Qualitative analysis

Total Marks : 21

Q1.

A precipitate is produced when an alkaline solution is added to a solution containing some metal ions.

(i) Which of these is evidence of a precipitate being produced?

(1)

- ☐ **A** fizzing
- ☐ **B** solid forms in the solution
- ☐ **C** the solution turns purple
- ☐ **D** the solution gets hot

(ii) You are given two solutions, one containing Ca^{2+} ions and the other containing Al^{3+} ions.

Devise a plan to identify which solution is which.

(4)

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(Total for question = 5 marks)

Q2.

Iron(III) ions, Fe^{3+}, react with hydroxide ions in solution to form iron(III) hydroxide.

Complete the ionic equation for this reaction.

(1)

$Fe^{3+} + 3OH^- \rightarrow$ .....

(Total for question = 1 mark)

Q3.

Qualitative tests can be used to identify ions in substances.

Sodium hydroxide solution is warmed with a solution of ammonium ions. Ammonia gas is given off.

Describe the test to show the gas is ammonia.

(2)

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(Total for question = 2 marks)

Q4.

Tests are carried out to identify the ions in two solids, **P** and **Q**.

A flame test is used to identify the metal ions in each of these solids.

(i) Describe how to do a flame test.

(2)

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(ii) Different metal ions produce different coloured flames.

Draw **one** straight line from each metal ion to its flame colour.

(2)

metal ion	flame colour
	green
calcium	yellow
	lilac
potassium	orange-red
	blue-green

(Total for question = 4 marks)

Q5.

A sample of potassium carbonate is contaminated with a small amount of sodium carbonate. When a flame test is carried out on the sample, a bright yellow flame is seen.

Describe how you could show that potassium and sodium ions are present in this sample.

(2)

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(Total for question = 2 marks)

Q6.

Sodium hydroxide solution is used to identify some cations present in compounds.

(i) Sodium hydroxide solution is warmed with a solution of ammonium ions. Ammonia gas is given off.

Describe the test to show the gas is ammonia.

(2)

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(ii) Sodium hydroxide solution is also used to distinguish between iron(II) ions, Fe^{2+} and iron(III) ions, Fe^{3+}, in solution.

You are given a solution containing iron(II) ions and another solution containing iron(III) ions.
Describe what is seen when sodium hydroxide solution is added to each of these solutions.

(2)

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(Total for question = 4 marks)

Q7.

Tests are carried out to identify the ions in two solids, **P** and **Q**.

P and **Q** dissolve in water to form colourless solutions.

Figure 7 shows the results of tests on these solutions.

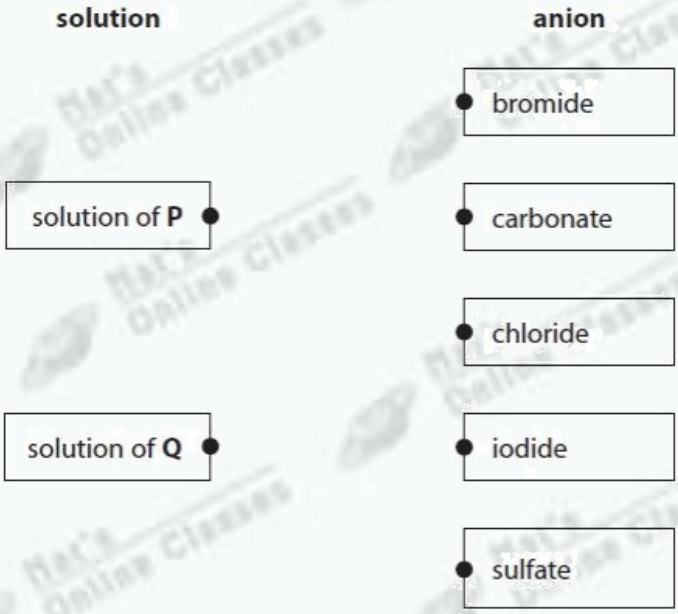
test	results	
	solution of P	solution of Q
dilute hydrochloric acid added, then barium chloride solution	a white precipitate	remains colourless
dilute nitric acid added, then silver nitrate solution	remains colourless	a yellow precipitate

Figure 7

(i) The anions in solutions of **P** and **Q** can be identified from the results of the tests shown in Figure 7.

Draw one straight line from each solution to the anion present.

(2)



(ii) The formula of barium chloride is $BaCl_2$.

Give the total number of ions in the formula $BaCl_2$.

(1)

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(Total for question = 3 marks)

Mark schemes :

Q1.

Question number	Answer	Mark
(i)	**B** solid forms in the solution is the only correct answer. **A**, **C**, and **D** are incorrect because a precipitate is a solid (of any colour)	(1) AO2 2

Question number	Answer	Additional guidance	Mark
(ii)	A plan including • add **named** alkaline solution / sodium hydroxide (solution) / potassium hydroxide (solution) (1) • white precipitate forms (in both) (1) • white precipitate dissolves with excess (alkali) indicates Al^{3+} (1) • white precipitate does not dissolve in excess (alkali) indicates Ca^{2+} (1)	accept correct formulae ignore 'alkaline solution' accept Al / Ca without charges mark independently as alternative tests allow • flame test • will show orange red / brick red for $Ca^{(2+)}$ for max 2 marks or • sulfuric acid • white precipitate for calcium ions for max 2 marks	(4) AO1 2

Q2.

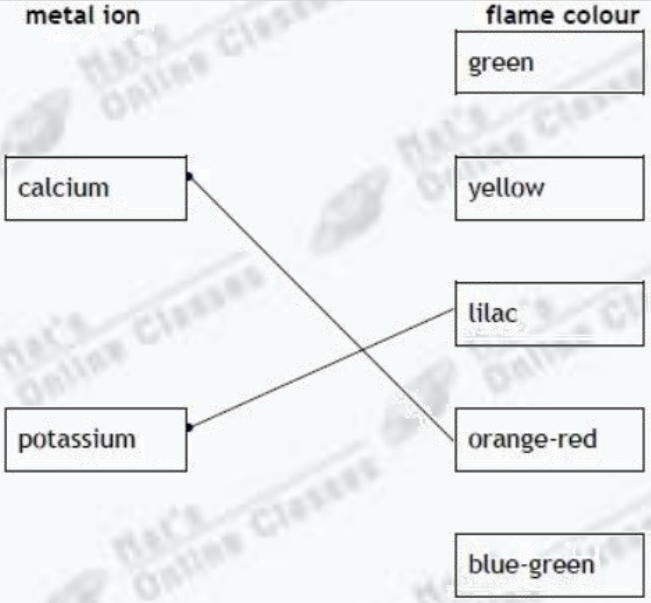
Question number	Answer	Mark
	$(Fe^{3+} + 3OH^{-}) \rightarrow Fe(OH)_3$	(1)

Q3.

Question number	Answer	Additional guidance	Mark
	An answer that provides a description by making reference to: • test gas with moist (red) litmus paper (1) • turns blue (1)	Allow universal indicator paper/pH paper (1) and yellow to blue/purple (1).	(2)

Q4.

Question number	Answer	Additional guidance	Mark
(i)	A description including • put (clean) wire into solid (1) • hold (wire) in (Bunsen) flame (1)	put (damp) splint into solid (1) hold splint in (Bunsen) flame (1) ignore: hold over flame reject use of yellow flame	(2)

Question number	Answer	Mark
(ii)	 Each line 1 mark Do not award mark if more than one line join the left hand boxes with those on the right	(2)

Q5.

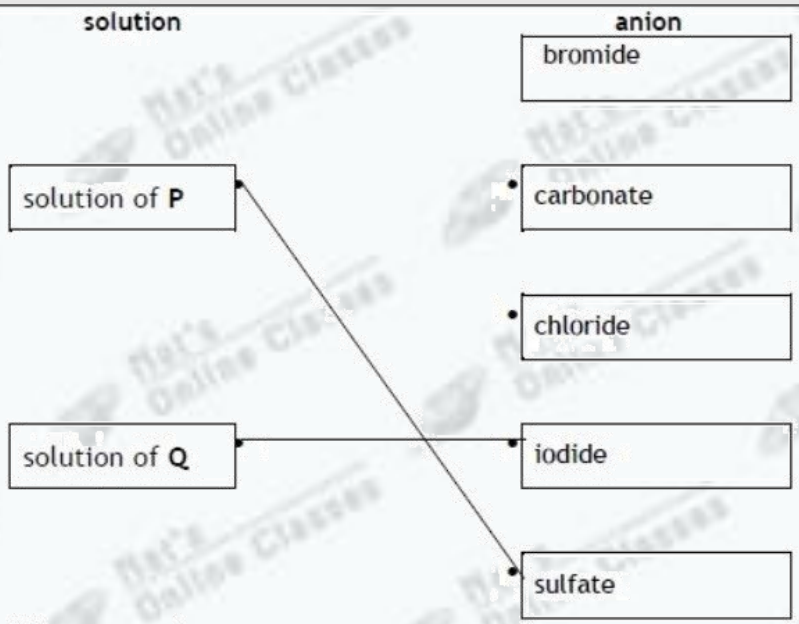
Question number	Answer	Additional guidance	Mark
	A description to include **flame** photometer (1) two (sets of) emissions / OWTTE (1)	 allow flame emission spectroscopy / spectroscope ignore flame test allow compare emission to reference samples	**(2)**

Q6.

Question number	Answer	Additional guidance	Mark
	An answer that provides a description by making reference to: • test gas with moist (red) litmus paper (1) • turns blue (1)	Allow universal indicator paper/pH paper and yellow to blue/purple	**(2)**

Question number	Answer	Additional guidance	Mark
	An answer that provides a description by making reference to: • iron(II) – green/pale green/grey-green **and** precipitate /solid (1) • iron(III) – red-brown/brown **and** precipitate /solid (1)	Allow two correct colours (1)	**(2)**

Q7.

Question number	Answer	Mark
(i)	 Each line 1 mark Do not award mark if more than one line join the left hand boxes with those on the right	(2)

Question number	Answer	Mark
(ii)	3 / three	(1)