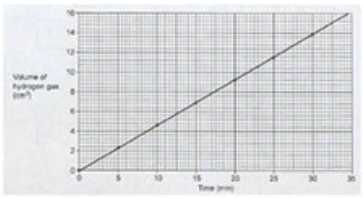
Mark scheme

Question			Answer/Indicative content	Marks	Guidance
1			**C**	1 (AO 2.2)	**Examiner's Comments** Selecting option D was a common misconception in this question indicating that candidates did not recall that reduction occurs at the cathode and oxidation occurs at the anode.
			Total	**1**	
2			**B**	1 (AO 1.2)	
			Total	**1**	
3			**A**	1 (AO 1.2)	**Examiner's Comments** Selecting option B was a common misconception in this question, being the products formed in the electrolysis of molten sodium chloride. Candidates should be encouraged to read the question carefully and to underline key words, e.g. 'solution' in this case.
			Total	**1**	
4	a		**Level 3 (5–6 marks)** Accurately applies knowledge and a detailed understanding to explain the product made at the electrode in each experiment **AND** Determines that the scientist should use experiment 2 *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Clearly, but with some limitations, applies knowledge and understanding to explain the product made at the	6 (4 × AO 2.2) (2 × AO 3.2b)	**AO3.2b Applies knowledge and understanding of electrolysis** • In experiment 1, molten copper chloride contains only Cu^{2+} ions and Cl^- ions • In experiment 2, copper sulfate solution contains Cu^{2+}, SO_4^{2-}, H^+ and OH^- ions • Positive metal / hydrogen ions are attracted to the negative cathode • Negative non-metal ions and are attracted to the positive anode • Cu^{2+} ions are less reactive than H^+ ions • Cu^{2+} ions are discharged in preference to H^+ ions

			electrode in each experiment **AND** Determines that the scientist should use experiment 2 *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** Attempts to apply knowledge and understanding to explain the product made at the electrode in one of the experiments *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant*. **0 mark** *No response or no response worthy of credit.*		**AO3.2b Analyses information and ideas to draw conclusions** • Experiment 1 forms chlorine at the anode • Experiment 1 forms copper at the cathode • Experiment 2 forms copper at the cathode • Experiment 2 forms oxygen at the anode • Experiment 2 should be used **Examiner's Comments** This 6 mark Level of Response question assessed AO2 and AO3. At Level 3 (5 – 6 marks) candidates needed to accurately apply their knowledge and understanding to give a detailed explanation of the product made at each electrode in each experiment and determine that the scientist should use Experiment 2. All candidates attempted the question which generated a wide range of responses and discriminated well. High attaining candidates demonstrated an excellent level of understanding relating to the electrolysis of copper sulfate solution, with many writing about the presence of hydrogen ions and how the reactivity series determines which product is discharged at the cathode, although some did not explain where the hydrogen ions had come from. These candidates also tended to support their answers with correct half equations. Some candidates stated the rules they had learnt for what is produced in a solution during electrolysis, for example, oxygen is produced if no halogen present, which didn't demonstrate a complete understanding. A common incorrect response seen was that sulfur would be produced at the anode. Many candidates did not explicitly discuss the charges on the ions and electrodes but were able to identify the correct products and the use of

					Experiment 2 to collect copper to achieve Level 2 and 4 marks. Exemplar 2  This is a Level 3 response which correctly determined that the scientist should use Experiment 2. The candidate has accurately applied their knowledge and understanding of electrolysis to explain the product made at each electrode in the experiment. This response was given 6 marks.
	b		Electrodes should be in the lead bromide / electrolyte ✓ Lead bromide should be molten / the lead bromide should be heated (until it is molten) ✓	2 (2 × AO 3.3b)	**IGNORE** use inert electrodes **IGNORE** connect the wire together **IGNORE** lead bromide should be in aqueous solution **<u>Examiner's Comments</u>** Successful responses to this question stated that the lead bromide needed to be molten for electrolysis to occur, but fewer candidates appreciated that the electrodes need to touch the electrolyte. Common incorrect answers included switching the electrodes around, making the lead bromide a solution, connecting the circuit together because they misunderstood the +/- symbol at the top of the diagram, adding a power supply, using inert electrodes, and adding an electrolyte to the beaker.

					Misconception The difference between molten and aqueous liquids was a common misconception. Some candidates wrote about molten solutions. Most were unaware that lead bromide is insoluble.
	c		$2Br^- - \mathbf{2e^-} \rightarrow \mathbf{Br_2}$ Correct species ✓ Balancing ✓	2 (2 × AO 1.2)	Second MP is dependent on the first **Examiner's Comments** Most candidates correctly completed the half equation. The main error was not knowing that bromine is a diatomic molecule.
			Total	**10**	
5	a		Weigh the negative electrode / cathode before the experiment ✓ Weigh the negative electrode / cathode with the copper formed ✓ Calculate the change in mass / mass increase ✓	3(3 ×AO3.3b)	**ALLOW** idea of weighing both electrodes in MP1 and MP2 MP3 is independent of MP1 and MP2, i.e. MP3 can still be awarded if anode referred to **ALLOW** for MP3 weigh the mass of copper formed on the cathode / weigh the residue on the cathode **ALLOW** weigh the electrode before the experiment and weigh the electrode after the experiment for 1 mark if no other mark awarded **Examiner's Comments** This question required candidates to describe an adaptation to the experiment. Good responses described weighing the cathode before and after the experiment and calculating the mass increase. Less successful candidates described collecting the copper in the measuring cylinder or using the measuring cylinder to measure the volume of copper. Some responses were vague

					and talked about measuring the electrodes, rather than weighing them. **OCR support** The Practical Skills Booklet – Student Book could be used by centres to prepare them for questions about practical skills and apparatus. Specifically, the activity for electrolysis invites students to use micro test tubes of syringes to collect the gas.
	b	i	 ✓	1(AO1.2)	LOBF must go through the origin **Examiner's Comments** When candidates did not gain this mark, it was usually because they did not include the point at the origin in their line of best fit. **OCR support** Our GCSE (9-1) Science Exam hints for Students is a useful resource to provide candidates with when revising to help them avoid common mistakes like this when drawing lines of best fit. They can also be downloaded as an A3 version to display in classrooms.
		ii	10.5 (cm^3) ✓	1(AO2.2)	**ALLOW** Answer ± ½ square of their own graph **Examiner's Comments** Many candidates correctly read the volume of hydrogen gas from the graph. The most common error was not reading the x-axis scale correctly and taking the reading at 21.5 minutes instead of at 23 minutes. **OCR support** Topic Check in 4 -Graphs might be a useful resource to use in the

					classroom to improve graph reading skills. The answers and support with how to use the resource can be found in the Mathematicals Skills Handbook.
		iii	Cathode / negative electrode ✓	1(AO1.2)	**Examiner's Comments** Most candidates knew that hydrogen gas is given off at the cathode. Understandably, anode was the most common incorrect answer.
		iv	Chlorine / Cl_2 ✓	1(AO1.2)	**DO NOT ALLOW** Cl **DO NOT ALLOW** Chloride /Cl^- **Examiner's Comments** The most common incorrect answers were chloride and sodium.
	c		Idea that hydrogen is produced (at the cathode) if ions from a more reactive metal (than hydrogen) are present / idea that only 1 ion is discharged at each electrode / discharge is based on the reactivity series / less reactive ions are discharged in preference ✓ Hydrogen is less reactive than sodium / ORA ✓ Copper is less reactive than hydrogen / ORA ✓	3(3 ×AO1.2)	**Examiner's Comments** Good responses to this question described that discharge is based on the reactivity series and that less reactive ions are discharged in preference. Many candidates appreciated that hydrogen is less reactive than sodium and copper is less reactive than hydrogen. Lower attaining candidates compared the reactivity of chlorine and hydrogen to explain why hydrogen is given off. **Misconception** Common misconceptions were that no hydrogen gas is given off in the electrolysis of $CuSO_4$ because $CuSO_4$ does not contain any hydrogen or that one ion displaces the other, possibly muddling up the terms discharge and displace. **OCR support**

					The Electrolysis Topic exploration pack could be used to develop understanding for this here by providing extra teacher guidance and a range of activities to use in the classroom.
			Total	**10**	
6			C ✓	1(AO1.2)	
			Total	**1**	