C8: Chemical Analysis 1

ANSWER KEY

19.1	In everyday language what is a “pure” substance?	A substance that has had nothing added to it and is in its “natural” state
19.2	In chemistry what is a “pure” substance?	A substance made of a single element or compound
19.3	**How can pure substances be distinguished from impure ones?**	**By their melting/boiling points**
19.4	**Describe the melting and boiling points of pure substances**	**Melt and boil at one very specific temperature e.g. pure water melts at 0°C and boils at 100°C**
19.5	Describe the melting and boiling points of impure substances	They change state over a range of temperatures
19.6	**What is a formulation?**	**A mixture designed as a useful product**
19.7	Give three examples of formulations	Petrol, toothpaste, paints, medicines, alloys, fertilisers and chocolate biscuits
19.8	What is chromatography?	A process to separate the substances in a mixture like coloured inks or dyes
19.9	**In paper chromatography, what is the stationary phase and what is the mobile phase?**	• **paper is the stationary phase** • **solvent (eg. water or ethanol) is the mobile phase**
19.10	**How can chromatography show the difference between pure and impure substances?**	**Pure substances will only show 1 spot**
19.11	**How can you tell how many different substances are in the mixture?**	**Count the number of spots arranged vertically**
19.12	**How is the Rf value calculated?**	**Rf = <u>distance moved by spot</u> / distance moved by solvent**

C8: Chemistry Analysis 2

ANSWER KEY

20.1	What does a substance's Rf value depend on?	How soluble it is in the solvent – more soluble substances move further and have larger Rf values
20.2	**In chromatography, why must the start line be drawn in pencil?**	**Pencil will not dissolve in the solvent**
20.3	Why must the solvent height be below the pencil line?	So that the substances do not dissolve into the solvent without moving up the paper
20.4	**Why might a spot not move from the start line when a solvent is added?**	**It doesn't dissolve in the solvent**
20.5	If a substance is more attracted to the mobile phase, where will it be on the paper?	Further up
20.6	If a substance is more attracted to the stationary phase, where will it be on the paper?	Lower down
20.7	**How can hydrogen be tested for, and what is the correct observation?**	**Test = lit splint Observation = squeaky pop**
20.8	**How can oxygen be tested for, and what is the correct observation?**	**Test = glowing splint Observation = relights**
20.9	**How can carbon dioxide be tested for, and what is the correct observation?**	**Test = bubble through limewater Observation = turns milky/cloudy**
20.10	**How can chlorine be tested for, and what is the correct observation?**	**Test = damp blue litmus paper Observation = bleached white**

FOUNDATION TIER

Q1. This question is about mixtures.

(a) Which substance is a mixture? Tick (✓) **one** box.

Air ☐ Gold ☐ Methane ☐ Nitrogen ☐

(1)

(b) Food colourings are often mixtures of dyes.

What name is given to mixtures that are designed as useful products?

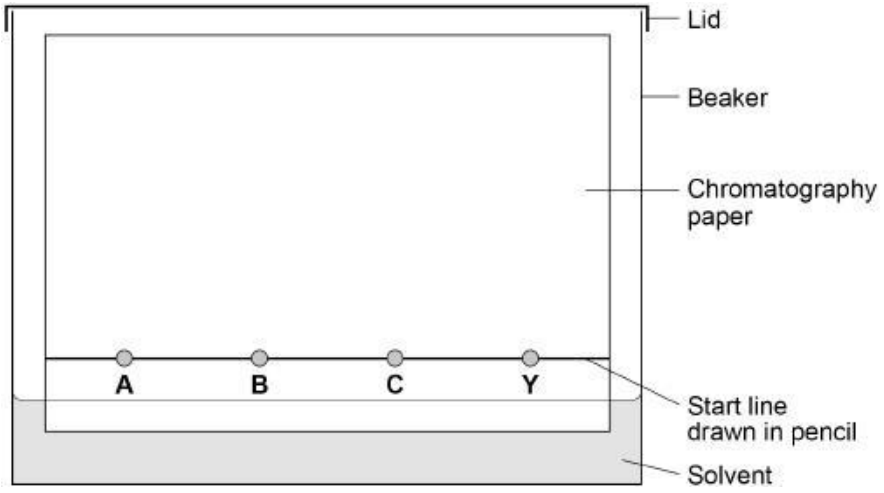
_____

(1)

A student investigated a purple food colouring, **Y**, using chromatography.

The student compares **Y** with dyes **A**, **B** and **C**.

(c) **Figure 1** shows the apparatus used.



Chromatography involves a stationary phase and a mobile phase.

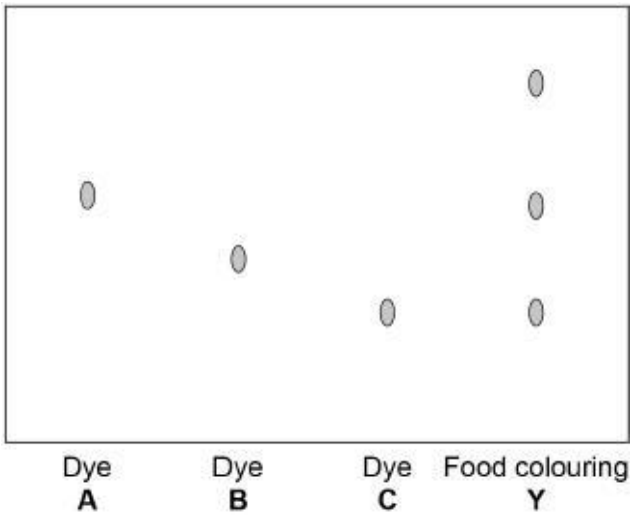
Draw **one** line from each phase to what is used for that phase. Use **Figure 1**.

Phase	What is used
	Beaker
Mobile phase	Chromatography paper
	Food colouring
Stationary phase	Pencil line
	Solvent

(2)

Figure 2 shows the student's results.

Figure 2



(d) What **three** conclusions can you make about the dyes in food colouring **Y**?

1. _____

_____

2. _____

_____

3. _____

_____

(3)

(e) In a different experiment a student recorded these results:

Distance moved by dye **G** = 60 mm
Distance moved by solvent = 80 mm

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

$$R_f = \frac{\text{distance moved by dye } \mathbf{G}}{\text{distance moved by solvent}}$$

_____

_____

_____

_____

R_f = _____

(2)

(Total 9 marks)

Q2. This question is about the Earth's resources.

When most fuels burn carbon dioxide is produced.

Propane (C_3H_8) is a fuel.

(a) Balance the equation for the combustion of propane.

$$C_3H_8 + \_\_\_\_\_ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$$

(1)

(b) Describe the test for carbon dioxide.

Give the result of the test.

Test _____

Result _____

_____

(2)

(c) Propane can be cracked to produce propene and hydrogen.

Complete the symbol equation for the reaction.

$$\underset{\text{propane}}{C_3H_8} \rightarrow \underset{\text{propene}}{\_\_\_\_\_} + \underset{\text{hydrogen}}{H_2}$$

(1)

(d) Describe the test for hydrogen.

Give the result of the test.

Test _____

Result _____

_____

(2)

(e) Propene is an alkene.

Describe the test for alkenes.

Give the colour change in the test.

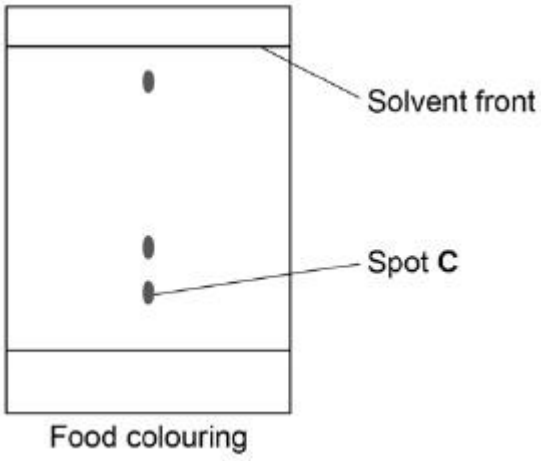
Test _____

Colour change _____ to _____

(3)

(Total 9 marks)

Q3. The diagram shows a chromatogram for a food colouring.



(a) How does the chromatogram show that the food colouring is a mixture?

_____

_____

(1)

(b) A student makes measurements for spot **C**.

The table shows the results.

	Distance in mm
Distance moved by spot **C**	7
Distance moved by solvent	39

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

Give your answer to 2 significant figures.

Use the results in the table.

_____

_____

_____

_____

R_f value = _____

(3)

(c) Plan a chromatography experiment to investigate the colours in an ink.

(6)

(Total 10 marks)

HIGHER TIER

Q4. This question is about chromatography of food colouring.

(a) Food colouring is a formulation.

What is a formulation?

_____

_____

(1)

(b) Explain how paper chromatography separates the dyes in a food colouring.

Do **not** give details of how to do the experiment.

_____

_____

_____

_____

(2)

(c) Explain how the student could tell from the chromatogram that the food colouring contained more than one dye.

_____

_____

_____

_____

(2)

(d) Explain how the student could use chromatography to identify unknown dyes in the food colouring.

_____

_____

_____

_____

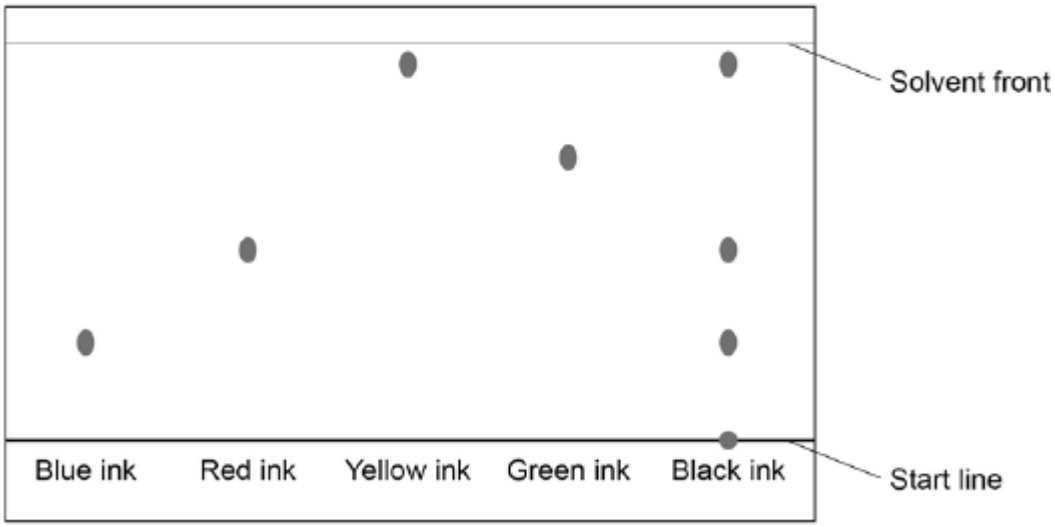
_____

_____

(3)

(Total 8 marks)

Q5. The figure below shows a paper chromatogram of five different inks.



(a) Explain how paper chromatography separates substances.

(3)

(b) Analyse the chromatogram. Describe and explain the result for black ink.

(4)

(c) Use the figure above to calculate the R_f value of the blue ink.

_____

_____

_____

_____

R_f value = _____

(3)

(Total 10 marks)

Q1.

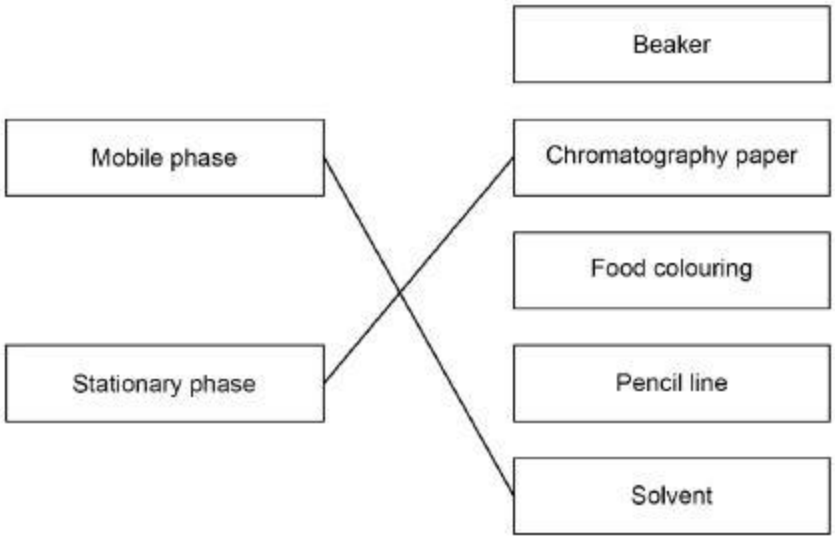
(a) air

1

(b) formulation(s)

1

(c)



1

additional line from a box on the left negates the mark for that box

1

(d) *allow colour for dyes*

Y contains 3 dyes

1

Y contains 2 known dyes

*allow **Y** contains **A** and **C***

1

Y contains an unknown dye

*allow **Y** does not contain dye **B***

1

alternative approach:

Y contains 3 dyes (1)

Y contains 1 known dye (1)

*allow **Y** contains dye **C***

Y contains 2 unknown dyes (1)

*allow **Y** does not contain dyes **A** and **B***

(e)

(R_f =) $\frac{60}{80}$

1

= 0.75

ignore units

1

[9]

Q2.

(a) $C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$

allow multiples

1

(b) *MP2 is dependent upon correct response in MP1*

(bubble gas through) lime water

allow (bubble gas through) calcium hydroxide (solution)

1

turns milky / cloudy / white
or
white precipitate forms

1

(c) C_3H_6

1

(d) *MP2 is dependent upon correct response in MP1*

burning / lit splint

allow flame
*do **not** accept glowing splint*

1

burns with a (squeaky) pop sound

allow pops

1

(e) bromine (water)

*do **not** accept bromide*

1

(colour change) orange*

1

(to) colourless*

**allow 1 mark for colourless (to) orange*
ignore clear

1

[9]

Q3.

(a) more than 1 dot in a vertical line

1

(b) correct equation and substitution 7/39

accept R_f = distance moved by spot C / distance moved by solvent

1

calculation and answer 0.1795

1

answer to 2 significant figures 0.18

1

(c)

Level 3: The plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5-6
Level 2: The 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 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 • put dots of known colours, and a dot of the ink on a pencil line on the chromatography paper. • place the bottom of the paper in water, making sure the start line is above the water • leave for solvent to rise up through paper. • when solvent near top of paper, remove and leave to dry. • compare positions of dots for known colours with those from ink	

6

[10]

Q4.

(a) a mixture designed as a useful product

1

(b) dyes distributed differently between the stationary and mobile phase

allow dyes have different solubilities

allow dyes have different forces of attraction for stationary phase

allow dyes have different forces of attraction for mobile phase
allow dyes have different forces of attraction to the paper
allow dyes have different forces of attraction to the solvent
ignore density

1

(so dyes) move up the paper at different speeds / rates
allow (so dyes) move different distances up the paper
ignore references to time

1

(c) (because chromatogram has) different dots / colours

1

in a (vertical) column
allow above the (original) spot

1

(d) run known dyes and food colouring (as a chromatogram)

1

compare distances moved
or
compare R_f values

(so) can identify those that move the same distance as known dyes
allow (so) can identify those that move different distances as unknown dyes
or
(so) can identify those that have the same R_f values as known dyes
allow (so) can identify those that have different R_f values as unknown dyes

1

[8]

Q5.

(a) mobile phase / solvent moves through paper

1

and carries substances different distances

1

which depend on their attraction for paper and solvent
allow which depend on solubility in solvent and attraction to paper

1

(b) **Level 2 (3–4 marks):**
A relevant and coherent description which provides a clear analysis of the chromatogram. The response makes logical links between the points raised and uses sufficient examples
to support these links.

Level 1 (1–2 marks):
Simple statements are made which demonstrate a basic attempt to analyse the

chromatogram. The response may fail to make logical links between the points raised.

0 marks:
No relevant content

Indicative content

- black ink is a mixture
- because more than one spot
- contains blue, red and yellow
- because Rf values / positions match
- does not contain green
- contains an unknown
- which is insoluble
- yellow is most soluble or has highest Rf value, blue is least

4

(c) both measurements from artwork for **1** mark (1.3 ± 0.1 cm and 5.3 ± 0.1 cm)

1

correct equation used for **1** mark

1

0.25 ± 0.02

1

*accept 0.25 ± 0.02 without working shown for **3** marks*
*allow ecf from incorrect measurement to final answer for **2** marks*

[10]