ST ANDREW'S SECONDARY SCHOOL

NAME _____ CLASS _____

DATE _____

CHEMISTRY (G3) **6092**

14.1 Electrolytic Cells

Assessment for Learning

ELECTROLYSIS

1 Metal M forms the chloride MCl_2. M is found between copper and silver in the reactivity series.

Which reaction would occur at the anode and at the cathode, of which both are inert, used during the electrolysis of a concentrated aqueous solution of MCl_2?

	Anode	Cathode
A	$2\ Cl^- \rightarrow Cl_2 + 2\ e^-$	$M^+ + e^- \rightarrow M$
B	$2\ Cl^- \rightarrow Cl_2 + 2\ e^-$	$M^{2+} + 2\ e^- \rightarrow M$
C	$4\ OH^- \rightarrow 2\ H_2O + O_2 + 4\ e^-$	$M^+ + e^- \rightarrow M$
D	$4\ OH^- \rightarrow 2\ H_2O + O_2 + 4\ e^-$	$M^{2+} + 2\ e^- \rightarrow M$

2 In which electrolyte would the cathode used increase in mass during electrolysis?

A Aqueous copper(II) sulfate
B Concentrated aqueous sodium chloride
C Concentrated hydrochloric acid
D Dilute sulfuric acid

3 Inert electrodes are used in the electrolysis of an aqueous solution containing both $CuSO_4$ and $MgSO_4$.

What would be the product formed at the negative electrode?

A Copper **B** Hydrogen **C** Magnesium **D** Oxygen

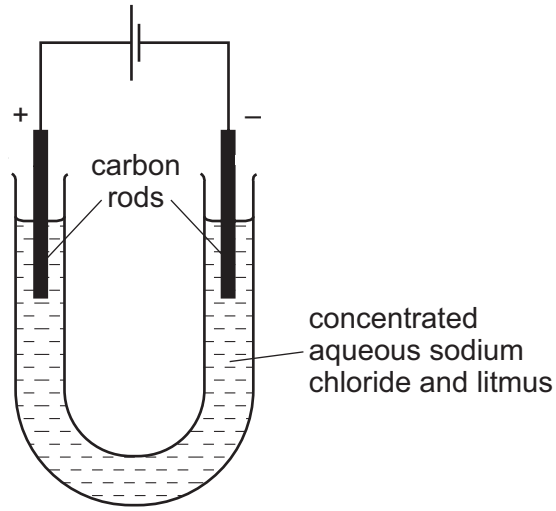
4 What happens when molten barium chloride is electrolysed using inert electrodes?

A Ba^{2+} ions gain electrons at the anode.
B Ba^{2+} ions lose electrons at the cathode.
C Cl^- ions gain electrons at the anode.
D Cl^- ions lose electrons at the cathode.

5 What would be observed during the electrolysis of aqueous copper(II) sulfate using carbon electrodes?

A A pink-brown solid is deposited at the anode.
B Bubbles form at the negative electrode.
C The colour of the solution fades.
D The negative electrode becomes smaller.

6 The diagram shows the electrolysis of concentrated aqueous sodium chloride.



What would be the colour of the litmus at each electrode after five minutes?

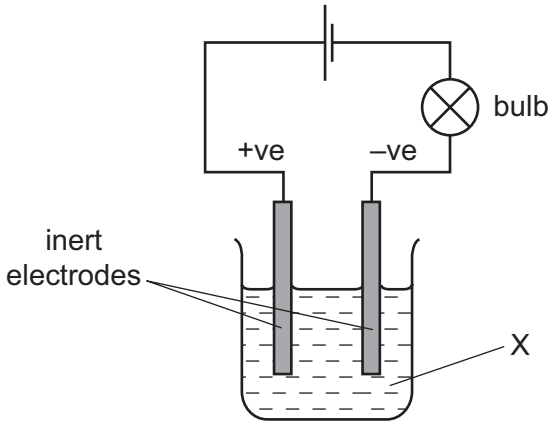
	Colour at anode	Colour at cathode
A	Blue	Red
B	Colourless	Blue
C	Red	Colourless
D	Red	Blue

7 The electrolysis of a molten compound using inert electrodes would form two atoms of X at the negative electrode and three atoms of Y at the positive electrode.

Which row is correct?

	X is a	Y is a	Chemical formula of compound
A	metal	non-metal	X_2Y_3
B	metal	non-metal	X_3Y_2
C	non-metal	metal	X_2Y_3
D	non-metal	metal	X_3Y_2

8 The bulb lights with a gas produced at each electrode could be observed during this experiment.



What is X?

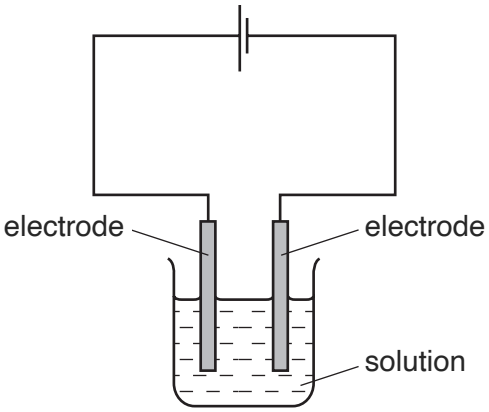
A Aqueous copper(II) sulfate

B Concentrated aqueous sodium chloride

C Ethanol

D Molten lead(II) bromide

9 Four different solutions were electrolysed in separate experiments.



In one of the experiments, X_2 was formed at the anode.

For which combination of solution and electrodes can the reaction for the formation of X_2 be represented by the equation shown below?

$$2\ X^- \rightarrow X_2 + 2\ e^-$$

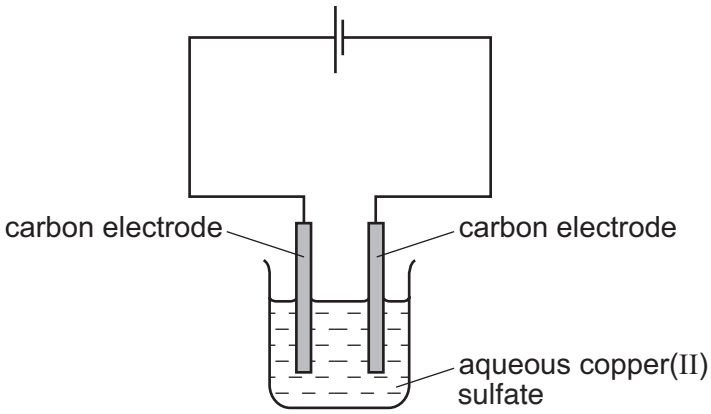
A Aqueous copper(II) sulfate with copper electrodes

B Aqueous copper(II) sulfate with inert electrodes

C Concentrated aqueous sodium chloride with inert electrodes

D Dilute aqueous sodium chloride with inert electrodes

10 Aqueous copper(II) sulfate is electrolysed using carbon electrodes.



Which pair of ionic equations represent the reactions at the electrodes?

1 $Cu^{2+} + 2\ e^- \rightarrow Cu$

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

3 $2\ H^+ + 2\ e^- \rightarrow H_2$

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

A 1 and 2

B 1 and 4

C 2 and 3

D 3 and 4

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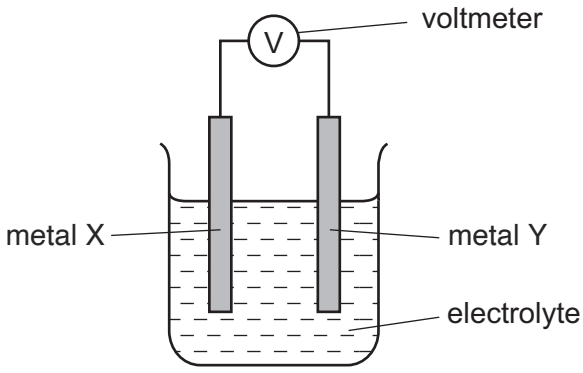
14.2 Simple Cells
Assessment for Learning

ELECTROLYSIS

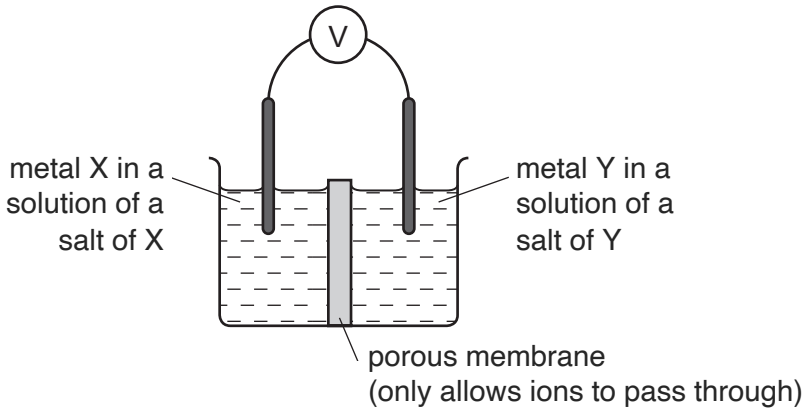
1 The diagram shows a simple cell.



Which pair of metals X and Y would give the smallest reading on the voltmeter?

	X	Y
A	Mg	Cu
B	Mg	Fe
C	Zn	Cu
D	Zn	Fe

2 Which pair of metals X and Y would produce the largest voltage in the simple cell shown?



	X	Y
A	Cu	Ag
B	Mg	Ag
C	Mg	Zn
D	Zn	Cu

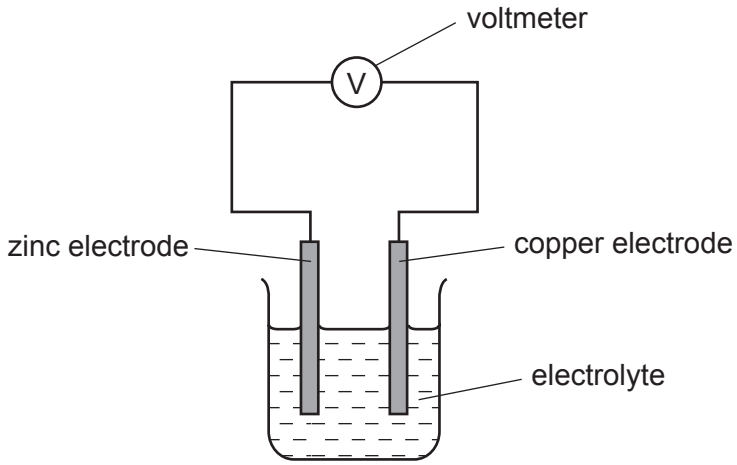
3 A simple cell is constructed by connecting two different metal electrodes in an aqueous electrolyte.

Which statements about simple cells are correct?

1 A larger voltage is produced when magnesium is connected to silver instead of copper.
2 The electrolyte contains both positive and negative ions.
3 The more reactive metal loses a greater amount of electrons.

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

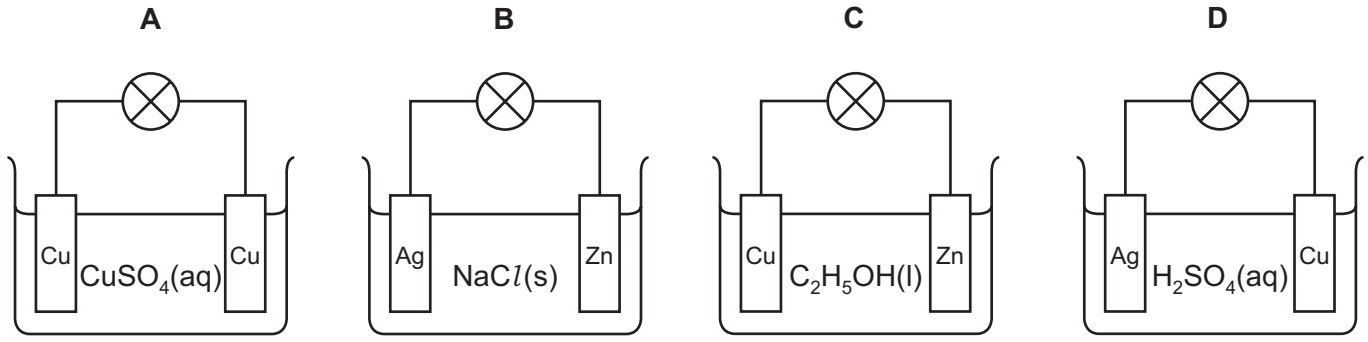
4 The diagram shows a simple cell.



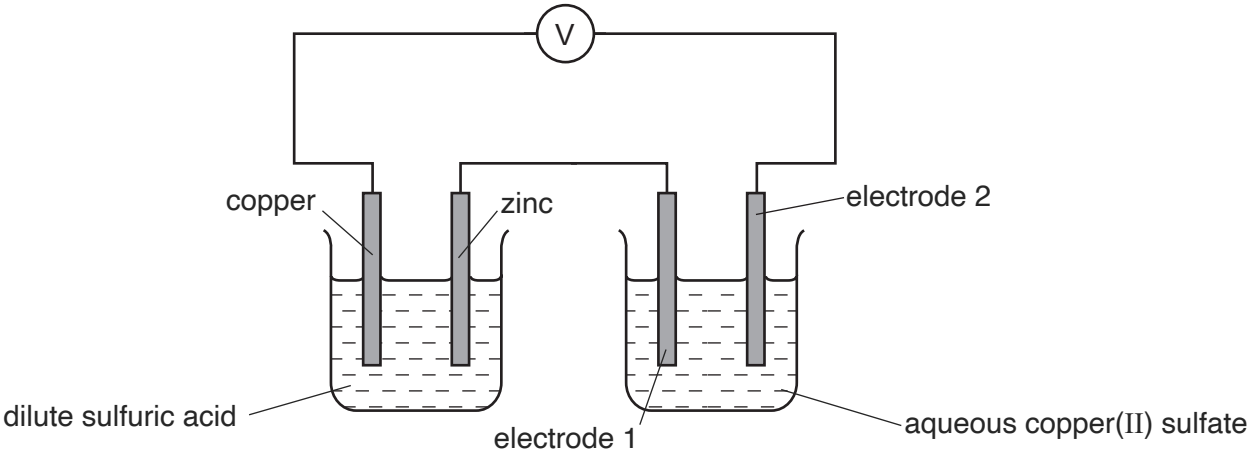
Which statement about this simple cell is correct?

A Electrons move through the electrolyte.
B Mass of the zinc electrode increases.
C The electrolyte changes its colour to blue.
D The equation for the reaction is $Zn \rightarrow Zn^{2+} + 2\ e^-$.

5 In which circuit would the bulb light?



6 An electrical circuit was set up using two simple cells as shown.

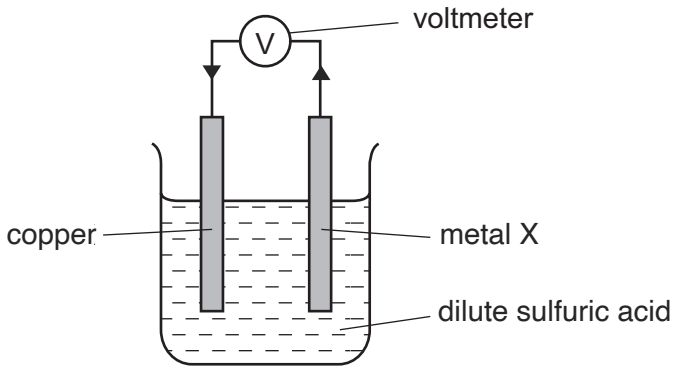


Both electrodes 1 and 2 are made of graphite.

Which row shows the products formed at electrodes 1 and 2?

	Electrode 1	Electrode 2
A	Cu metal	H_2 gas
B	Cu metal	O_2 gas
C	H_2 gas	Cu metal
D	O_2 gas	Cu metal

7 The diagram shows a simple cell made using copper and metal X as electrodes. The direction of electron flow in the cell is indicated with arrows.



Which statement about this simple cell is correct?

A Copper is the anode.

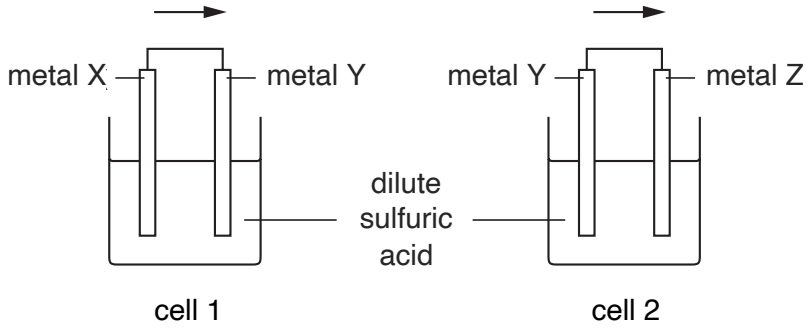
B Mass of the copper electrode decreases.

C Mass of the metal X electrode decreases.

D Metal X is below copper in the reactivity series.

Use the information provided below to answer questions **8** – **10**.

Metals X, Y and Z form two simple cells as shown in the diagrams. The arrows represent the directions of electron flow in each cell.



8 Which set of metals would lead to the electron flow in the directions shown?

	X	Y	Z
A	Ag	Cu	Zn
B	Ag	Zn	Cu
C	Cu	Zn	Ag
D	Zn	Cu	Ag

9 Which statement about the observation made in cell 1 is correct?

A Dilute sulfuric acid changes colour.
B Size of the metal X electrode increases.
C Size of the metal Y electrode increases.
D The temperature of cell 1 decreases.

10 Which statement about the observation made in cell 2 is **not** correct?

A Dilute sulfuric acid changes colour.
B Effervescence is observed at metals Y and Z.
C Size of metals Y and Z remains the same.
D Volume of the dilute sulfuric acid decreases.

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CHEMISTRY (G3) **6092**

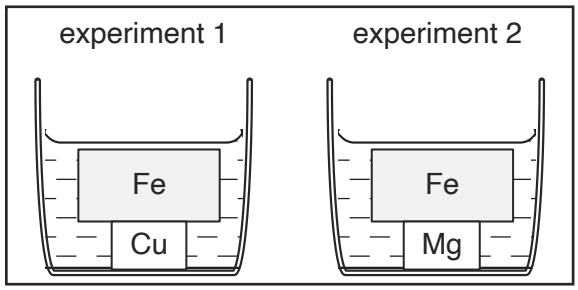
14.3 Practical Applications of Electrochemistry
Assessment for Learning

ELECTROLYSIS

1 A student investigated the reaction between iron and two different metals, copper and magnesium, separately. Two experiments were carried out.

Experiment 1
- A piece of iron was attached to a smaller piece of copper and placed in an empty glass tank.
- Tap water was added into the glass tank until both metals were completely submerged.

Experiment 2
- Experiment 1 was repeated using magnesium instead of copper.



Which are equations for the reactions that would take place in experiment 1 and experiment 2?

	Reaction in experiment 1	Reaction in experiment 2
A	$Cu\ (s) \rightarrow Cu^{2+}\ (aq) + 2\ e^-$	$Fe\ (s) \rightarrow Fe^{2+}\ (aq) + 2\ e^-$
B	$Cu\ (s) \rightarrow Cu^{2+}\ (aq) + 2\ e^-$	$Mg\ (s) \rightarrow Mg^{2+}\ (aq) + 2\ e^-$
C	$Fe\ (s) \rightarrow Fe^{2+}\ (aq) + 2\ e^-$	$Fe\ (s) \rightarrow Fe^{2+}\ (aq) + 2\ e^-$
D	$Fe\ (s) \rightarrow Fe^{2+}\ (aq) + 2\ e^-$	$Mg\ (s) \rightarrow Mg^{2+}\ (aq) + 2\ e^-$

2 Which metal could **not** be used for electroplating by using an aqueous solution?

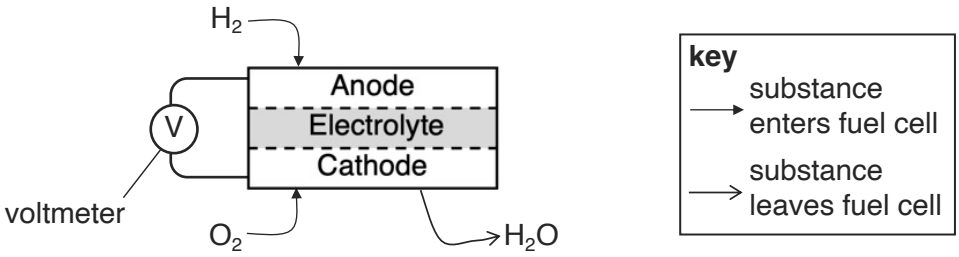
A Chromium **B** Copper **C** Silver **D** Sodium

3 Which statement about the electrolytic purification of copper is correct?

A The anode used must be made of pure Cu.
B The cathode used must be made of pure Cu.
C The colour of the electrolyte used gradually decolorises.
D The electrolyte used is a solution of an oxide of copper in water.

Use the information provided below to answer questions **4** & **5**.

Hydrogen is used in fuel cells that are typically fitted in cars. The diagram shows an example of a hydrogen fuel cell.



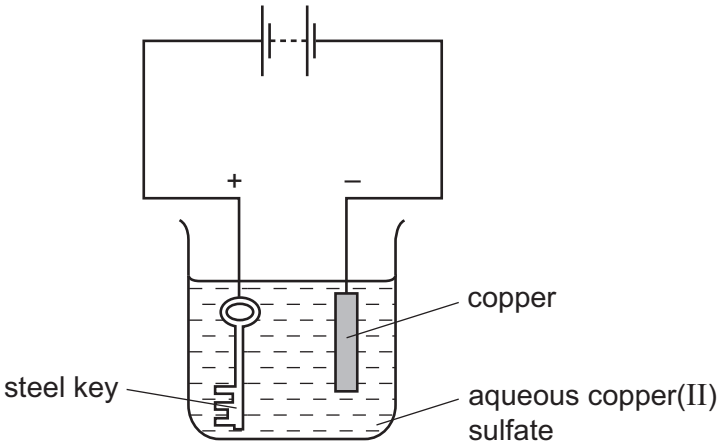
4 Which statement about the hydrogen fuel cell is correct?

A Hydrogen gas is oxidised at the negative electrode.
B Hydrogen gas is reduced at the positive electrode.
C Oxygen gas is oxidised at the positive electrode.
D Oxygen gas is reduced at the negative electrode.

5 Which statement describes a drawback of the hydrogen fuel cell?

A The hydrogen fuel cell produces less energy compared to combustion of fossil fuels in engines.
B The hydrogen gas used is expensive.
C The hydrogen gas used is highly flammable.
D The product formed is an environmental pollutant.

6 The diagram shows an experiment used to electroplate a steel key with copper.

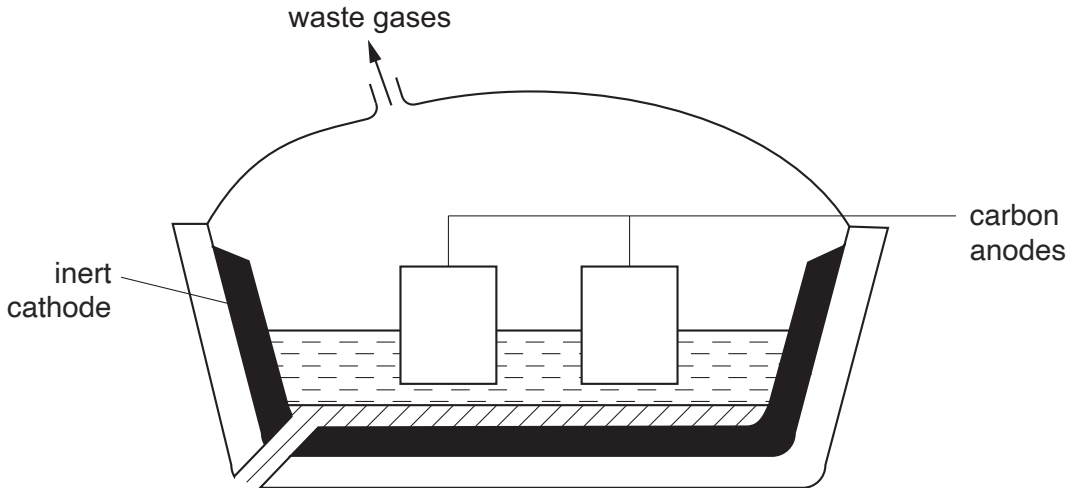


However, this experiment did **not** work.

Which change is required for this experiment to work?

A Increasing the concentration of the aqueous copper(II) sulfate
B Increasing the voltage
C Replacing the electrolyte with dilute sulfuric acid
D Reversing the electrical connections

7 The diagram shows the electrolytic production of aluminium from aluminium oxide in the industry.



Which statement is correct about the aluminium and aluminium oxide during this process?

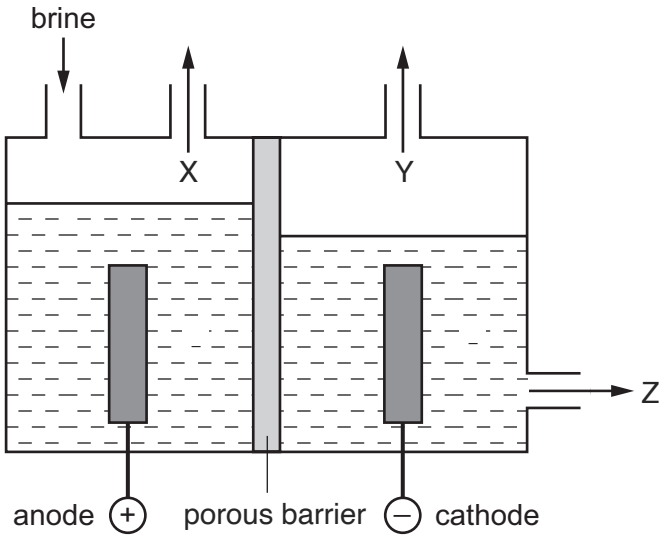
A Both aluminium and aluminium oxide are in the liquid states, with aluminium formed at the anode.

B Both aluminium and aluminium oxide are in the liquid states, with aluminium formed at the cathode.

C Only aluminium is in the liquid state, and is formed at the anode.

D Only aluminium is in the liquid state, and is formed at the cathode.

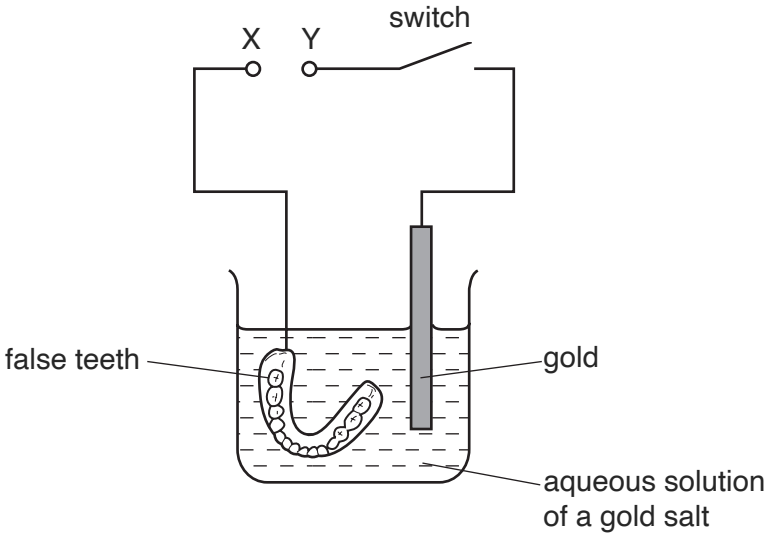
8 The diagram shows the industrial electrolysis of brine to produce substances X, Y and Z.



What are X, Y and Z produced in this electrolysis?

	X	Y	Z
A	Cl_2	H_2	H_2O
B	Cl_2	H_2	NaOH
C	H_2	Cl_2	H_2O
D	H_2	Cl_2	NaOH

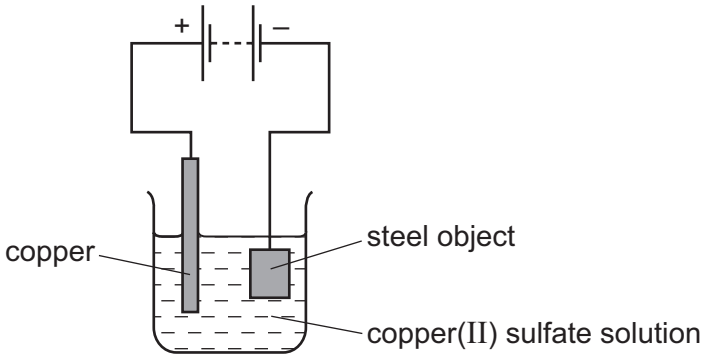
9 Winston Churchill, a British Prime Minister, had his set of false teeth electroplated with gold. His set of false teeth were coated with a thin layer of carbon powder before being placed in the apparatus shown.



Which row is correct?

	Terminal X is	The carbon powder could be
A	negative	diamond
B	negative	graphite
C	positive	diamond
D	positive	graphite

10 The diagram shows the electroplating of a steel object with copper.



A student predicted the following results.

1 The copper decreases in size.
2 The copper(II) sulfate solution decolourises over time.
3 The steel object changes to a red-brown colour.

Which predictions are correct?

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