Exampro GCSE Chemistry

C2 Chapter 5 Higher

Name:

Class:

Author:

Date:

Time: 73

Marks: 73

Comments:

Q1. (a) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

The salt called potassium chloride is made when potassium hydroxide solution reacts with hydrochloric acid.

potassium hydroxide solution + hydrochloric acid → potassium chloride solution + water

Describe a method for making **crystals** of potassium chloride from potassium hydroxide solution and hydrochloric acid.

In this method you should:

- describe how you will add the correct amount of the hydrochloric acid to neutralise the potassium hydroxide solution
- describe how you will get crystals of potassium chloride.

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(6)

(b) Ammonium nitrate is another salt.
Ammonium nitrate is made when ammonia solution is neutralised with an acid.

Name the acid to complete the word equation.

ammonia + ... acid → ammonium nitrate

(1)

(c) Read the information.

Ammonium nitrate – good or bad?

Some farmers put a lot of ammonium nitrate on their farmland.

Many people are worried about this use of ammonium nitrate.

Rain water can wash the ammonium nitrate off the farmland and into rivers and lakes. The ammonium nitrate may get into drinking water supplies and could be harmful to health.

(i) Why do some farmers put ammonium nitrate on their farmland?

.....

.....

(1)

(ii) Which **one** of the questions in the table cannot be answered by science alone?

Tick (✓) **one** question.

Question	Tick (✓)
How much ammonium nitrate is in drinking water?	
Should farmers stop using ammonium nitrate on their farmland?	
Is ammonium nitrate soluble in rain water?	

Give **two** reasons why this question **cannot** be answered by science alone.

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(3)

(Total 11 marks)

Q2. Read the article.

In the late eighteenth century the French scientist Nicolas Leblanc invented a process to change sodium chloride into sodium carbonate.

The main steps in the original process were:

Step 1. Sodium chloride was reacted with sulfuric acid to make sodium sulfate. Hydrogen chloride was formed and escaped into the atmosphere.
The hydrogen chloride damaged plants over a wide area around the factory.

Step 2. The sodium sulfate was heated with limestone and coal. A solid mixture was formed which contained sodium carbonate, calcium sulfide and unreacted coal.
The calcium sulfide gave off a very unpleasant smell.

Step 3. The sodium carbonate was dissolved in water and separated from the insoluble calcium sulfide and unreacted coal.

Step 4. Crystals of sodium carbonate were obtained from the solution of sodium carbonate.

The process was later improved.

- The hydrogen chloride produced in **Step 1** was changed into chlorine which was used to make bleach.
- The calcium sulfide produced in **Step 2** was converted into sulfur. This sulfur was used to make sulfuric acid.

(a) The symbol equation for the reaction in **Step 1** is shown below.

$$2NaCl(s) + H_2SO_4(l) \rightarrow Na_2SO_4(s) + 2HCl(g)$$

What property of hydrogen chloride allowed it to escape into the atmosphere?

.....

(1)

(b) The insoluble solids, calcium sulfide and unreacted coal were separated from the sodium carbonate solution in **Step 3**.

Suggest how this was done.

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(1)

(c) Sodium carbonate crystals were obtained from sodium carbonate solution in **Step 4**.

Suggest how this was done.

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(1)

(d) It has been stated that: 'the Chemical Industry can turn problems into profit'.

State **two** problems with the original process and explain how they were turned into profit.

1 .....

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2 .....

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(4)
(Total 7 marks)

Q3. Copper sulfate ($CuSO_4$) is a salt that has many uses.

An aqueous solution of copper sulfate can be made by reacting copper oxide (CuO) with an acid.

(a) (i) Name this acid. .....

(1)

(ii) Write a balanced symbol equation, including state symbols, for this reaction.

.....

(2)

(b) Copper oxide reacts much faster with acid at 40 °C than at 20 °C.

Explain why in terms of particles.

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(2)
(Total 5 marks)

Q4. The following passage is about the preparation of lead iodide, an insoluble salt.

> An excess of potassium iodide in solution was shaken with some lead nitrate solution in a test tube.
>
> The lead iodide precipitate was separated from the mixture and then washed several times with water.
>
> The lead iodide was dried and then placed in a bottle.

(a) Suggest a reason why excess potassium iodide was used.

.....

.....

(1)

(b) What word used in the passage shows that lead iodide is insoluble?

.....

(1)

(c) Suggest how lead iodide can be separated from the mixture.

.....

.....

(1)

(d) Why was the lead iodide washed with water?

.....

.....

(1)

(e) Suggest a method which could be used to dry this lead iodide.

.....

.....

(1)

(f) Lead compounds are toxic.

Suggest a suitable safety precaution that should be taken when using toxic substances in laboratories.

.....

(1)

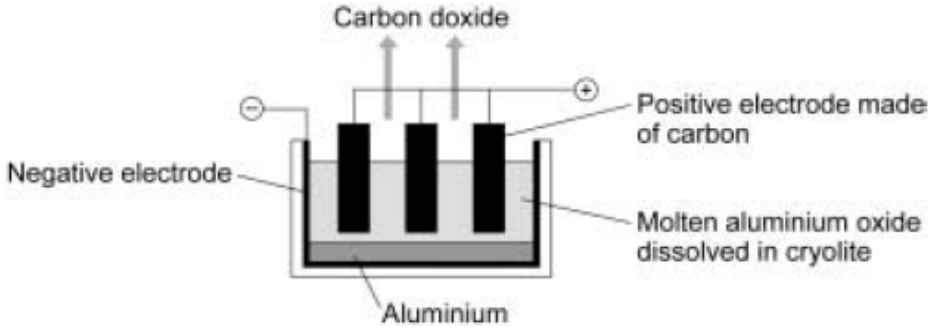
(Total 6 marks)

Q5. Read the information in the box and then answer the question.

Aluminium is made by the electrolysis of aluminium oxide.

Aluminium oxide is an ionic compound containing aluminium ions (Al^{3+}) and oxide ions (O^{2-}).

The diagram below shows the apparatus used to electrolyse aluminium oxide.



(a) *In this question you will get marks on using good English, organising information clearly and using specialist terms correctly.*

Use information in the box and your knowledge and understanding of this process to answer this question.

Explain, as fully as you can, how aluminium and carbon dioxide are formed in this process.

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(6)

(b) Aluminium is a metal.

Explain why aluminium conducts electricity.

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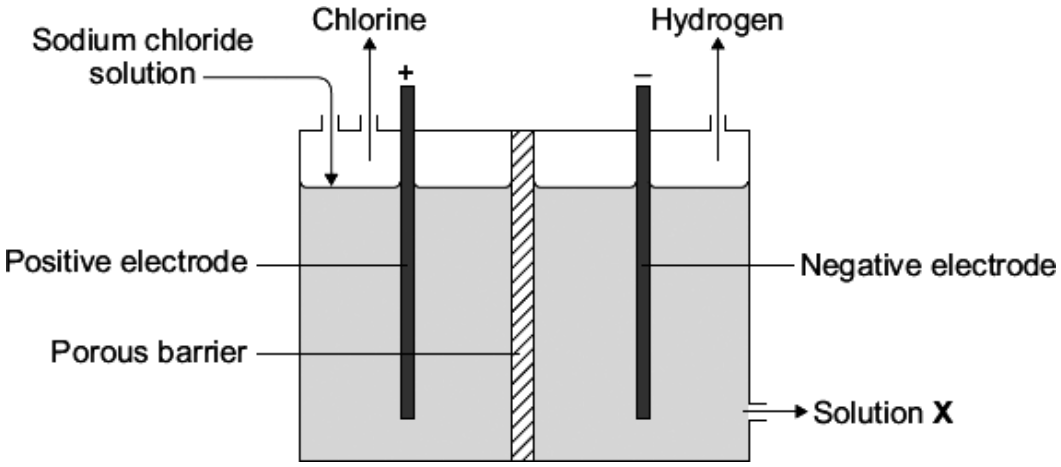
(2)
(Total 8 marks)

Q6. The electrolysis of sodium chloride solution is an industrial process.



(a) Why do chloride ions move to the positive electrode?

.....

(1)

(b) Sodium chloride solution contains two types of positive ions, sodium ions (Na^+) and hydrogen ions (H^+).

Tick (✓) the reason why hydrogen is produced at the negative electrode and **not** sodium.

Reason	Tick (✓)
Hydrogen is a gas.	
Hydrogen is less reactive than sodium.	
Hydrogen is a non-metal.	
Hydrogen ions travel faster than sodium ions.	

(1)

(c) Solution **X** is alkaline.

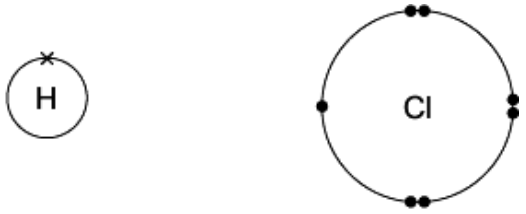
Which ion makes solution **X** alkaline?

.....

(1)

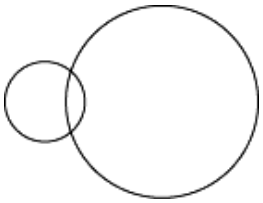
(d) Electrolysis of sodium chloride solution produces hydrogen and chlorine.
The hydrogen and chlorine can be used to make hydrogen chloride.

(i) The diagrams show how the outer electrons are arranged in atoms of hydrogen and chlorine.



Hydrogen atom Chlorine atom

Complete the diagram to show how the electrons are arranged in a molecule of hydrogen chloride (HCl).



(1)

(ii) Name the type of bond between the hydrogen and the chlorine atoms in a molecule of hydrogen chloride.

.....

(1)

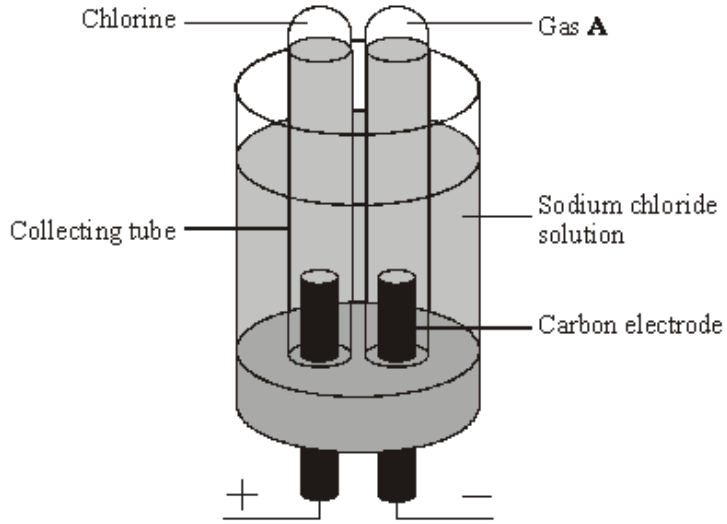
(iii) Some hydrogen chloride was bubbled into water. This made a solution with a pH of 1.

Which ion gave the solution a pH of 1?

.....

(1)
(Total 6 marks)

Q7. The electrolysis of sodium chloride solution is an important industrial process. The apparatus shown below can be used to show this electrolysis in the laboratory.



(a) Name gas **A**. .....

(1)

(b) Chlorine is produced at the positive electrode. Describe and give the result of a chemical test to prove that the gas is chlorine.

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(2)

(c) Chloride ions move to the positive electrode. Explain why.

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(1)

(d) A small quantity of chlorine is added to drinking water. Explain why.

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(1)

(e) The solution around the negative electrode becomes alkaline. Name the ion which makes the solution alkaline.

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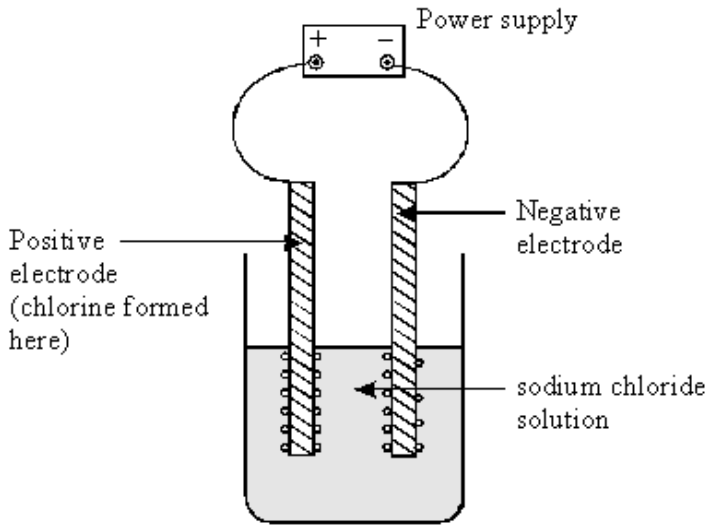
(1)

(Total 6 marks)

Q8. The diagram below shows the electrolysis of sodium chloride solution, in the laboratory.



(a) Which gas forms at the negative electrode? .....

(1)

(b) Explain why chlorine gas forms at the positive electrode.

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.....

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(2)

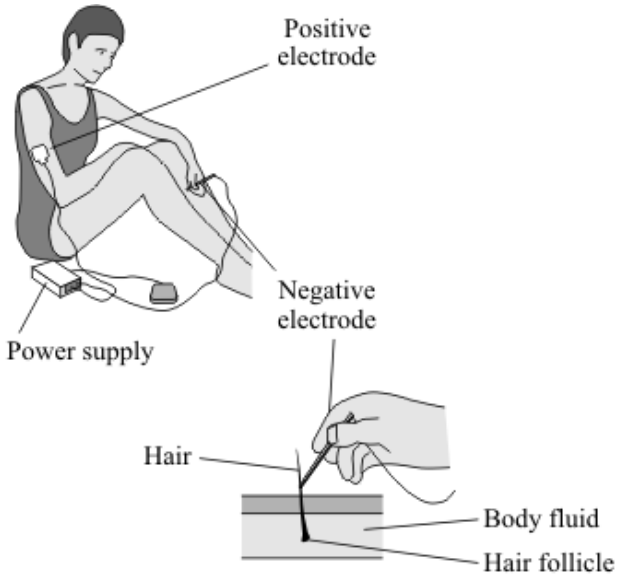
(c) State **one** use of chlorine gas.

.....

(1)

(Total 4 marks)

Q9. Electrolysis can be used to remove unwanted hair from the skin.



The positive electrode is connected by a patch to the skin.

The negative electrode is connected to the hair.

The body fluid is a solution that contains sodium chloride. The electricity causes the electrolysis of a small amount of this solution.

(a) In this solution hydrogen ions move to the negative electrode.

Complete the sentence using **one** word from the box.

negative	**neutral**	**positive**

Hydrogen ions move to the negative electrode because they have a

..... charge.

(1)

(b) Draw a ring around the name of the gas produced at the positive electrode during the electrolysis of sodium chloride solution.

chlorine **hydrogen** **nitrogen**

(1)

(c) The electrolysis of the sodium chloride solution forms a strong alkali around the hair follicle.

(i) Complete the name of this strong alkali using **one** of the words from the box.

chloride **hydroxide** **nitrate**

The name of this strong alkali is sodium ..... .

(1)

(ii) Suggest how this strong alkali helps to remove the hair.

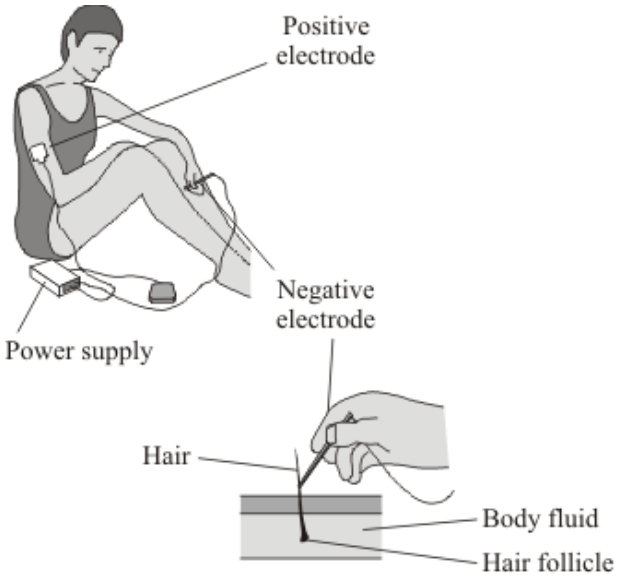
.....

.....

(1)

(Total 4 marks)

Q10. Electrolysis can be used to remove unwanted hair from the skin.



The hair is first coated with a layer of gel containing ions in solution.

The positive electrode is connected by a patch to the skin.

The negative electrode is connected to the hair. Electricity flows through the gel and causes electrolysis of the body fluid around the hair follicle.

(a) Metal wires conduct electricity to the electrodes.

Explain how metals conduct electricity.

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(2)

(b) Explain why the gel containing ions in solution can conduct electricity.

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(1)

(c) The body fluid is a solution that contains sodium chloride. The electricity causes the electrolysis of a small amount of this solution.

This solution contains hydrogen ions that move to the negative electrode.

(i) The half equation represents the reaction at the negative electrode.

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

Explain why this reaction is a reduction.

.....

.....

(1)

(ii) As a result of the electrolysis of sodium chloride solution, an alkali forms which kills the hair follicle.

What is the name of this alkali? .....

(1)

(iii) Complete the half equation for the reaction at the positive electrode.

$Cl^- \rightarrow Cl_2$

(1)

(Total 6 marks)

Q11. This question is about potassium.

(a) Humphrey Davy was a professor of chemistry.

In 1807 Davy did an electrolysis experiment to produce potassium.

(i) Davy first tried to electrolyse a solid potassium salt to produce potassium.

Explain why this electrolysis did **not** work.

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(2)

(ii) Humphrey Davy was the first person to produce potassium.

Humphrey Davy's experiment to produce this new element was quickly accepted by other scientists.

Suggest why.

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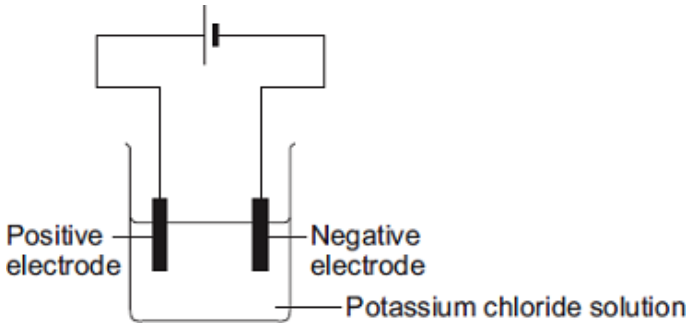
(1)

(b) A student dissolved some potassium chloride in water. The student tried to electrolyse the potassium chloride solution to produce potassium.

The apparatus the student used is shown in the diagram.



The student expected to see potassium metal at the negative electrode, but instead saw bubbles of a gas.

- Name the gas produced at the negative electrode.
- Explain why this gas was produced at the negative electrode **and** why potassium was not produced.

The reactivity series of metals on the Chemistry Data Sheet may help you to answer this question.

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(3)

(c) The student tried to electrolyse molten potassium chloride to produce potassium.

(i) Potassium metal was produced at the negative electrode.

Describe how potassium atoms are formed from potassium ions.

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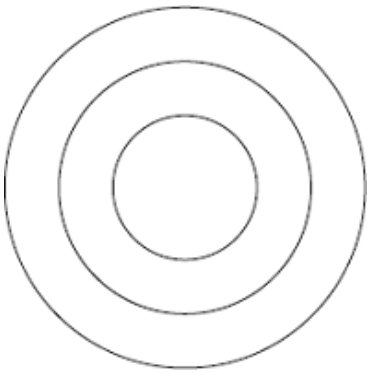
(2)

(ii) Complete and balance the equation for the reaction at the positive electrode.

.....Cl^- ⟶ Cl_2 + ...

(1)

(iii) Complete the diagram to show the electronic structure of a chloride ion (Cl^-).



(1)

(Total 10 marks)

M1. (a) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also apply a 'best-fit' approach to the marking.

0 marks

No relevant content.

Level 1 (1-2 marks)
There is a simple description of a laboratory procedure for obtaining potassium chloride.

Level 2 (3-4 marks)
There is a clear description of a laboratory procedure for obtaining potassium chloride from potassium hydroxide solution and hydrochloric acid that does not necessarily allow the procedure to be completed successfully by another person. The answer must include the use of an indicator or a method of obtaining crystals.

Level 3 (5-6 marks)
There is a detailed description of a laboratory procedure for obtaining potassium chloride from potassium hydroxide solution and hydrochloric acid that can be followed by another person. The answer must include the use of an indicator and a method of obtaining crystals.

examples of the chemistry/social points made in the response:

- One reagent in beaker (or similar)
- Add (any named) indicator
- Add other reagent
- Swirl or mix
- Add dropwise near end point
- Stop addition at change of indicator colour
- Note volume of reagent added
- Repeat without indicator, adding same volume of reagent **or** remove indicator using charcoal
- Pour solution into basin / dish
- Heat (using Bunsen burner)
- Leave to crystallise / leave for water to evaporate / boil off water

Accept any answers based on titration

6

(b) nitric (acid)

allow HNO_3

ignore incorrect formula

1

(c) (i) because it is a fertiliser / helps plants grow

allow plant food

*do **not** accept pesticide / herbicide / neutralising soil*

1

(ii) tick by: 'Should farmers stop using ammonium nitrate on their land?'

1

any **two** from:

- cannot be done by experiment
  accept difficult to get / not enough evidence
- based on opinion / view
  allow must be done by survey
- ethical **or** economic issue
  *if top box ticked allow **1** mark for drinking water varies from place to place*

2

[11]

M2. (a) gas / g

accept low density / low boiling point
or** weak intermolecular forces **or
*small molecules **or** simple molecules*
***or** simple molecular (structure)*
accept volatile or easy to evaporate
ignore very light
ignore incorrect name of gas

1

(b) filter / filtration

accept filter paper
accept decant / centrifuge
ignore filter funnel / sieving / drained off / funnelling
ignore names of compounds
ignore evaporation / heating if after filtration
*do **not** accept crystallisation*

1

(c) evaporation / crystallisation

accept heating / boiling
accept 'leave for a few days' owtte
allow cool
*do **not** allow freeze*
ignore filtration

1

(d) *candidates can gain marks from any two of the three linked pairs*

hydrogen chloride escaped / released (into atmosphere) **or** (hydrogen chloride) damaged vegetation / harmful

used to make chlorine / bleach

*to get both of these **2** marks hydrogen chloride must be mentioned*
ignore HCl formed / produced / made
ignore sale of hydrogen chloride

1

1

unpleasant smell (of calcium sulfide)

or
waste of calcium (sulfide)

converted to sulfur

or
used to make sulfuric acid

ignore calcium sulfide alone
allow calcium / calcium sulfate for calcium sulfide
to get both of these 2 marks calcium (sulfide) must be mentioned
ignore sale of calcium sulfide

1

unreacted coal (1)

recycled / burnt / used / sold (1)

must be linked to first coal point

1

[7]

M3. (a) (i) sulfuric

accept H_2SO_4
accept sulphuric
allow phonetic spellings

1

(ii) $CuO + H_2SO_4 \rightarrow CuSO_4 + H_2O$

***1** mark for reactants*
***1** mark for products*
ignore state symbols
*max **1** mark for incorrect balancing*

2

(b) any **two** from:

- particles gain energy **or** particles have more energy
  allow have more activation energy
- particles move faster
  allow they collide faster / quicker
  ignore move / vibrate more
- collide more often
  allow more collisions
- collide more energetically
- more of the collisions are successful
  or more particles have the activation energy
  ***NB** more successful collisions alone = **1** mark*
  *if particles are identified as electrons = max **1** mark*

2

[5]

M4. (a) all lead nitrate reacted
or no lead nitrate left
or enough KI to react with lead nitrate
or to remove all the lead ions
or to get maximum amount of I_2

ignore comments about speed
*do **not** accept to remove all the lead*

1

(b) precipitate

allow phonetic spelling
*do **not** accept ppt*

1

1

(c) filter / filtration / centrifuge / decant

*do **not** accept sieve*

(d) any **one** from:

- removes (soluble) impurities
- removes (unreacted) KI
- removes KNO_3
- removes (excess) solution
- removes nitrates

purifying is insufficient
*do **not** accept removes potassium*
*do **not** accept removes iodide*

1

(e) answer based on filter paper, desiccator, suitable solvent
(gentle) heat, drying cabinet, oven etc.

Accept any method of heating i.e.
bunsen / hairdryer etc.
*Accept leave to evaporate / stand **or** leave in a warm room*

e.g. place between dry filter paper, allow to dry
e.g. use propanone, allow to dry
e.g. leave on sunny window sill
e.g. leave in a draught

the answer leave / evaporate /
draught alone is insufficient

1

(f) wear gloves / mask
or fume-cupboard
or wash hands afterwards

*ignore goggles / labcoat **or** extractor fan / do not touch etc.*

1

[6]

M5. (a) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response.

No relevant content.

0 marks

There is a brief description of the electrolysis of aluminium oxide.

Level 1 (1–2 marks)

There is some description of the electrolysis of aluminium oxide.

Level 2 (3–4 marks)

There is a clear, balanced and detailed description of the electrolysis of aluminium oxide.

Level 3 (5–6 marks)

examples of the chemistry points made in the response

- aluminium oxide is melted / made liquid
- aluminium ions are attracted to the negative electrode
- at the negative electrode aluminium is formed **or** aluminium ions gain electrons
- oxide ions are attracted to the positive electrode
- oxygen is formed at the positive electrode **or** oxide ions lose electrons
- the oxygen reacts with carbon to make carbon dioxide **or** carbon dioxide formed at positive electrode.

(b) there are delocalised electrons / free electrons / electrons which move within the aluminium / metallic structure

1

therefore these electrons are able to carry the current / charge

1

if the candidates use the terms covalent / ionic / molecules / intermolecular incorrectly in the answer this will limit the mark to a maximum of 1.

[8]

M6. (a) any **one** from:

- they are negative / anions

  allow Cl^-

  ignore atoms / chlorine

  *do **not** accept chloride ions are negative electrodes*

- they are attracted
- they are oppositely charged

1

(b) hydrogen is less reactive than sodium

1

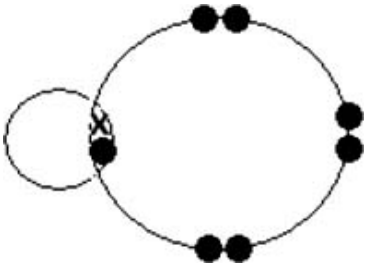
(c) hydroxide (ions) / OH^-

ignore OH

*do **not** accept NaOH / sodium hydroxide*

1

(d) (i)



allow any combination of dots or crosses

ignore chemical symbols

1

(ii) covalent

allow close spelling errors

apply list principle

1

(iii) hydrogen (ion) / H^+

ignore (aq) / H

do not accept hydrochloric acid / HCl

apply list principle

1

[6]

M7. (a) hydrogen

accept H_2

*do **not** accept H*

1

(b) litmus paper / Universal Indicator paper / pH paper

allow any suitable named indicator

1

bleached / turns white **or** loses its colour

*do **not** accept bleached cloth / leaves etc.*

allow second mark unless incorrect indicator given

allow starch iodide paper (1)
goes black / blue black (1)

allow potassium iodide solution (1) goes brown / orange / black precipitate (1)

1

(c) because they have a negative charge **or** opposite charges attract

accept (because) it is Cl^-
*accept chlorine, Cl **or** chlorine ions has a negative charge*

*do **not** accept Cl^- on its own*
*do **not** accept Cl_2 o.e. has negative charge*

1

(d) kill bacteria / germs, etc. **or** sterilise / disinfect

accept destroys bacteria etc.
ignore clean / purify water (owtte)
*do **not** accept just gets rid of bacteria*

1

(e) hydroxide (ion)

accept OH^-

1

[6]

##

(a) hydrogen

for 1 mark

1

(b) chloride ions are negative;
negative ions move to positive electrode

each for 1 mark

2

(c) any **one** use of chlorine e.g.
sterilisation;
bleaching;
making plastics

any one for 1 mark

1

[4]

M9. (a) positive

*accept + **or** +ve **or** plus*

1

(b) chlorine

1

(c) (i) hydroxide

Any indication of hydro…

1

(ii) destroys / damages / dissolves (owtte) the hair / follicle / root

allow burns / reacts with the hair
ignore incorrect name of compound

1

[4]

M10. (a) any **two** from:

- outer shell electrons / electrons in highest energy level (in metals)
- electrons are delocalised / sea of electrons
- electrons are free **or** electrons move around **or** electrons are free to flow **or** electrons attracted to positive terminal
- electrons carry charge / current **or** electrons form the current / electrons transfer charge / electrons pass charge

ignore electrons carry electricity
ignore reference to positively charged atoms / ions
*if they state electrons have +ve charge = max **1** mark*
*if they state covalent bonding then max **1** mark*

2

(b) ions can move / are attracted to electrode

accept ions are free

allow 'they' for ions

or

attracted to named electrode

or

ions are charged **or** ions form / carry the current **or** ions form the charge

1

(c) (i) electron gain

ignore hydrogen reduces charge

1

(ii) sodium hydroxide **or** NaOH **or** caustic soda

*do **not** allow hydroxide alone*

1

(iii) $2Cl^- - 2\ e^- \rightarrow Cl_2$

or

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

*allow fractions **or** multiples*

*allow e **or** e^-*

*do **not** allow e^+*

1

[6]

M11. (a) (i) current / charge couldn't flow

allow could not conduct (electricity)

1

because the ions / particles couldn't move

*do **not** accept electrons/ molecules / atoms*

or

(salt) needs to be molten / (1) dissolved (to conduct electricity)

so that the ions / particles can move (1)

*do **not** accept electrons / molecules / atoms*

1

(ii) he had status

*accept he had authority **or** experience*

or

he had evidence / proof

accept the experiment could be repeated

1

(b) hydrogen / H_2

*do **not** allow hydrogen ions*

1

the ions are positive

accept because opposite (charges) attract

1

potassium is more reactive (than hydrogen)

accept potassium ions are less easily discharged (than hydrogen)

***or** potassium ions are less easily reduced (than hydrogen)*

1

(c) (i) gain electron(s)

*accept fully balanced correct equation for **2** marks*

1

one electron

*if no other marks awarded allow (potassium ions) reduced for **1** mark*

1

(ii) $2\ Cl^- \rightarrow Cl_2 + \mathbf{2e^-}$

must be completely correct, including charge on electron

accept correct multiples

1

(iii) 2, 8, 8

accept any combination of dots, crosses, "e" or any other relevant symbol

ignore any charges if given

1

[10]