

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 Ca²⁺

1

sodium ions

allow Na⁺

1

(f) two different colours

or

Ca²⁺ / one is orange-red and Na⁺ / the other is yellow

allow brick red for Ca²⁺ 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) limewater **or** calcium hydroxide solution 1

(reacts with carbon dioxide and) turns cloudy / milky

linked to first point

if no other mark awarded 'puts out lighted splint' gains 1 mark

1

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

- same volume / amount of the acids
- concentration of the acids
- temperature
- same surface area / size / mass / amount of calcium carbonate
- same measuring equipment

2

(ii) any **three** from:

- (after about 4 minutes) the sulfuric acid stops reacting **or** nitric acid continues to react
accept more CO₂ with nitric acid at any time after 4 minutes
- (initially) the reaction with sulfuric acid is faster
- (the reaction stops) because calcium sulfate is a solid
allow sulfuric acid produces a solid
- (the reaction continues) because calcium nitrate is soluble / in solution / aqueous
allow nitric acid produces an (aqueous) solution
- because the calcium sulfate prevents the sulfuric acid reacting with the calcium carbonate
- (the rate is faster) because sulfuric acid contains two hydrogens

3

[7]

- M3.** (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]

- M4. (a) (i) test: limewater
accept calcium hydroxide solution 1
- result: 'goes' cloudy
accept white or milky
do not accept misty or chalky test must be correct before result mark can be considered 1
- (ii) $2 \text{NaHCO}_3 + \text{H}_2\text{SO}_4 \rightarrow$
 $\text{Na}_2\text{SO}_4 + (2) \text{H}_2\text{O} + (2) \text{CO}_2$ 1
- correctly balanced 1
- (b) (i) $\text{H}^+ + \text{OH}^-$ 1
- $\rightarrow \text{H}_2\text{O}$
- deduct **one** mark if incorrectly balanced
accept H_3O^+ instead of H^+ then $2\text{H}_2\text{O}$ needed for balance 1
- (ii) pH increases
accept numerical indication 1
- (c) addition of sulphuric acid 1
- correct use of an indicator
accept idea of forming a neutral solution 1
- crystallisation (of neutral solution)
accept description using evaporation 1

[10]