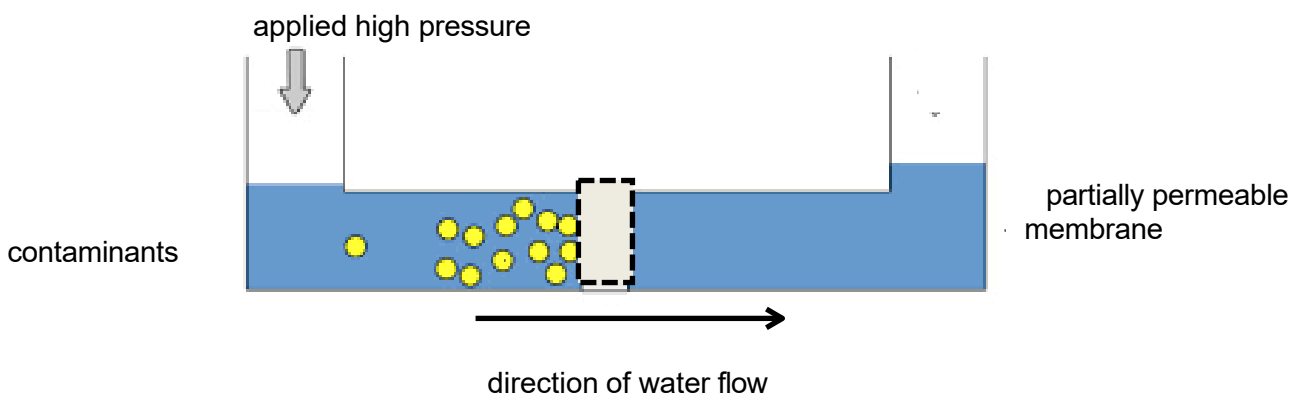


Figure 3.3

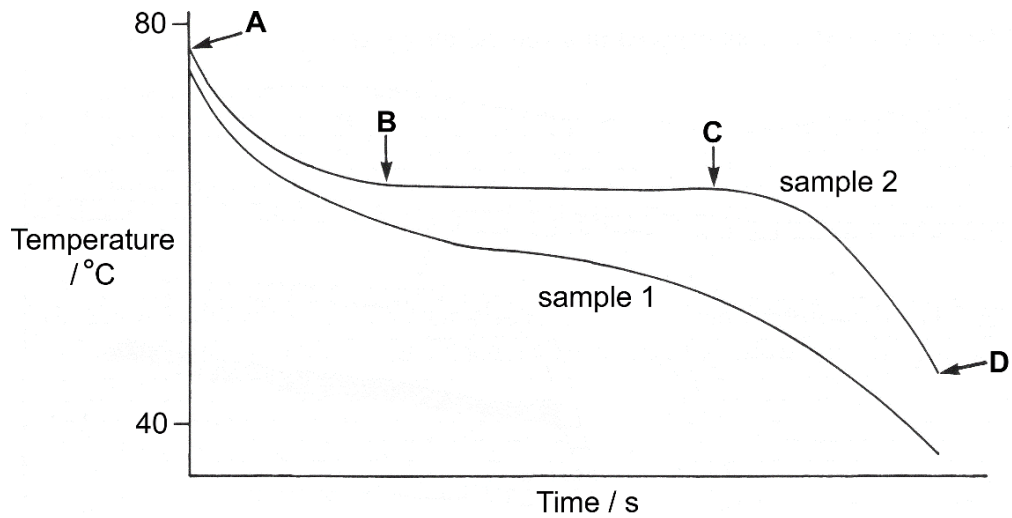
Suggest a disadvantage of using reverse osmosis.

[1]

Expensive to apply pressure / Safety considerations / Partially permeable membrane needs to be replaced regularly

Total [9]

6 Soap is manufactured from fats. Two samples of the same fat from different suppliers were tested for purity. Both samples were heated until they completely melted, and then allowed to cool down to room temperature. The cooling curves obtained for the two samples are given below.



(a) State which of the two samples is **pure**.

Sample 2 is pure. [1]

(b) With reference to the data presented in the graph, state what effect an impurity has on the melting point of a pure substance.

An impurity lowers the melting point. OR
An impurity causes the chemical / substance to melt over a range of temperatures / causes the chemical *not* to have a sharp melting point.

[1]

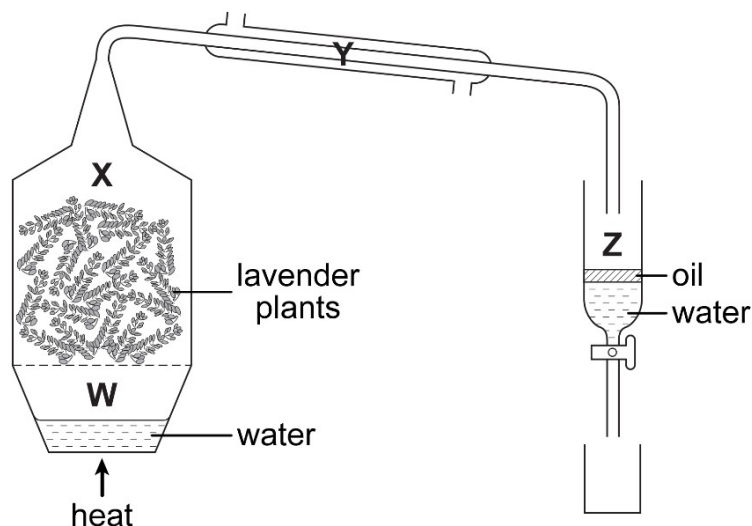
(c) With reference to the cooling curve given for sample 2, describe how the movement of the particles changes between point **B** and point **C**.

At point B (liquid), the particles are moving randomly, travelling short distances by sliding over each other.
At point C (solid), the particles are vibrating about fixed positions.
A number of students thought that the fat was melting and so the particles' movement was the wrong-way-round. Some students failed to describe the movement of the particles, but described their arrangement instead.

[2]

[Total: 4m]

- 7 Lavender oil is used in perfumery. It is composed of a mixture of relatively delicate organic molecules called *monoterpenes*. Lavender oil can be extracted from lavender plants using the process of *steam distillation*. The apparatus used for the steam distillation of lavender is shown below.



- (a) Suggest a reason why the lavender is heated using steam, and is not heated directly by a flame.

The delicate molecules in the lavender oil would decompose / break-down (at a high temperature)

OR

The high temperature would damage / burn the lavender plant OR

If the lavender plant burns, smoke may contaminate the oil that is collected.

[1]

- (b) The temperature of the steam produced at **W** is 100°C. The chemicals in lavender oil boil at approximately 200°C. Name the process by which lavender oil is changing from a liquid to a gas at **X**.

Evaporation [1]

- (c) State the function of the apparatus labelled **Y**.

To condense the vapours (lavender oil vapour and steam).[1]

- (d) Explain why lavender oil and water can be separated by the process shown at **Z**.

Lavender oil and water are immiscible.

[1]

[Total: 4m]