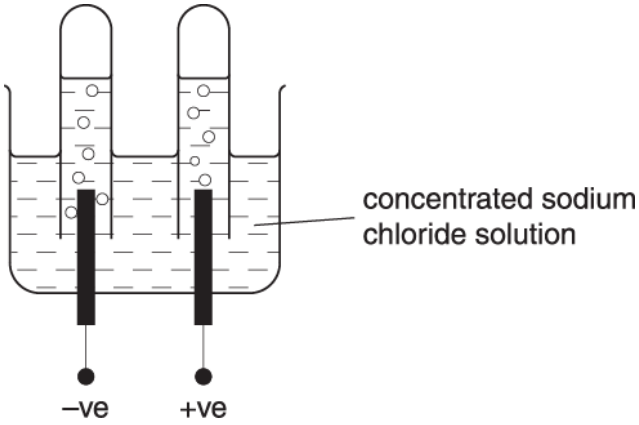
1. Sodium chloride (salt) is a very important chemical.

Concentrated sodium chloride solution can be electrolysed to make useful products.

Look at the diagram below. It shows how this can be done in the laboratory.



Sodium chloride solution contains the ions Na^+, Cl^-, H^+ and OH^-.

What happens during the electrolysis of concentrated sodium chloride solution?

Your answer should include equations for the reactions at each electrode.

Use e^- to represent an electron.

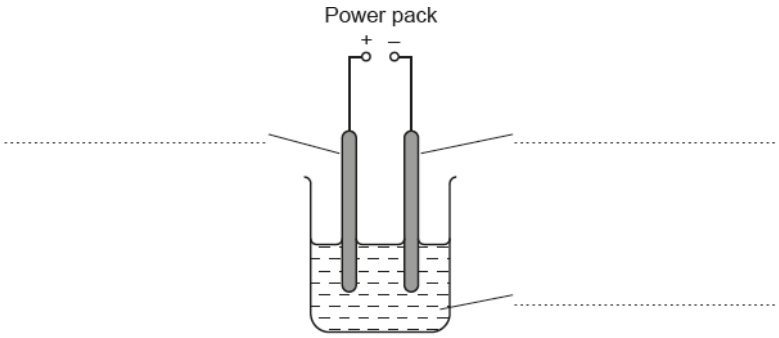
The quality of written communication will be assessed in your answer to this question.

[6]

2.

Look at the diagram of an electrolysis experiment.

(i) Complete the labels on the diagram.



[2]

(ii) Sodium chloride is an **ionic** compound.

Sodium chloride

- Will **not** conduct electricity when it is solid
- Will conduct electricity when it is dissolved in water.

Explain why.

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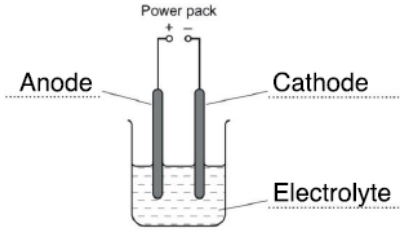
[2]

END OF QUESTION PAPER

Question			Answer/Indicative content	Marks	Guidance
1			Level 3 All three of the products are correctly identified AND one correct equation for the reaction at one of the electrodes is written. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) Level 2 Two of the products are correctly identified with at least one correct location Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) Level 1 One of the products is correctly identified OR a sensible attempt at an equation for the reaction at one of the electrodes is made Quality of written communication impedes communication of the science at this level. (1 – 2 marks) Level 0 Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted at grades up to A/A*. Indicative scientific points may include: Products • chlorine at the anode • hydrogen at the cathode • sodium hydroxide Equations • $2H^+ + 2e^? ? H_2$ • $2Cl^? ? 2e^? ? Cl_2$ / $2Cl ? ? Cl_2 + 2e^?$ Other • Na^+ and $OH^?$ remain in the solution making sodium hydroxide **allow** products and location from (incorrect) equation At Level 1 **allow** correct identification of electrodes to which ions are attracted i.e. Na^+ and H^+ attracted to cathode or negative electrode **and** $Cl^?$ and $OH^?$ attracted to anode or positive electrode. At Level 1 **allow** oxidation at anode or positive electrode **and** reduction at cathode or negative electrode. Use the L1, L2, L3 annotations in Scoris; do not use ticks. Examiner's Comments About half of candidates either failed to score or omitted this question. Electrolysis continues to be a part of the specification

Question			Answer/Indicative content	Marks	Guidance
					that candidates find difficult. Good candidates gave some excellent answers, correctly identifying the products and the electrodes at which they are formed and writing correct half equations. There was considerable confusion with last year's question on the purification of silver and/or copper. Many candidates gave irrelevant answers referring to copper purification. A number of candidates thought that there were both positive and negative electrons moving in the solution. Some candidates gained level 1 (1 or 2 marks) by correctly identifying the electrodes that the ions were attracted to.
			Total	6	

Question			Answer/Indicative content	Marks	Guidance
2		i	Anode (+) **AND** cathode (–) ✓ Electrolyte ✓  	2 (AO2 × 1.1)	**ALLOW** for electrolyte: solution of metal salt / metal salt / solution containing ions / salt solution / molten salt / named electrolyte such as sodium chloride **DO NOT ALLOW** solvent, water **IGNORE** solution unless qualified Examiner's Comments This question was a good discriminator. Some higher ability candidates could name the anode and cathode correctly, but fewer could label the electrolyte. However, some gained credit by giving a correct example of an electrolyte instead. Some stated sodium chloride, having presumably seen it in the question that followed. Common incorrect responses were positive or negative terminal / rod for the electrodes and solution or water for the electrolyte. A few thought the dashes in the beaker were electrons.
		ii	The **ions** cannot move in NaC*l* solid ✓ The **ions** are free to move in NaC*l* solution ✓	2 (AO2 × 2.1)	**DO NOT ALLOW** electrons instead of ions **But ALLOW** electrical conduction requires the movement of ions and the ions cannot move in NaC*l* solid / ora for 2 marks **IGNORE** charged particles Examiner's Comments Some of the highest ability candidates were able to explain that ions are only able to freely in solution. Most answers were irrelevant. Candidates frequently wrote about electricity / electrons having space to move through liquids not solids. They often referred to electrons, sometimes delocalised electrons, instead of ions.
			Total	**4**	