

Purity and Separating Mixtures (H)

1. The accurate relative atomic mass of aluminium is 26.9815385.

What is this number to **5** significant figures?

- A 26.98153
- B 26.981
- C 26.98154
- D 26.982

Your answer

[1]

2. The formula of ammonium carbonate is $(\text{NH}_4)_2\text{CO}_3$.

What is the relative formula mass of ammonium carbonate?
(A r: C = 12, H = 1, N = 14, O = 16)

- A 78
- B 90
- C 96
- D 120

Your answer

[1]

3. Which purification technique is used to separate ethanol and water from a mixture?

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

Your answer

[1]

4. What is the amount, in mol, of 15 g of carbonate ions, CO_3^{2-} ?

- A 0.18
- B 0.25
- C 4.0
- D 5.6

Your answer

[1]

5. 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]

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

What is the formula used to calculate an R_f value?

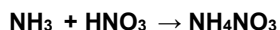
- A $R_f = \frac{\text{distance travelled by solvent}}{\text{distance travelled by substance}}$
- B $R_f = \frac{\text{distance travelled by substance}}{\text{distance travelled by solvent}}$
- C $R_f = \frac{\text{distance travelled by stationary phase}}{\text{distance travelled by mobile phase}}$
-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

Your answer

[1]

7. Ammonium nitrate, NH_4NO_3 , is a fertiliser made from ammonia.

Ammonium nitrate is made by reacting ammonia with nitric acid.



i. Calculate the mass of **ammonium nitrate** that could be made from 25.5 tonnes of ammonia.

A r: H = 1.0, N = 14.0, O = 16.0

Mass of ammonium nitrate = tonnes **[3]**

ii. A student makes some ammonium nitrate in the laboratory.

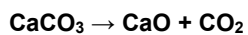
He predicts that he should make 12.5 g of ammonium nitrate.

His percentage yield is 80%.

Calculate the **actual mass** of ammonium nitrate that the student makes.

Actual mass of ammonium nitrate g **[2]**

8. Calcium carbonate thermally decomposes to make calcium oxide and carbon dioxide.



Calculate the mass of calcium carbonate needed to make 209g of calcium oxide.

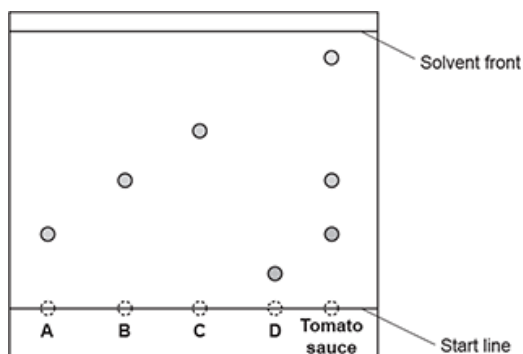
(A r: Ca = 40.1, C = 12.0, O = 16.0)

Give your answer to **3** significant figures.

Mass of calcium carbonate = g **[4]**

9 (a). 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.



i. Calculate the R_f value for **C**.

Give your answer to **2** significant figures.

R_f value = [3]

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

Tick (✓) **all the correct** boxes.

- A
- B
- C
- D

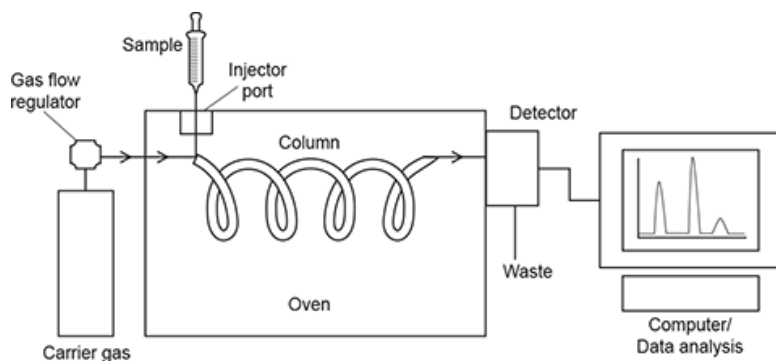
[1]

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

----- [1]

(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]

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

[1]

10. 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 |

i. Which alcohol will be distilled first?

Tick (✓) **one** box.

Methanol

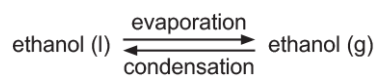
Ethanol

Propanol

Explain your answer.

[2]

ii. Simple distillation uses evaporation and condensation to separate mixtures.



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

[1]

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

[1]

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.

----- [2]

11 (a). An alloy is a mixture of a metal with one or more other elements.

When lithium is mixed with aluminium it makes an alloy that can be used in aircraft.

Adding different amounts of lithium to the aluminium changes the properties of the alloy.

| Alloy | Percentage of lithium (%) | Density (g / cm ³) | Melting point (°C) | Strength (MPa) |
|-------|---------------------------|--------------------------------|--------------------|----------------|
| A | 2.00 | 2.58 | 670 | 550 |
| B | 2.20 | 2.56 | 580 | 555 |
| C | 2.45 | 2.55 | 655 | 565 |

A scientist thinks that alloy C is best for making an aircraft.

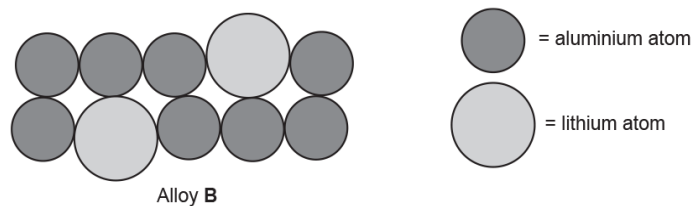
Is she correct?

Explain your answer using evidence from the table.

----- [2]

(b). The scientist uses the particle model to show the elements present in alloy **B**.

Look at her diagram.



not to scale

i. Calculate the **percentage of lithium atoms** in the diagram of alloy **B**.

Percentage of lithium atoms = % [1]

ii. Use your answer to part (i) to explain if the diagram accurately shows the structure of alloy **B**.

----- [1]

12. Tim is separating the colours in a sample of black ink using paper chromatography.

He puts a spot of black ink onto filter paper.

He dips the filter paper into ethanol in a beaker.

What is the name given to **ethanol** in this experiment?

- A. gas phase
- B. mobile phase
- C. solid phase
- D. stationary phase

Your answer

[1]

13 (a). A student is separating a mixture of three substances, **A**, **B** and **C**.

Look at the table. It gives information about these substances.

| Substance | State at room temperature | Melting point (°C) | Boiling point (°C) | Solubility in water |
|-----------|---------------------------|--------------------|--------------------|---------------------|
| A | liquid | 0 | 100 | soluble |
| B | liquid | -117 | 78 | soluble |
| C | solid | 1535 | 2750 | insoluble |

A and **B** mix together completely.

* Suggest how the student can separate the mixture to get pure samples of substances **A**, **B** and **C**.

Explain in detail how each method works.

[6]

(b). The student has separated a **pure** sample of substance **B** from the mixture.

Suggest how the student can check that the sample of substance **B** is pure.

[2]

14. The **molecular formula** of decene is $C_{10}H_{20}$.

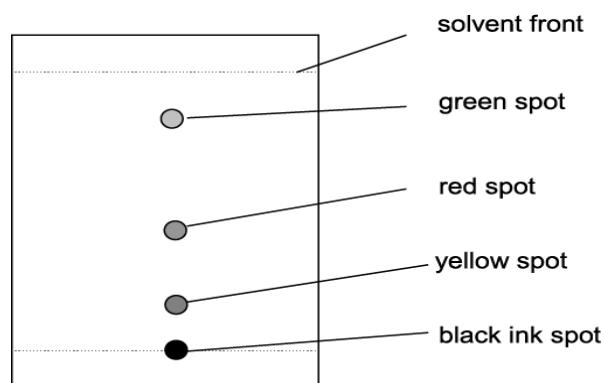
What is the **empirical formula** of decene?

- A. CH_2
- B. C_2H_4
- C. C_5H_{10}
- D. $C_{20}H_{40}$

Your answer

[1]

15. Look at Tim's chromatogram.



What is the R_f value of the **green** spot? Use a ruler to help you.

- A. 0.17
- B. 0.42
- C. 0.83
- D. 1.00

Your answer

[1]

END OF QUESTION PAPER