Paper Chromatography

1. Define

1. Paper chromatography:

The method of separating pigments(colored substances) using filter paper is paper chromatography.

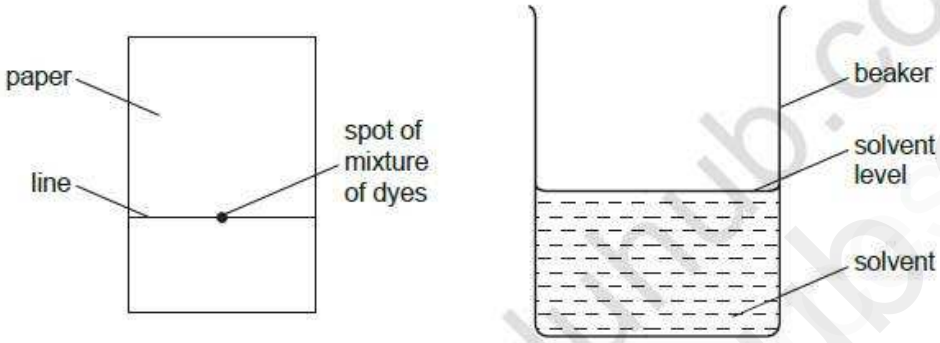
Key points about chromatography:

1. **The colours separate if:**

- The pigments have different solubilities in the solvent.
- The pigments have different degrees of attraction to the filter paper.

[O/N/08-P1-Q2]-Ans b

2 An experiment is carried out to separate a mixture of two dyes. A line is drawn on a piece of chromatography paper and a spot of the dye mixture placed on it. The paper is dipped into a solvent and left for several minutes.



Which statement about this experiment is correct?

A The dyes must differ in their boiling points.

B The dyes must differ in their solubilities in the solvent.

C The line must be drawn in ink.

D The line must be placed below the level of the solvent.

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2. If a mixture of solvents is not soluble in water then other solvents such as ethanol , alcohol ,acetone or propanone can be used.

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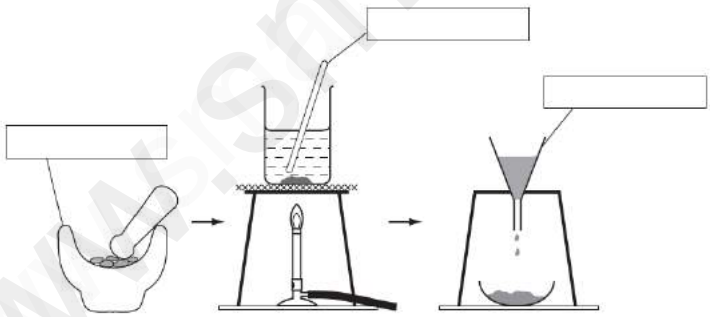
1 The colours present in some blackcurrant sweets can be separated by chromatography.
The colours are water-soluble dyes.
The diagrams show how the colours can be extracted from the sweets.



(a) Complete the empty boxes to name the pieces of apparatus. [3]

3. You must know to extract colours from given substances using suitable methods and label the apparatus used

[O/N/2008-P6-Q1]

[M/J/2006-P6-Q2]

2 A sample of orange fruit jam was investigated to check the three colourings present.

Step 1 The jam was boiled with water.

Step 2 The mixture was filtered.

Step 3 The filtrate was concentrated.

Step 4 The concentrate was analysed by chromatography.

Note: Step 1 was done to extract the colour.

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4. You must be able to identify the base line (origin) and the solvent front.

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5. You must be able to name a locating agent while identifying colourless substances like amino acids.

Note: the locating agent reacts with the chemicals in the colourless spot and a coloured compound is formed.
To detect amino acids a locating agent called as ninhydrin is used.

6. You must be able to calculate the R_f values and explain the meaning of R_f values.

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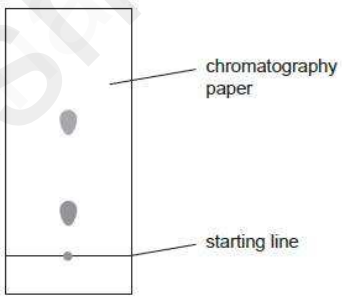
7. You must be able to identify the number of dyes (substances) in a mixture by looking at the chromatogram.
(2 in this case)

3 A coin is dissolved in an acid. Chromatography is used to test the solution formed. The diagram shows the chromatogram obtained.



What is the coin made from?

A a metal element

B a non-metal element

C a mixture of metals

D a mixture of non-metals

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8. The reliability of the results of a chromatogram can be checked by: either repeating the experiment/measuring the R_f values.

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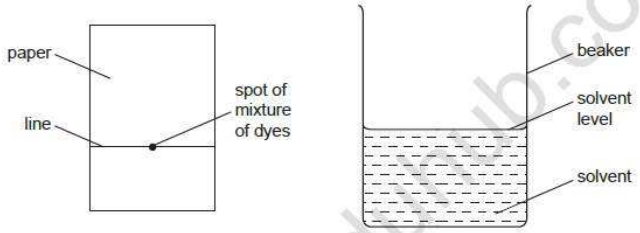
9. You must know that the base line must be always drawn with a pencil. As the pencil line does not interfere with the chromatography results since it does not dissolve in the solvent.
[O/N/2008-P1]

2 An experiment is carried out to separate a mixture of two dyes. A line is drawn on a piece of chromatography paper and a spot of the dye mixture placed on it. The paper is dipped into a solvent and left for several minutes.



Which statement about this experiment is correct?

A The dyes must differ in their boiling points.

B The dyes must differ in their solubilities in the solvent.

C The line must be drawn in ink.

D The line must be placed below the level of the solvent.

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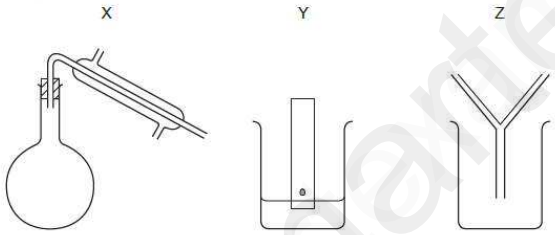
10. You must be able to look at the apparatus and identify the name of the experiment
[O/N/2007-P1]

3 The outline diagrams show three methods of separation.



What are the three methods called?

	X	Y	Z
A	chromatography	distillation	filtration
B	distillation	chromatography	filtration
C	distillation	filtration	chromatography
D	filtration	chromatography	distillation

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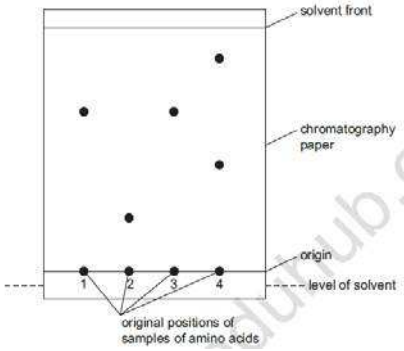
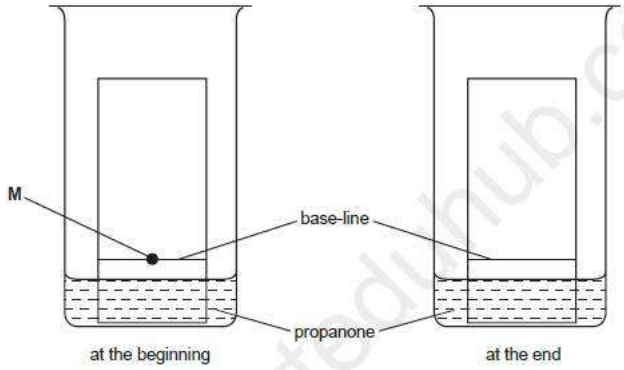
11. **You must know that the number of spots that the sample breaks into tells us the number of substances present in the mixture being tested.**



This the following chromatogram shows 2 amino acids being present in a protein sample being tested.

12.You must know that the level of the solvent should be below the base line. The reason is that if the solvent is above the base line, the dyes would get washed off in the solvent(or in other words, they would dissolve in the solvent)



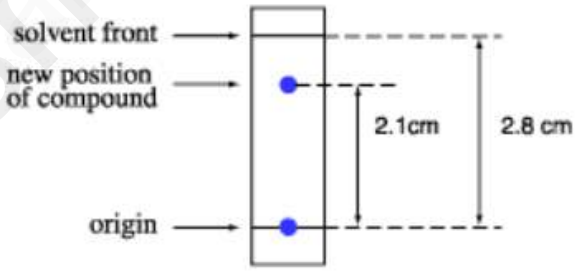
13.Sometimes a cover may be placed on the beaker to prevent the loss of solvent.

14.The chromatography paper must only be removed when the solvent is near the top of the paper.

15.Once the process of chromatography is over, the products can be verified in 2 ways.

- By calculating the R_f values.
- By comparing the results with known samples.

16.Measuring R_f value: (no units)-Calculation

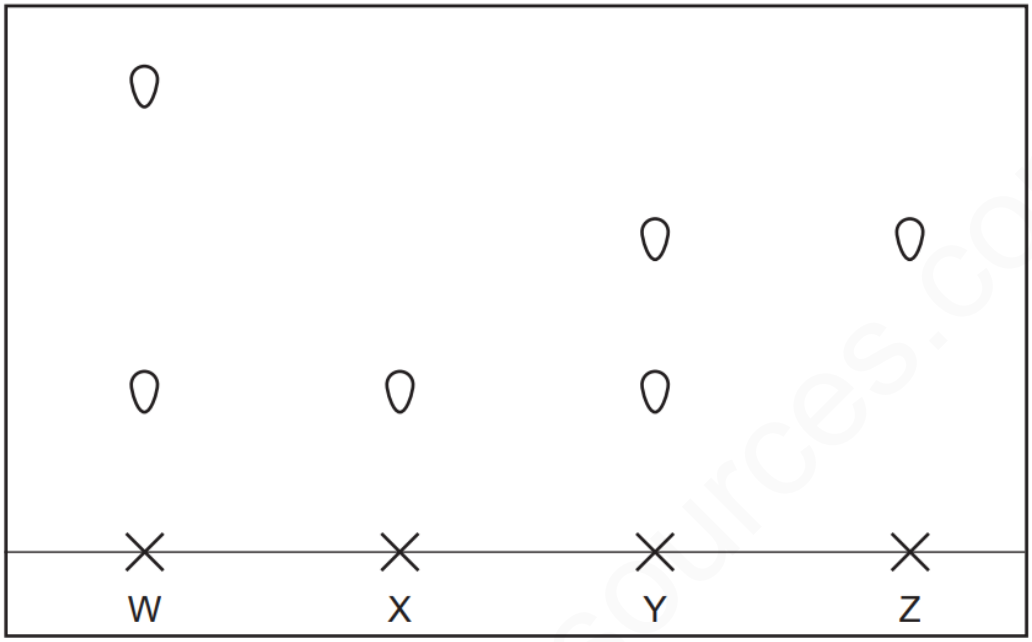


$$R_f = \frac{2.1}{2.8} = 0.75$$

The R_f value of a sample = $\frac{\text{distance travelled by sample}}{\text{distance travelled by solvent front}}$

APPLICATION BASED QUESTIONS-NEW

The diagram shows the paper chromatograms of four substances, W, X, Y and Z.



Which two substances are pure?

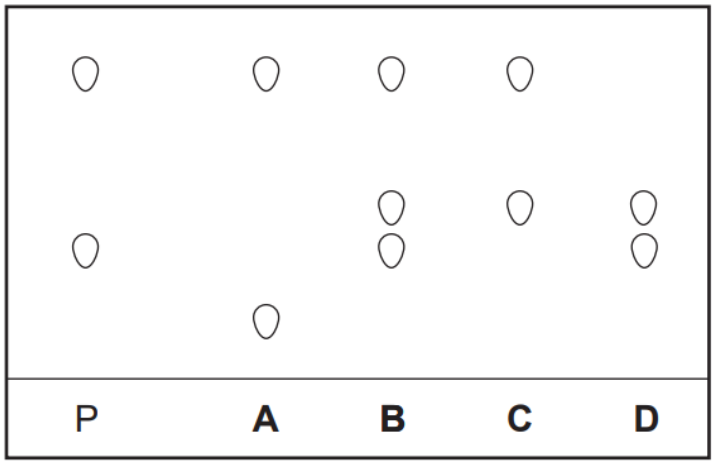
A W and X **B** W and Y **C** X and Y **D** X and Z

ANSWER: D

Chromatography is used to find out if a banned dye, P, is present in foodstuffs.

The results are shown in the diagram.

Which foodstuff contains P?



ANSWER:B

An aqueous solution is coloured.

Which method of separation would show that the solution contains ions of different colours?

A chromatography

B crystallisation

C distillation

D filtration

ANSWER: A

Solid W melts at exactly 54 °C and boils at exactly 302 °C.

Solid X, when dissolved in water and examined using paper chromatography, shows a blue colour and a red colour.

Which row is correct?

	contains only one substance	contains more than one substance
A	W and X	–
B	W	X
C	X	W
D	–	W and X

MARKING SCHEME:B

Diagram 1 shows the paper chromatogram of substance X.

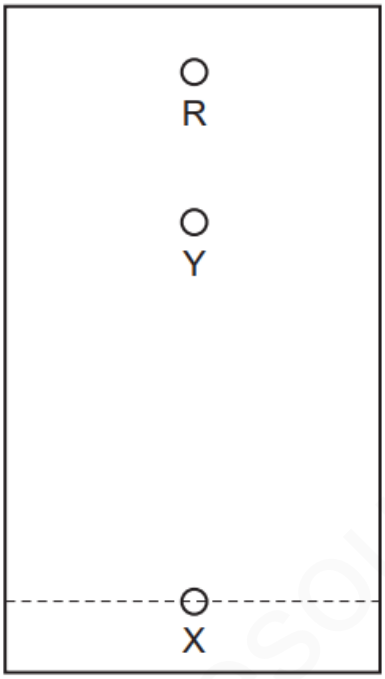


diagram 1

Diagram 2 shows the cooling curve for substance Y.

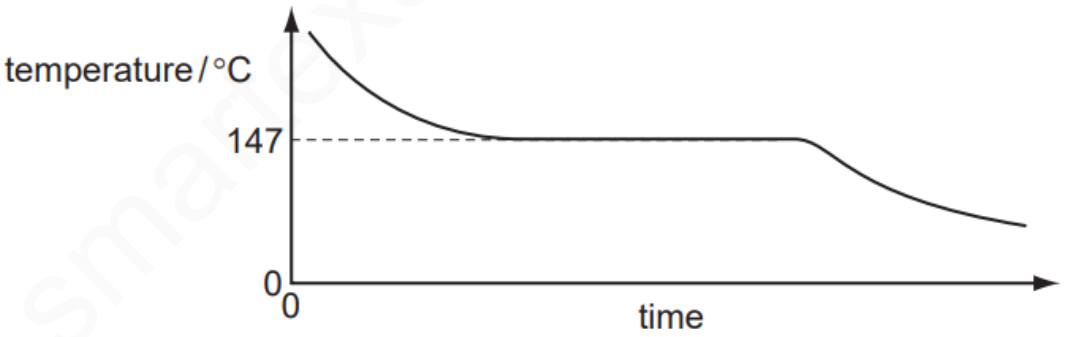


diagram 2

Which statement about X and Y is correct?

A X is a mixture and Y is a pure substance.

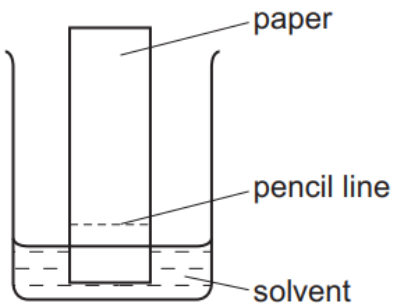
B X is a pure substance and Y is a mixture.

C X and Y are mixtures.

D X and Y are pure substances.

MARKING SCHEME:A

A student is investigating a coloured mixture using chromatography.



Where should he place the coloured mixture?

A in the solvent

B just above the pencil line

C just below the pencil line

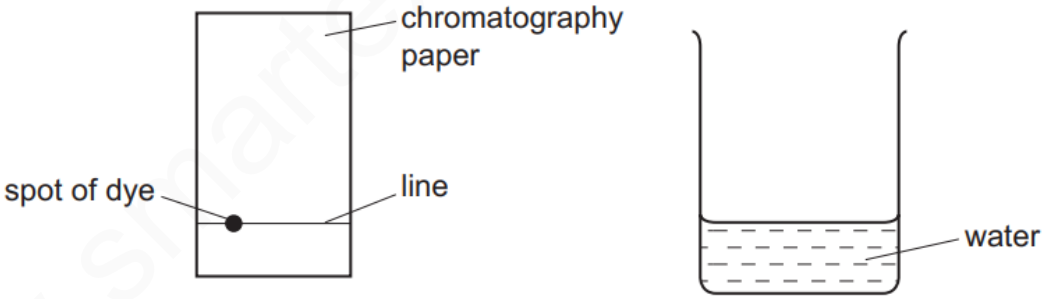
D on the pencil line

ANSWER: D

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 placed in water.

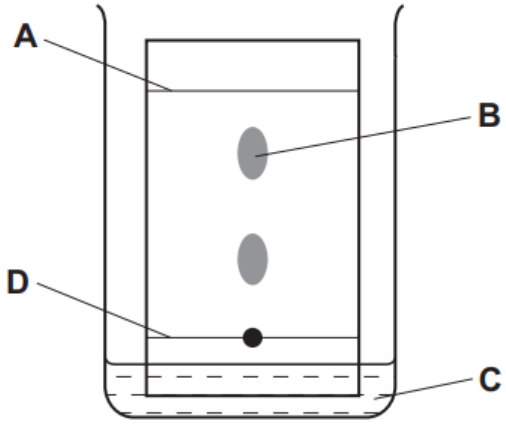


Which row is correct?

	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

ANSWER:C

In the chromatography experiment shown, which label represents the solvent front?

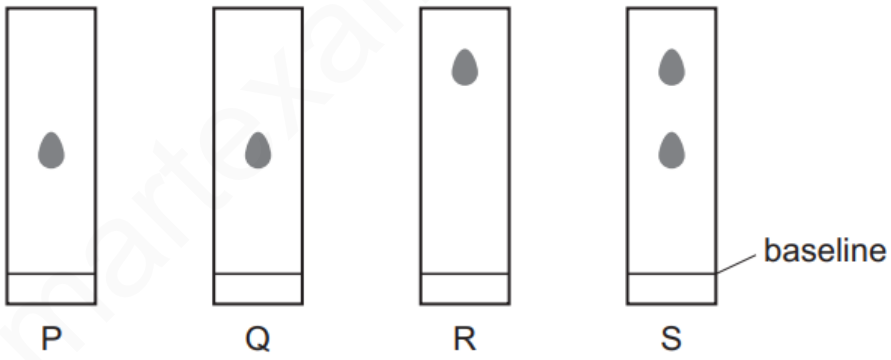


ANSWER:A

Chromatography experiments are carried out on four substances, P, Q, R and S.

The same solvent is used in each experiment.

The resulting chromatograms are shown below.



Which statement is **not** correct?

A P and Q are pure substances.

B P and R are different substances.

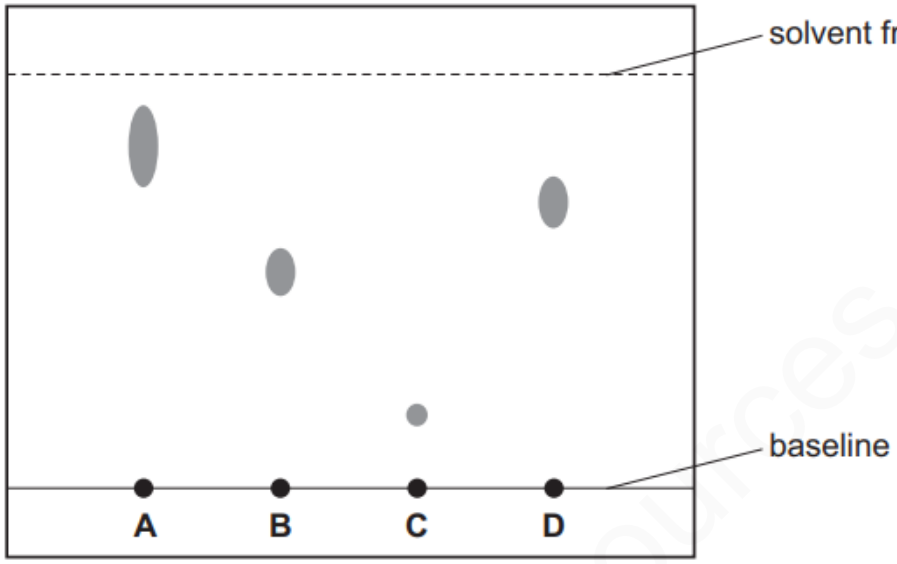
C R and S are pure substances.

D S is a mixture of substances.

ANSWER:C

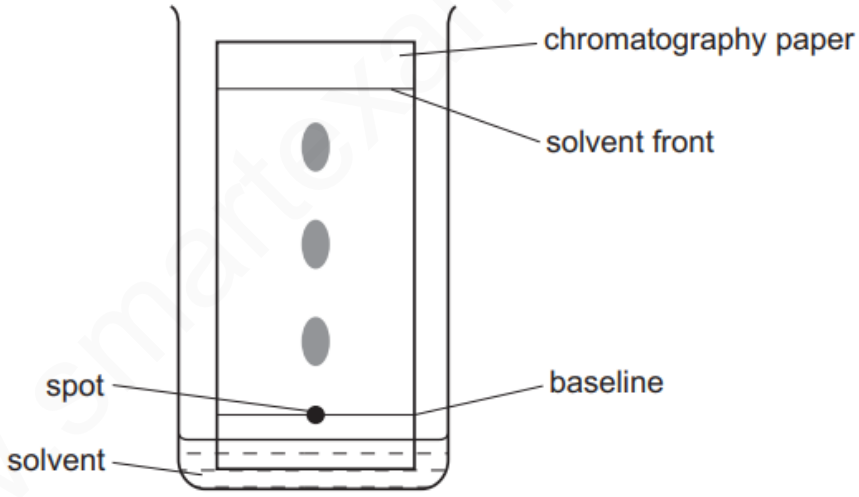
The paper chromatogram below was obtained from four different dyes.

Which dye has an R_f value of 0.7?



ANSWER:D

The diagram shows the apparatus used to separate the different components of a mixture by chromatography.



Which statement about this experiment is correct?

A A locating agent is used to find the position of the solvent front.

B The components to be separated must be soluble in the solvent.

C The baseline on which the spot of the mixture is placed is drawn in ink.

D The R_f value is calculated by $\frac{\text{the distance travelled by the solvent front}}{\text{the distance travelled by the component}}$

ANSWER: B

APPLICATION BASED QUESTIONS:-THEORY-NEW

A list of techniques used to separate mixtures is given below.

filtration

diffusion

fractional distillation

simple distillation

crystallisation

chromatography

From this list, choose the most suitable technique to separate the following mixtures. A technique may be used once, more than once or not at all.

(a) butane from a mixture of propane and butane ..... [1]

(b) oxygen from liquid air ..... [1]

(c) water from aqueous magnesium sulfate ..... [1]

(d) potassium chloride from aqueous potassium chloride ..... [1]

(e) silver chloride from a mixture of silver chloride and water ..... [1]

(f) glucose from a mixture of glucose and maltose ..... [1]

[Total: 6]

MARKING SCHEME:

4 **(a** diffusion or fractional distillation;

(b) fractional distillation;

(c) simple distillation;

(d) crystallisation;

(e) filtration;

(f) chromatography;

[Total: 6]

The following techniques are used to separate mixtures.

A simple distillation	**B** fractional distillation	**C** evaporation
D chromatography	**E** filtration	**F** diffusion

From this list, choose the most suitable technique to separate the following.

(a) methane from a mixture of the gases, methane and ethane ..... [1]

(b) water from aqueous magnesium sulfate ..... [1]

(c) glycine from a mixture of the amino acids, glycine and lysine ..... [1]

(d) iron filings from a mixture of iron filings and water ..... [1]

(e) zinc sulfate crystals from aqueous zinc sulfate ..... [1]

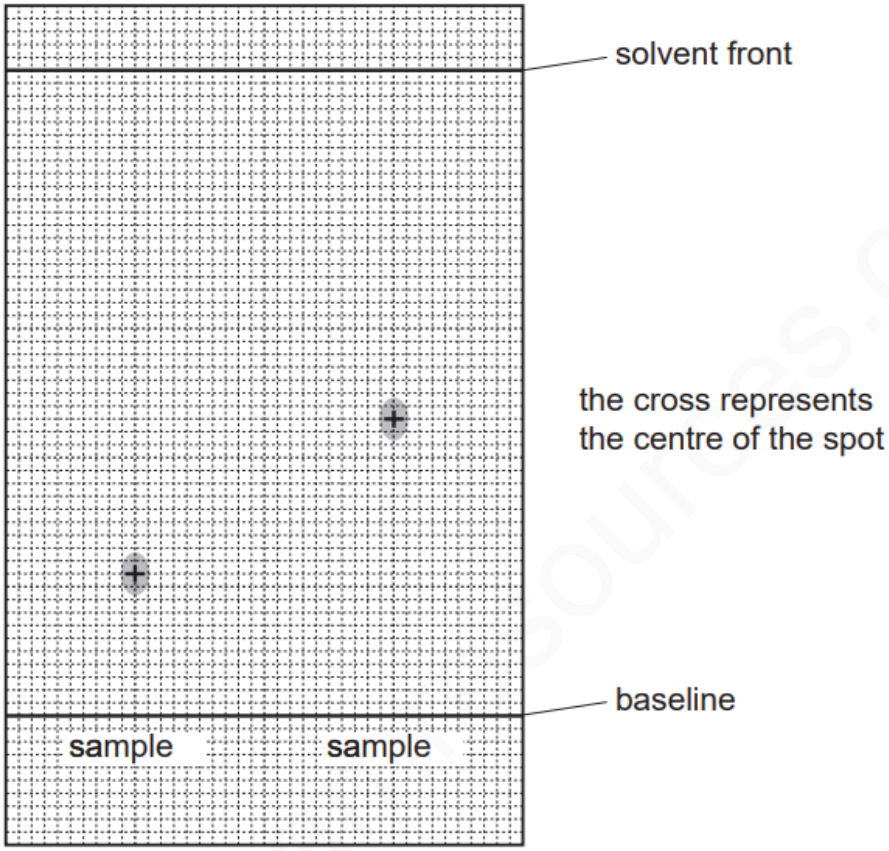
(f) hexane from a mixture of the liquids, hexane and octane ..... [1]

[Total: 6]

MARKING SCHEME:

(a)	F **or** B	diffusion / <u>fractional</u> distillation	[1]
(b)	A	simple distillation	[1]
(c)	D	chromatography	[1]
(d)	E	filtration	[1]
(e)	C	evaporation	[1]
(f)	B	<u>fractional</u> distillation	[1]

Esters can be used as solvents in chromatography. The following shows a chromatogram of plant acids.



An ester was used as the solvent and the chromatogram was sprayed with bromothymol blue.

(i) Suggest why it was necessary to spray the chromatogram.

.....

..... [2]

(ii) Explain what is meant by the R_f value of a sample.

.....

..... [1]

(iii) Calculate the R_f values of the two samples and use the data in the table to identify the plant acids.

plant acid	R_f value
tartaric acid	0.22
citric acid	0.30
oxalic acid	0.36
malic acid	0.46
succinic acid	0.60

sample 1 R_f = ... It is ..... acid.

sample 2 R_f = ... It is ..... acid. [2]

MARKING SCHEME:

to make colourless / invisible (spots) [1]
visible / coloured / seen / position made clear / indicate [1]

(ii) $\frac{\text{distance travelled by sample}}{\text{distance travelled by solvent (front)}} = R_f$ [1]

(iii) sample 1 R_f = 0.20 to 0.24 tartaric (acid) [1]
sample 2 R_f = 0.44 to 0.48 malic (acid) [1]