Atmosphere part 5 AQA Triple Chemistry

Name: _____

Class: _____

Date: _____

Time: **71 minutes**

Marks: **71 marks**

Comments:

1. The colours of fireworks are produced by chemicals.

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(a) Information about four chemicals is given in the table.

Complete the table below.

Chemical	Colour produced in firework
barium chloride	green
_____ carbonate	crimson
sodium nitrate	_____
calcium sulfate	red

(2)

(b) Describe a test to show that barium chloride solution contains chloride ions.

Give the result of the test.

_____

_____

_____

_____

(2)

(c) A student did two tests on a solution of compound **X**.

Test 1
Sodium hydroxide solution was added.
A blue precipitate was formed.

Test 2
Dilute hydrochloric acid was added.
Barium chloride solution was then added.
A white precipitate was formed.

The student concluded that compound **X** is iron(II) sulfate.

Is the student's conclusion correct?

Explain your answer.

_____

_____

_____

_____

_____

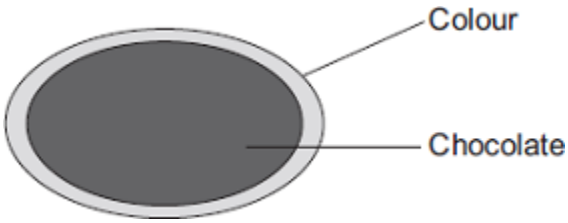
_____

(3)

(Total 7 marks)

2. Colours are used to coat some chocolate sweets.

Some of these colours are given E-numbers.



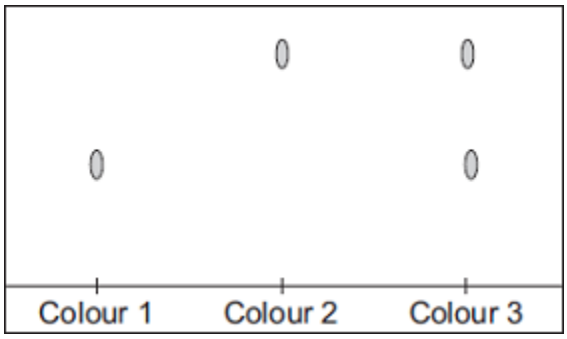
(a) Use the correct word from the box to complete the sentence.

additive	**element**	**fuel**

An E-number is used to identify a permitted food _____

(1)

(b) Chromatography was used to compare three of the colours used to coat the chocolate sweets.



What do these results tell you about these three colours?

_____

_____

_____

_____

_____

_____

(3)

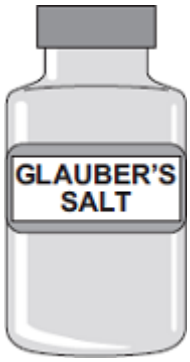
(Total 4 marks)

3. Four bottles of chemicals made in the 1880s were found recently in a cupboard during a Health and Safety inspection at Lovell Laboratories.

Sodium carbonate

Sodium chloride

Sodium nitrate



Sodium sulfate

The chemical names are shown below each bottle.

(a) You are provided with the following reagents:

- aluminium powder
- barium chloride solution acidified with dilute hydrochloric acid
- dilute hydrochloric acid
- silver nitrate solution acidified with dilute nitric acid
- sodium hydroxide solution.
- limewater
- red litmus paper

(i) Describe tests that you could use to show that these chemicals are correctly named.

In each case give the reagent(s) you would use **and** state the result.

Test and result for carbonate ions:

_____

_____

_____

Test and result for chloride ions:

_____

_____

_____

Test and result for nitrate ions:

_____

_____

_____

Test and result for sulfate ions:

_____

_____

_____

(4)

(ii) Suggest why a flame test would **not** distinguish between these four chemicals.

_____

(1)

(b) Instrumental methods of analysis linked to computers can be used to identify chemicals.

Give **two** advantages of using instrumental methods of analysis.

_____

_____

_____

_____

(2)

(Total 7 marks)

4. This is part of an article about food additives.

> **THE PERIL OF FOOD ADDITIVES**
>
> Some orange drinks contain the additives E102 (Tartrazine), E104 (Quinoline Yellow) and E110 (Sunset Yellow).These three coloured additives are thought to cause hyperactivity in children.

(a) State **two** reasons that a manufacturer might give to justify the use of these additives.

1. _____

_____

2. _____

_____

(2)

(b) Some scientists asked 4000 twelve-year-old children to help them investigate if there is a link between these three coloured additives and hyperactivity.

How would the scientists use these 4000 children to investigate if there is a link between these three coloured additives and hyperactivity in children?

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(c) A manufacturer used an independent scientist to show that their orange drink did not contain these three coloured additives.

(i) Suggest why the manufacturer would use a scientist who was independent instead of using their own scientist.

_____

_____

(1)

(ii) The scientist had samples of E102, E104 and E110 and the orange drink. The scientist used paper chromatography for the test.

Describe how the scientist could use the results to show if the orange drink contained any of these three coloured additives.

You may include a diagram of the paper chromatography results.

_____

_____

_____

_____

_____

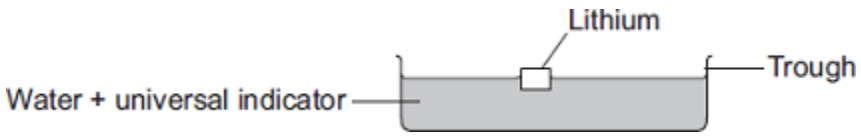
_____

(2)

(Total 9 marks)

5. A student was investigating the reaction of lithium and water.

She added a few drops of universal indicator to water in a trough and added a piece of lithium.



The word equation for the reaction is:

lithium + water ⟶ lithium hydroxide + hydrogen

(a) (i) The lithium floated on the water.

State **two** other observations that the student would **see** during the reaction.

1. _____

2. _____

(2)

(ii) Balance the symbol equation for the reaction of lithium and water.

2 Li(s) + _____ $H_2O(l)$ ⟶ _____ LiOH(aq) + $H_2(g)$

(2)

(iii) Describe a simple test and the result that would show the gas was hydrogen.

_____

_____

(1)

(iv) All Group 1 metals have similar reactions with water.

State why, in terms of electronic structure.

_____

_____

(1)

(b) Lithium and other Group 1 metals have different properties from the transition metals.

Tick (✓) **two** properties that are properties of Group 1 metals.

They react with oxygen. ☐

They form coloured compounds. ☐

They are strong and hard. ☐

They have low melting points. ☐

(2)

(c) The electronic structure of a potassium atom is 2, 8, 8, 1

(i) Draw a diagram to show the electronic structure of a potassium ion.

Show the charge on the potassium ion.

(2)

(ii) Potassium is more reactive than sodium.

Explain why, in terms of electronic structure.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 13 marks)

6. Carbon dioxide is produced when metal carbonates are heated.

(a) (i) Draw a ring around the correct answer to complete the word equation.

magnesium carbonate → magnesium / magnesium hydroxide / magnesium oxide + carbon dioxide

(1)

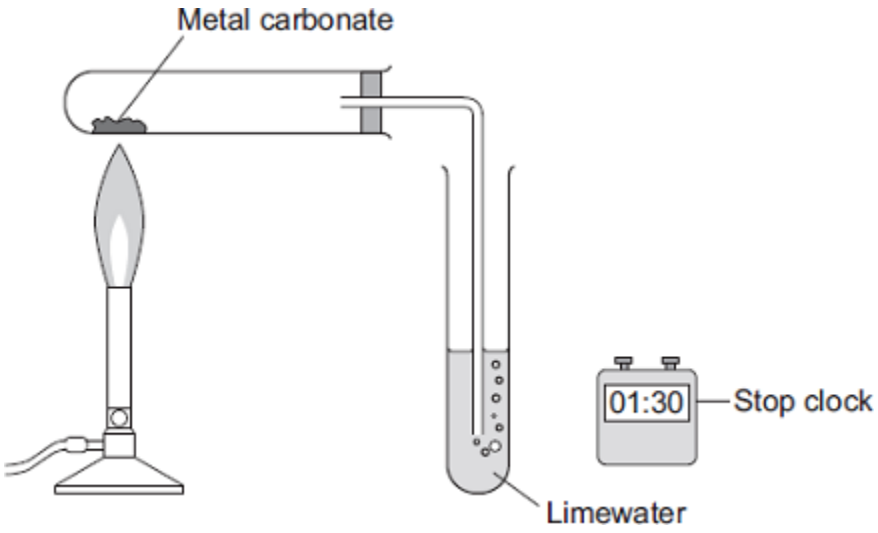
(ii) Draw a ring around the correct answer to complete the sentence.

The reaction to produce carbon dioxide from magnesium carbonate is

combustion.
decomposition.
fermentation.

(1)

(b) A student investigated what happens when metal carbonates are heated.



The student:

- used the apparatus to investigate heating four metal carbonates
- started the stop clock at the same time as he began to heat the metal carbonate
- stopped the stop clock when carbon dioxide was produced.

The student's results are shown in the table.

Metal carbonate	Time taken for the production of carbon dioxide to start in seconds
Calcium carbonate	163
Copper carbonate	24
Magnesium carbonate	92
Zinc carbonate	67

(i) Tick (✓) the type of graph the student should draw from these results.

Type of graph	Tick (✓)
Bar chart	
Line graph	
Scatter graph	

(1)

(ii) Use the Chemistry Data Sheet to help you to answer this question.

Draw a ring around the correct answer to complete the sentence.

The more reactive the metal in the carbonate the

less
more
same

time is

taken for the production of carbon dioxide to start.

(1)

(iii) How did the student know that carbon dioxide was produced?

Use the diagram of the apparatus to help you to answer this question.

_____

_____

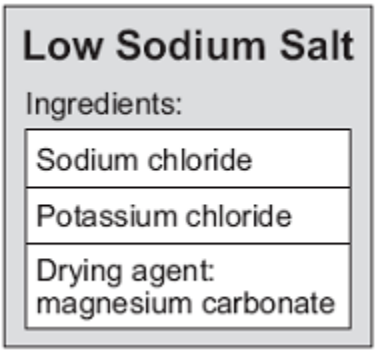
_____

_____

(2)

(Total 6 marks)

7. Low sodium salt is used on food. This label is from a packet of low sodium salt.



A student tests the low sodium salt for the substances on the label.

(a) (i) The same test can be used to identify sodium ions and potassium ions.

Describe the test.

Give the result of the test for sodium ions and for potassium ions.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(ii) It is difficult to identify potassium ions when sodium ions are present.

Suggest why.

_____

_____

(1)

(b) Describe how the student would test a solution of the low sodium salt for chloride ions.

Give the result of the test.

_____

_____

_____

_____

_____

_____

(3)

(c) To test for magnesium ions, the student adds a few drops of sodium hydroxide solution to a solution of the low sodium salt.

A white precipitate is produced.

This test also gives a white precipitate with aluminium ions and calcium ions.

(i) Describe how the student could confirm that the low sodium salt contains magnesium ions and **not** aluminium ions.

_____

_____

_____

_____

_____

(2)

(ii) Describe a test the student could do to confirm that the low sodium salt does **not** contain calcium ions.

_____

_____

_____

_____

_____

(2)

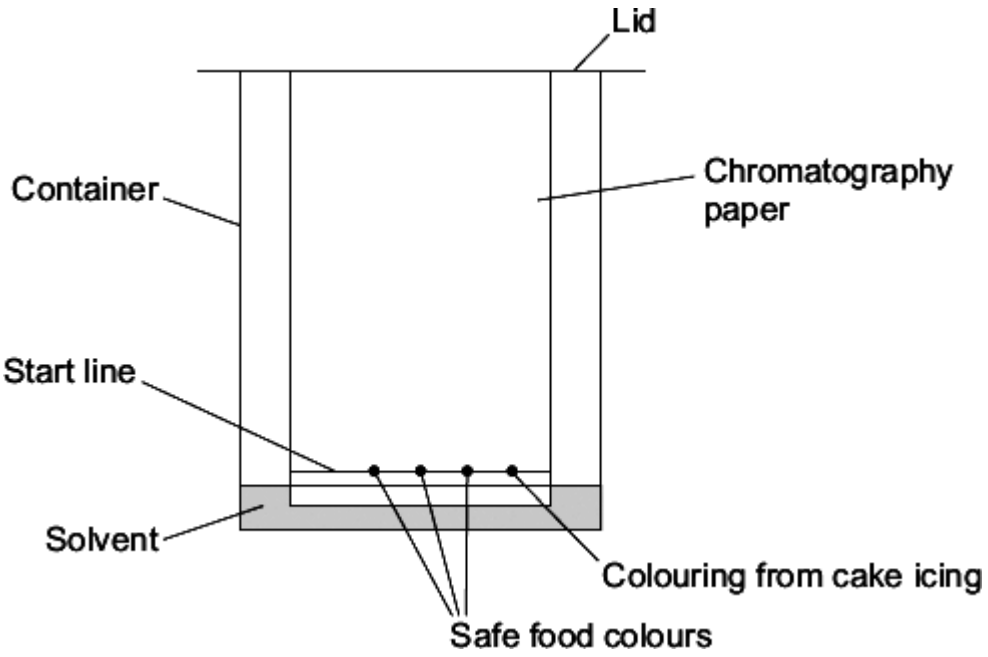
(Total 11 marks)

8. Icing on cakes is tested to check that safe colours were used when they were made.

By Megan Chromik [CC-BY-SA-2.0], via Wikimedia Commons

Paper chromatography is one method of testing which colours are in cake icing.

(a) The diagram shows an experiment a student did.



(i) Suggest why there is a lid on the container.

_____

_____

(1)

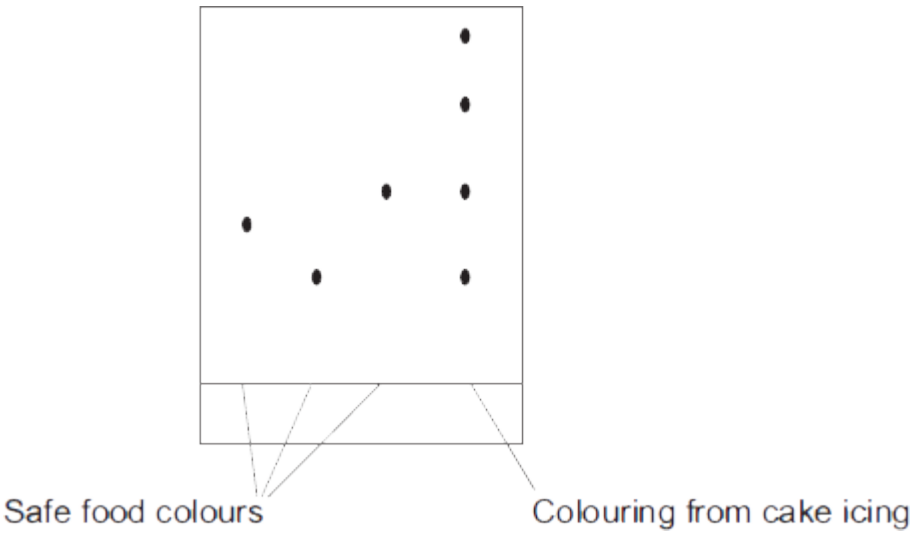
(ii) The start line should be drawn in pencil **not** in ink.
Suggest why.

_____

_____

(1)

(b) The diagram shows the results of the paper chromatography experiment.



(i) How many different food colours were used in the colouring from the cake icing?

_____

(1)

(ii) Is the cake icing safe to eat?

Give a reason for your answer.

_____

_____

(1)

(c) Gas chromatography linked to mass spectroscopy is an example of an instrumental method. This method was used on a mixture of solvents.

(i) Give **two** advantages of gas chromatography compared with paper chromatography.

_____

_____

_____

_____

(2)

(ii) What does gas chromatography do to the mixture of solvents?

_____

_____

(1)

(iii) What information does mass spectroscopy give?

_____

_____

(1)

(Total 8 marks)

9. Read the article.

Problem food colourings

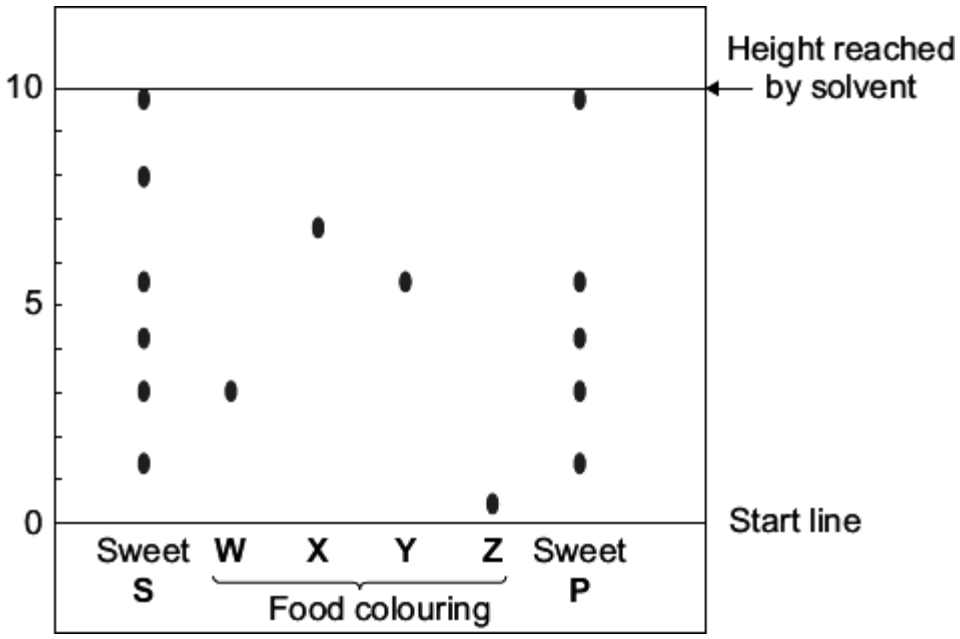
Scientists say they have evidence that some food colourings cause hyperactive behaviour in young children.

These food colourings are added to some sweets.

W, **X**, **Y** and **Z** are food colourings that may cause hyperactive behaviour in young children.

A scientist used chromatography to see if these food colourings were used in two sweets, **S** and **P**.

The results are shown on the chromatogram.



(a) Food colourings, such as **W**, **X**, **Y** and **Z**, are added to some sweets.

Suggest **one** reason why.

_____

_____

(1)

(b) In chromatography, the R_f value = $\frac{\text{distance moved by the colouring}}{\text{distance moved by the solvent}}$

Use the scale on the chromatogram to help you to answer this question.

Which food colouring, **W**, **X**, **Y** or **Z**, has an R_f value of 0.7?

(1)

(c) From the chromatogram, what conclusions can the scientist make about the colourings in sweets **S** and **P**?

(3)

(Total 5 marks)

1.

(a) lithium

allow Li^+ / Li

1

yellow

allow orange

1

(b) silver nitrate (solution)

*incorrect test = **0** marks*

ignore (nitric) acid

*do **not** allow other named acids*

1

white precipitate

1

(c) blue precipitate (with sodium hydroxide) indicates copper ions

allow Cu^{2+}

1

and white precipitate (with barium chloride) indicates sulfate ions

allow SO_4^{2-}

*accept compound X is copper sulfate / $CuSO_4$ for **1** mark*

1

but iron(II) ions produce a green precipitate (with sodium hydroxide)

1

[7]

2.

(a) additive

1

(b) colour 3 is a mixture of colours 1 and 2

any **two** from:

accept E-number or additive instead of colour

ignore comments about height / level

1

- colour 1 is made up of only one colour / dye
- colour 2 is made up of only one colour / dye
- colour 3 is made up of two colours / dyes
  or
  more colours (than colours 1 and 2)

2

[4]

3. (a) (i) Na_2CO_3: HCl → gas / effervescence / bubbles (1)
CO_2 / carbon dioxide / turns lime water milky (1)

1

NaCl: $AgNO_3$ → white ppt (1)
silver chloride (1)

1

$NaNO_3$: Al + NaOH → pungent / sharp smell / choking gas (1)
NH_3 / ammonia / turns (red) litmus blue(1)

1

Na_2SO_4: $BaCl_2$ → white ppt (1)
barium sulfate (1)

1

*each correct test and one result = **1** mark*

***one** other result for any test = **1** mark this mark can only be awarded <u>once</u>*

(ii) all would give a yellow / yellow-orange (flame) / same coloured (flame) / same results

allow <u>orange</u> (flame) 1

or

they all contain sodium

1

(b) any **two** from:

ignore cost/errors

- fast / quick or comment about speed
  allow precise
- small amounts/sensitive
  allow can be left to run/continuous analysis
- accurate
- ease of automation
  accept operators do not need chemical skills
- sample not used up
- reliable / efficient

2

[7]

4. (a) any **two** from:

ignore reference to taste / shelf-life / sales etc

- improve the colour / appearance
- additives are permitted / not banned / listed on the label
- link between additives and hyperactivity not proved
- maintain the low cost of the drink **or** natural colours would make the drink cost more

allow cheaper if qualified

2

(b) have a control group / placebo **or** test children before any drink given

1

give a drink to at least 3 groups **or** give a drink at least 3 times

1

give each additive to different group / children / at different times

1

observe / monitor / compare behaviour of group / children

1

(c) (i) so that there would be trust / respect / no bias

1

(ii) compare the colours / spots from the orange drink with those of the (three) additives

accept diagram of chromatogram(s) with spots for E102, 104, 110 and sample from the orange drink

1

there should be no matching colours / spots

1

[9]

5. (a) (i) any **two** from:

- bubbles / effervescence / fizzing

  ignore hydrogen / gas produced
- lithium disappears / gets smaller

  allow dissolves

  *do **not** allow melts / burns*
- lithium moves on the surface of the water

  ignore floats
- (universal indicator) turns blue / purple

2

(ii) 2

left-hand side correct

1

2

right-hand side correct

allow multiples for full credit

1

(iii) light / burn, which will give a (squeaky) pop / explosion

1

(iv) all have 1 electron in their outer shell / energy level

allow have the same number of electrons in their outer shell / energy level

1

(b) They react with oxygen

1

They have low melting points

1

(c) (i) electronic structure [2,8,8] is drawn

*incomplete inner shells scores a maximum of **1** mark*

1

charge is +

*allow $[2,8,8]^+$ for **1** mark*

1

(ii) because (in potassium) the outer shell electron is further away from the nucleus **or** because potassium atoms are larger than sodium atoms

*it should be clear that the candidate is referring to the outer shell electron: if this is not clear a maximum of **2** marks can be awarded*

1

therefore the outer shell electron is less strongly attracted to the nucleus **or** is more shielded from the attraction of the nucleus and so the outer shell electron in potassium is more easily lost

1

***3** marks can be scored for answering the question in terms of sodium*

1

[13]

6. (a) (i) magnesium oxide

1

(ii) decomposition

1

(b) (i) bar chart

1

(ii) more

1

(iii) limewater

1

turns cloudy / milky

accept forms a white precipitate

1

[6]

7. (a) (i) place sample in flame

accept flame test

accept any workable method

allow burn

ignore heat

1

sodium: yellow (flame)

allow orange

1

potassium: lilac (flame)

allow purple

1

(ii) (lilac) colour (of potassium) obscured by (yellow) colour of sodium

allow difficult to see two colours

allow sodium colour is brighter

allow colours mix

1

(b) acidify (with nitric acid)

*do **not** accept if acidified with anything other than nitric acid*

1

add silver nitrate (solution)

1

white precipitate

depends on second marking point

allow white solid

ignore silver chloride

ignore solution goes cloudy / milky

1

(c) (i) add excess (sodium hydroxide)

allow add sodium hydroxide

1

aluminium (ions / hydroxide (re)dissolve

depends on first marking point
allow if aluminium, (white) precipitate / solid dissolves
allow magnesium (ions / hydroxide) do not (re)dissolve

1

(ii) place sample in flame

accept flame test

accept any workable method
allow burn

ignore heat

1

flame does not go red

accept calcium (ions / hydroxide would produce) red flame

allow magnesium (ions / hydroxide) (produce) no flame colour

1

[11]

8. (a) (i) prevent evaporation of solvent

allow prevent loss of solvent

allow to support the (chromatography) paper

1

(ii) ink dissolves in the solvent

allow ink 'runs' / spreads ***or*** *pencil does not 'run' / spread*

allow ink would affect the result / mixes with colours

or

carbon / graphite does not dissolve in the solvent

accept pencil for carbon / graphite

1

(b) (i) 4

1

(ii) *no mark for 'no / don't know'* ,

ignore numbers

any **one** from:

- because not all colours match
- not all colours are safe
- some colours could be unsafe
- some colours travelled higher (than safe colours)

1

(c) (i) any **two** from:

ignore reliable / precise

- rapid / quick
- accurate
- sensitive **or** detects very small quantities

accept small sample

2

(ii) separates

1

(iii) identifies solvents / compounds / substances

accept (relative) molecular mass

accept formula mass

accept M_r

accept relative mass

accept molecular ion peak

1

[8]

9. (a) (improve) appearance

allow add colour

allow these food colourings have not been proven to cause hyperactive behaviour in young children

*do **not** accept taste / flavour / preservatives*

ignore reference to E-numbers

1

(b) X

1

(c) any **three** from:

- S contains six / 6 colourings
- P contains five / 5 colourings

  *if neither of first 2 bullet points given allow **1** mark for S contains more colours than P **or** converse*

- both S and P contain the same

  five / 5 colourings

- both contain W **and** Y
- both sweets (may) cause hyperactivity

  ignore unsafe

- neither contain X **and** Z

3

[5]