C3 Revision – Chemical Tests

Q1. 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:

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Test and result for chloride ions:

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Test and result for nitrate ions:

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Test and result for sulfate ions:

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.....

.....**(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.

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(2)
(Total 7 marks)

Q2. Four labels have come off four bottles.

Describe and give the results of the **chemical** tests that you would do to identify which bottle contained which substance.

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..... **(Total 5 marks)**

Q3. The label is from a packet of Low Sodium Salt.

(a) A student tested some Low Sodium Salt to show that it contains carbonate ions and chloride ions.

(i) Describe and give the result of a test for carbonate ions.

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..... **(2)**

(ii) A student identified chloride ions using acidified silver nitrate solution.

State what you would **see** when acidified silver nitrate solution is added to a solution of Low Sodium Salt.

..... **(1)**

(iii) Flame tests can be used to identify potassium ions and sodium ions.

Suggest why it is difficult to identify **both** of these ions in Low Sodium Salt using a flame test.

.....

.....**(1)**

(b) Read the following information and then answer the questions.

Salt – friend or foe?

Sodium chloride (salt) is an essential mineral for our health. It is used to flavour and preserve foods. Too much sodium in our diet may increase the risk of high blood pressure and heart disease. Heart disease is the biggest cause of death in the United Kingdom. Some people claim that excess sodium is a poison that can cause cancer, while others say that more evidence is needed.

Many processed foods contain salt, so it is easy to exceed the recommended daily upper limit of about 5 g of salt per person. A ‘healthier’ amount should be about 3 g. In the United Kingdom many people consume over 10 g of salt each day.

One way to reduce sodium in our diet is to use Low Sodium Salt. This has two thirds of the sodium chloride replaced by potassium chloride.

A national newspaper asked readers for their views on two options.

Option 1: Ban the use of sodium chloride in foods.

Option 2: Reduce the amount of sodium chloride in all foods to a ‘healthier’ level.

(i) Suggest why Option **1** was rejected.

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.....**(1)**

(ii) Suggest **two** advantages and **one** disadvantage of Option **2**.

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.....**(3)(Total 8 marks)**

Q4. This label has been taken from a packet of *My Baby Food*.

MY BABY FOOD

Infant milk
Pure and natural

Closest to mothers' breast milk
Contains traces of essential minerals

500 g

One of the minerals in *My Baby Food* is calcium carbonate, $CaCO_3$.

(a) Chemical tests are used to identify elements and compounds.

(i) A flame test can be used to identify calcium ions.
What colour do calcium ions give in a flame test?

.....**(1)**

(ii) When a flame test was carried out on *My Baby Food*, the presence of calcium ions was **not** seen. A yellow flame was produced.

Name the ion which gives a yellow flame test.

.....**(1)**

(iii) Suggest **one** advantage of using an instrumental method to detect the elements present in *My Baby Food*.

.....

..... **(1)**

(iv) Name an instrumental method for detecting elements.

.....**(1)**

(b) Read the information in the box below and then answer the question.

Calcium carbonate occurs naturally as marble and limestone. They are important building materials and are often used for gravestones.

Calcium carbonate is also an essential mineral for good health and is present in many baby foods in small amounts.

My Baby Food is recommended as being the closest to a mother's own breast milk. It is given free to mothers in the developing world – without it their babies might die of malnutrition.

Responsible Mothers Are Us (RMAU) is a United Kingdom pressure group. They want to ban chemicals in baby foods. The group was founded by Mrs I. M. Right who has made a career in 'goodness' and is paid from donations given to *RMAU* by members of the public.

When interviewed, she said: "Calcium carbonate is a chemical and so it is a pollutant. *My Baby Food* must be banned to prevent the mass medication of babies. I don't feed my baby the stuff of gravestones."

Many people do **not** agree with Mrs Right's ideas.

Suggest why.

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..... **(3)(Total 7 marks)**

Q5. 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.

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.....**(3)**

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

Suggest why.

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.....**(1)**

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

Give the result of the test.

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(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.

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.....**(2)**

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

contain calcium ions.

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.....**(2)** **(Total 11 marks)**

Q6. Chemical tests can be used to identify compounds.

The table shows the results of some tests carried out on three solutions, **A**, **B** and **C**.

Solution	Flame Test	Hydrochloric acid is added	Sodium hydroxide solution is added	Silver nitrate solution is added
A	Yellow	Carbon dioxide gas produced		
B	Brick-red		White precipitate insoluble in excess sodium hydroxide solution	White precipitate
C			Dark green precipitate	

Use the information in the table to identify solutions **A**, **B** and **C**.

Give the name of:

(a) solution **A**; .....

(2)

(b) solution **B**; .....

(2)

(c) the metal ion in solution **C**. .....

(1)

(Total 5 marks)

Q7. A student investigated an egg shell.

Trish Steel [CC-BY-SA-2.0], via Wikimedia Commons

(a) The student did some tests on the egg shell.

The student's results are shown in the table below.

Test	Observation

1	Dilute hydrochloric acid was added to the egg shell.	A gas was produced. The egg shell dissolved, forming a colourless solution.
2	A flame test was done on the colourless solution from test **1**.	The flame turned red.
3	Sodium hydroxide solution was added to the colourless solution from test **1**.	A white precipitate formed that did not dissolve in excess sodium hydroxide solution.
4	Silver nitrate solution was added to the colourless solution from test **1**.	A white precipitate formed.

(i) The student concluded that the egg shell contains carbonate ions.

Describe how the student could identify the gas produced in test **1**.

.....

.....

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.....**(2)**

(ii) The student concluded that the egg shell contains aluminium ions.

Is the student's conclusion correct? Use the student's results to justify your answer.

.....

.....

.....

.....**(2)**

(iii) The student concluded that the egg shell contains chloride ions.

Is the student's conclusion correct? Use the student's results to justify your answer.

.....

.....

.....

.....**(2)**

(b) Some scientists wanted to investigate the amount of lead found in egg shells.
They used a modern instrumental method which was *more sensitive* than older methods.

(i) Name **one** modern instrumental method used to identify elements.

.....

.....**(1)**

(ii) What is the meaning of *more sensitive*?

.....

.....**(1)(Total 8 marks)**

M1.(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]

M2. any series of chemical tests that work should be given credit

each mark is for test + result + inference

identifying all 4 substances unambiguously with no errors gains **5** marks

e.g.

- Flame test: yellow / orange
  Na^+ sodium sulphate

  ignore incorrect flame test colours for other compounds

  1

- Add NaOH to remaining 3 samples:
  no (white) ppt / ammonia

  no need to test for ammonia

  1

  NH_4^+ ammonium sulphate (white) ppt magnesium ions or aluminium ions

  1

- add excess NaOH to the 2 samples which gave a (white) ppt:
  ppt dissolves aluminium sulphate
  ppt insoluble magnesium sulphate

  2

or

- Add NaOH:

  no ppt: ammonia NH_4^+ (1)
  ammonium sulphate
  the other one is sodium sulphate (1)

  (damp red) litmus goes blue*
  NH_3 ammonium sulphate
  the other one is sodium sulphate

- Add excess NaOH to the 2 samples
  which gave the white ppt (1)
  ppt dissolves aluminium sulphate (1)

ppt insoluble magnesium sulphate (1)

(*) or UI/pH indicator goes blue/purple

[5]

M3. (a) (i) hydrochloric acid / HCl

accept any (named) acid

1

carbon dioxide / CO_2

*accept bubbles / fizz / gas **or** limewater gets milky*

ignore 'add limewater'

*do **not** accept other named gases*

2nd mark dependant on first mark

*accept for this answer only heat gives CO_2 / limewater milky = **1** mark*

1

(ii) (white) precipitate / solid

ignore names of substances even if incorrect

accept <u>white</u> deposit / substance

*do **not** accept any coloured precipitate*

1

(iii) eg flame colour of (Na) and flame colour of (K)
interfere / mask / mix with each other

*accept 'can't see the colours' **or** 'difficult to determine the colour' **or** 'both produce <u>different</u> colours' **or** a correct statement of colours **or** hard to distinguish*

1

(b) (i) eg essential (mineral) **or** everyone
needs it / some (salt) **or** problems
with health if have no salt

accept preservative / flavouring / taste

it = salt

(all) foods contain / use it / sodium chloride / salt

1

(ii)

mark positively ie no list principle

advantages

any **two** from:

*ignore economic arguments throughout **or** people eat less salt*

- more people will be healthier
- (should have) less heart disease
- (should have) less cancer
- (more people with) lower blood pressure

2

disadvantages

any **one** from:

ignore references to too much / too little (salt)

- not everyone affected
- not enough evidence
- does not provide choice
- undemocratic
- less taste / flavour
  ignore <u>no</u> flavour / taste
- shorter shelf life / not preserved (as long)
  ignore references to sell by dates
- too much potassium chloride might be bad

1

[8]

M4. (a) (i) red / brick-red / orange-red / red-orange

allow red-brown or brown-red

*do **not** accept orange alone eg 'red or orange' = 0*

1

(ii) sodium

allow sodium compounds

ignore incorrect symbol

or Na / Na^+

*if symbol alone given do **not** accept Na^{2+} **or** Na^-*

1

(iii) any **one** from

- accurate / sensitive
- use small amounts
- fast / quick / rapid
- ease of automation
- reliable / efficient
- operatives do not need chemical skills

*ignore cost / safety / human error **or** ease of use **or** shows all the elements*

1

(iv) (atomic absorption) spectroscopy **or** (mass) spectrometry

*accept AAS / aas **or** mass spec*
accept atomic absorption
ignore ms / MS
*do **not** allow UV / IR / NMR / chromatography / GLC*

1

(b) any **three** from:

- (safe because) similar to mothers. milk

  allow calcium carbonate is in breast milk
  allow some mothers unable to breast feed
  ignore 'recommended' alone

- babies (in developing world) would die

  accept causes malnutrition

- if banned there would be a cost involved

  allow it is free

- it is not a pollutant / harmful / dangerous

  accept not all chemicals are pollutants / harmful / dangerous

- not mass medication
- not just used for gravestones

  allow it has many uses
  *ignore only small amounts of it **or** it occurs naturally*

- (calcium carbonate) is needed for bones / teeth / health

  allow 'essential mineral'

- Mrs Right has a personal interest **or** not impartial **or** distorts information / bias **or** she is paid by a charity

  accept 'it is (only) her opinion'

[7]

M5.(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 pointallow white solid
ignore silver chloride
ignore solution goes cloudy / milky

1

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

allow add sodium hydroxide

1

<u>aluminium</u> (ions / hydroxide (re)dissolve

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

1

(ii) place sample in flame

accept flame test

accept any workable methodallow 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]

M6. (a) sodium carbonate / sodium hydrogencarbonate / sodium bicarbonate

Na_2CO_3 / $NaHCO_3$

ie
*sodium / sodium ions (**1** mark)*
carbonate / carbonate ions
*(**1** mark)*
*incorrect formula including Na and CO_3 = **1** mark*

2

(b) calcium chloride

$CaCl_2$

*ie calcium / calcium ions (**1** mark) chloride / chloride ions (**1** mark)*
*incorrect formula including Ca and Cl = **1** mark*

2

(c) iron or iron(II) ions

Fe^{2+} ferrous ions
ignore anions

ignore nickel / chromium
do not accept iron(III) or ferric ions5

1

[5]

M7. (a) (i) (bubble gas produced through) limewater
incorrect tests = zero

1

(limewater) goes cloudy / milky

1

(ii) *ignore yes or no*

red flame indicates that calcium / lithium ions present
allow aluminium has no flame colour

or

Ca/Mg also produce a (white) precipitate with NaOH

1

the (white) precipitate formed in test 3 **or** by adding sodium hydroxide solution would dissolve (in excess) if aluminium ions were present

1

(iii) *ignore yes or no*

because a white precipitate is formed in test 4 **or** by adding silver nitrate

1

but chloride ions are in hydrochloric acid

1

(b) (i) mass spectrometry
allow MS

or

atomic absorption spectroscopy

allow AAS
spectrometry / spectroscopy alone is insufficient

1

(ii) can detect a small(er) amount of the substance
allow can detect small(er) changes
allow small(er) sample sizes
ignore references to precision / accuracy

1

[8]