

Chemical Changes 1

Name: _____

Class: _____

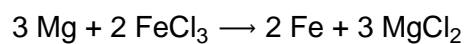
Date: _____

Time: **65 minutes**

Marks: **62 marks**

Comments:

- (d) Explain which species is reduced in the reaction between magnesium and iron chloride.



Your answer should include the half equation for the reduction.

(3)

(Total 10 marks)

3.

This question is about electrolysis.

- (a) How many different elements are in the formula AgNO_3 ?

Tick **one** box.

2 3 5 6

(1)

- (b) How many atoms are in the formula AgNO_3 ?

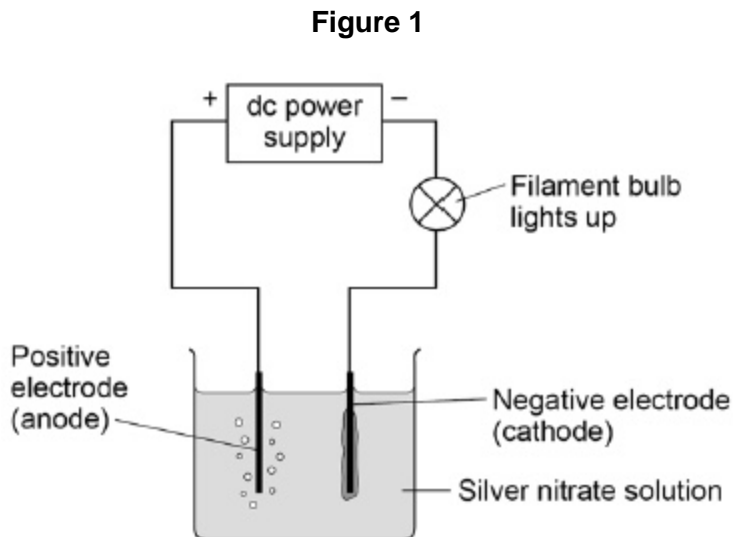
Tick **one** box.

2 3 5 6

(1)

An electric current is passed through silver nitrate solution.

Figure 1 shows the apparatus.



The solution contains four ions:

- Ag^+
- H^+
- NO_3^-
- OH^-

(c) Where do the H^+ and OH^- ions come from?

Tick **one** box.

Air

Electrodes

Silver nitrate

Water

(1)

(d) Ag^+ ions and H^+ ions are attracted to the negative electrode (cathode).

Give a reason why.

(1)

(e) Silver is produced at the negative electrode (cathode) and not hydrogen.

What does this tell you about the reactivity of silver?

Tick **one** box.

Silver is less reactive than hydrogen

Silver is less reactive than oxygen

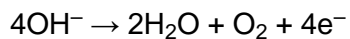
Silver is more reactive than nitrate

Silver is more reactive than water

(1)

(f) The hydroxide ion (OH^-) is attracted to the positive electrode (anode).

The equation shows what happens at the positive electrode (anode).



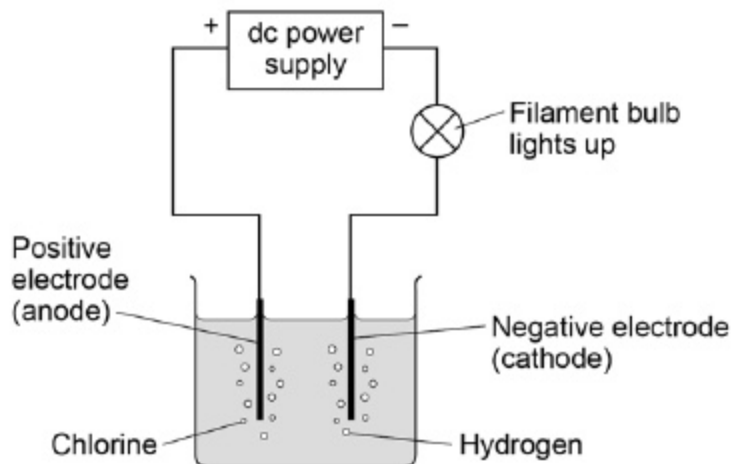
Name the gas produced at the positive electrode (anode).

(1)

(g) An electric current is passed through sodium chloride solution.

Figure 2 shows the apparatus.

Figure 2



After passing an electric current through sodium chloride solution one product is sodium hydroxide (NaOH) solution.

The presence of sodium hydroxide can be shown by adding an indicator.

Name an indicator.

Give the colour of the indicator in sodium hydroxide solution.

Indicator _____

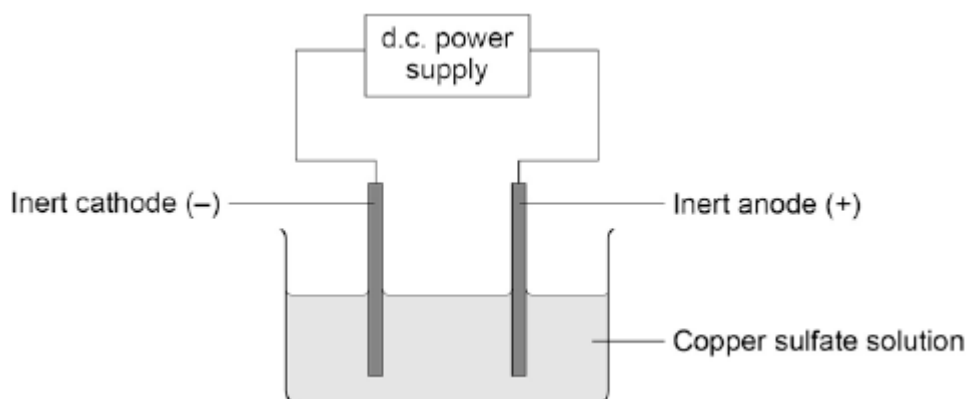
Colour _____

(2)

(Total 8 marks)

4.

The figure below shows an apparatus to produce elements from a solution of an ionic compound.



(a) What is the name of the process in the figure?

Tick **one** box.

Combustion

Crystallisation

Distillation

Electrolysis

(1)

(b) The table below shows the products formed from three experiments using different compounds and the apparatus shown in the figure above.

Compound	State	Product at cathode	Product at anode
Copper chloride	Molten	Copper	Chlorine
Copper chloride	Aqueous solution	Copper	Chlorine
Potassium bromide	Molten	Potassium	Bromine

Use the table above to name the products formed at each electrode if using an aqueous solution of potassium bromide.

At cathode _____ At anode _____

(2)

(c) Explain why copper is formed at the cathode during the electrolysis of its salts.

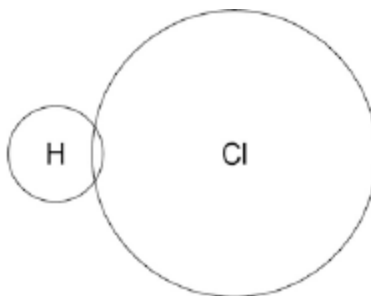
(2)

(Total 5 marks)

5.

Hydrogen chloride (HCl) is a gas.

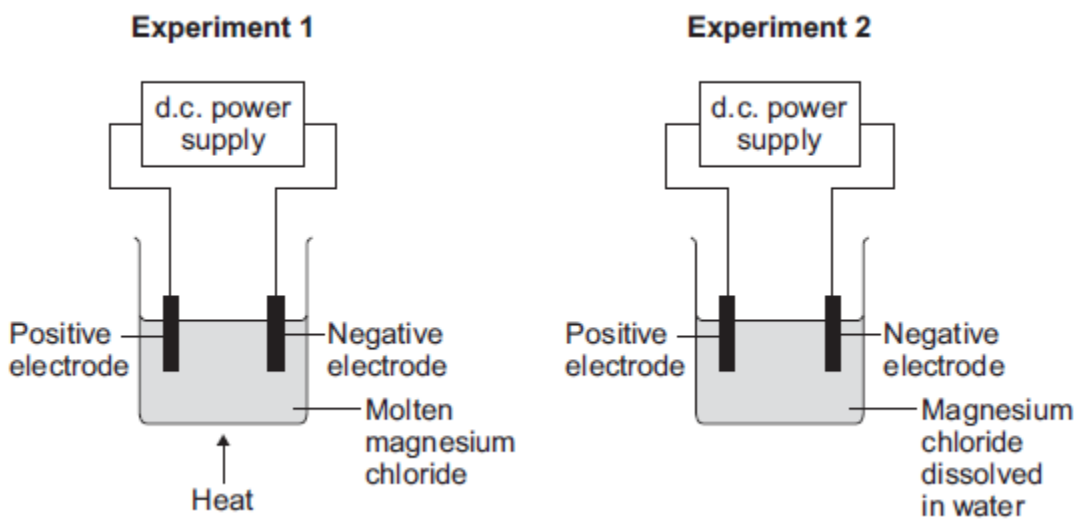
(a) Complete the diagram to show all of the arrangement of the outer shell electrons of the hydrogen and chlorine atoms in hydrogen chloride.



(1)

(b) Magnesium chloride can be electrolysed.

The diagram below shows two experiments for electrolysing magnesium chloride.



(i) Explain why magnesium chloride must be molten or dissolved in water to be electrolysed.

(2)

(ii) Explain how magnesium is produced at the negative electrode in **Experiment 1**.

(3)

(iii) In **Experiment 2** a gas is produced at the negative electrode. Name the gas produced at the negative electrode.

(1)

(iv) Suggest why magnesium is **not** produced at the negative electrode in **Experiment 2**.

(1)

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



(1)

(c) Magnesium is a metal.

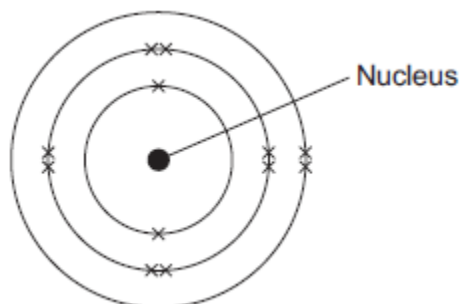
Explain why metals can be bent and shaped.

(2)

(Total 14 marks)

7. This question is about magnesium.

(a) (i) The electronic structure of a magnesium atom is shown below.



Use the correct answer from the box to complete each sentence.

electrons	neutrons	protons	shells
------------------	-----------------	----------------	---------------

The nucleus contains protons and _____ .

The particles with the smallest relative mass that move around the nucleus are called _____ .

Atoms of magnesium are neutral because they contain the same number of electrons and _____ .

(3)

(ii) A magnesium atom reacts to produce a magnesium ion.

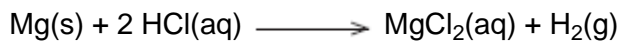
Which diagram shows a magnesium ion?

Tick (✓) **one** box.

 <input type="checkbox"/>	 <input type="checkbox"/>	 <input type="checkbox"/>
------------------------------	------------------------------	------------------------------

(1)

- (b) Magnesium and dilute hydrochloric acid react to produce magnesium chloride solution and hydrogen.



- (i) State **two** observations that could be made during the reaction.

1. _____

2. _____

(2)

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

Describe a method for making pure crystals of magnesium chloride from magnesium and dilute hydrochloric acid.

In your method you should name the apparatus you will use.

You do **not** need to mention safety.

(6)

(Total 12 marks)

Mark schemes

1.

Level 3: Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.

5–6

Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.

3–4

Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.

1–2

No relevant content

0

Indicative content

- uses sulfuric acid not hydrochloric acid
or sulfuric acid needed
- uses copper carbonate / oxide not calcium carbonate
or copper carbonate / oxide needed
- add solid until solid remains **or** is in excess **or** no more reacts / dissolves so that most / all of the acid reacts
- filter
to remove excess **or** unreacted carbonate / oxide / solid
- heat gently **or** partially evaporate **or** leave
until crystals appear **or** to crystallise

for **level 3** the correct chemicals must have been selected

[6]

2.

(a) hydrogen **or** H₂

allow hydrogen gas

ignore H without the 2 subscript

1

(b) filtration / filter

*allow magnet **or** decant*

ignore heating

1

(c) (Mg) $\frac{0.12}{24}$ or 0.005 (moles)

mark is for ÷ by 24

1

(Fe) $\frac{2}{3} \times 0.005 = 0.00333$ (moles)

mark is for $\times \frac{2}{3}$

1

(mass Fe) = 0.00333×56

mark is for $\times 56$

1

= 0.1866 (g)

1

= 187 (mg)

1

an answer of 280 (mg) scores 4 marks

an answer of 0.280 scores 3 marks (no ratio from equation)

184 scores 0 [= (3 × 24) + (2 × 56)]

OR

(Mg) = $\frac{0.12}{(3 \times 24 =) 72}$ (1)

= 0.00166 **or** $\frac{1}{600}$ (moles) (1)

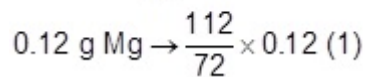
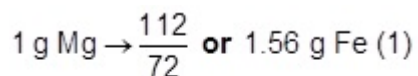
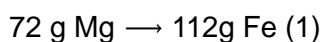
(mass of Fe) = 0.00166

or $\frac{1}{600} \times 112(2 \times 56)$ (1)

= 0.1866 (g) (1)

187 (mg) (1)

OR



$$= 0.1866 \text{ (g) (1)}$$

$$= 187 \text{ (mg) (1)}$$

an answer of 185–190 (mg) scores 5 marks

an answer of 0.185–0.19 scores 4 marks

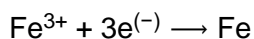
(d) Fe^{3+}

1

(because) reduction is gain of electrons

allow change in oxidation state / (+)3 to 0

1



1

[10]

3.

(a) 3

1

(b) 5

1

(c) water

1

(d) opposite charges attract

1

(e) silver is less reactive than hydrogen

1

(f) oxygen

1

(g) universal indicator

allow other indicators

1

blue / purple

1

[8]

4.

(a) electrolysis

1

- (b) Cathode – hydrogen 1
- Anode – bromine 1
- (c) copper ions are positive 1
- so the copper ions are attracted to the negative cathode
allow so the copper ions gain electrons from the cathode to form copper atoms 1

[5]

5.

- (a) bonded pair of electrons and
 6 non-bonded electrons on chlorine 1

- (b) **Level 3 (5–6 marks):**
 A detailed and coherent explanation of comparative results of a reaction in terms of concentration and ionisation. The response makes logical links between the points raised and uses sufficient examples to support these links.

Level 2 (3–4 marks):

A description of a reaction with results is given but may miss some details. Links are made but may not be fully articulated and / or precise.

Level 1 (1–2 marks):

Simple statements are made. The response may fail to make logical links between the points raised.

0 marks:

No relevant content

Indicative content

Simple statements / descriptions of a reaction

- correct comparative pH, such as, 0–3 (strong) 4–6 (weak)
- named reaction, such as, with a reactive metal or a named carbonate
- comparative results or observations of the named reaction, such as, faster reaction (strong) or greater volume of gas produced in a given time (strong)

Explanations of different results

- weak acids are only partially ionised in aqueous solution
- strong acids are completely ionised in aqueous solution / greater concentration of H⁺ ions
- aqueous solutions of acids at the same concentration / same state of division of metal / powder, same temperature

6

[7]

6.

- (a) magnesium loses two electrons **and** chlorine gains one electron

*accept magnesium loses electrons **and** chlorine gains electrons for*

1 mark

ignore oxidation and reduction

2

one magnesium and two chlorines

accept $MgCl_2$

1

noble gas structure

or

eight electrons in the outer shell

accept full outer shell (of electrons)

or

(electrostatic) attraction between ions

or

forms ionic bonds

*do **not** accept covalent bonds*

1

*reference to incorrect particles **or** incorrect bonding **or** incorrect structure = **max 3***

- (b) (i) because ions can move

ignore ions attracted

*do **not** accept molecules / atoms moving*

*do **not** accept incorrect reference to electrons moving*

1

(and ions move) to the electrodes

or

(and ions) carry charge

1

accept converse for solid

- (ii) magnesium (ions) attracted (to the electrode)

1

so magnesium ions gain electrons

accept magnesium ions are reduced

ignore oxidised

1

2 electrons

accept a correct half equation for 2nd and 3rd marking points

1

(iii) hydrogen

allow H₂

1

(iv) magnesium is more reactive than hydrogen

accept converse

allow magnesium is high in the reactivity series or magnesium is very/too reactive.

do not accept magnesium ions are more reactive than hydrogen ions

1

(v) $2 \text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$

must be completely correct

1

(c) layers (of particles/atoms/ions)

1

(particles/atoms/ions/layers) can slide

1

any mention of intermolecular / weak bonds/forces = max 1

[14]

7.

(a) (i) neutrons

this order only

1

electrons

1

protons

1

(ii) box on the left ticked

1

(b) (i) effervescence / bubbling / fizzing / bubbles of gas

do not accept just gas alone

1

magnesium gets smaller / disappears

allow magnesium dissolves

allow gets hotter or steam produced

ignore references to magnesium moving and floating / sinking and incorrectly named gases.

1

- (ii) Marks awarded for this answer will be determined by the Quality of Communication (QC) as well as the standard of the scientific response. Examiners should also refer to the information in the Marking Guidance and apply a 'best-fit' approach to the marking.

0 marks

No relevant content

Level 1 (1–2 marks)

There are simple statements of some of the steps in a procedure for obtaining magnesium chloride.

Level 2 (3–4 marks)

There is a description of a laboratory procedure for obtaining magnesium chloride from dilute hydrochloric acid and magnesium.

The answer must include a way of ensuring the hydrochloric acid is fully reacted **or** a method of obtaining magnesium chloride crystals.

Level 3 (5–6 marks)

There is a well organised description of a laboratory procedure for obtaining magnesium chloride that can be followed by another person.

The answer must include a way of ensuring the hydrochloric acid is fully reacted **and** a method of obtaining magnesium chloride crystals.

examples of the points made in the response:

- hydrochloric acid in beaker (or similar)
- add small pieces of magnesium ribbon
- until magnesium is in excess or until no more effervescence occurs *
- filter using filter paper and funnel
- filter excess magnesium
- pour solution into evaporating basin / dish
- heat using Bunsen burner
- leave to crystallise / leave for water to evaporate / boil off water
- decant solution
- pat dry (using filter paper).

*Student may choose to use a named indicator until it turns a neutral colour, record the number of pieces of magnesium added then repeat without the indicator.