2.9 Chemical Analysis: 30-minute Pack

AQA 8462 · Calculator allowed · about 30 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 State how you would test for oxygen gas and the observation you would expect.

(a) Test and observation for oxygen. **(1)**

(Total for Question 1 is 1 mark)

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2 Chemists distinguish between pure substances, mixtures and formulations.

(a) State what is meant by a 'pure substance' in chemistry. **(1)**

(b) A student says: 'Orange juice from a carton is a pure substance, because the label says it is 100% juice.' Explain why the student is incorrect. **(2)**

(c) State what is meant by a 'formulation'. **(1)**

(Total for Question 2 is 4 marks)

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3 Chemists use simple tests 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)**

(Total for Question 3 is 4 marks)

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4 Describe the test for chloride ions in solution and the observation that indicates chloride is present. Include the reagents needed.

(a) Describe the chloride test and observation. **(2)**

(Total for Question 4 is 2 marks)

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5 In a chromatography experiment a student places a spot of ink 2.0 cm from the base line. After running the solvent the solvent front moved 7.0 cm from the base line and the ink spot moved 4.2 cm from the base line. Calculate the Rf value for the ink.
Use Rf = distance travelled by substance / distance travelled by solvent.

(a) Calculate Rf and give your answer to two decimal places. **(2)**

(Total for Question 5 is 2 marks)

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6 A technician wants to check whether a white solid is a pure sample of sulfur (melting point 115°C).

(a) Describe how the technician could use melting point to test whether the solid is pure sulfur. **(3)**

(b) The solid started melting at 109°C and finished melting at 118°C. State, with a reason, whether the solid is pure sulfur. **(2)**

(Total for Question 6 is 5 marks)

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7 You are given two white solid samples. Sample A dissolves in dilute hydrochloric acid with effervescence. Sample B does not react with dilute hydrochloric acid. Explain a sequence of simple tests you would do to distinguish between sodium chloride and calcium carbonate, identify which sample is which, and how you would check the purity of each solid. Your answer should describe observations and give reasons.

(Total for Question 7 is 6 marks)

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Mark scheme · 2.9 Chemical Analysis: 30-minute Pack

Question 1

(a) place a glowing splint into the gas and it relights or glows brighter **B1**

(a) Answer: Put a glowing splint into the gas; the splint relights showing oxygen is present.

Question 2

(a) a single element or compound, not mixed with any other substance oe **B1**

(a) Answer: A pure substance is a single element or compound that is not mixed with any other substance.

(b) orange juice contains several different substances (e.g. water, sugars, citric acid, vitamins) mixed together oe **M1**

(b) so it is a mixture, not a single element or compound, even though every component came from the orange (100% juice describes its origin, not its chemical purity) oe **A1**

(b) Answer: Orange juice contains many different substances, such as water, sugars and citric acid, mixed together, so it is a mixture rather than a single pure compound; '100% juice' describes where it came from, not its chemical purity.

(c) a mixture that has been designed as a useful product, in which each component is present in a carefully measured (controlled) quantity oe **B1**

(c) Answer: A formulation is a mixture that has been designed as a useful product, with each component present in a carefully controlled amount.

Question 3

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

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

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

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

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

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

Question 4

(a) acidify with dilute nitric acid to remove carbonate ions **B1**

(a) add silver nitrate and a white precipitate of silver chloride forms **B1**

(a) Answer: Acidify the solution with dilute nitric acid then add silver nitrate; a white precipitate (silver chloride) shows chloride ions are present.

Question 5

(a) substitutes distances measured from the origin: Rf = (4.2 - 2.0) / (7.0 - 2.0) **M1**

(a) 0.44 cao **A1**

(a) Answer: 0.44

Question 6

(a) heat a small sample of the solid slowly (e.g. in a capillary tube using a melting point apparatus) oe **B1**

(a) record the temperature at which the solid starts to melt and the temperature at which it has completely melted oe **B1**

(a) compare the melting range measured to the known melting point of pure sulfur (115°C); a pure substance melts sharply at a single, exact temperature oe **B1**

(a) Answer: Heat a small sample slowly using a melting point apparatus, recording the temperature at which melting starts and finishes, then compare this to the known melting point of pure sulfur (115°C). A pure substance melts sharply at one exact temperature.

(b) the solid is not pure sulfur oe **M1**

(b) because it melts over a range of temperatures (109-118°C) rather than sharply at 115°C; impurities lower and widen the melting point range oe **A1**

(b) Answer: It is not pure sulfur, because it melts gradually over a range (109 to 118°C) instead of sharply at exactly 115°C; the presence of an impurity lowers and widens the melting point range.

Question 7

Level 3 Detailed explanation using a clear sequence of tests, correct observations, and correct reasons that distinguish sodium chloride and calcium carbonate and give methods to check purity. **5-6**

Level 2 Some correct tests and observations with partial reasons, but the sequence or purity checks are incomplete or partly incorrect. **3-4**

Level 1 Limited or vague description of tests with little or no correct reasoning. **1-2**

Indicative content:

- Add dilute hydrochloric acid to a sample: calcium carbonate reacts with effervescence producing CO_2; sodium chloride does not fizz.
- Confirm gas is CO_2 by bubbling through limewater which turns cloudy; this identifies carbonate.
- For sodium chloride, dissolve sample in water and test with silver nitrate after acidification: a white precipitate (silver chloride) forms for chloride ions.
- To check purity of calcium carbonate, measure melting point is not suitable; instead check that adding acid always gives CO_2 and that remaining solid gives expected mass loss on heating (if described simply), or compare with a pure sample reaction strength; for sodium chloride, evaporate solution to recrystallise and check crystals and melting point or compare conductivity of solution.
- Give reasons: carbonate reacts with acid to produce CO_2 because $CO_3(2-) + 2H^+ \rightarrow CO_2 + H_2O$; chloride gives silver chloride precipitate because $Ag^+ + Cl^- \rightarrow AgCl(s)$.
- Clear sequence: acid test first to separate which is carbonate, then confirm chloride test on the other; show how recrystallisation or consistent sharp melting point / consistent test results indicate purity.

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