

1. An unknown compound is tested to identify whether it contains sulfate, carbonate or halide ions.

What is the correct sequence of tests required?

- A carbonate, halide, sulfate
- B carbonate, sulfate, halide
- C halide, carbonate, sulfate
- D sulfate, carbonate, halide

Your answer

[1]

2. A student analyses a solution of a salt.

The results are shown below.

Test	Observation
Reaction with NaOH(aq)	Green precipitate
Reaction with Ba(NO <sub>3</sub> ) <sub>2</sub> (aq)	White precipitate

What is the formula of the salt?

- A CuCl<sub>2</sub>
- B CuSO<sub>4</sub>
- C FeCl<sub>2</sub>
- D FeSO<sub>4</sub>

Your answer

[1]

3. Solid ammonia, NH<sub>3</sub>, contains hydrogen bonds.

- i. Suggest why solid ammonia has a lower melting point than ice.

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[2]

- ii. When ammonia dissolves in water, ammonium ions,  $\text{NH}_4^+$ , are formed.

Draw a 'dot-and-cross' diagram to show the bonding in an  $\text{NH}_4^+$  ion.

Show outer electrons only.

[2]

- iii. Outline how you would test for the presence of  $\text{NH}_4^+$  ions in a solution.

Your answer should include observations.

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[2]

4. Tutton's salts are 'double salts' with the formula  $\text{X}_2\text{Y}(\text{Z}\text{O}_4)_2 \cdot 6\text{H}_2\text{O}$ .

A Tutton's salt contains two cations:  $\text{X}^+$  and  $\text{Y}^{2+}$ .

- $\text{X}^+$  can be an ion of the Group 1 elements K, Rb, Cs or Fr, or an ammonium ion.
- $\text{Y}^{2+}$  can be a 2+ ion of magnesium or an ion of most of the transition elements in Period 4.
- $\text{Z}$  can be S or Cr.

$(\text{NH}_4)_2\text{Cu}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$  is an example of a Tutton's salt.

The student dissolves their Tutton's salt in water. A pale blue solution forms.

The student carries out two tests on this aqueous solution.

- i. The student adds an excess of aqueous ammonia to their aqueous solution of Tutton's salt. A deep blue solution forms.

The complex ion responsible for the deep blue solution has a molar mass of  $167.5 \text{ g mol}^{-1}$ .

Suggest the formula of this complex ion.

[1]

- ii. The student adds NaOH(aq) to the aqueous solution of Tutton's salt and warms the mixture.

A precipitate and a gas are formed.

Write the formulae of the precipitate and gas and suggest a test that could confirm the identity of the gas.

Formula of precipitate

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Formula of gas

\_\_\_\_\_

Test to confirm the identity of the gas

\_\_\_\_\_

\_\_\_\_\_

[3]

- iii. How could the student carry out a test-tube test to confirm the anion in the Tutton's salt?

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\_\_\_\_\_

\_\_\_\_\_

[2]

5. A student adds aqueous potassium carbonate to one test tube and aqueous silver nitrate to a second test tube.

The student adds dilute hydrochloric acid to each test tube.

Which row has the correct observations?

	Aqueous potassium carbonate	Aqueous silver nitrate
A	no change	precipitate
B	no change	no change
C	effervescence	no change
D	effervescence	precipitate

Your answer

☐

[1]

6. This question is about some elements in Period 3 and compounds they form.

A student has a 5.00 g mixture of sodium chloride,  $\text{NaCl(s)}$ , and barium nitrate,  $\text{Ba(NO}_3)_2\text{(s)}$ .

The student also has a solution of sodium sulfate,  $\text{Na}_2\text{SO}_4\text{(aq)}$ .

The student uses the method below to determine the percentage by mass of  $\text{NaCl(s)}$  in the mixture.

- Step 1**      Dissolve the 5.00g mixture in distilled water.
- Step 2**      Add an excess of  $\text{Na}_2\text{SO}_4\text{(aq)}$  to the solution. A precipitate of barium sulfate forms.
- Step 3**      Filter off the precipitate, wash with water, and dry.
- Step 4**      Weigh the dried precipitate.

The molar mass of barium sulfate is  $233.4 \text{ g mol}^{-1}$ .

- i. Write an equation for the formation of barium sulfate in **step 2**.

Include state symbols.

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[2]

- ii. The student obtains 3.28 g of precipitate.

Calculate the percentage by mass of  $\text{NaCl(s)}$  in the 5.00 g mixture.

Give your answer to **3** significant figures.

percentage by mass of  $\text{NaCl (s)}$  = ..... % [4]

- iii. The student changes the method in **2(b)**.

In **step 2**, the student adds an excess of silver nitrate solution,  $\text{AgNO}_3\text{(aq)}$ , instead of  $\text{Na}_2\text{SO}_4\text{(aq)}$ .

Explain whether this change would allow the student to determine the percentage by mass of  $\text{NaCl(s)}$  in the mixture.

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[2]

In your answer, include observations, colours and equations.

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8. This question is about the reactions of Group 2 metals and their compounds.

A sample of barium oxide is added to distilled water at 25 °C.

A colourless solution forms containing barium hydroxide, Ba(OH)<sub>2</sub>.

The solution is made up to 250.0 cm<sup>3</sup> with distilled water.

The pH of this solution is 13.12.

- i. Determine the mass of barium oxide that was used.

Give your answer to **3** significant figures.

mass of barium oxide = ..... g **[5]**

- ii. 10 cm<sup>3</sup> of dilute sulfuric acid is added to 10 cm<sup>3</sup> of the colourless solution of Ba(OH)<sub>2</sub>. Write an ionic equation, including state symbols, for the reaction.

----- **[1]**

9. An aqueous solution contains a mixture of chloride, bromide and iodide ions.

AgNO<sub>3</sub>(aq) is added to this mixture, followed by an excess of dilute NH<sub>3</sub>(aq).

The resulting mixture is then filtered.

Which compound(s) is/are present in the residue on the filter paper?

- A** AgCl only  
**B** AgCl and AgBr  
**C** AgBr only  
**D** AgBr and AgI

Your answer ☐

**[1]**

**10.** This question is about some Group 2 elements and their compounds.

A student adds barium oxide, BaO, to water.

A reaction takes place forming a colourless solution.

- i. Predict the approximate pH of the colourless solution.

pH = .....

**[1]**

- ii. A student adds a few drops of dilute sulfuric acid to the colourless solution.

Describe what the student would observe, and give the formula of the barium compound produced.

Observation

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Formula of barium compound

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**[2]**

**END OF QUESTION PAPER**