M1.(a) water level above the start line
and
start line drawn in ink

allow water level too high

1

water level
food colours would dissolve into water
or
start line
the ink would 'run' on the paper

1

(b) (distance moved by **A**) 2.8cm **and** 8.2 cm (distance moved by solvent)

allow values in range 2.7 – 2.9 cm and 8.1 – 8.3 cm

1

$\frac{2.8}{8.2}$

1

0.34

allow 0.33 or 0.35

*allow ecf from incorrect measurement to final answer for **2** marks if given to 2 significant figures*

*accept 0.34 without working shown for **3** marks*

1

(c) 6.6 cm

allow values between 6.48 and 6.64 cm

1

(d) solvent moves through paper

1

different dyes have different solubilities in solvent

1

and different attractions for the paper

1

and so are carried different distances

1

(e) calcium ions

allow Ca^{2+}

1

sodium ions

allow Na^{+}

1

(f) two different colours

or

Ca^{2+} / one is orange-red and Na^{+} / the other is yellow

allow brick red for Ca^{2+} and / or orange for Na^{+}

*allow incorrect colours if consistent with answer to **7.5***

1

(so) colours mix

or

(so) one colour masks the other

1

(g) (Student **A** was incorrect)

because sodium compounds are white not green

or

because sodium carbonate is soluble

1

so can't contain sodium ions

1

(Student **B** was incorrect)

because adding acid to carbonate produces carbon dioxide

1

so must contain carbonate not chloride ions

1

[18]

M2.(a) **X:**

Fe^{2+} / iron(II), SO_4^{2-} / sulfate

allow iron(II) sulfate
or *$FeSO_4$*

1

Y:

Na^+ / sodium, I^- / iodide

allow sodium iodide
or *NaI*

1

Z:

Fe^{3+} / iron(III), Br^- / bromide

allow iron(III) bromide
or *$FeBr_3$*
correct identification of any two ions = one mark
correct identification of any four ions = two marks

1

(b) any **five** from:

allow converse arguments

method 1

- weighing is accurate
- not all barium sulfate may be precipitated
- precipitate may be lost
- precipitate may not be dry
- takes longer
- requires energy

allow not all the barium hydroxide has reacted

method 2

- accurate
- works for low concentrations

allow reliable / precise

5

[8]

M3.(a) (i) ionic (bonding)

1

(ii) ions cannot move in solid **or** are in fixed positions

*do **not** accept electrons / atoms / molecules*

ignore particles

***must** mention ions*

1

but can move in solution

1

(b) silver chloride formed

1

which is insoluble

1

(c) (i) aluminium

1

calcium

accept other metal ions that also give white precipitates (such as lead and zinc)

1

(ii) add excess sodium hydroxide solution

the second mark of each pair is dependent on the first mark being awarded.

1

precipitate remains

1

carry out a flame test

1

not red / orange

accept any colour that is not orange / red

give full credit for answers that correctly eliminate other cations in ***(c)(i)*** *that would give white precipitates with a few drops of NaOH*

1

[11]

M4. Marks awarded for this answer will be determined by the Quality of Communication (QC) as well as the standard of the scientific response. Examiners should also apply a 'best-fit' approach to the marking.

0 marks
No relevant content

Level 1 (1 – 2 marks)
Any description of a method used and / or a result given

Level 2 (3 – 4 marks)
Description of workable methods used, with results to identify positive **or** negative ions

Level 3 (5 – 6 marks)
Description of methods used to identify both positive **and** negative ions, with relevant results

examples of the points made in the response

extra information

Test: add (platinum / nichrome) wire (for the flame test)

accept any method of introducing the solution into the flame, eg a splint soaked in the solution or sprayed from a bottle

Result: the sodium compounds result in a yellow / orange / gold flame **or** the potassium compound results in a lilac / purple / mauve flame

student could state that potassium carbonate gives a different colour to the three sodium compounds as long as it is clear that the flame test colour comes from Na^+ or K^+

Test: add dilute nitric acid to all four solutions

allow any acid

Result: sodium carbonate and potassium carbonate will effervesce **or** sodium chloride and sodium iodide will not effervesce

Test: add dilute nitric acid followed by silver nitrate

Result: sodium chloride and sodium iodide produce a precipitate **or** sodium chloride produces a white precipitate and sodium iodide produces a yellow precipitate

accept sodium carbonate and potassium carbonate do not produce a precipitate

[6]

M5.(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]

M6.(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]