Past-paper walk-through

Electrolysis ▪ 4.1

eXercise

Questions in this set

- 0620/21 N25 Q12 ▪ 1 mark
- 0620/21 N25 Q13 ▪ 1 mark
- 0620/22 N25 Q13 ▪ 1 mark
- 0620/23 N25 Q13 ▪ 1 mark
- 0620/23 N25 Q14 ▪ 1 mark
- 0620/21 J25 Q10 ▪ 1 mark
- 0620/21 J25 Q11 ▪ 1 mark
- 0620/42 J25 Q3 ▪ 15 marks
- 0620/22 M25 Q14 ▪ 1 mark

Reading the mark scheme

- **B1** a mark that stands on its own – the point is either made or not.
- **M1** a *method* mark: the right approach, even if the number is wrong.
- **A1** an *answer* mark, and it usually needs its M mark first.
- **C1** a working mark on the way to the answer.
- // separates answers the examiner accepts equally.
- **ecf** = error carried forward: a later part is marked on your own earlier answer.
- **owtte** = "or words to that effect" – the wording need not match.

Question 12

0620/21 N25 ▪ Q12 ▪ 1 mark

12 Aqueous copper(II) sulfate is electrolysed using copper electrodes.

Which statement is correct?

A Oxygen gas is produced at the positive electrode.

B The blue colour of the solution gradually fades.

C The concentration of copper ions in the solution stays the same.

D The mass of the negative electrode decreases.

Solution 12

Answer: **C**

Why

- With copper electrodes the anode dissolves as fast as the cathode plates out.
- So copper ions are replaced as quickly as they are removed.
- The concentration of the solution – and its blue colour – stays constant, and no oxygen is formed.

Question 13

0620/21 N25 ▪ Q13 ▪ 1 mark

13 Which row describes the reactions during the electrolysis of dilute aqueous sodium chloride?

	anode reaction	cathode reaction
A	$H_2 \rightarrow 2H^+ + 2e^-$	$2H_2O + O_2 + 4e^- \rightarrow 4OH^-$
B	$2H^+ + 2e^- \rightarrow H_2$	$4OH^- \rightarrow 2H_2O + O_2 + 4e^-$
C	$2H_2O + O_2 + 4e^- \rightarrow 4OH^-$	$H_2 \rightarrow 2H^+ + 2e^-$
D	$4OH^- \rightarrow 2H_2O + O_2 + 4e^-$	$2H^+ + 2e^- \rightarrow H_2$

Solution 13

Answer: **D**

Why

- In *dilute* sodium chloride solution it is the water that is discharged at the anode, not the chloride.
- So oxygen is released: $4\mathrm{OH}^- \rightarrow 2\mathrm{H_2O} + \mathrm{O_2} + 4e^-$.
- At the cathode hydrogen ions gain electrons: $2\mathrm{H}^+ + 2e^- \rightarrow \mathrm{H_2}$.

Question 13

0620/22 N25 ▪ Q13 ▪ 1 mark

13 A solution of copper(II) sulfate can be electrolysed using copper electrodes or carbon electrodes.

Which statements are correct?

1 Using copper electrodes, oxygen gas forms at the anode.

2 Using copper electrodes, copper atoms lose electrons at the anode.

3 Using carbon electrodes, copper metal forms at the cathode.

4 Using carbon electrodes, copper ions gain electrons at the cathode.

A 1 and 2 **B** 1 and 3 **C** 2, 3 and 4 **D** 4 only

Solution 13

Answer: **C**

Why

- With *copper* electrodes the anode dissolves, so no oxygen forms and the blue colour stays.
- With *carbon* electrodes the anode cannot dissolve, so oxygen is released and the blue colour fades.
- Copper is deposited at the cathode in both cases – it is the anode that differs.

Question 13

0620/23 N25 ▪ Q13 ▪ 1 mark

13 Which product is initially obtained at each electrode during the electrolysis of concentrated aqueous sodium chloride?

	cathode	anode
A	hydrogen	chlorine
B	hydrogen	oxygen
C	sodium	chlorine
D	sodium	oxygen

Solution 13

Answer: **A**

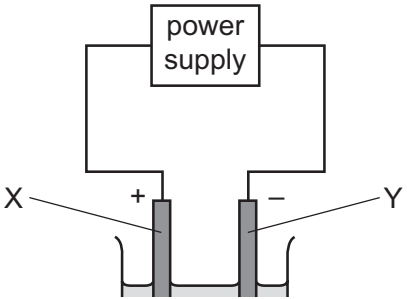
Why

- At the cathode hydrogen is produced, because hydrogen is below sodium in the reactivity series.
- At the anode chlorine is produced, because the solution is *concentrated* in chloride.
- Sodium is never deposited from aqueous solution, and oxygen would need a dilute solution.

Question 14

0620/23 N25 ▪ Q14 ▪ 1 mark

14 Molten lead(II) bromide is electrolysed using inert electrodes.



Question 14

Which statement describes the movement of electrons?

A from X to Y through the external wire

B from Y to X through the external wire

C from X to Y through the electrolyte

Question 14

D from Y to X through the electrolyte

Solution 14

Answer: **A**

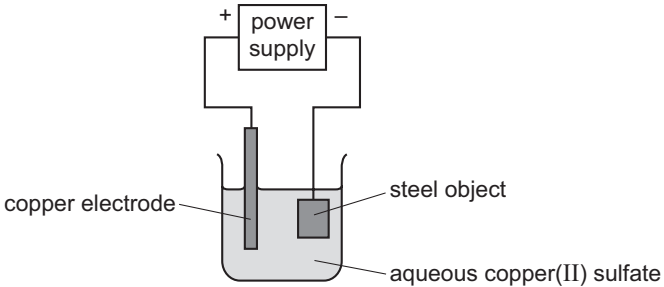
Why

- Bromide ions lose electrons at the anode – the positive electrode.
- Those electrons travel out through the external wire, round through the power supply, to the cathode.
- At the cathode they are handed to the lead ions, so electron flow is from the positive electrode round to the negative one.

Question 10

0620/21 J25 ▪ Q10 ▪ 1 mark

10 The diagram shows the electroplating of a steel object.



A student makes three statements.

Question 10

A student makes three statements.

1 The steel object turns a reddish-brown colour.

2 The aqueous copper(II) sulfate changes to a paler blue colour.

3 The copper electrode becomes thinner.

Which statements are correct?

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

Solution 10

Answer: **C**

Why

- The steel object is the negative electrode, so Cu^{2+} gains electrons there and coats it reddish-brown.
- The copper anode dissolves at the same rate, so the solution's blue colour does not fade.
- The copper electrode loses mass while the steel object gains it.

Question 11

0620/21 J25 ▪ Q11 ▪ 1 mark

11 Concentrated aqueous sodium chloride is electrolysed using inert electrodes.

Which equation shows the correct ionic half-equation for the reaction at the anode?

A $Cl^- + e^- \rightarrow Cl$

B $2Cl^- \rightarrow Cl_2 + 2e^-$

C $H^+ \rightarrow H + e^-$

D $2H^+ + 2e^- \rightarrow H_2$

Solution 11

Answer: **B**

Why

- The anode is positive, so negative ions travel there and *lose* electrons.
- In concentrated chloride solution it is chloride that is discharged.
- $2Cl^- \rightarrow Cl_2 + 2e^-$: two ions per molecule, with the electrons on the right.

Question 3

0620/42 J25 ▪ Q3 ▪ 15 marks

3 This question is about electrolysis.

(a) Complete the definition of electrolysis by filling in the missing words.

Question 3

[3]

(b) Electrolysis of aqueous copper(II) sulfate is carried out using the apparatus shown in Fig. 3.1. The electrodes are made of platinum.

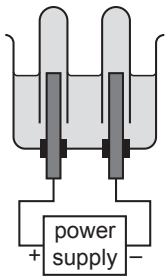


Fig. 3.1

Question 3

(i) State whether the mass of the cathode increases, decreases or remains the same when platinum electrodes are used.

Question 3

(ii) Describe the change in appearance, if any, of the electrolyte when platinum electrodes are used.

Question 3

(iii) Describe what is seen at the anode when platinum electrodes are used.

Question 3

(iv) Write the ionic half-equation for the reaction at the anode.

Question 3

(c) The electrolysis is repeated using copper electrodes.

(i) State whether the mass of the cathode increases, decreases or remains the same when copper electrodes are used.

Question 3

(ii) Describe the change in appearance, if any, of the electrolyte when copper electrodes are used.

Question 3

(d) Aluminium is extracted from its purified ore by electrolysis.

(i) Name this ore of aluminium.

Question 3

(ii) Name the substance added to this process to reduce the operating temperature.

Question 3

(iii) Explain why the anodes need to be continually replaced during this process.

Question 3

[Total: 15]

Solution 3

(a)

Mark scheme

- M1 ionic M2
- molten M3
- in aqueous solution
- 3

Solution 3

(b)(i)

Mark scheme

- increase
- 1

Solution 3

(b)(ii)

Mark scheme

- becomes paler blue
- or
- becomes colourless
- 1

Solution 3

(b)(iii)

Mark scheme

- bubbles
- 1

Solution 3

(b)(iv) Mark scheme

- $4OH^- \rightarrow 2H_2O + O_2 + 4e^-$ **M1**
- any negatively charged OH species losing electrons
- OR
- $H_2O + O_2$ as only products (other than electrons) on RHS **M2**
- any negatively charged OH species losing electrons
- AND
- $H_2O + O_2$ as only products (other than electrons) on RHS **M3**
- correct equation

Solution 3

- 3

Solution 3

(c)(i)

Mark scheme

- increases
- 1

(c)(ii)

Mark scheme

- no change
- 1

Solution 3

(d)(i)

Mark scheme

- bauxite
- 1

(d)(ii)

Mark scheme

- cryolite
- 1

Solution 3

(d)(iii)

Mark scheme

- M1 anodes or carbon / graphite react with oxygen / O2 **M2**
- (form) carbon dioxide
- 2
- 0620/42
- May/June 2025

Question 14

0620/22 M25 ▪ Q14 ▪ 1 mark

14 Dilute sulfuric acid is electrolysed using inert electrodes.

What are the ionic half-equations for the reactions that take place at each electrode?

	positive electrode	negative electrode
A	$2H^+ + 2e^- \rightarrow H_2$	$4OH^- \rightarrow 2H_2O + O_2 + 4e^-$
B	$2H^+ + 2e^- \rightarrow H_2$	$4OH^- + 4H^+ \rightarrow 4H_2O$
C	$4OH^- \rightarrow 2H_2O + O_2 + 4e^-$	$2H^+ + 2e^- \rightarrow H_2$
D	$4OH^- + 4H^+ \rightarrow 4H_2O$	$2H^+ + 2e^- \rightarrow H_2$

Solution 14

Answer: **C**

Why

- At the negative electrode positive ions gain electrons: $2H^+ + 2e^- \rightarrow H_2$.
- At the positive electrode negative ions lose electrons: $4OH^- \rightarrow 2H_2O + O_2 + 4e^-$.
- Reduction always happens at the cathode and oxidation at the anode, so the pair cannot be swapped.