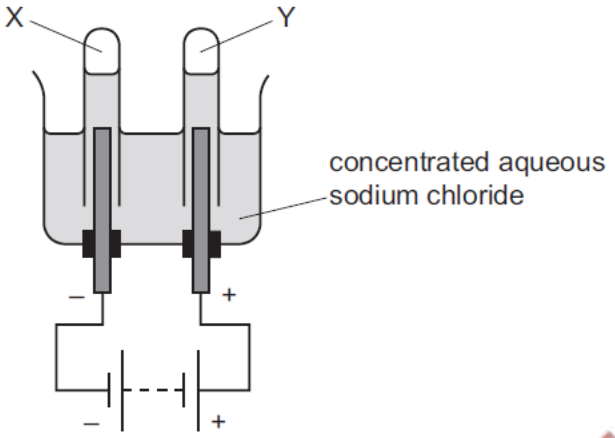
# Electricity and Chemistry – 2023 June IGCSE Chemistry 0620

**1.** June/2023/Paper_ 0620/11/No.9

Concentrated aqueous sodium chloride is electrolysed using inert electrodes.

Gases X and Y are produced at the electrodes shown.




What are X and Y?

| | X | Y |
|---|---|---|
| **A** | chlorine | hydrogen |
| **B** | hydrogen | chlorine |
| **C** | hydrogen | oxygen |
| **D** | oxygen | hydrogen |



**2.** June/2023/Paper_ 0620/11/No.10

Which statement about hydrogen fuel cells is correct?

**A** Hydrogen fuel cells do not produce carbon dioxide.

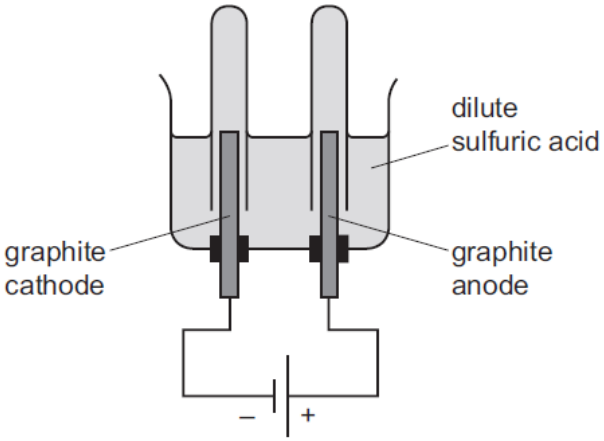
**B** Hydrogen fuel cells do not need oxygen.

**C** The waste from a hydrogen fuel cell is an acidic gas.

**D** The reaction in a fuel cell is endothermic.

**3.** June/2023/Paper_ 0620/12/No.9

Dilute sulfuric acid is electrolysed using inert electrodes. The apparatus is set up as shown.




30 $cm^3$ of a gas is collected at the cathode. A different gas is collected at the anode.

Which row is correct?

| | gas at cathode | gas at anode | volume of gas collected at anode / $cm^3$ |
|---|---|---|---|
| **A** | hydrogen | oxygen | 15 |
| **B** | hydrogen | oxygen | 30 |
| **C** | oxygen | hydrogen | 15 |
| **D** | oxygen | hydrogen | 30 |



**4.** June/2023/Paper_ 0620/12/No.10

Four statements about hydrogen fuel cells are listed.

1 The fuel cell converts chemical energy into electrical energy.

2 In the fuel cell, hydrogen combines with oxygen.

3 Carbon dioxide and water are produced in the fuel cell.

4 The hydrogen fuel is extracted from the air.

Which statements are correct?

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

**5.** June/2023/Paper_ 0620/13/No.9

Dilute sulfuric acid is electrolysed using inert electrodes.

What is produced at the anode?

**A** hydrogen

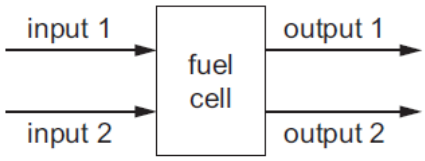
**B** oxygen

**C** sulfur

**D** sulfur dioxide

**6.** June/2023/Paper_ 0620/13/No.10

The flow diagram represents a hydrogen–oxygen fuel cell.




Which row shows the inputs and outputs?

| | input 1 | input 2 | output 1 | output 2 |
|---|---|---|---|---|
| **A** | electricity | electrolyte | hydrogen | oxygen |
| **B** | electricity | water | hydrogen | oxygen |
| **C** | fuel | hydrogen | water | electricity |
| **D** | fuel | oxygen | water | electricity |

**7.** June/2023/Paper_ 0620/21/No.9

Which substance produces hydrogen and bromine when electrolysed?

**A** concentrated aqueous copper(II) bromide

**B** concentrated aqueous sodium bromide

**C** dilute aqueous potassium bromide

**D** molten lead(II) bromide

**8.** June/2023/Paper_ 0620/21/No.10

Which statements about hydrogen fuel cells are correct?

1 Water is formed as the only waste product.

2 Both water and carbon dioxide are formed as waste products.

3 The overall reaction is $2H_2 + O_2 \rightarrow 2H_2O$.

4 The overall reaction is endothermic.

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

**9.** June/2023/Paper_ 0620/22/No.9

In experiment 1, aqueous copper(II) sulfate is electrolysed using graphite electrodes.

In experiment 2, aqueous copper(II) sulfate is electrolysed using copper electrodes.

Which statement identifies a half-equation for a reaction at one of the electrodes?

**A** In experiment 1, the half-equation for the anode reaction is $4OH^- \rightarrow 2H_2O + O_2 + 4e^-$.

**B** In experiment 1, the half-equation for the cathode reaction is $2H^+ + 2e^- \rightarrow H_2$.

**C** In experiment 2, the half-equation for the anode reaction is $Cu^{2+} + 2e^- \rightarrow Cu$.

**D** In experiment 2, the half-equation for the cathode reaction is $4OH^- \rightarrow 2H_2O + O_2 + 4e^-$.

**10.** June/2023/Paper_ 0620/22/No.10

Which substance is **not** produced during the electrolysis of concentrated aqueous sodium chloride?

**A** chlorine

**B** hydrogen

**C** sodium

**D** sodium hydroxide

**11.** June/2023/Paper_ 0620/23/No.10

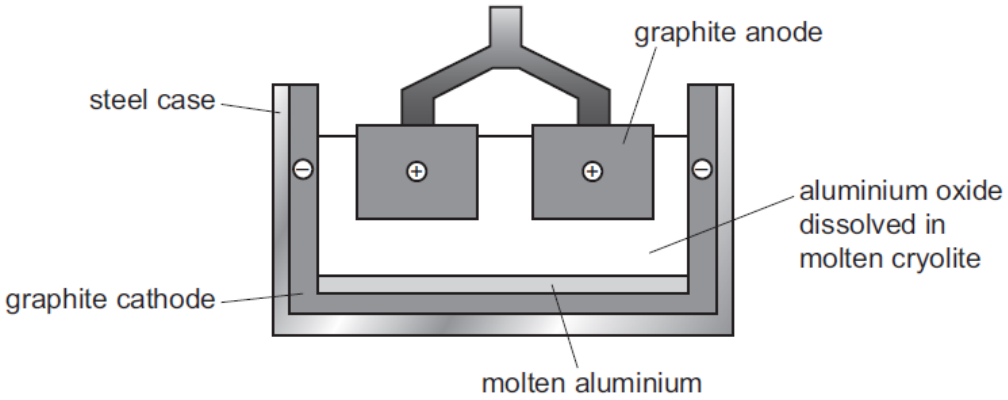
A dilute aqueous solution of sodium bromide is electrolysed using inert electrodes.

Which row identifies the product at the cathode and at the anode?

| | cathode | anode |
|---|---|---|
| **A** | bromine | hydrogen |
| **B** | hydrogen | bromine |
| **C** | hydrogen | oxygen |
| **D** | oxygen | hydrogen |

**12.** June/2023/Paper_ 0620/23/No.11

Aluminium is extracted by electrolysis, as shown.




Which row shows the ionic half-equations at the cathode and the anode?

| | cathode | anode |
|---|---|---|
| **A** | $Al^{3+} \rightarrow Al + 3e^-$ | $2O^{2-} \rightarrow O_2 + 4e^-$ |
| **B** | $Al^{3+} \rightarrow Al + 3e^-$ | $2O^{2-} + 4e^- \rightarrow O_2$ |
| **C** | $Al^{3+} + 3e^- \rightarrow Al$ | $2O^{2-} \rightarrow O_2 + 4e^-$ |
| **D** | $Al^{3+} + 3e^- \rightarrow Al$ | $2O^{2-} + 4e^- \rightarrow O_2$ |

**(d)** Fig. 4.2 shows the apparatus used for the electrolysis of dilute sulfuric acid using graphite electrodes.

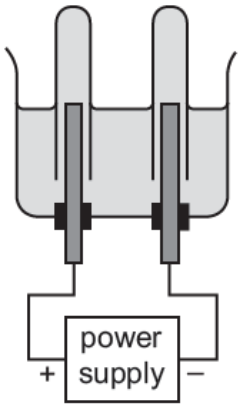



**Fig. 4.2**

**(i)** Label Fig. 4.2 to show:
- the cathode
- the electrolyte. [2]

**(ii)** Name the products and state the observations at the positive and negative electrodes.

product at the positive electrode

.....

observations at the positive electrode

.....

product at the negative electrode

.....

observations at the negative electrode

.....

[4]

**14.** June/2023/Paper_ 0620/32/No.4(f)

**(f)** Fig. 4.2 shows the apparatus used for the electrolysis of concentrated aqueous sodium chloride using graphite electrodes.

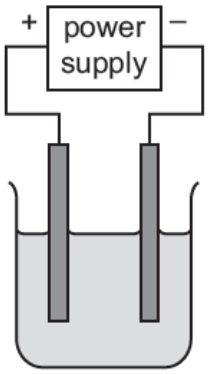



**Fig. 4.2**

**(i)** Label Fig. 4.2 to show:

- the anode
- the electrolyte. [2]

**(ii)** Name the products and state the observations at the positive and negative electrodes.

product at the positive electrode

.....

observations at the positive electrode

.....

product at the negative electrode

.....

observations at the negative electrode

.....

[4]

**15.** June/2023/Paper_ 0620/33/No.4(d)

**(d)** Fig. 4.2 shows the apparatus used for the electrolysis of molten lead(II) bromide using graphite electrodes.

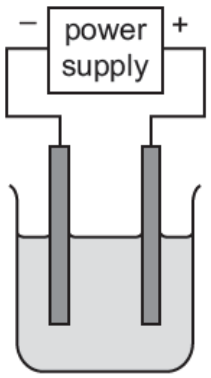



**Fig. 4.2**

**(i)** Label Fig. 4.2 to show:
- the cathode
- the electrolyte. [2]

**(ii)** Name the products and state the observations at the positive and negative electrodes.

product at the positive electrode

.....

observations at the positive electrode

.....

product at the negative electrode

.....

observations at the negative electrode

.....

[4]

**(iii)** State **one** property of graphite that makes it useful as an electrode.

..... [1]

**16.** June/2023/Paper_ 0620/41/No.5

This question is about electricity and chemical reactions.

**(a)** The electrolysis of concentrated aqueous potassium bromide using graphite electrodes forms:

- hydrogen at the cathode
- bromine at the anode.

The electrolyte becomes aqueous potassium hydroxide.

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

.....

..... [2]

**(ii)** State why graphite is suitable for use as an electrode.

..... [1]

**(iii)** Write an ionic half-equation for the formation of hydrogen at the cathode.

..... [2]

**(iv)** Name the type of particle responsible for the transfer of charge in the conducting wires.

..... [1]

**(v)** Name the type of particle responsible for the transfer of charge in aqueous potassium bromide.

..... [1]

**(vi)** State the names of the products formed when electricity is passed through **dilute** aqueous potassium bromide using graphite electrodes.

at the anode .....

at the cathode ..... [2]

**(b)** Bauxite is an ore containing aluminium.
Aluminium is extracted by electrolysis of purified bauxite in molten cryolite using carbon electrodes.

**(i)** Name the aluminium compound in purified bauxite.

..... [1]

**(ii)** State **two** reasons why cryolite is used in this electrolysis.

1 .....

2 .....
[2]

**(iii)** The anode is made from carbon.

Explain why the carbon anode has to be replaced regularly.

.....

..... [1]

**(c)** Hydrogen–oxygen fuel cells can be used to produce electricity in vehicles.

**(i)** Write the symbol equation for the overall reaction in a hydrogen–oxygen fuel cell.

..... [2]

**(ii)** State **one** advantage of using hydrogen–oxygen fuel cells instead of petrol in vehicle engines.

..... [1]

[Total: 16]

**17.** June/2023/Paper_ 0620/43/No.5

This question is about electricity and chemical reactions.

**(a)** Aqueous copper(II) sulfate is an electrolyte.
The electrolysis of aqueous copper(II) sulfate using inert electrodes forms:

- copper at the cathode
- oxygen at the anode.

**(i)** State what is meant by the term electrolyte.

.....

..... [2]

**(ii)** State the term given to the Roman numeral, (II), in the name copper(II) sulfate.

..... [1]

**(iii)** State what happens to the colour of the aqueous copper(II) sulfate as this electrolysis progresses.

..... [1]

**(iv)** Write an ionic half-equation for the formation of copper at the cathode.

..... [2]

**(v)** Give the formula of the ion that forms oxygen at the anode.

..... [1]

**(b)** The electrolysis of aqueous copper(II) sulfate is repeated using **copper** electrodes.

State what happens to the anode.

..... [1]

**(c)** Spoons can be electroplated with silver.

**(i)** Name the substances used as:

the anode (positive electrode) .....

the cathode (negative electrode) .....

the electrolyte. .....

[3]

**(ii)** State **two** reasons why spoons are electroplated.

1 .....

2 .....

[2]

**(d)** Hydrogen–oxygen fuel cells can be used to produce electricity to power cars.
Petrol produces carbon dioxide and carbon monoxide when it powers cars.

**(i)** State **one** adverse effect of carbon dioxide and carbon monoxide.

carbon dioxide .....

carbon monoxide .....

[2]

**(ii)** State **one** disadvantage, other than cost, of using hydrogen–oxygen fuel cells to power cars compared to using petrol.

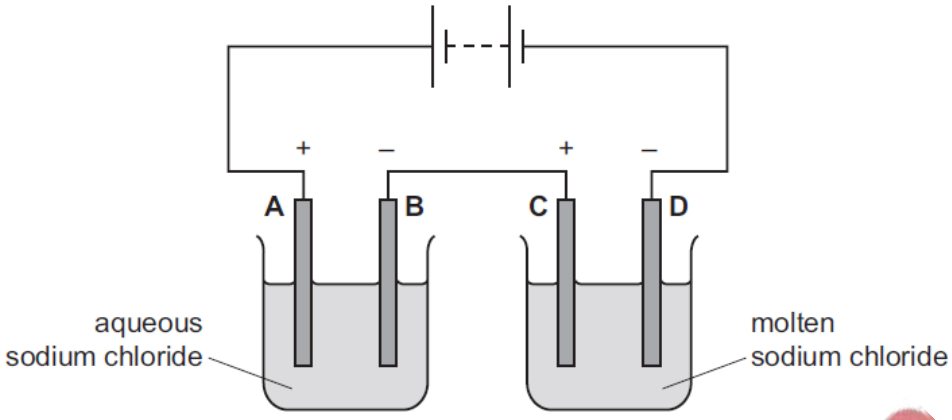
..... [1]

[Total: 16]

**18.** March/2023/Paper_ 0620/12/No.10

The diagram shows an electrolysis circuit.

At which electrode is hydrogen formed?




**19.** March/2023/Paper_ 0620/12/No.11

Which gases are used to generate electricity in a fuel cell?

**A** carbon dioxide and oxygen

**B** hydrogen and methane

**C** hydrogen and oxygen

**D** methane and carbon dioxide

**20.** March/2023/Paper_ 0620/22/No.10

An electrolysis experiment is done using carbon electrodes.

Hydrogen and oxygen are formed at the electrodes.

What is the electrolyte?

**A** aqueous copper(II) sulfate

**B** concentrated hydrochloric acid

**C** dilute aqueous sodium chloride

**D** molten potassium oxide

**21.** March/2023/Paper_ 0620/22/No.11

Concentrated aqueous copper(II) sulfate is electrolysed using copper electrodes.

Which ionic half-equation describes the reaction taking place at the cathode?

**A** $2H^+ + 2e^- \rightarrow H_2$

**B** $4OH^- \rightarrow O_2 + 2H_2O + 4e^-$

**C** $Cu \rightarrow Cu^{2+} + 2e^-$

**D** $Cu^{2+} + 2e^- \rightarrow Cu$

**22.** March/2023/Paper_ 0620/32/No.5

Potassium iodide is an ionic compound.

**(a)** State **two** properties of an ionic compound.

1 .....

2 .....

[2]

**(b)** Molten potassium iodide is electrolysed using graphite electrodes.

**(i)** Name the products formed at the positive and negative electrodes.

positive electrode .....

negative electrode .....

[2]

**(ii)** State the name of the positive electrode in an electrolysis experiment.

..... [1]

**(c)** Deduce the number of protons and neutrons in the iodide ion shown.

$^{127}_{53}I^-$

number of protons .....

number of neutrons .....

[2]

**(d)** Aqueous chlorine reacts with aqueous potassium iodide.

**(i)** Complete the symbol equation for this reaction.

$$Cl_2 + 2KI \rightarrow \text{.....} + \text{....}KCl$$ [2]

**(ii)** Choose from the list the name of this type of reaction.

Draw a circle around your chosen answer.

**addition** **combustion** **displacement** **neutralisation** [1]

**(iii)** State the colour of chlorine gas at room temperature and pressure.

..... [1]

[Total: 11]