

**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<sup>2+</sup>*

1

sodium ions

*allow Na<sup>+</sup>*

1

(f) two different colours

**or**

Ca<sup>2+</sup> / one is orange-red and Na<sup>+</sup> / the other is yellow

*allow brick red for Ca<sup>2+</sup> and / or orange for Na<sup>+</sup>*

*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 CO<sub>2</sub> 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  $\text{H}_3\text{O}^+$  instead of  $\text{H}^+$  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]