2.11 Chemistry Required Practicals and Data Analysis: Test Pack

AQA 8464 · Calculator allowed · about 25 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A technician tests the purity of three water samples, P, Q and R, by measuring their electrical conductivity using a simple circuit with a battery, an ammeter and two graphite electrodes dipped into each sample in turn. Results: Sample P (tap water): current = 0.35 A. Sample Q (deionised water): current = 0.02 A. Sample R (sea water): current = 1.20 A.

(a) Identify which sample is most likely to be pure water, and explain your reasoning based on the results. **(2)**

(b) Explain why sample R (sea water) produces the largest current. **(2)**

(c) Suggest one variable that should be controlled for this to be a valid comparison between the three samples. **(1)**

(d) Higher tier only. Suggest how a calibration curve could be produced to estimate the concentration of dissolved ions in an unknown water sample from its current reading. **(2)**

(Total for Question 1 is 7 marks)

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2 A technician electrolyses dilute sulfuric acid using inert (platinum) electrodes, collecting the gas produced at each electrode in an inverted, water-filled test tube.

(a) Describe a chemical test the technician could use to confirm that the gas collected at the cathode is hydrogen, including the positive result. **(2)**

(b) Describe a chemical test the technician could use to confirm that the gas collected at the anode is oxygen, including the positive result. **(2)**

(c) The technician notices that, in any given time, roughly twice as much gas is collected at the cathode as at the anode. Explain this observation in terms of the formula of water. **(2)**

(Total for Question 2 is 6 marks)

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3 A different student investigates how the current affects the mass of copper deposited on the cathode during the electrolysis of copper sulfate solution, using copper electrodes. Table of results (10 minutes of electrolysis at each current):

Current (A): 0.50, 1.00, 1.50, 2.00

Mass of copper deposited (g): 0.10, 0.20, 0.30, 0.40

(a) State the independent variable, the dependent variable, and one variable that should be controlled in this investigation. **(3)**

(b) Describe the relationship shown by the table between the current and the mass of copper deposited. **(2)**

(c) Suggest one safety precaution that should be taken during this investigation. **(1)**

(Total for Question 3 is 6 marks)

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Mark scheme · 2.11 Chemistry Required Practicals and Data Analysis: Test Pack

Question 1

(a) sample Q **B1**

(a) pure water contains (almost) no free/dissolved ions to carry charge, so it conducts electricity very poorly, giving the smallest current oe **B1**

(a) Answer: Sample Q, because pure water contains very few free-moving ions to carry charge, so it conducts electricity poorly, giving the smallest current.

(b) sea water contains a high concentration of dissolved ionic compounds (e.g. sodium chloride) oe **M1**

(b) this provides many free-moving ions to carry the charge, so it conducts electricity well, giving the largest current oe **A1**

(b) Answer: Sea water contains a high concentration of dissolved ionic compounds, providing many free ions to carry the charge, so it conducts well and gives the largest current.

(c) any one of: the voltage (p.d.) applied, the distance between the electrodes, the volume of sample tested, the temperature of the samples **B1**

(c) Answer: E.g. the voltage applied to the circuit should be the same for every sample tested.

(d) measure the current for a series of solutions of known concentration (e.g. standard sodium chloride solutions) using the same apparatus oe **M1**

(d) plot a graph of current against known concentration, then read the current of the unknown sample against this graph to estimate its concentration oe **A1**

(d) Answer: Measure the current for several standard solutions of known ion concentration, plot current against concentration to give a calibration graph, then use the unknown sample's current to read off its estimated concentration from the graph.

Question 2

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

(a) hydrogen burns rapidly with a squeaky pop **B1**

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

(b) insert a glowing splint into the mouth of the test tube **B1**

(b) oxygen relights the glowing splint **B1**

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

(c) water, H_2O, contains twice as many hydrogen atoms as oxygen atoms oe **M1**

(c) so hydrogen and oxygen gas are produced in a 2:1 ratio by volume, matching the 2:1 ratio of hydrogen to oxygen atoms in water oe **A1**

(c) Answer: Water is H_2O, containing twice as many hydrogen atoms as oxygen atoms, so hydrogen and oxygen gas are produced in the same 2:1 ratio by volume.

Question 3

(a) independent variable: current **B1**

(a) dependent variable: mass of copper deposited (on the cathode) **B1**

(a) control: any one of time of electrolysis, concentration of copper sulfate solution, distance between electrodes **B1**

(a) Answer: Independent variable: current. Dependent variable: mass of copper deposited. Control: e.g. time of electrolysis, kept the same for every current tested.

(b) as the current increases, the mass of copper deposited increases oe **M1**

(b) the mass deposited is directly proportional to the current (e.g. doubling the current doubles the mass deposited), supported by the data given **A1**

(b) Answer: The mass of copper deposited is directly proportional to the current; for example, doubling the current from 1.00 A to 2.00 A doubles the mass deposited from 0.20 g to 0.40 g.

(c) any sensible precaution, e.g. do not touch the electrodes or bare wires with wet hands, to avoid an electric shock oe **B1**

(c) Answer: Do not touch the electrodes or bare wires with wet hands, to avoid the risk of an electric shock.

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