

Electrolytic Processes

Total Marks : 16

Q1.

Figure 10 shows the equipment used to electrolyse a sample of sodium sulfate solution.

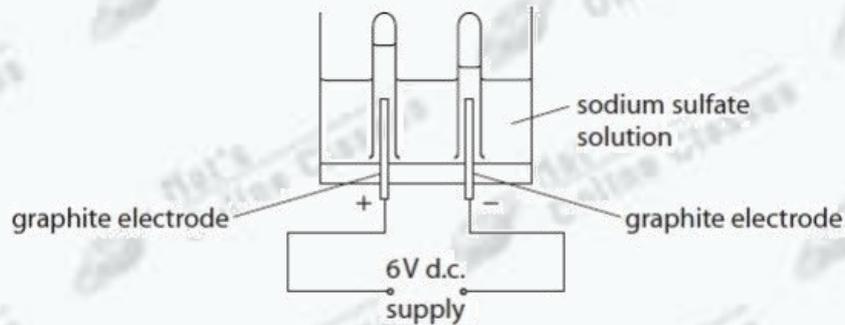


Figure 10

Graphite electrodes are used in the electrolysis of sodium sulfate solution. Graphite is used because it is inert and conducts electricity.

(i) Figure 11 shows the ions in the sodium sulfate solution.

Draw a circle around each of the ions in Figure 11 that are attracted to the negative graphite electrode during the electrolysis.

(1)



Figure 11

(ii) State why it is important that the electrodes are inert.

(1)

.....
.....

(iii) Explain, in terms of its structure, how graphite conducts electricity.

(2)

.....
.....
.....

(Total for question = 4 marks)

Q2.

Answer the question with a cross in the box you think is correct . If you change your mind about an answer, put a line through the box and then mark your new answer with a cross .

Figure 11 shows the apparatus that can be used to electrolyse sodium sulfate solution using inert electrodes.

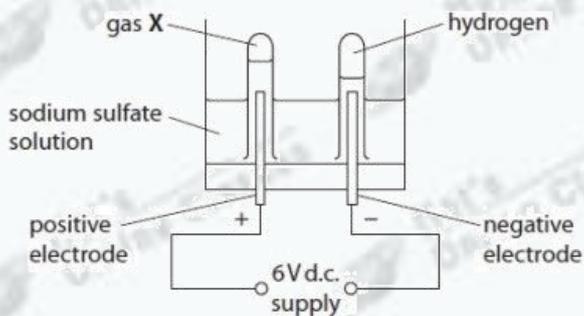


Figure 11

Hydrogen is produced at the negative electrode during electrolysis.

(i) Describe the test to show the gas is hydrogen.

(2)

.....
.....
.....
.....

(ii) What is the name of gas X that forms at the positive electrode?

(1)

- A ammonia
- B oxygen
- C nitrogen
- D sulfur dioxide

(iii) State what is meant by the term **electrolysis**.

(2)

.....
.....
.....
.....

(Total for question = 5 marks)

Q3.

Figure 4 shows the results obtained from an electrolysis experiment when copper sulfate solution was electrolysed for 10 minutes.

	electrodes	
	anode	cathode
mass of electrode before electrolysis in g	6.43	6.17
mass of electrode after electrolysis in g	5.62	6.95
change in mass in g	- 0.81	+ 0.78

Figure 4

(i) Explain, in terms of ions, the changes in mass of the two electrodes shown in the results in Figure 4.

(3)

.....

.....

.....

.....

.....

.....

(ii) The electrolysis was repeated using another pair of copper electrodes of the same masses.

Explain a change that could be made to the electrolysis experiment to cause the mass of the cathode to increase by 2.34 g in 10 minutes.

(2)

.....

.....

.....

.....

(Total for question = 5 marks)

Q4.

When copper sulfate solution is electrolysed using copper electrodes, the mass of each electrode changes.

Draw a labelled diagram to show the apparatus that can be used to electrolyse copper sulfate solution using copper electrodes.

(2)

(Total for question = 2 marks)

Mark Schemes :

Q1.

Question number	Answer	Additional guidance	Mark
(i)	H ⁺ and Na ⁺ only circled		(1) AO1-1

Question number	Answer	Additional guidance	Mark
(ii)	so that they do not react (with the electrolyte/sodium sulfate solution / products formed)	allow graphite is unreactive allow so they do not corrode	(1) AO1-1

Question number	Answer	Additional guidance	Mark
(iii)	An explanation linking: <ul style="list-style-type: none">• electrons (1)• move (through graphite) / are {delocalised / free / sea of electrons} (1)	ignore 'charged particles' for MP1 but allow for MP2 reject ions for MP1 and MP2 'electrons in bonds/ electrons in outer shell' scores MP1 only MP2 depends on electrons or charged particles being mentioned ignore any other material about structure of graphite, correct or otherwise	(2) AO1-1

Q2.

Question number	Answer	Additional guidance	Mark
(i)	A description including <ul style="list-style-type: none">• apply lighted splint (1)• gas burns / (squeaky) pop (1)	allow flame / ignite gas ignore 'squeaky pop test' / glowing splint second mark is dependent on first	(2)

Question number	Answer	Mark
(ii)	B oxygen The only correct answer is B A, C & D these gases are not produced in the electrolysis of sodium sulfate solution	(1)

Question number	Answer	Additional guidance	Mark
(iii)	<ul style="list-style-type: none">• electrical energy / electricity (1)• {decomposes / breaks down / splits} {electrolytes / (ionic) compounds / substances} (1)	allow electric current allow separates ions reject decomposing elements for MP2	(2)

Q3.

Question number	Answer	Additional guidance	Mark
(i)	<p>An explanation linking</p> <ul style="list-style-type: none"> at anode copper / atoms {lose electrons / oxidised} / (copper) ions leave anode (- cause mass loss) (1) (copper) ions (in solution) move to cathode (1) At cathode (copper) ions {gain electrons / reduced} (- cause mass increase) (1) 	<p>allow $\text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}^{-}$ reject mass loss is due to loss of electrons ignore copper dissolves</p> <p>allow $\text{Cu}^{2+} + 2\text{e}^{-} \rightarrow \text{Cu}$ reject mass gain is due to gain of electrons if no other mark scored</p> <p>allow oxidation at anode and reduction at cathode (1)</p>	(3) AO3-2
Question number	Answer	Additional guidance	Mark
(ii)	<p>An explanation linking</p> <ul style="list-style-type: none"> mass of copper increased by {3x / calculated 2.34/0.78} (=3) (1) (so) need (3x) / more {current / voltage} passing through solution (1) 	<p>allow need (3 x) {greater surface area of electrode / larger electrode / greater concentration (of copper sulfate solution)} / reduce distance between electrodes allow power in place current or voltage</p> <p>3x { current / voltage / power }= 2 marks</p>	(2) AO2-2

Q4.

Question number	Answer	Additional guidance	Mark
	<p>Diagram showing</p> <ul style="list-style-type: none"> two (copper) electrodes in {beaker / suitable container} of {copper sulfate / solution / electrolyte} (1) connected to {power supply / battery / cell} (1) 	<p>diagram needs to be labelled to score full marks</p> <p>electrodes must go into solution for MP1</p> <p>reject AC / mains supply</p>	(2) AO1-2