

Purity and Separating Mixtures

Q1. (2018)

7 Which statement correctly describes a pure substance?

- A Consists of just one element or compound
- B Has a low melting point
- C Is a mixture of two or more substances
- D Melts over a range of temperatures

Your answer

☐

[1]

Q2. (2018)

8 A student separates a dye using thin layer chromatography.

She puts a thin layer of solid alumina onto a glass plate. She puts the dye on the pencil line. She puts the glass plate into a tank containing water.

Which of the following is the **stationary** phase?

- A Alumina
- B Glass
- C Pencil line
- D Water

Your answer

☐

[1]

Q3. (2018)

20 A student has a mixture of three substances.

Look at some information about these substances.

Substance	Melting point (°C)	Boiling point (°C)	Solubility in water
Sand	1710	2230	Insoluble
Sodium chloride	801	1413	Soluble
Water	0	100	

A)

(a) Describe how the student can separate the mixture to get pure samples of all **three** substances.

Explain why each method of separation works.

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..... [4]

B)

- (b) The student separates two solid substances **A** and **B**.

She wants to check that they are **pure**.

She measures the melting points of four samples of solid **B**.

Look at her results.

Sample	Melting point (°C)
1	109
2	105
3	104–108
4	110–112

The student knows that a pure sample of solid **B** has a melting point of 110 °C.

She concludes that sample 4 is the purest sample of solid **B**.

Do the results support her conclusion?

Explain your answer using evidence from the table.

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..... [3]

Q4. (2019)

- 4 R_f values are used to compare the different spots on a chromatogram.

What is the formula used to calculate an R_f value?

- A $R_f = \frac{\text{distance travelled by solvent}}{\text{distance travelled by substance}}$
B $R_f = \frac{\text{distance travelled by substance}}{\text{distance travelled by solvent}}$
C $R_f = \frac{\text{distance travelled by stationary phase}}{\text{distance travelled by mobile phase}}$
D $R_f = \frac{\text{distance travelled by solvent}}{\text{distance travelled by mobile phase}}$

Your answer

☐

[1]

Q5. (2019)

- 12 Paper chromatography can be used to separate the colours in ink.

Water is the solvent used to separate the colours in water soluble ink.

What name is given to the water used in paper chromatography?

- A Absorption phase
B Liquid phase
C Mobile phase
D Stationary phase

Your answer

☐

[1]

Q6. (2019)

- 18 Simple distillation can be used to separate mixtures of liquids.

A scientist is using simple distillation to separate a mixture of alcohols.

Look at the table. It shows the boiling points of three alcohols.

Alcohol	Boiling point (°C)
Methanol	65
Ethanol	78
Propanol	97

A)

- (a) (i) Which alcohol will be distilled first?

Tick (✓) **one** box.

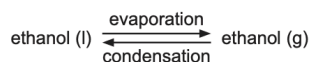
Methanol	☐
Ethanol	☐
Propanol	☐

Explain your answer.

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.....
..... [2]

B)

- (ii) Simple distillation uses evaporation and condensation to separate mixtures.



Describe the change in the **arrangement** of particles as substances evaporate.

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..... [1]

C)

- (iii) Describe the change in the **movement** of particles as substances evaporate.

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..... [1]

D)

- (iv) The scientist wants to improve the separation of the mixture of alcohols.

Suggest a piece of equipment he could use.

Explain how this will improve the separation of the mixture of alcohols.

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.....
..... [2]

E)

- (b) Ethanol can be used as a biofuel. The combustion of ethanol is an **exothermic** reaction.

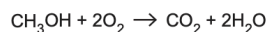
Explain why combustion is an exothermic reaction.

Use ideas about bond breaking and bond making in your answer.

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.....
..... [1]

F)

- (c) (i) Methanol is another biofuel that can be used in combustion reactions.



Look at the table. It shows some bond energies.

Bond	Bond energy (kJ/mol)
C-H	413
O=O	498
C-O	358
C=O	805
O-H	464

Calculate the energy transferred to break all the bonds in the reactants.

Energy transferred = kJ/mol [2]

Q7. (2020)

- 2 Which purification technique is used to separate ethanol and water from a mixture?

- A Chromatography
- B Distillation
- C Evaporation
- D Filtration

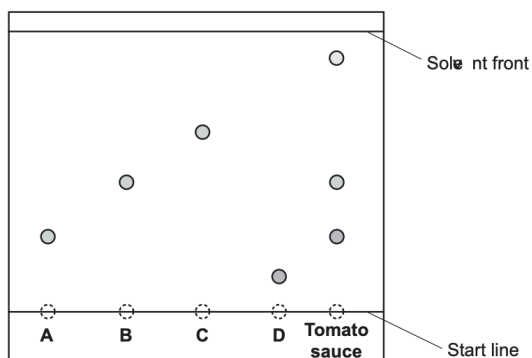
Your answer

[1]

Q8. (2020)

20 A student analyses a sample of tomato sauce using thin-layer chromatography.

The tomato sauce was compared to four known food additives, **A**, **B**, **C** and **D**, as shown in the chromatogram.



A)

(a) (i) Calculate the R_f value for **C**.

Give your answer to 2 significant figures.

R_f value = [3]

B)

(ii) Which additives are shown to be in the tomato sauce?

Tick (✓) **all the correct** boxes.

A ☐

B ☐

C ☐

D ☐

[1]

C)

(iii) Suggest why **D** has **not** travelled as far up the plate as **C**.

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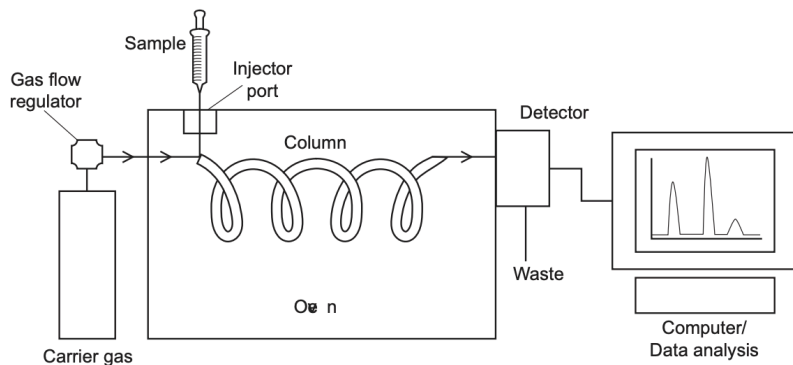
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..... [1]

D)

- (b) Gas chromatography is another type of chromatography.

The diagram shows the equipment used for gas chromatography.



- (i) State **one similarity** and **one difference** between gas chromatography and thin-layer chromatography.

Similarity

.....

Difference

.....

[2]

E)

- (ii) Explain why thin-layer chromatography is used instead of gas chromatography to analyse the tomato sauce.

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..... [1]

Q9. (2021)

- 13 A student investigates if an unknown liquid sample is pure.

Which method should the student use?

- A Filter the sample to see if any solid can be separated.
B Gas chromatography.
C Measure the boiling point of the sample.
D Titration.

Your answer

☐

[1]

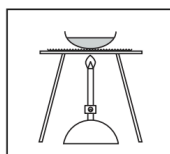
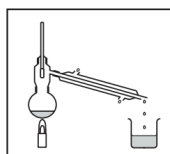
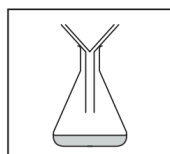
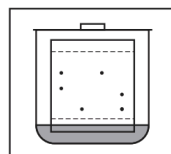
Q10. (2021)

17 The table shows information about some properties of four substances.

Substance	Melting point (°C)	Boiling point (°C)	Solubility in water	Does the substance conduct electricity?
M	−98	65	Soluble	No
N	−114	78	Soluble	No
O	661	1304	Soluble	Only when molten or dissolved
P	1085	2562	Insoluble	Yes

A)

- (a) Which diagram shows the apparatus that should be used to separate a mixture of substance M and substance N? Tick (✓) **one** box.


☐

☐

☐

☐

[1]

B)

- (b) (i) Describe a method that could be used to separate a mixture of substance O and substance P to obtain pure samples.

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 [3]

C)

- (ii) A student separates substance O from a mixture.

They start with 6.2 g of the mixture and obtain 2.6 g of pure substance O.

Calculate the mass of pure substance O that could be separated from 10.0 g of the mixture.

Give your answer to 3 significant figures.

Mass of pure substance O = g [3]

[1]

Q12. (2022)

- 7 A student wants to separate substances by filtration.

They write a method for the experiment but **not** in the correct order as shown.

1. Pour the mixture through the funnel into the conical flask.
2. Fold the filter paper.
3. Collect the filtrate in the conical flask.
4. Put the filter paper into the funnel.
5. Collect any insoluble substances on the filter paper.

What is the correct method order for this experiment?

- A** 1, 2, 4, 5, 3
B 2, 1, 4, 5, 3
C 2, 4, 1, 5, 3
D 4, 2, 5, 3, 1

Your answer

[1]

Q13. (2022)

- 12 A scientist investigates the melting point of some substances that may contain paracetamol as shown in the table.

The melting point of pure paracetamol is 169 °C.

Substance	Melting point (°C)
1	169
2	156
3	166 – 169
4	170 – 174

Which statement about the results is correct?

- A** All of the substances contain paracetamol.
B Substance 2 does not contain paracetamol.
C Substance 3 is pure paracetamol.
D Substance 4 is impure paracetamol.

Your answer

[1]

Q14. (2022)

A)

- 17 A student has a sample of a **liquid**.

- (a) (i) State a method the student uses to find out if the sample is **pure**.

..... [1]

B)

- (ii) The student finds out that the sample is **impure**.

The sample contains hexane, C₆H₁₄, and cyclohexane, C₆H₁₂.

What is the **empirical formula** of hexane?

..... [1]

C)

- (iii) The boiling point of hexane is lower than the boiling point of cyclohexane.

Describe a method the student could use to obtain a sample of **pure** hexane from the mixture of cyclohexane and hexane.

You can include a labelled diagram in your answer.

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.....

..... [4]

D)

- (b) (i) The student obtains 12.0 g of hexane from 15.2 g of the mixture of hexane and cyclohexane.

Calculate the percentage of hexane obtained.

Give your answer to 2 significant figures.

Percentage of hexane = % [2]

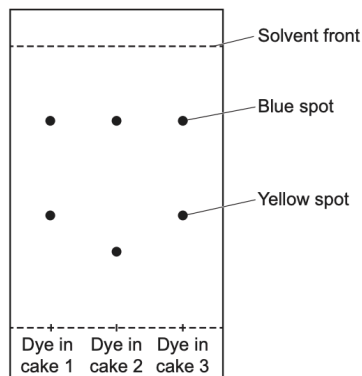
Q15. (2022)

20 Three cakes each contain a different brand of food colouring dye.

- The colour is the same in each cake, but the taste in one is different.
- The cakes' baker thinks it is because of the food colouring dye.

(a) The baker compares the food colouring dyes that were used in the three different cakes using thin layer chromatography. The chromatogram is shown in Fig. 20.1.

Fig. 20.1



A)

(i) Calculate the R_f value of the blue spot in the dye in cake 3.

Give your answer to 2 significant figures.

R_f value of blue spot in the dye in cake 3 = [3]

B)

(ii) Which of the cakes would you expect to taste the same?

Explain your answer using data from Fig. 20.1.

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..... [2]

C)

(b) The baker thinks the dyes are mixtures where the substances are combined in exact amounts.

(i) What is the name given to this type of mixture?

..... [1]

D)

(ii) Brass is also a mixture of different substances combined in exact amounts.

What type of substance is brass?

Tick (✓) **one** box.

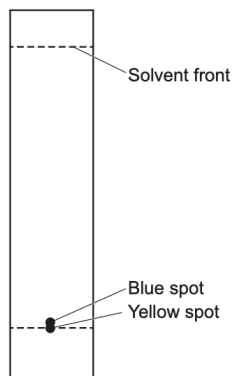
- | | |
|-----------|--------------------------|
| Allotrope | ☐ |
| Alloy | ☐ |
| Fullerene | ☐ |
| Isotope | ☐ |
| Polymer | ☐ |

[1]

E)

(c) The student tests another dye. The chromatogram is shown in Fig. 20.2.

Fig. 20.2



What should the student change in their experiment to separate the blue and yellow spots?

..... [1]

Q16. (2023)

- 2 Which equipment is needed for distillation?
- A Condenser, funnel, thermometer
- B Condenser, round-bottomed flask, thermometer
- C Thermometer, beaker, pH probe
- D Thermometer, measuring cylinder, filter paper

Your answer

[1]

Q17. (2023)

- 6 Which fraction is collected at the **top** of the fractional distillation column?

	Melting point range (°C)	Boiling point range (°C)
A	-70 – -60	20 – 25
B	-50 – -40	30 – 50
C	0 – 20	100 – 120
D	20 – 40	130 – 160

Your answer

[1]

Q18. (2023)

- 15 A student investigates some samples using gas chromatography.

The student also measures the melting point of each sample.

Which results should the student expect from a **pure** sample?

	Gas chromatogram	Melting point (°C)
A	3 peaks	123–127
B	1 peak	123–127
C	2 peaks	125
D	1 peak	125

Your answer

[1]

Q19. (2023)

- 20 (a) A scientist has a sample of seawater. The sample contains sand, water and salt.

The scientist wants to collect **pure** samples of:

- sand
- water
- salt.

Describe a method the scientist could use to separate and collect the sand, water and salt.

You can include labelled diagrams in your answer.

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[4]

Q20. (2023) – 20c (iii)

Context:

- 20 (a) A scientist has a sample of seawater. The sample contains sand, water and salt.

The scientist wants to collect **pure** samples of:

- sand
- water
- salt.

Question:

- (c) Seawater can contain isotopes of sulfur.

- (iii) A scientist wants to separate magnesium sulfate from other compounds using thin layer chromatography.

The spot does **not** move from the start line on the chromatogram.

State what the scientist should change so that magnesium sulfate is separated from the other compounds.

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[1]

Q21. (2024) – 16b

Context:

16

- (a) A scientist investigates dissolving four different tablets in water.

Each tablet has a different surface area.

They add each tablet to 20 cm³ of water and time how long it takes for the tablet to dissolve.

The table shows their results.

Tablet	Surface area of tablet (cm ²)	Volume of tablet (cm ³)	Surface area to volume ratio	Time taken to dissolve (seconds)
A	2.8	0.3	9.33 : 1	43
B	2.5	0.2	12.5 : 1	27
C	1.5	0.2		62
D	3.0	0.2	15.0 : 1	

Question:

A)

- (b) The scientist performs thin layer chromatography on solutions of each of the tablets.

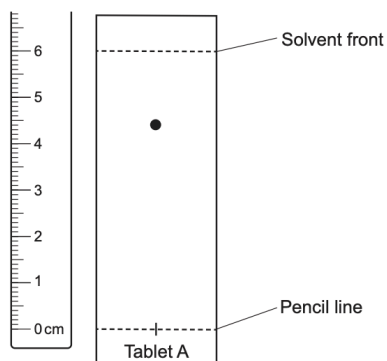
- (i) The spots on the chromatogram are **colourless**.

State what the scientist could use to see the spots.

..... [1]

B)

- (ii) After the scientist uses a method to see the spots, the chromatogram for Tablet A is shown.



Calculate the R_f value for the spot seen from tablet A.

R_f value = [3]

Q22. (2024)

- 17 A student wants to separate a mixture of compounds.

Different separation methods are used depending on the mixture.

A)

- (a) Draw lines to connect each **separation method** to the correct **mixture**.

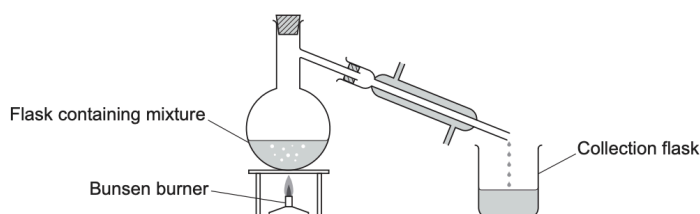
Separation method	Mixture
Crystallisation	Insoluble solid and liquid
Filtration	Solution containing a soluble solid dissolved in a liquid
Fractional distillation	Three liquids with different boiling points

[2]

B)

- (b) The student decides to use simple distillation to separate a mixture.

They set up the apparatus shown in the diagram.



- (i) A liquid in the mixture is **flammable**.

Suggest a change the student could make to the apparatus to make the distillation safer.

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..... [1]

C)

- (ii) The student wants to record the boiling point of the pure liquid that is collected in the collection flask.

Suggest an improvement the student could make to the apparatus so that they can record the boiling point.

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..... [1]

Q23. (2024)

- 22 A student is making a sample of magnesium carbonate, MgCO_3 .

The table gives information about four different methods the student could use.

Method	Cost of starting materials (£)	Mass of MgCO_3 produced (g)	Is the MgCO_3 pure?
1	12.11	6.24	yes
2	11.37	16.90	no
3	15.23	15.34	yes
4	20.50	10.86	no

A)

- (a) Which method should the student use to make their sample?

Explain your answer.

Method

Reason.....

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.....

[3]

B)

- (b) A teacher shows the student how to purify magnesium carbonate.

If the student knows how to purify magnesium carbonate, should they use the **same** method as they used in part (a)?

Explain your answer.

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..... [1]