2.9 Chemical Analysis: Test Pack

AQA 8462 · Calculator allowed · about 50 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Define the term "pure substance" in chemistry.

(Total for Question 1 is 1 mark)

2 Which simple separation method would you use to separate a soluble salt from sand in a mixture?

(a) Name the method to separate a soluble salt from sand. **(1)**

(Total for Question 2 is 1 mark)

3 Give the typical pH value for each of the following and state whether it is acidic, neutral or alkaline.

(a) Neutral substance **(1)**

(b) A typical acidic substance **(1)**

(c) A typical alkaline substance **(1)**

(Total for Question 3 is 3 marks)

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4 Describe a simple test for carbon dioxide gas and the observation that confirms its presence.

(a) Test and observation for carbon dioxide. **(1)**

(Total for Question 4 is 1 mark)

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5 A student adds dilute hydrochloric acid to a sample and sees vigorous fizzing. This suggests the sample contains carbonate ions. State the gas produced and how to test that the gas is carbon dioxide.

(a) State the gas produced when acid is added to a carbonate. **(1)**

(b) Describe a test to confirm the gas is carbon dioxide. **(1)**

(Total for Question 5 is 2 marks)

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6 A laboratory analyses a sample of impure copper sulfate crystals, obtained from an industrial process, with a total mass of 12.5 g. Chemical analysis shows the sample contains 10.75 g of pure hydrated copper sulfate, the rest being an insoluble impurity.

(a) Calculate the percentage purity of the sample of copper sulfate crystals. Give your answer to 3 significant figures. **(3)**

(b) Suggest one reason why a formulation, such as a fertiliser or a medicine, might deliberately be made using less than 100% of the pure active substance. **(1)**

(Total for Question 6 is 4 marks)

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7 A technician uses flame tests as part of a required practical to identify unknown metal ions in four solid salts, labelled P, Q, R and S.

(a) Describe how the technician should safely carry out a flame test on a sample of one of the solid metal salts. **(3)**

(b) Table 1 shows the flame colour observed for each salt: P gave an orange-red flame, Q gave a lilac flame, R gave a yellow flame, and S gave a blue-green flame. Identify the metal ion present in each of salts P, Q, R and S. **(4)**

(Total for Question 7 is 7 marks)

8 A technician wants to identify which halide ion, if any, is present in an unknown solution.

(a) Describe the method used to test for halide ions in solution, including the reagents that should be added. **(3)**

(b) State the colour of the precipitate formed for chloride ions, for bromide ions and for iodide ions. **(3)**

(Total for Question 8 is 6 marks)

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9 A student wants to check the purity of a sample of aspirin by measuring its melting point.

State what result would indicate the aspirin sample is impure, and explain why an impurity has this effect on melting point.

(Total for Question 9 is 2 marks)

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10 A technician has 25.0 cm^3 of a 2.00 mol/dm3 stock solution of sodium chloride, which is diluted with water to a total volume of 250 cm^3 to make a reference standard for ion analysis. Calculate the concentration of the diluted sodium chloride solution.

(Total for Question 10 is 3 marks)

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11 Higher tier only. To calibrate a flame emission spectrometer, a chemist must prepare a series of standard solutions of known concentration from a 1.00 mol/dm3 stock solution of potassium chloride.

(a) Describe how the chemist could accurately prepare 100 cm^3 of a 0.100 mol/dm3 standard solution of potassium chloride from the stock solution, naming the apparatus used to measure the two volumes involved. **(3)**

(b) Calculate the number of moles of potassium chloride present in the 100 cm^3 of 0.100 mol/dm3 standard solution. **(2)**

(Total for Question 11 is 5 marks)

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Mark scheme · 2.9 Chemical Analysis: Test Pack

Question 1

contains only one type of element or compound or has fixed melting and boiling points, oe **B1**

Answer: A substance that contains only one type of element or compound and has fixed melting and boiling points.

Question 2

(a) filtration followed by evaporation or crystallisation **B1**

(a) Answer: Filtration to remove sand, then evaporate or crystallise the solution to get the salt.

Question 3

(a) pH 7 and neutral **B1**

(a) Answer: pH 7, neutral

(b) pH 2-3 and acidic **B1**

(b) Answer: pH 2 or 3, acidic

(c) pH 11-12 and alkaline **B1**

(c) Answer: pH 11 or 12, alkaline

Question 4

(a) bubble the gas through limewater and it turns milky or cloudy **B1**

(a) Answer: Bubble the gas through limewater; the limewater turns milky or cloudy.

Question 5

(a) carbon dioxide **B1**

(a) Answer: Carbon dioxide

(b) bubble the gas through limewater which turns cloudy/milky **B1**

(b) Answer: Bubble the gas through limewater; it turns cloudy, confirming carbon dioxide.

Question 6

(a) percentage purity = (mass of pure substance / total mass of sample) x 100 **M1**

(a) (10.75 / 12.5) x 100 **M1**

(a) 86.0% cao **A1**

(a) Answer: 86.0%

(b) the pure active substance may be too concentrated/strong to use safely or effectively on its own, so it is diluted with a filler/carrier substance to give the correct, safer dose or strength oe **B1**

(b) Answer: The pure active substance may be too concentrated to use safely, so it is mixed with a filler or carrier to give a controlled, safer dose or strength.

Question 7

(a) dip a clean (nichrome or platinum) 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, non-luminous part of a blue Bunsen flame oe **B1**

(a) observe and record the colour of the flame produced; wear eye protection throughout oe **B1**

(a) Answer: Dip a clean wire loop into the solid (or a paste of the solid with a little dilute hydrochloric acid), hold it in the clear blue part of a roaring Bunsen flame, and observe the colour produced, wearing eye protection.

(b) P: calcium ion (Ca^{2+}) **B1**

(b) Q: potassium ion (K^{+}) **B1**

(b) R: sodium ion (Na^{+}) **B1**

(b) S: copper ion (Cu^{2+}) **B1**

(b) Answer: P contains calcium ions (Ca^{2+}); Q contains potassium ions (K^{+}); R contains sodium ions (Na^{+}); S contains copper ions (Cu^{2+}).

Question 8

(a) add a few drops of dilute nitric acid to the solution oe **B1**

(a) then add a few drops of silver nitrate solution oe **B1**

(a) a coloured precipitate forming confirms the presence of a halide ion (the colour identifies which one) **B1**

(a) Answer: Add dilute nitric acid to the solution, then add silver nitrate solution; a coloured precipitate forming confirms a halide ion is present, and its colour identifies which one.

(b) chloride: white precipitate **B1**

(b) bromide: cream precipitate **B1**

(b) iodide: yellow precipitate **B1**

(b) Answer: Chloride ions give a white precipitate; bromide ions give a cream precipitate; iodide ions give a yellow precipitate.

Question 9

an impure sample melts over a range of temperatures and starts melting below the true (sharp) melting point of pure aspirin, oe **B1**

an impurity disrupts the regular arrangement of particles in the crystal lattice, which lowers the melting point and widens the temperature range over which melting occurs, oe **B1**

Answer: An impure sample melts below the true melting point and over a range of temperatures, because the impurity disrupts the regular crystal lattice structure, weakening it.

Question 10

concentration1 x volume1 = concentration2 x volume2 stated or used oe **M1**

2.00 x 25.0 = C2 x 250, so C2 = (2.00 x 25.0) / 250 **M1**

0.200 mol/dm3 cao **A1**

Answer: 0.200 mol/dm3

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Question 11

(a) use a (volumetric) pipette to accurately measure 10.0 cm^3 of the 1.00 mol/dm3 stock solution into a volumetric flask oe **B1**

(a) add distilled water to make the total volume up to the 100 cm^3 graduation mark on the volumetric flask oe **B1**

(a) mix (invert/swirl) the flask thoroughly to give an evenly diluted solution **B1**

(a) Answer: Use a volumetric pipette to measure exactly 10.0 cm^3 of the stock solution into a 100 cm^3 volumetric flask, then add distilled water carefully up to the graduation mark, and mix thoroughly.

(b) moles = concentration x volume (in dm3); 0.100 x (100/1000) **M1**

(b) 0.0100 mol (or 1.00 x 10^{-2} mol) cao **A1**

(b) Answer: 0.0100 mol

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