Atmosphere part 2 AQA Triple Chemistry

Name: _____

Class: _____

Date: _____

Time: **70 minutes**

Marks: **67 marks**

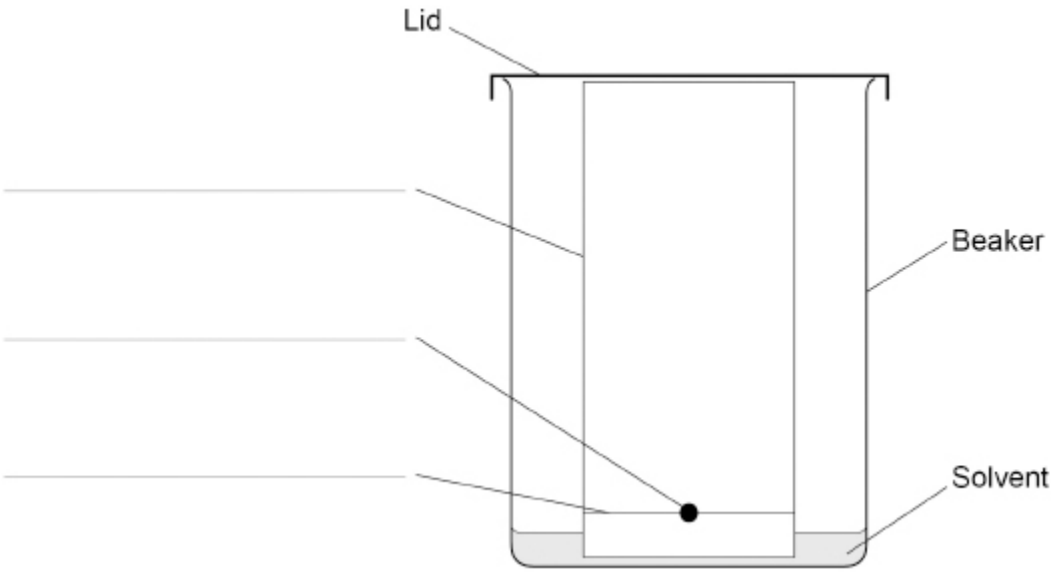
Comments:

1. This question is about chromatography.

A student investigated an orange dye using paper chromatography.

(a) **Figure 1** shows the apparatus at the start of the investigation.

Figure 1

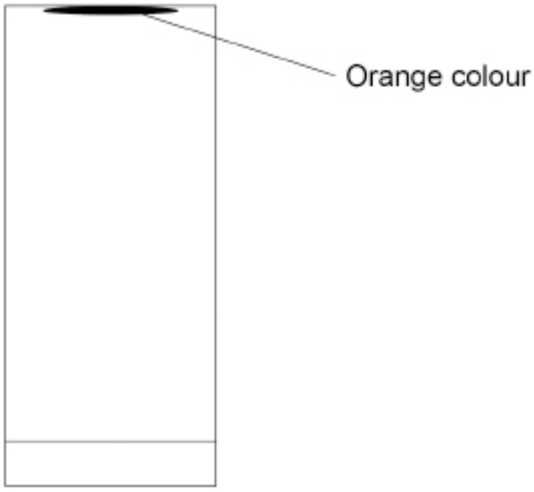


Complete the labels on **Figure 1**.

(3)

(b) **Figure 2** shows the results at the end of the investigation.

Figure 2



The student made a mistake in the investigation.

What mistake did the student make to produce the results shown in **Figure 2**?

Tick (✓) **one** box.

Left the investigation for too long ☐

Used a lid on the beaker ☐

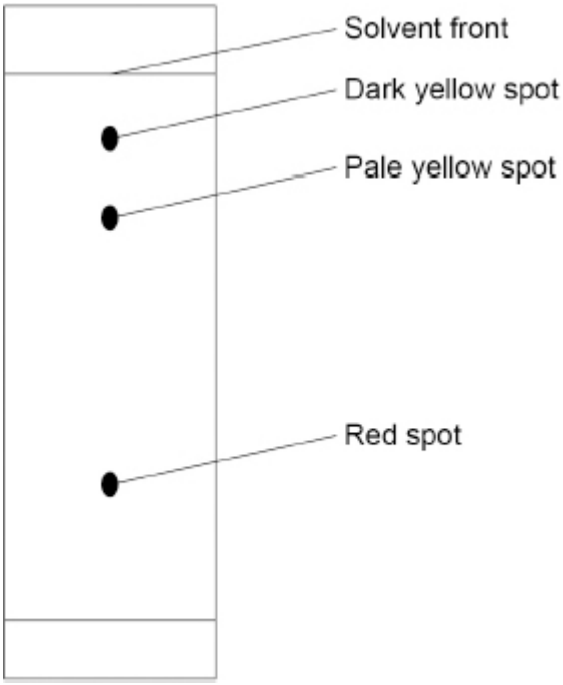
Used a solvent which did not dissolve the dye ☐

(1)

A different student did the investigation correctly.

Figure 3 shows the results.

Figure 3



(c) How do the results in **Figure 3** show that the orange dye is **not** a pure substance?

_____

_____

(1)

(d) Determine the Rf value for the red spot.

You should measure:

- the distance moved by the red spot
- the distance moved by the solvent.

Use **Figure 3** and the equation:

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

Distance moved by red spot _____ cm

Distance moved by solvent _____ cm

_____

_____

R_f = _____

(4)

(e) Which spot had the greatest R_f value?

Use **Figure 3**.

Tick (✓) **one** box.

Dark yellow spot ☐

Pale yellow spot ☐

Red spot ☐

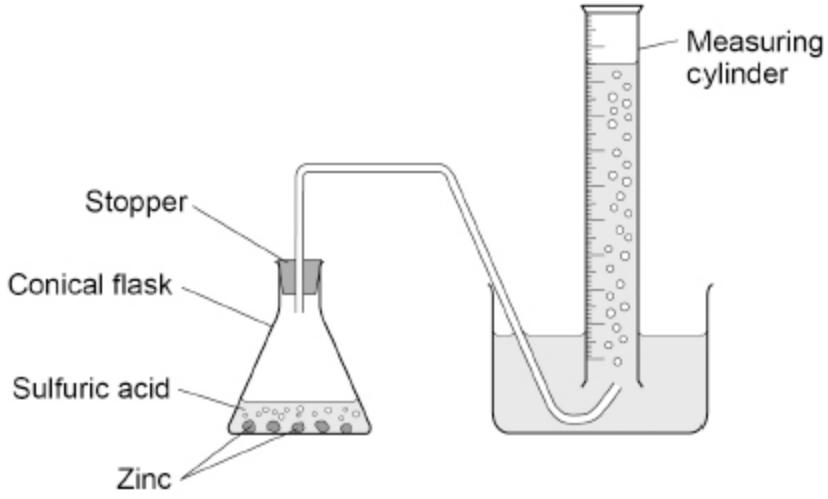
(1)

(Total 10 marks)

2. A student investigated the rate of the reaction between zinc and sulfuric acid.

Hydrogen gas is produced during this reaction.

The figure below shows the apparatus.



This is the method used.

1. Add 50 cm^3 of sulfuric acid to a conical flask.

2. Add 2.0 g of zinc to the conical flask.

3. Quickly put a stopper in the conical flask and start a timer.

4. Measure the time taken to collect 20 cm^3 of gas.

5. Repeat steps 1 to 4 three more times.

(a) Suggest why the stopper must be put in the conical flask as quickly as possible in **step 3**.

_____

_____

(1)

(b) The student calculated the rate of the reaction for each trial.

The table below shows the results of the calculations.

	Trial 1	**Trial 2**	**Trial 3**	**Trial 4**
Rate of reaction in cm^3/s	0.78	0.81	0.68	0.81

Determine the mean time taken to collect 20 cm^3 of gas.

Do **not** include any anomalous results.

Use the equation:

$$\text{mean rate of reaction} = \frac{\text{volume of gas collected}}{\text{mean time taken}}$$

Mean time taken = _____ s

(5)

(c) The student changed the investigation so that the mean time taken to collect 20 cm^3 of gas was greater.

Which **two** changes would increase the mean time taken to collect 20 cm^3 of gas?

Tick (✓) **two** boxes.

- Use a catalyst ☐
- Use a larger conical flask ☐
- Use a lower temperature ☐
- Use smaller pieces of zinc ☐
- Use sulfuric acid of a lower concentration ☐

(2)

(d) Hydrogen gas is produced during this reaction.

Describe the test for hydrogen gas.

Give the result of the test.

Test _____

_____

Result _____

_____

(2)

(Total 10 marks)

3. This question is about chemical analysis.

Potassium bromide is used in medicine.

A scientist tested a sample of medicine to show the presence of potassium ions and of bromide ions.

The sample is soluble in water.

(a) Plan a method the scientist could use to show that the sample of medicine contains potassium ions **and** bromide ions.

The scientist has:

- a Bunsen burner
- a metal wire
- test tubes
- a dropping pipette
- distilled water
- dilute nitric acid
- silver nitrate solution.

You should give the results of the tests.

(6)

The scientist could also use an instrumental method to show the presence of potassium ions in the medicine.

(b) Which instrumental method could be used to show the presence of potassium ions in the medicine?

_____

(1)

(c) Give **one** advantage of using this instrumental method instead of a chemical test.

_____

_____

(1)

(Total 8 marks)

4. This question is about chromatography.

A student investigated an orange food colouring using two different types of chromatography paper.

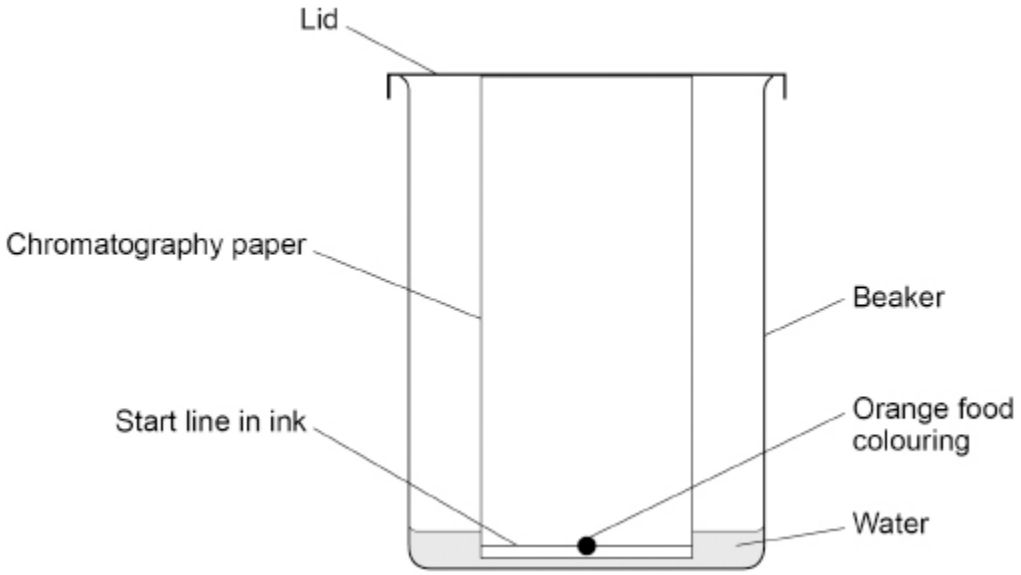
The food colouring:

- contained a mixture of red and yellow dyes
- was soluble in water.

This is the method used.

1. Draw a start line on a piece of type **A** chromatography paper.
2. Put a spot of orange food colouring on the line.
3. Put the paper into a beaker containing water as a solvent.
4. Wait for the water to travel up the paper.
5. Measure the distance above the start line moved by the red and yellow dyes and the water.
6. Repeat steps 1 to 5 using type **B** chromatography paper.

The figure below shows how the student set up the apparatus.



(a) The student made **two** mistakes when setting up the apparatus.

Give **two** mistakes the student made.

1 _____

_____

2 _____

_____

(2)

Another student set up the apparatus correctly.

The table below shows the results.

	Type A chromatography paper		**Type B chromatography paper**	
	Red dye	**Yellow dye**	**Red dye**	**Yellow dye**
Distance moved by dye in cm	4.8	6.6	5.4	**X**
Distance moved by water in cm	12.0	12.0	12.0	12.0
R_f value	0.40	0.55	0.45	0.60

(b) Determine value **X** in the table above.

X = _____ cm

(3)

Changing the type of chromatography paper resulted in different R_f values for the red dye.

(c) Explain why the R_f values for the red dye are different using the two types of chromatography paper.

Use the table above.

(3)

(d) What other change to the investigation could result in a different R_f value for the red dye?

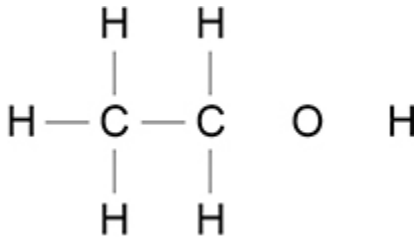
(1)

(Total 9 marks)

5. This question is about ethanol.

(a) The formula of ethanol is C_2H_5OH

Complete the displayed structural formula of ethanol.



(1)

(b) Which is **one** use of ethanol?

Tick (✓) **one** box.

As a protective coating on aluminium ☐

In hand gel to kill microbes ☐

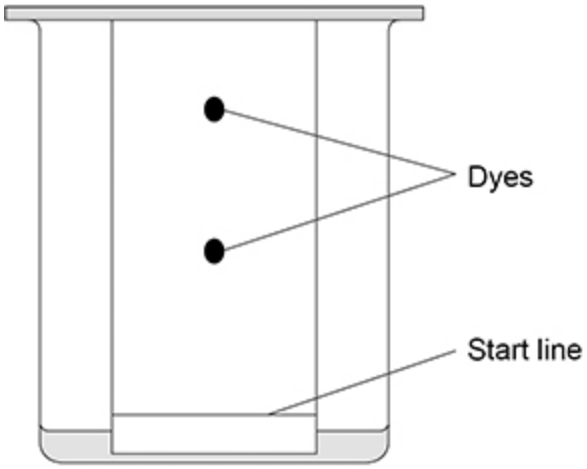
To test for the presence of hydrogen gas ☐

(1)

(c) Ethanol is used as a solvent in some inks.

A student used paper chromatography to show that an ink contained two different dyes.

The figure below shows the apparatus at the end of the investigation.



Describe a method the student could have used for the investigation.

(4)

(d) Ethanol can be produced from sugar solution by fermentation.

What must be added to sugar solution to produce ethanol?

(1)

E5 and E10 are types of fuel used in cars.

These fuels contain ethanol and petrol.

Table 1 shows information about E5 and E10.

Table 1

Fuel	Percentage (%) by mass of ethanol	Percentage (%) by mass of petrol
E5	5	95
E10	10	90

(e) Calculate the mass of ethanol in 4.4 kg of E5.

Give your answer in grams.

Use **Table 1**.

Mass = _____g

(3)

(f) The ethanol in E5 and E10 is produced from sugar.

Sugar is produced from plants.

Explain why the production of E10 removes more carbon dioxide from the atmosphere than the production of E5.

Use **Table 1**.

(3)

(g) **Table 2** shows the energy content of ethanol and petrol.

Table 2

	Energy content in MJ (megajoules) per kg
Ethanol	30.0
Petrol	46.4

Suggest **one** disadvantage of using E10 instead of E5.

Complete the sentence.

A disadvantage of using E10 is that _____

_____

(1)

(Total 14 marks)

6. Potash alum is a chemical compound.

Potash alum contains potassium ions, aluminium ions and sulfate ions.

(a) Which **two** methods can be used to identify the presence of potassium ions in potash alum solution?

Tick (✓) **two** boxes.

- Flame emission spectroscopy ☐
- Flame test ☐
- Measuring boiling point of solution ☐
- Paper chromatography ☐
- Using litmus paper ☐

(2)

(b) Sodium hydroxide solution is used to test for some metal ions.

Sodium hydroxide solution is added to a solution of potash alum until a precipitate forms.

Complete the sentence.

Choose the answer from the box.

blue	**brown**	**green**	**white**

The colour of the precipitate formed is _____.

(1)

(c) Complete the sentence.

Choose the answer from the box.

barium chloride solution	**limewater**
red litmus paper	**silver nitrate solution**

Sulfate ions can be identified using dilute hydrochloric acid

and _____.

(1)

(d) A solution of potash alum has a concentration of 258 g/dm^3

Calculate the mass of potash alum needed to make 800 cm^3 of a solution of potash alum with a concentration of 258 g/dm^3

Give your answer to 3 significant figures.

_____

_____

_____

_____

_____

_____

_____

Mass (3 significant figures) = _____ g

(4)

(Total 8 marks)

7. This question is about paper chromatography.

A food colouring contains a dye.

(a) Plan an investigation to determine the R_f value for the dye in this food colouring.

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

Your plan should include the use of:

- a beaker
- a solvent
- chromatography paper.

(6)

(b) Two students investigated a dye in a food colouring using paper chromatography.

Each student did the investigation differently.

The R_f values they determined for the **same** dye were different.

How did the students' investigations differ?

Tick (✓) **one** box.

- Different length of paper used ☐
- Different period of time used ☐
- Different size of beaker used ☐
- Different solvent used ☐

(1)

(c) Paper chromatography involves a stationary phase.

What is the stationary phase in paper chromatography?

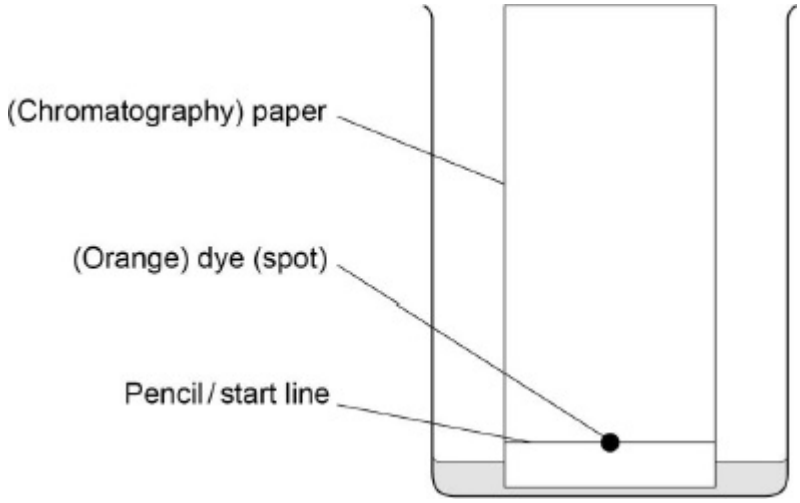
Tick (✓) **one** box.

- Beaker ☐
- Dye ☐
- Paper ☐
- Solvent ☐

(1)

(Total 8 marks)

1. (a)



3

(b) left the investigation for too long

1

(c) (there is) more than one spot
or
(there are) three spots

1

(d) (distance moved by red spot) = 1.8 (cm)
allow a value in the range 1.6 to 2.0 (cm)

1

(distance moved by solvent) = 7.2 (cm)
allow a value in the range 7.1 to 7.3 (cm)

1

$(R_f =) \frac{1.8}{7.2}$
allow correct use of incorrectly determined distance(s)

1

0.25

1

(e) dark yellow spot

1

[10]

2. (a) to reduce the escape of gas

1

(b) (mean rate =)

$$\frac{0.78 + 0.81 + 0.81}{3}$$

1

0.80 (cm^3/s)

1

allow

$$\frac{0.78 + 0.81 + 0.68 + 0.81}{4}$$

*= 0.77 (cm^3/ s) for **1** mark*

$$0.80 = \frac{20}{\text{mean time taken}}$$

allow correct use of incorrectly determined mean rate

1

$$\text{(mean time taken =)}\ \frac{20}{0.80}$$

1

= 25 (s)

1

alternative approach:

$$0.78 = \frac{20}{\text{time}}$$

or

$$0.81 = \frac{20}{\text{time}}\ (1)$$

$$\text{(trial 1 time} = \frac{20}{0.78} \text{ =) 25.6 (1)}$$

(trial 2 and 4 time =

$$\frac{20}{0.81} \text{ =) 24.7 (1)}$$

(mean time =)

$$\frac{25.6 + (2 \times 24.7)}{3}\ (1)$$

= 25 (s) (1)

allow correct use of incorrectly determined value(s) for time

allow $\frac{25.6 + 29.4 + (2 \times 24.7)}{4}$

= 26.1 (s)

*for **1** mark*

(c) use a lower temperature

1

use sulfuric acid of a lower concentration

1

(d) (test)
burning / lit splint

allow flame

*do **not** accept glowing splint*

1

(result)
burns with a (squeaky) pop sound

allow pops

1

MP2 is dependent upon MP1 being awarded

[10]

3. (a) **Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.

5-6

Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.

3-4

Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.

1-2

No relevant content

0

Indicative content

(potassium ions)

- **place sample on (clean metal) wire**
- **introduce into (blue / non-luminous) flame**
- using (Bunsen) burner
- **observe lilac flame colour**
- which shows presence of potassium (ions)

(bromide ions)
- **dissolve sample**
- in (distilled) water
- in test tube
- add (dilute) nitric acid

- **add silver nitrate (solution)**
- using (dropping) pipette

- **observe cream precipitate (formed after addition of silver nitrate solution)**
- which shows presence of bromide (ions)

(b) flame emission spectroscopy

1

(c) any **one** from:
- (more) accurate
- (more) sensitive
- fast(er)
- determine the concentration of ions present

allow requires a small(er) sample

1

[8]

4. (a) the start line is drawn in ink

allow the start line should be drawn in pencil

1

the start line is below the water level

allow the start line should be above the water level

1

(b) $0.60 = \frac{\text{distance moved by dye}}{12.0}$

1

(distance moved by dye =) 0.60 × 12.0

1

= 7.2 (cm)

1

(c) the R_f value is smaller for Paper **A**

1

(because the red dye) is more attracted to Paper **A** (than to Paper **B**)

1

(so the red dye) spends a greater (proportion of the) time distributed in Paper **A** (than in Paper **B**)

1

allow converse

*if no other mark awarded allow **1** mark for the dye has a different attraction to each paper*

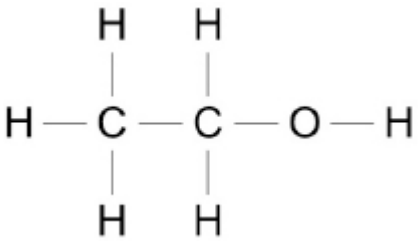
(d) use a different solvent

allow use ethanol (as the solvent)

1

[9]

5. (a)



1

(b) in hand gel to kill microbes

1

(c) **Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.

3–4

Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.

1–2

No relevant content

0

Indicative content

- **draw** pencil **start line**
- **place spot of ink on start line**
- name suitable solvent
- place solvent in beaker
- **place paper in solvent so solvent is below start line**
- use a lid
- **allow solvent / dyes to travel up paper** (until near top)
- dry
- count spots

(d) yeast

1

(e) (mass =) $\frac{4.4 \times 5}{100}$

1

= 0.22 (kg)

1

(conversion 0.22 kg = 220 (g)

allow a correct conversion of an incorrectly calculated mass

1

alternative approach:

(conversion 4.4 kg = 4400 g (1)

(mass =) $\frac{4400 \times 5}{100}$ (1)

allow correct use of an incorrectly converted mass

= 220 (g) (1)

(f) E10 contains more ethanol (produced from sugar than E5)

1

(so) more sugar is used

allow (so) more plants are grown

1

(so more) carbon dioxide is absorbed by plants (when growing)

allow (so more) carbon dioxide is used in photosynthesis (by plants)

1

allow converse argument for E5

(g) (E10 has) less energy (in a fixed mass)

allow cannot travel as far (on a full tank of E10)

1

[14]

6. (a) flame emission spectroscopy

1

flame test

1

(b) white

1

(c) barium chloride (solution)

1

(d) (conversion)

(800 cm^3 = $\frac{800}{1000}$ =) 0.8

1

(dm^3)

allow correct use of incorrect / no volume conversion

1

(mass =) 0.8 × 258 (g)

1

= 206.4 (g)

= 206 (g)

allow an answer correctly calculated to 3 significant figures from an incorrect calculation which uses the values in the question

1

alternative approach:

(conversion)

(258 g/dm^3 = $\frac{258}{1000}$=) 0.258

(g/cm^3) (1)

(mass =) 0.258 × 800 (g) (1)

allow correct use of incorrect / no concentration conversion

= 206.4 (g) (1)

= 206 (g) (1)

allow an answer correctly calculated to 3 significant figures from an incorrect calculation which uses the values in the question

[8]

7. (a) **Level 3**: The design/plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.

5–6

Level 2: The design/plan would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.

3–4

Level 1: The design/plan would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.

1–2

No relevant content

0

Indicative content

Method

- draw (pencil) start line on (chromatography) paper
- place spot of food colouring on start line
- use of suitable solvent
- place solvent in beaker / container
- place (chromatography) paper in beaker / container
- so (chromatography) paper is in solvent
- but solvent is below start line
- use a lid
- wait for solvent to travel up the (chromatography) paper (until near top)
- mark solvent front
- dry the (chromatography) paper

Measurements

- measure distance between start line and centre of spot
- measure distance between start line and solvent front
- use of measurements to determine R_f value

(b) different solvent used

1

(c) paper

1

[8]