2.26 Tests for Ions, Gases and Flame Tests: 1-hour Pack

AQA 8464 · Calculator allowed · about 60 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Silver nitrate solution and barium chloride solution are used as test reagents for different anions.

(a) Write an ionic equation, including state symbols, for the reaction between silver ions and chloride ions. **(2)**

(b) Write an ionic equation, including state symbols, for the reaction between barium ions and sulfate ions. **(2)**

(Total for Question 1 is 4 marks)

© Revision Library | revisionlibrary.co.uk

2 An unknown white solid is tested by a student. Test 1: a small sample is used in a flame test, and a lilac flame is produced. Test 2: a separate sample is dissolved in water and sodium hydroxide solution is added; no precipitate forms. Test 3: dilute hydrochloric acid is added to a separate sample of the solid; effervescence occurs, and the gas produced turns limewater cloudy.

(a) State what Test 1 shows about the identity of the solid. **(1)**

(b) Explain what Test 2 shows about the identity of the solid. **(2)**

(c) Identify the gas produced in Test 3, and state what this confirms about the solid. **(2)**

(d) Using the results of all three tests, identify the unknown solid, giving both its name and chemical formula. **(2)**

(Total for Question 2 is 7 marks)

© Revision Library | revisionlibrary.co.uk

3 Higher tier only. Aluminium hydroxide is unusual among the metal hydroxides tested in this topic because it is soluble in excess sodium hydroxide solution.

(a) State what would be observed if excess sodium hydroxide solution is added to a solution containing aluminium ions, Al^{3+}, and compare this with what would be observed for calcium ions, Ca^{2+}. **(3)**

(b) Write a balanced ionic equation, including state symbols, for aluminium hydroxide dissolving in excess hydroxide ions to form the soluble ion $Al(OH)_4^-$. **(2)**

(c) Explain why both the dropwise addition and the excess addition of sodium hydroxide solution must be observed in order to distinguish a solution of calcium ions from a solution of aluminium ions. **(2)**

(Total for Question 3 is 7 marks)

© Revision Library | revisionlibrary.co.uk

4 Simple chemical tests can be used to identify common gases produced in reactions.

(a) Describe the test for hydrogen gas, and state the result of a positive test. **(2)**

(b) Describe the test for oxygen gas, and state the result of a positive test. **(2)**

(c) Describe the test for carbon dioxide gas, and state the result of a positive test. **(2)**

(d) Describe the test for chlorine gas, and state the result of a positive test. **(2)**

(Total for Question 4 is 8 marks)

© Revision Library | revisionlibrary.co.uk

5 An unknown blue solution, X, is tested as follows. A flame test on a sample produces a green flame. Sodium hydroxide solution is added dropwise to a separate sample of X; a blue precipitate forms, which remains insoluble even when excess sodium hydroxide solution is added. A third sample of X is acidified with dilute hydrochloric acid, and barium chloride solution is then added; a white precipitate forms.

(a) Identify the cation present in solution X, giving a reason from the relevant tests. **(2)**

(b) Identify the anion present in solution X, giving a reason. **(2)**

(c) State the full name and formula of compound X. **(2)**

(d) Write ionic equations, including state symbols, for the two precipitation reactions described. **(4)**

(Total for Question 5 is 10 marks)

© Revision Library | revisionlibrary.co.uk

6 State the colour of the precipitate formed when sodium hydroxide solution is added dropwise to separate solutions containing each of the following ions: calcium ions, Ca^{2+}; copper(II) ions, Cu^{2+}; iron(II) ions, Fe^{2+}; iron(III) ions, Fe^{3+}; and aluminium ions, Al^{3+}.

(Total for Question 6 is 5 marks)

---

7 A student reacts small samples of a solid with dilute acid and wants to identify the gases produced.

(a) The student adds dilute hydrochloric acid to a sample of magnesium ribbon and collects the gas produced in a test tube. Describe how the student could test this gas, and state the result that would show the gas is hydrogen. **(2)**

(b) The student also bubbles a separate sample of gas, produced when a different white solid reacts with dilute acid, through limewater, and the limewater turns cloudy. Identify the gas, and explain what this confirms about the white solid. **(2)**

(Total for Question 7 is 4 marks)

© Revision Library | revisionlibrary.co.uk

Mark scheme · 2.26 Tests for Ions, Gases and Flame Tests: 1-hour Pack

Question 1

(a) correct formulae and balance: $Ag^+ + Cl^- \rightarrow AgCl$ **M1**

(a) correct state symbols: $Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$ (cao) **A1**

(a) Answer: $Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$

(b) correct formulae and balance: $Ba^{2+} + SO_4^{2-} \rightarrow BaSO_4$ **M1**

(b) correct state symbols: $Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$ (cao) **A1**

(b) Answer: $Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$

Question 2

(a) it contains potassium ions, K^+ (cao) **B1**

(a) Answer: It contains potassium ions, K^+.

(b) no precipitate forms with sodium hydroxide solution because potassium hydroxide is soluble, so this is consistent with the metal ion being potassium (as shown by Test 1) (oe) **B1**

(b) it rules out calcium, copper(II), iron(II), iron(III) and aluminium ions, since all of these would have given a coloured or white precipitate with sodium hydroxide solution (oe) **B1**

(b) Answer: No precipitate is consistent with a soluble Group 1 hydroxide (potassium), and rules out calcium, copper, iron(II), iron(III) and aluminium.

(c) carbon dioxide (cao) **B1**

(c) this confirms the solid contains carbonate ions, CO_3^{2-} (oe) **B1**

(c) Answer: Carbon dioxide; this confirms the solid contains carbonate ions.

(d) potassium carbonate (ecf from a and c) **B1**

(d) K_2CO_3 (cao, ecf) **B1**

(d) Answer: Potassium carbonate, K_2CO_3.

Question 3

(a) the initial white precipitate of aluminium hydroxide dissolves in excess sodium hydroxide solution (oe) **B1**

(a) forming a colourless solution (oe, cao) **B1**

(a) this differs from calcium ions, where the white precipitate of calcium hydroxide remains/does not dissolve, even in excess sodium hydroxide solution (oe) **B1**

(a) Answer: The aluminium hydroxide precipitate dissolves in excess NaOH to give a colourless solution; the calcium hydroxide precipitate does not dissolve.

(b) correct formulae and balance: $Al(OH)_3 + OH^- \rightarrow Al(OH)_4^-$ **M1**

(b) correct state symbols: $Al(OH)_3(s) + OH^-(aq) \rightarrow Al(OH)_4^-(aq)$ (cao) **A1**

(b) Answer: $Al(OH)_3(s) + OH^-(aq) \rightarrow Al(OH)_4^-(aq)$

(c) both ions form a white precipitate when sodium hydroxide is first added dropwise, so this step alone cannot distinguish between them (oe) **B1**

(c) only when excess sodium hydroxide is added does a difference appear, since only the aluminium hydroxide precipitate dissolves, so both stages must be observed to reliably distinguish the two ions (oe) **B1**

(c) Answer: Both give a white precipitate dropwise, so only observing the excess stage (where only aluminium hydroxide dissolves) allows the two ions to be told apart.

Question 4

(a) hold a lit (burning) splint at the mouth of the test tube containing the gas (oe) **B1**

(a) a positive test gives a squeaky pop, as the hydrogen ignites/burns rapidly (oe) **B1**

(a) Answer: Hold a lit splint at the mouth of the test tube; hydrogen gives a squeaky pop.

(b) insert a glowing splint into the test tube containing the gas (oe) **B1**

(b) a positive test relights (re-ignites) the glowing splint (oe, cao) **B1**

(b) Answer: Insert a glowing splint into the test tube; oxygen relights the glowing splint.

(c) bubble the gas through (or shake with) limewater (calcium hydroxide solution) (oe) **B1**

(c) a positive test turns the limewater cloudy/milky (oe, cao) **B1**

(c) Answer: Bubble the gas through limewater; carbon dioxide turns limewater cloudy.

(d) hold a piece of damp litmus paper in the gas (oe) **B1**

(d) a positive test bleaches the litmus paper, turning it white (oe, cao) **B1**

(d) Answer: Hold damp litmus paper in the gas; chlorine bleaches it white.

Question 5

(a) copper(II) ions, Cu^{2+} (cao) **B1**

(a) because the flame test is green and the precipitate with sodium hydroxide is blue and insoluble in excess, both characteristic of copper(II) ions (oe) **B1**

(a) Answer: Copper(II) ions, Cu^{2+}, shown by the green flame and the blue, insoluble precipitate with NaOH.

(b) sulfate ions, SO_4^{2-} (cao) **B1**

(b) because a white precipitate formed when the solution was acidified with dilute hydrochloric acid and barium chloride solution was added, the characteristic positive test for sulfate ions (oe) **B1**

(b) Answer: Sulfate ions, SO_4^{2-}, shown by the white precipitate with acidified barium chloride solution.

(c) copper(II) sulfate (ecf from a and b) **B1**

(c) $CuSO_4$ (cao, ecf) **B1**

(c) Answer: Copper(II) sulfate, $CuSO_4$.

(d) correct formulae and balance for the hydroxide precipitate: $Cu^{2+} + 2OH^- \rightarrow Cu(OH)_2$ **M1**

(d) correct state symbols: $Cu^{2+}(aq) + 2OH^-(aq) \rightarrow Cu(OH)_2(s)$ (cao) **A1**

(d) correct formulae and balance for the sulfate precipitate: $Ba^{2+} + SO_4^{2-} \rightarrow BaSO_4$ **M1**

(d) correct state symbols: $Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$ (cao) **A1**

(d) Answer: $Cu^{2+}(aq) + 2OH^-(aq) \rightarrow Cu(OH)_2(s)$, and $Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$

© Revision Library | revisionlibrary.co.uk

Question 6

calcium ions, Ca^{2+}: white precipitate **B1**

copper(II) ions, Cu^{2+}: blue precipitate **B1**

iron(II) ions, Fe^{2+}: green precipitate **B1**

iron(III) ions, Fe^{3+}: brown (orange-brown) precipitate **B1**

aluminium ions, Al^{3+}: white precipitate **B1**

Answer: Ca^{2+}: white; Cu^{2+}: blue; Fe^{2+}: green; Fe^{3+}: brown; Al^{3+}: white.

Question 7

(a) hold a lit (burning) splint at the mouth of the test tube (oe) **B1**

(a) a squeaky pop is heard, confirming the gas is hydrogen (oe, cao) **B1**

(a) Answer: Hold a lit splint at the mouth of the test tube; a squeaky pop confirms hydrogen.

(b) carbon dioxide (cao) **B1**

(b) this confirms the white solid contains carbonate ions, since carbon dioxide is the characteristic gas produced when a carbonate reacts with an acid (oe) **B1**

(b) Answer: Carbon dioxide; this confirms the solid contains carbonate ions.

© Revision Library | revisionlibrary.co.uk