

Name: _____

Atmosphere part 1 AQA Triple Chemistry

Class: _____

Date: _____

Time: **78 minutes**

Marks: **73 marks**

Comments:

1.

This question is about chemical analysis.

Some metal ions can be identified using a flame test.

(a) Describe how to do a flame test using a metal wire and a Bunsen burner.

(2)

(b) Draw **one** line from each metal ion to the flame colour produced by the metal ion.

Metal ion	Flame colour
	Crimson
Lithium	Green
	Lilac
Potassium	Orange-red
	Yellow

(2)

(c) Which gas is produced when carbonates are reacted with dilute acids?

Tick (✓) **one** box.

Carbon dioxide	<input type="checkbox"/>
Hydrogen	<input type="checkbox"/>
Oxygen	<input type="checkbox"/>

(1)

(d) Which solution is used to test for sulfate ions?

Tick (✓) **one** box.

Barium chloride solution

Magnesium chloride solution

Sodium chloride solution

(1)

Precipitates are used to identify some ions.

(e) Complete the sentence.

Choose the answer from the box.

gas	liquid	solid
------------	---------------	--------------

A precipitate is a _____.

(1)

(f) Some metal ions in solution can be identified by adding sodium hydroxide solution.

Draw **one** line from each metal ion to the colour of the precipitate produced by the metal ion.

Metal ion	Colour of precipitate
	Blue
Copper(II)	Brown
	Green
Magnesium	White
	Yellow

(2)

(g) Dilute nitric acid and silver nitrate solution were added to a solution containing iodide ions.

Complete the sentence.

Choose the answer from the box.

brown	green	yellow
--------------	--------------	---------------

The colour of the precipitate produced is _____.

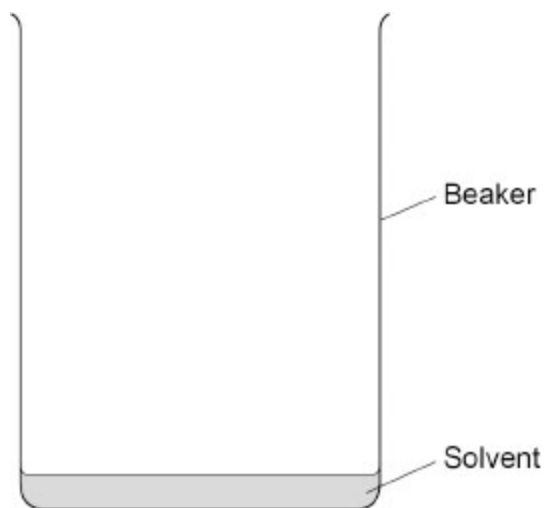
(1)

(Total 10 marks)

2.

This question is about chromatography.

The figure below shows some equipment used for paper chromatography.



(a) Complete the figure above to show how the equipment can be used to separate the dyes in an ink.

You should draw and **label**:

- a piece of chromatography paper **in the beaker**
- a start line on the chromatography paper
- a spot of the ink on the chromatography paper at the **start** of the experiment.

(3)

(b) Why should a pencil be used to draw the start line on the chromatography paper?

(1)

The R_f value of a dye was 0.80

A spot of the dye moved a distance of 5.2 cm.

(c) Calculate the distance moved by the solvent.

Use the equation:

$$R_f = \frac{\text{distance moved by spot}}{\text{distance moved by solvent}}$$

Distance moved by solvent = _____ cm

(3)

(d) How is the distance moved by the spot of the dye measured?

Tick (✓) **one** box.

From the start line to the bottom of the spot

From the start line to the centre of the spot

From the start line to the top of the spot

(1)

(e) Which **two** changes could produce a different R_f value for this dye?

Tick (✓) **two** boxes.

Use a different beaker.

Use a different length of time.

Use a different sized spot of dye.

Use a different solvent.

Use a different type of chromatography paper.

(2)

(f) A different dye is a pure substance.

How many spots will this dye produce during chromatography?

(1)

(g) Which is an advantage of using gas chromatography instead of paper chromatography?

Choose the answer from the box.

less sensitive

more accurate

slower

Gas chromatography is _____.

(1)

(Total 12 marks)

3.

This question is about paper chromatography.

A student investigated substance **Y** using paper chromatography.

This is the method used.

1. Draw a start line in ink on a piece of chromatography paper.
2. Put spots of four different dyes, **A**, **B**, **C** and **D**, and a spot of substance **Y** on the start line.
3. Dip the paper into water so that the water level is below the start line.
4. Wait until the water has risen to near the top of the paper.

(a) The student's method contains a mistake in **Step 1**.

What is the mistake in **Step 1**?

Give **one** reason for your answer.

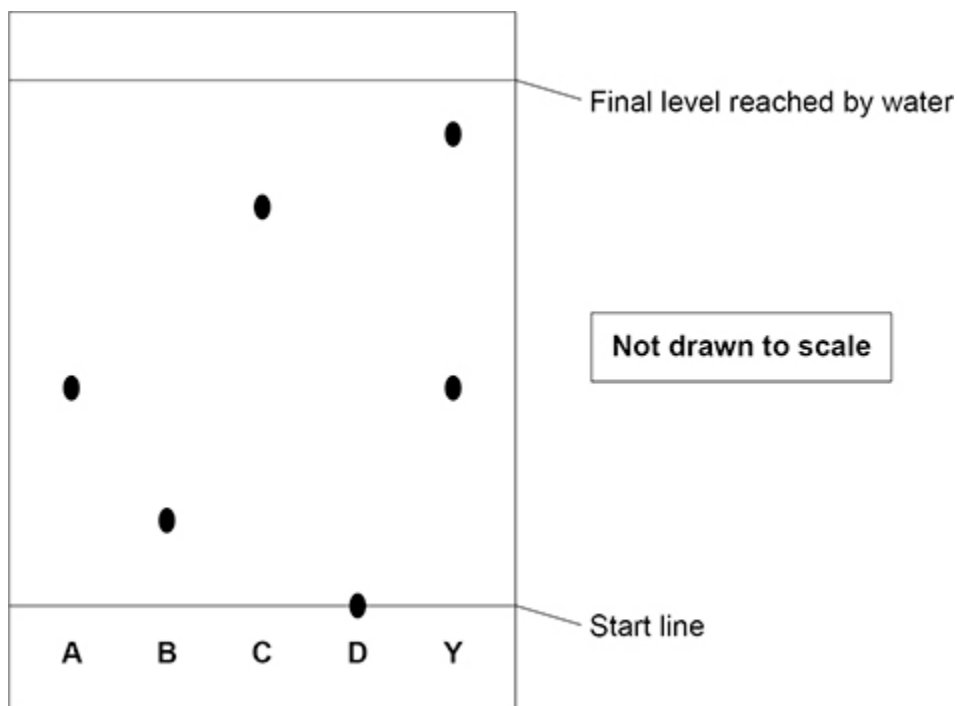
Mistake _____

Reason _____

(2)

A different student used a method which gave valid results.

The figure below shows the results.



(b) How many different dyes are in substance Y?

Use the figure above.

(1)

(c) Which of the four dyes, **A**, **B**, **C** and **D**, could be in substance **Y**?

Give **one** reason for your answer.

Use the figure above.

Dye _____

Reason _____

(2)

(d) Suggest why dye **D** remained on the start line at the end of the investigation.

Use the figure above.

(1)

(e) The student determined that:

- the distance moved by the water was 6.0 cm
- the distance moved by dye **A** was 2.4 cm.

Calculate the R_f value of dye **A**.

Use the equation:

$$R_f = \frac{\text{distance moved by dye A}}{\text{distance moved by water}}$$

$R_f =$ _____

(2)

(f) Complete the sentence.

Choose the answer from the box.

solute	solution	solvent
---------------	-----------------	----------------

The water in **step 3** is used as a _____ .

(1)

(Total 9 marks)

4.

A student analysed three solutions, **A**, **B** and **C**.

Each solution contained one ionic compound.

The student added a few drops of sodium hydroxide solution to solution **A**.

Solution **A** produced a white precipitate.

Aluminium ions produce a white precipitate with a few drops of sodium hydroxide solution.

- (a) Name **one other** metal ion which produces a white precipitate with a few drops of sodium hydroxide solution.

(1)

- (b) Describe how the student could confirm the presence of aluminium ions in solution **A**.

Give the result of the test.

Test _____

Result _____

(2)

The student tested solution **B** to identify the ions present.

- (c) The student did a flame test on solution **B**.

An orange-red flame was produced.

Write the symbol for the metal ion in solution **B**.

(1)

- (d) The student added dilute nitric acid followed by silver nitrate solution to solution **B**.

A white precipitate was produced.

Write the symbol for the non-metal ion in solution **B**.

(1)

The student added 1.0 mol/dm^3 nitric acid to solution **C**.

Bubbles of gas were produced.

- (e) Describe a test on the bubbles of gas that confirms that solution **C** contained carbonate ions.

Give the result of the test.

Test _____

Result _____

(2)

- (f) The student repeated the test on solution **C** using 1.0 mol/dm^3 ethanoic acid instead of 1.0 mol/dm^3 nitric acid.

Bubbles of gas were produced more slowly using ethanoic acid.

Explain why.

(4)

(Total 11 marks)

5.

A student investigated an aqueous solution of a salt.

The student identified that the salt solution contained only sodium ions and chloride ions.

(a) Describe a test to identify sodium ions.

Give the result of the test.

Test for sodium ions _____

Result _____

(2)

(b) Describe a test to identify chloride ions.

Give the result of the test.

Test for chloride ions _____

Result _____

(2)

The student determined the concentration of sodium chloride in the salt solution.

This is the method used.

1. Weigh an empty evaporating dish.
2. Add 25.0 cm³ of the salt solution into the evaporating dish.
3. Heat the evaporating dish and contents.
4. Weigh the evaporating dish and contents.
5. Repeat steps 3 to 4 until there is no further change in mass.
6. Repeat steps 1 to 5 three more times.

(c) Why did the student heat the evaporating dish and contents until the mass did not change?

(1)

- (d) How did the student calculate the mass of solid sodium chloride remaining after steps 1 to 5?

Tick (✓) **one** box.

Mass of 25 cm³ of salt solution + mass of empty evaporating dish

Mass of 25 cm³ of salt solution – mass of empty evaporating dish

Mass of evaporating dish and dry contents + mass of empty evaporating dish

Mass of evaporating dish and dry contents – mass of empty evaporating dish

(1)

- (e) The student calculated the concentration of sodium chloride in the salt solution.

The table below shows the results.

Concentration of sodium chloride in g/dm ³			
Trial 1	Trial 2	Trial 3	Trial 4
35.2	34.6	36.4	33.8

The percentage by mass of sodium ions in sodium chloride is 39.3%.

Calculate the mean concentration of sodium ions in the salt solution.

Mean concentration = _____ g/dm³

(4)

(Total 10 marks)

6.

This question is about sulfuric acid.

(a) Sulfuric acid contains sulfate ions.

Describe the test for the presence of sulfate ions in sulfuric acid.

Give the result of the test.

Test _____

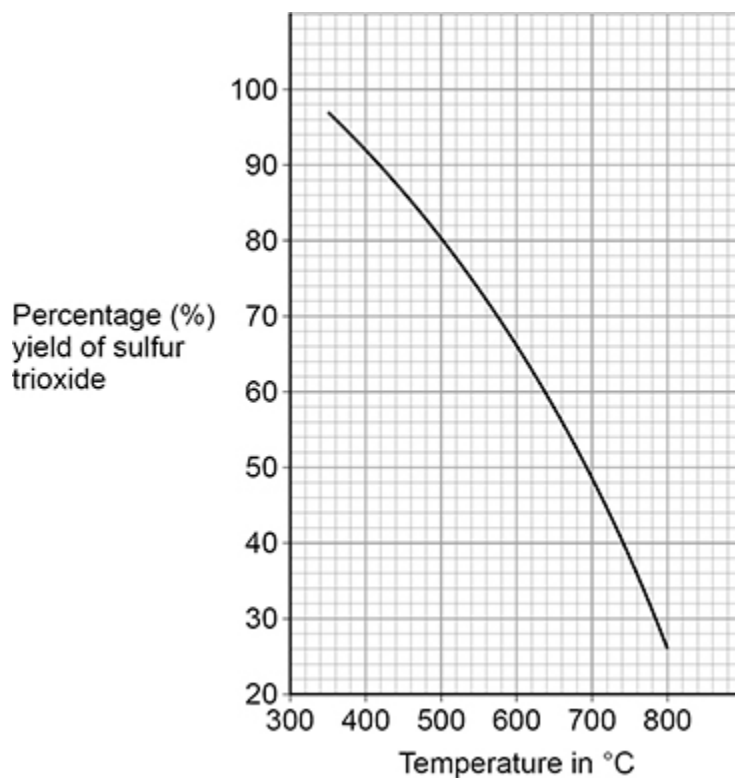
Result _____

(2)

One stage in the industrial production of sulfuric acid is the reaction of sulfur dioxide with oxygen to produce sulfur trioxide.

This reversible reaction reaches dynamic equilibrium.

The figure below shows the percentage yield of sulfur trioxide in this reaction at different temperatures.



(b) Which statement about the forward reaction is correct?

Use the above figure.

Tick (✓) **one** box.

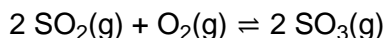
The yield is greater at higher temperatures because the reaction is exothermic.

The yield is greater at higher temperatures because the reaction is endothermic.

The yield is smaller at higher temperatures because the reaction is exothermic.

The yield is smaller at higher temperatures because the reaction is endothermic.

The equation for the reaction is:



(1)

(c) Explain why the percentage yield of sulfur trioxide in this reaction is greater if the pressure is higher.

(2)

(d) In industry, the reaction is done at 450 °C and atmospheric pressure.

Under these conditions the yield of sulfur trioxide is 86%.

Suggest **two** reasons why a higher pressure is **not** used.

1 _____

2 _____

(2)

(e) This reaction uses a catalyst to increase the rate of the reaction.

The catalyst is a metal oxide.

Which is the most likely metal in the metal oxide catalyst?

Use the periodic table.

Tick (✓) **one** box.

- | | |
|----------------|--------------------------|
| Aluminium (Al) | <input type="checkbox"/> |
| Barium (Ba) | <input type="checkbox"/> |
| Potassium (K) | <input type="checkbox"/> |
| Vanadium (V) | <input type="checkbox"/> |

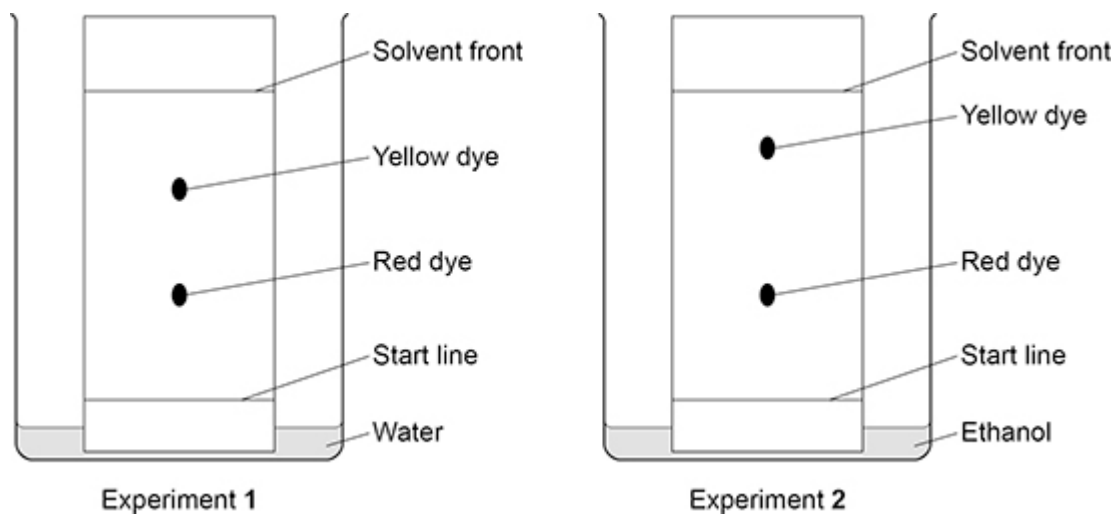
(1)
(Total 8 marks)

7.

A student investigated an orange dye (A) using paper chromatography.

Figure 1 shows the results of Experiment 1 and Experiment 2 using orange dye A.

Figure 1



- (a) Explain why the yellow dye and red dye travel different distances in Experiment 1.

Refer to forces of attraction between the dyes and the chromatography paper in your answer.

(2)

- (b) The student used the same type of chromatography paper in Experiment 1 and in Experiment 2.

Explain why the yellow dye is in different positions in Experiment 1 and in Experiment 2.

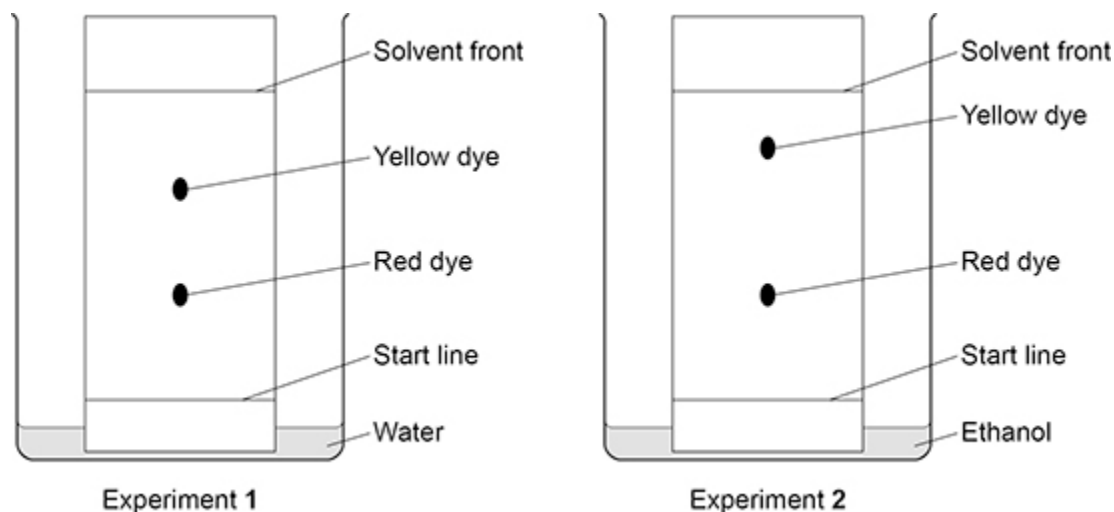
Use **Figure 1**.

(3)

Figure 1 is repeated below.

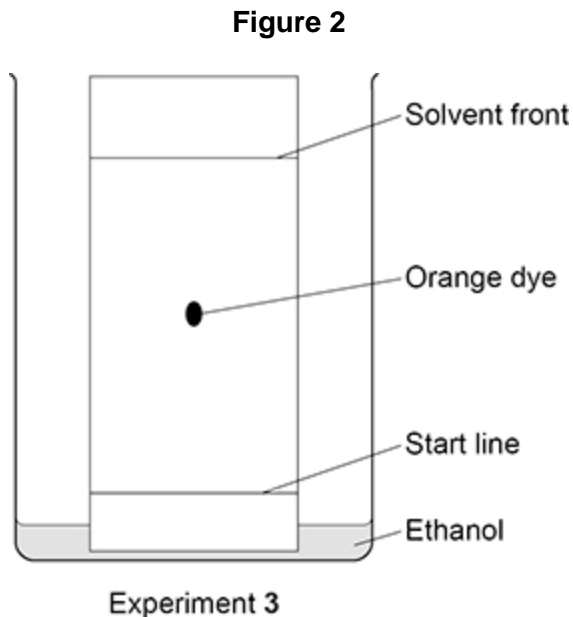
Figure 1 shows the results of Experiment 1 and Experiment 2 using orange dye A.

Figure 1



The student investigated a different orange dye (**B**).

Figure 2 shows the results of Experiment 3 using orange dye **B**.



(c) Compare the purity of the orange dyes **A** and **B**.

Give reasons for your answer.

Use **Figure 1** and **Figure 2**.

(2)

(d) The student calculated that the R_f value of the orange dye in the experiment shown in **Figure 2** was 0.48

Calculate the distance moved by the solvent front when the orange dye had moved 5.4 cm.

Distance moved by solvent front = _____ cm

(3)

(e) Why is the R_f value of a dye **not** affected by how far the solvent front is allowed to travel?

(1)

(f) Another type of chromatography is called gas chromatography.

Gas chromatography is an instrumental method of chemical analysis.

Scientists tested the orange dyes using gas chromatography.

Suggest **two** advantages of using the instrumental method of gas chromatography rather than paper chromatography.

1 _____

2 _____

(2)

(Total 13 marks)

Mark schemes

1.

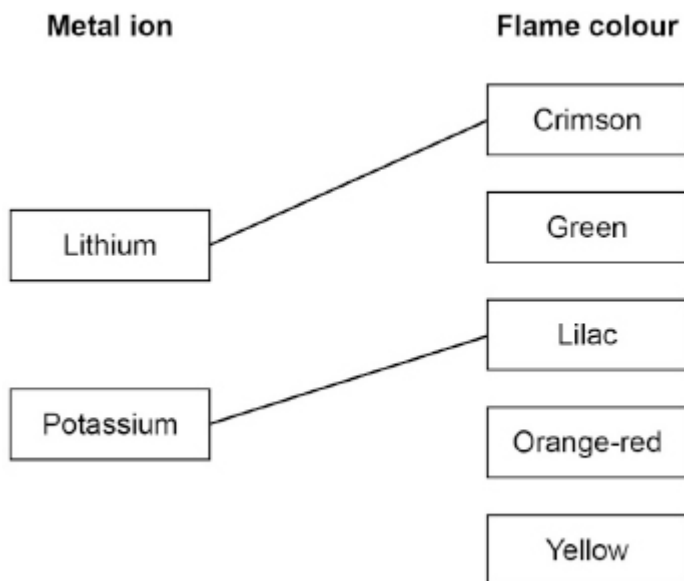
- (a) put sample on (metal) wire
ignore references to cleaning

1

hold wire in (blue / non-luminous) flame

1

(b)



1

do **not** accept more than one line from a box on the left

1

(c) carbon dioxide

1

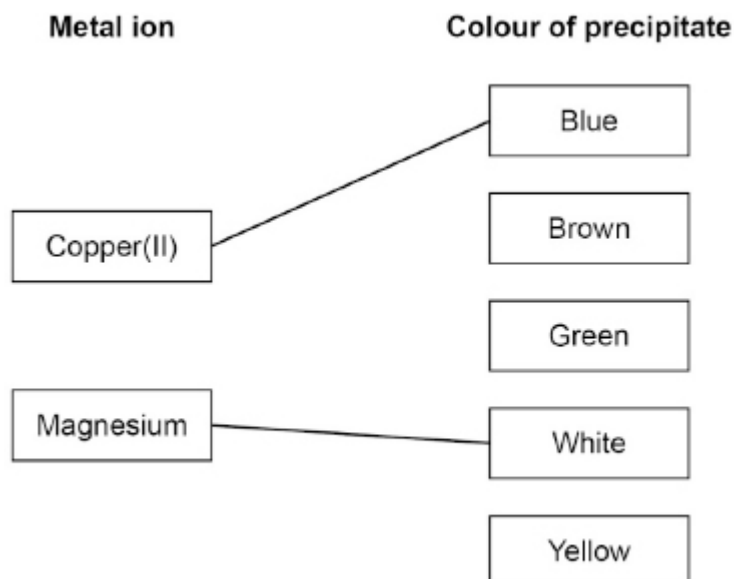
(d) barium chloride solution

1

(e) solid

1

(f)



1

do **not** accept more than one line from a box on the left

1

(g) yellow

1

[10]

2.

(a) labelled paper in solvent

allow paper touching solvent

1

labelled start line above solvent level

do not accept start line touching solvent

1

labelled ink spot on start line

if no other mark awarded allow 1 mark for a complete unlabelled diagram

1

(b) (so the start line) does not smudge / run / dissolve

or

pencil is insoluble

allow (because an ink line) would smudge / run / dissolve

1

(c)

$$0.80 = \frac{5.2}{\text{distance moved by solvent}}$$

1

$$\text{distance moved by solvent} = \frac{5.2}{0.80}$$

1

$$= 6.5 \text{ (cm)}$$

1

(d) from the start line to the centre of the spot

1

(e) use a different solvent

1

use a different type of chromatography paper

1

(f) 1

1

(g) more accurate

1

[12]

3.

(a) (drew start line in) ink

1

ink runs / smudges / dissolves

OR

a pencil should be used (to draw the start line) (1)

so that the ink does not run / smudge / dissolve (1)

1

(b) 2

1

(c) (dye)

A

1

(reason)

(dye) **A** travelled the same distance as a spot from (substance) **Y**

or

(dye) **A** has the same R_f value as a spot from (substance) **Y**

*allow (dyes) **B, C, and D** did not travel the same distance as either spot from (substance) **Y***

*allow (dyes) **B, C, and D** do not have the same R_f value as either spot from (substance) **Y***

MP2 is dependent upon the award of MP1

1

(d) (dye) **D** is insoluble (in water)

allow there is no attraction

*between (dye) **D** and water*

1

(e)

$$(R_f) = \frac{2.4}{6.0}$$

1

$$= 0.4$$

ignore units

1

(f) solvent

1

[9]

4.

(a) calcium (ions)

or

magnesium (ions)

allow Ca^{2+} (ion)

allow Mg^{2+} (ion)

allow zinc / Zn^{2+} (ion)

1

(b) (test)

add excess sodium hydroxide

(solution)

1

(result)

with sodium hydroxide the

(white) precipitate dissolves

allow with sodium hydroxide a colourless solution is produced

1

- (c) Ca^{2+}
ignore calcium 1
- (d) Cl^-
ignore chloride 1
- (e) (test)
(bubble the gas through) limewater
allow (bubble the gas through) calcium hydroxide solution 1
- (result)
(which) turns milky / cloudy
MP2 is dependent upon MP1 being awarded 1
- (f) (using ethanoic acid)
the rate of reaction is lower
allow converse argument 1
- (because) ethanoic acid is a weak(er) acid 1
- (so) the concentration of hydrogen ions is lower
allow (so) ethanoic acid is (only) partially ionised 1
- (and) the frequency of collisions is lower 1
- 5.** (a) (test)
flame test 1
- (result)
yellow (flame)
- OR**
- (test)
flame emission spectroscopy (1)
allow FES
- (result)
lines match sodium spectrum (1) 1
- [11]**

- (b) (test)
(add acidified) silver nitrate
(solution) 1
- (result)
white precipitate
MP2 is dependent upon the award of MP1 1
- (c) to ensure that all the water has evaporated 1
- (d) mass of evaporating dish and dry contents – mass of empty evaporating dish 1

(e)

$$\begin{aligned} & \text{(mean concentration of NaCl =)} \\ & \frac{35.2 + 34.6 + 36.4 + 33.8}{4} \end{aligned}$$

or

$$\frac{140}{4}$$

1

$$= 35.0 \text{ (g/dm}^3\text{)}$$

$$\begin{aligned} & \text{allow 1 mark for} \\ & \frac{35.2 + 34.6 + 33.8}{3} = 34.5 \end{aligned}$$

1

(mean concentration of Na⁺ =)

$$35.0 \times \frac{39.3}{100}$$

allow correct use of an incorrectly determined mean concentration of sodium chloride

1

$$= 13.8 \text{ (g/dm}^3\text{)}$$

allow 13.755 correctly rounded to at least 3 significant figures

1

alternative approach 1:

(total concentration of NaCl =

$$35.2 + 34.6 + 36.4 + 33.8 = 140$$

total concentration of Na⁺ =)

$$140 \times \frac{39.3}{100} \text{ (1)}$$

$$= 55.02 \text{ (g/dm}^3\text{) (1)}$$

allow 1 mark for

$$(35.2 + 34.6 + 33.8 = 103.6)$$

$$103.6 \times \frac{39.3}{100} = 40.71$$

(mean concentration of Na⁺ =)

$$\frac{55.02}{4} \text{ (1)}$$

allow correct use of incorrectly determined concentration(s) of Na⁺

$$= 13.8 \text{ (g/dm}^3\text{) (1)}$$

allow 13.755 correctly rounded to at least 3 significant figures

alternative approach 2:

(concentrations of Na⁺ =)

$$35.2 \times \frac{39.3}{100}$$

$$34.6 \times \frac{39.3}{100}$$

$$36.4 \times \frac{39.3}{100}$$

$$33.8 \times \frac{39.3}{100} \text{ (1)}$$

$$= 13.83 \ 13.60 \ 14.31 \ 13.28 \text{ (1)}$$

allow 1 mark if a concentration of 36.4 is treated as an anomaly and not used

(mean concentration of Na⁺ =)

$$\frac{13.83 + 13.60 + 14.31 + 13.28}{4} \text{ (1)}$$

allow correct use of an incorrectly determined total concentration of Na⁺

$$= 13.8 \text{ (g/dm}^3\text{)} \text{ (1)}$$

allow 13.755 correctly rounded to at least 3 significant figures

[10]

6.

(a) (test) add barium chloride (solution)

ignore (hydrochloric / nitric / sulfuric) acid

allow add barium nitrate (solution)

1

(result) white precipitate

MP2 is dependent upon MP1 being awarded

1

(b) the yield is smaller at higher temperatures because the reaction is exothermic

1

(c) there are more moles / molecules (of gas) on the left

allow converse

ignore particles

1

(so the position of) equilibrium shifts to the right

1

- (d) any **two** from:
- the yield is already high
 - more energy required
 - risk of explosion is increased
 - higher income from increased yield is outweighed by the extra expenditure
 - increased cost of safety precautions

allow requires stronger vessels

allow requires thicker walls

2

- (e) vanadium (V)

1

[8]

7.

- (a) the yellow dye travels further

allow converse argument

allow stationary phase for paper

1

(because the yellow) dye has a weaker attraction to the (chromatography) paper

if no other mark awarded

allow for 1 mark

the weaker the attraction to the (chromatography) paper the greater the distance travelled (by the dye)

1

(b) (in Experiment 2) the yellow dye travels further
allow mobile phase for solvent

1

(because) the solvents are different

1

(and) the yellow dye is more soluble in ethanol (than water)

allow the yellow dye is less soluble in water (than ethanol)

or

(and) the yellow dye is more attracted to ethanol (than water)

allow the yellow dye is less attracted to water (than ethanol)

OR

(in Experiment 1) the yellow dye does not travel as far (1)

(because) the solvents are different (1)

(and) the yellow dye is less soluble in water (than ethanol)

allow (and) the yellow dye is more soluble in ethanol (than water)

(and) the yellow dye is less attracted to water (than ethanol) (1)

or

allow (and) the yellow dye is more attracted to ethanol (than water)

1

(c) **A** is an impure (substance)

and

B is a pure (substance)

*allow **A** is a mixture*

and

***B** is a pure (substance)*

1

(because) **A** contains two dyes

and

B contains one dye

*allow (because) **A** produces two spots*

and

***B** produces one spot*

if no other mark awarded allow 1 mark for

***A** contains two dyes (so) is impure (substance)*

or

***A** contains two dyes (so) is a mixture*

or

***B** contains one dye (so) is pure (substance)*

1

(d)

$$0.48 = \frac{5.4}{\text{distance moved by solvent}}$$

1

(distance moved by solvent =)

$$\frac{5.4}{0.48}$$

1

=11.25 (cm)

*allow 11.25 correctly rounded to
at least 2 significant figures*

1

(e) the ratio / proportion of spot distance (moved) to solvent distance (moved) is fixed / constant

*allow the distance travelled by the spot relative to the distance
travelled by the solvent is constant*

*allow the distance travelled by the spot is (directly) proportional to
the distance travelled by the solvent*

1

(f) any **two** from:

- (more) sensitive
- (more) accurate
- fast(er)

allow small(er) sample

allow greater resolution

2

[13]