

Purity and Separating Mixtures

Total Marks: 23

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]

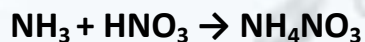
6. R_f values are used to compare the different spots on a chromatogram. What is the formula used to calculate an R_f value?

- 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.

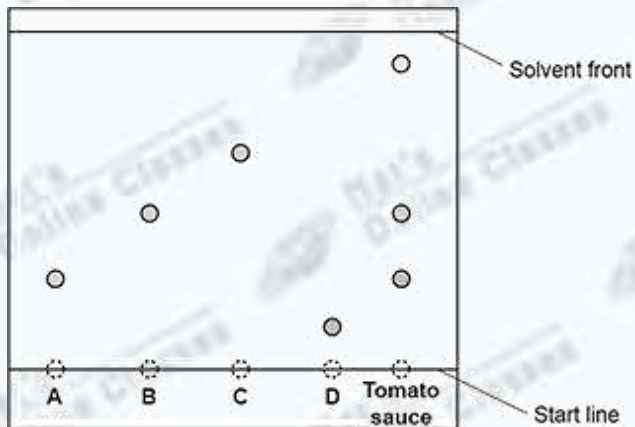
Mass of calcium carbonate =

..... 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

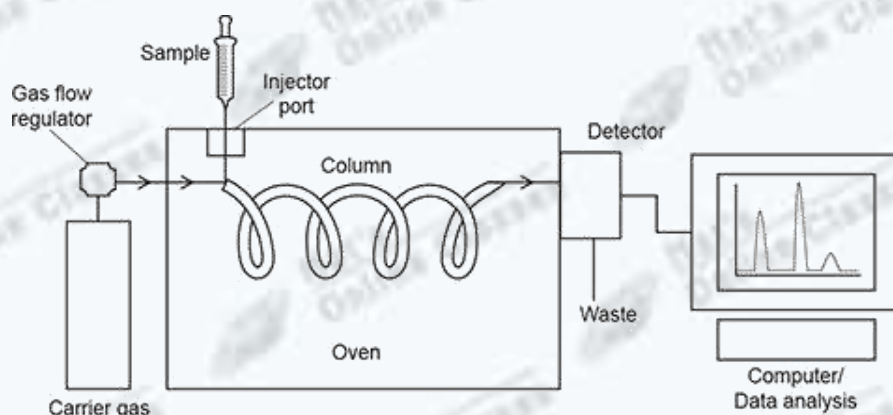
[1]

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]

Mark scheme

Question		Answer/Indicative content	Marks	Guidance
1		D ✓	1 (AO1.1)	
		Total	1	
2		C ✓	1 (AO 2.2)	
		Total	1	
3		B ✓	1 (AO2.2)	
		Total	1	
4		B ✓	1(AO2.2)	
		Total	1	
5		C ✓	1(AO1.2)	
		Total	1	
6		B ✓	1(AO1.1)	
		Total	1	
7	i	<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 120 (tonnes) award 3 marks</p> <p>Mr of NH₃ = 17 AND Mr of NH₄NO₃ = 80 ✓</p> <p>Mass of ammonium nitrate = $\times 25.5 / 1.5$ $\times 80$ ✓</p> <p>= 120 (tonnes) ✓</p>	3 (AO2.1)	ALLOW ECF from incorrect RMMs

		<p style="text-align: center;">□</p> <p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 10(g) award 2 marks</p> <p>ii</p> <p>Actual mass ✓</p> <p>= 10 (g) ✓ $= \frac{80 \times 12.5}{100}$</p>	<p style="text-align: center;">2</p> <p>(AO1.2)</p> <p>(AO2.2)</p> <p>ALLOW % yield = (am ÷ pm) × 100 OR 80 = (am ÷ 12.5) × 100 for 1 mark if no other mark awarded</p>
		Total	5
8		<p>FIRST CHECK ANSWER ON ANSWER LINE If answer = 373 (tonnes) award 4 marks</p>	4

		<p>$M_r \text{ CaCO}_3 = 100.1$ and $M_r \text{ CaO} = 56.1$ ✓</p> <p>_____</p> <p>$= 372.9215686 \text{ (g)}$ ✓</p> <p>$= 373 \text{ (g)}$ (3 significant figures) ✓</p>	<p>(AO3 × 2.2)</p> <p>(AO1.2)</p>	<p>Need both relative formula masses for 1 mark</p> <p>DO NOT ALLOW 100 or 56</p> <p>ALLOW ECF from incorrect RFMs</p> <p>ALLOW ECF</p> <p>ALLOW ECF for sig fig mark</p>
		Total	4	
9	a	<p>FIRST CHECK ANSWER ON ANSWER LINE</p> <p>If answer = 0.62 award 3 marks</p> <p>✓</p> <p>$= 0.61666\dots$ ✓</p> <p>$= 0.62$ (2 significant figures) ✓</p>	<p>3</p> <p>(AO1.1)</p> <p>(AO2.2)</p> <p>(AO1.2)</p>	<p>ALLOW ECF for use of correct calculation</p> <p>from incorrect measurements</p> <p>ALLOW 0.59 – 0.67</p> <p>ALLOW ECF for sig fig mark</p>
		<p>ii</p> <p>A and B</p>	<p>1</p> <p>(AO3.2a)</p>	<p>Both needed for the mark</p>
		<p>iii</p> <p>Idea that D forms weak(er) bonds with the mobile phase than C /</p> <p>Idea that D forms strong(er) bonds with stationary phase than C /</p> <p>D is less polar than C / ORA ✓</p>	<p>1</p> <p>(AO2.1)</p>	<p>ALLOW C is more soluble (in the solvent) than D / ORA</p>
	b	<p>i</p> <p>Similarity: Both have stationary and mobile phases / both use silica in the stationary phase ✓</p> <p>Difference: Thin-layer uses liquid for mobile phase / gas chromatography use gas for mobile phase ✓</p>	<p>2</p> <p>(AO2 × 1.1)</p>	<p>ALLOW the mobile phases are different states</p>
		Thin-layer chromatography is used to		

		ii	separate solids / gas chromatography is used to separate gases (in a gas mixture) ✓	1 (AO2.1)	ALLOW idea that the tomato sauce is a liquid or not a gas
			Total	8	