2.26 Tests for Ions, Gases and Flame Tests: 30-minute Pack

AQA 8464 · Calculator allowed · about 30 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Sodium hydroxide solution is added to solutions of two soluble salts.

(a) Write a balanced symbol equation, including state symbols, for the reaction between copper(II) sulfate solution and sodium hydroxide solution. **(2)**

(b) Write a balanced symbol equation, including state symbols, for the reaction between iron(III) chloride solution and sodium hydroxide solution. **(3)**

(Total for Question 1 is 5 marks)

2 Iron forms two common ions, Fe^{2+} and Fe^{3+}, which can be distinguished using sodium hydroxide solution.

(a) State the colour of the precipitate formed when sodium hydroxide solution is added to a solution containing Fe^{2+} ions, and to a solution containing Fe^{3+} ions. **(2)**

(b) A student adds sodium hydroxide solution to a solution of iron(II) sulfate and leaves the test tube open to the air. After several minutes, the outer edges of the green precipitate have turned brown. Suggest an explanation for this observation. **(2)**

(Total for Question 2 is 4 marks)

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3 A technician suspects that a 25.0 cm^3 sample of solution contains sulfate ions. Dilute hydrochloric acid is added, followed by excess barium chloride solution. A white precipitate of barium sulfate forms; it is filtered, washed, dried and weighed, giving a mass of 0.466 g. (Relative formula mass, Mr, of $BaSO_4$ = 233)

(a) Explain why dilute hydrochloric acid is added to the sample before the barium chloride solution. **(2)**

(b) Calculate the number of moles of barium sulfate precipitate formed. **(2)**

(c) State the number of moles of sulfate ions, SO_4^{2-}, that were present in the original 25.0 cm^3 sample, and use this to calculate the concentration of sulfate ions in the original solution, in mol/dm^3. **(3)**

(Total for Question 3 is 7 marks)

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4 A student reacts 50.0 cm^3 of 0.100 mol/dm^3 sodium chloride solution with excess silver nitrate solution. A white precipitate of silver chloride forms. (Relative formula mass, Mr, of AgCl = 143.5)

(a) Calculate the number of moles of sodium chloride used. **(2)**

(b) State the number of moles of silver chloride precipitate that would form, and use this to calculate its mass, to 3 significant figures. **(3)**

(Total for Question 4 is 5 marks)

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5 Flame tests are a required practical technique used to identify metal ions from the colour they produce in a flame.

(a) Describe how a student should carry out a flame test on a solid ionic compound, using a nichrome wire loop. **(3)**

(b) Explain why the wire loop must be cleaned before it is used to test a new sample. **(2)**

(Total for Question 5 is 5 marks)

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Mark scheme · 2.26 Tests for Ions, Gases and Flame Tests: 30-minute Pack

Question 1

(a) correct formulae and balance: $CuSO_4$ + 2NaOH -> $Cu(OH)_2$ + Na_2SO_4 **M1**

(a) correct state symbols: $CuSO_4$(aq) + 2NaOH(aq) -> $Cu(OH)_2$(s) + Na_2SO_4(aq) (cao) **A1**

(a) Answer: $CuSO_4$(aq) + 2NaOH(aq) -> $Cu(OH)_2$(s) + Na_2SO_4(aq)

(b) correct formulae: $FeCl_3$ + NaOH -> $Fe(OH)_3$ + NaCl **M1**

(b) correctly balanced: $FeCl_3$ + 3NaOH -> $Fe(OH)_3$ + 3NaCl **M1**

(b) correct state symbols throughout: $FeCl_3$(aq) + 3NaOH(aq) -> $Fe(OH)_3$(s) + 3NaCl(aq) (cao) **A1**

(b) Answer: $FeCl_3$(aq) + 3NaOH(aq) -> $Fe(OH)_3$(s) + 3NaCl(aq)

Question 2

(a) Fe^{2+}: green precipitate **B1**

(a) Fe^{3+}: brown precipitate **B1**

(a) Answer: Fe^{2+}: green precipitate. Fe^{3+}: brown precipitate.

(b) the iron(II) hydroxide precipitate has been oxidised by oxygen in the air (oe) **B1**

(b) forming iron(III) hydroxide, which is brown, at the surface/edges where it is in contact with the air (oe) **B1**

(b) Answer: The iron(II) hydroxide has been oxidised by oxygen in the air to iron(III) hydroxide, which is brown.

Question 3

(a) to remove/react with any carbonate ions present (oe) **B1**

(a) which would otherwise also form a white precipitate (barium carbonate) with barium chloride, giving a false positive result for sulfate (oe) **B1**

(a) Answer: It removes any carbonate ions present, which would otherwise also give a white precipitate with barium chloride, causing a false positive.

(b) moles = mass / Mr = 0.466 / 233 **M1**

(b) 0.00200 mol (2.00×10^{-3} mol) (cao) **A1**

(b) Answer: 0.00200 mol

(c) moles of SO_4^{2-} = moles of $BaSO_4$ = 0.00200 mol (1:1 ratio) (ecf from b) **M1**

(c) concentration = moles / volume in dm^3 = 0.00200 / 0.0250 **M1**

(c) 0.0800 mol/dm^3 (awrt 0.08, ecf) **A1**

(c) Answer: 0.00200 mol of sulfate ions; concentration = 0.0800 mol/dm^3

Question 4

(a) moles = concentration x volume (dm^3) = 0.100 x (50.0/1000) **M1**

(a) 0.00500 mol (cao) **A1**

(a) Answer: 0.00500 mol

(b) moles of AgCl = moles of NaCl = 0.00500 mol (1:1 ratio) (ecf from a) **M1**

(b) mass = moles x Mr = 0.00500 x 143.5 **M1**

(b) 0.718 g (awrt 0.718, ecf) **A1**

(b) Answer: 0.00500 mol of AgCl; mass = 0.718 g

Question 5

(a) dip the (nichrome) wire loop into dilute hydrochloric acid, then rinse it in distilled water, to clean it (oe) **B1**

(a) dip the clean wire loop into the solid sample, or into a paste made with the solid and a few drops of dilute hydrochloric acid, so a small amount sticks to the loop (oe) **B1**

(a) hold the wire loop in the clear, roaring (blue) part of a Bunsen flame and observe/record the colour produced; wear eye protection throughout (oe) **B1**

(a) Answer: Clean the wire loop with dilute hydrochloric acid and water, dip it into the sample, then hold it in a blue Bunsen flame and observe the colour, wearing eye protection.

(b) to remove any of the previous sample remaining on the wire (oe) **B1**

(b) otherwise contamination could produce or mask a flame colour that does not belong to the new sample, causing a misleading result (oe) **B1**

(b) Answer: Cleaning removes traces of the previous sample, which could otherwise contaminate the result and produce or mask a misleading flame colour.

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