Surname

Other Names

Candidate Signature

AQA

General Certificate of Secondary Education
Higher Tier
June 2012

Additional Science
Unit Chemistry C2

CHY2H

H

Chemistry
Unit Chemistry C2

Written Paper

Thursday 24 May 2012   9.00 am to 9.45 am

For this paper you must have:
- a ruler
- the Data Sheet (enclosed).
You may use a calculator.

Time allowed
- 45 minutes

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 45.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

Advice
- In all calculations, show clearly how you work out your answer.

Answer **all** questions in the spaces provided.

1 The electrolysis of sodium chloride solution is an industrial process.
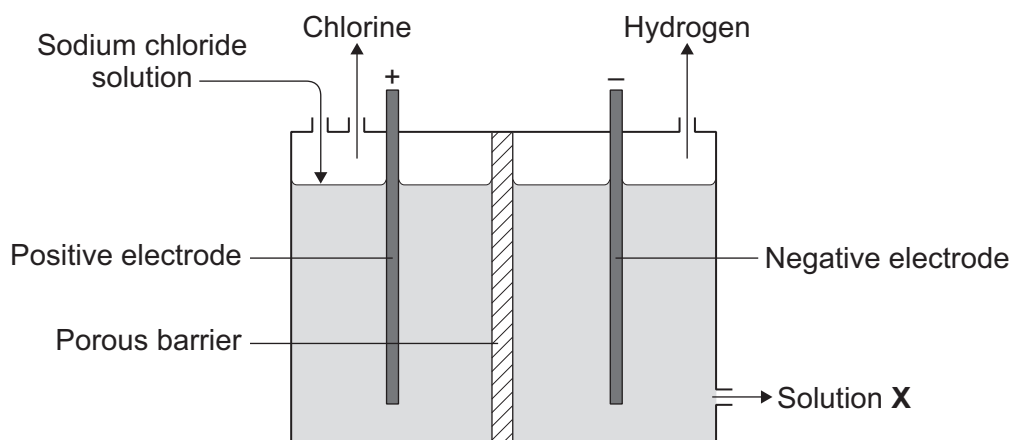
1 (a) Why do chloride ions move to the positive electrode?

....

(1 mark)

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 mark)

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

Which ion makes solution **X** alkaline?

....

(1 mark)

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

1 (d) (i)   The diagrams show how the outer electrons are arranged in atoms of hydrogen
and chlorine.
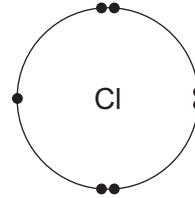
Hydrogen atom   Chlorine atom

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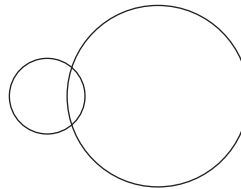
(1 mark)

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

....

(1 mark)

1 (d) (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 mark)

6

Turn over for the next question

Turn over ▶

2 Some students did an experiment to find the relative formula mass (M_r) of a gas.

1 dm³ measuring cylinder

Trough

Water

Canister containing gas
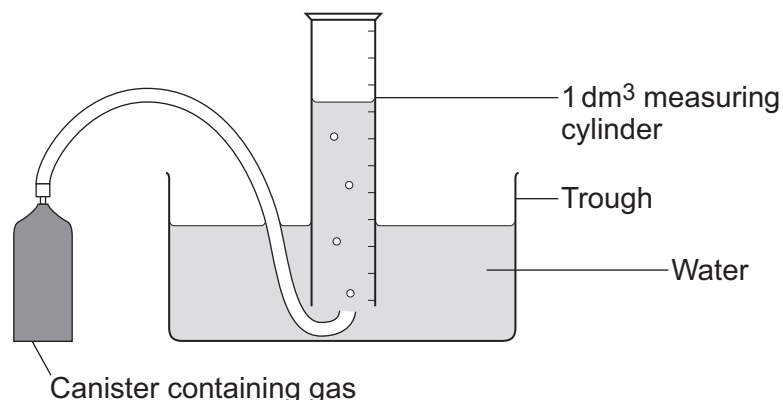
This is the method they used.

- The mass of the canister of gas was measured using a balance, which weighed to two decimal places.
- The measuring cylinder was filled with 1 dm³ of the gas from the canister.
- The mass of the canister of gas was measured again.
- The temperature of the laboratory was measured.
- The air pressure in the laboratory was measured.

The students repeated the experiment three times.

2 (a) The results for one of the experiments are shown in the table below.

Mass of the canister of gas before filling the measuring cylinder	53.07 g
Mass of the canister of gas after filling the measuring cylinder	51.21 g

Calculate the mass of the 1 dm³ of gas in the measuring cylinder.

....

Mass = ... g

(1 mark)

2 (b) How could the results be made more precise?

....

....

(1 mark)

2 (c) The students used their results to calculate values for the relative formula mass (M_r) of this gas.
The results are shown in the table below.

Experiment	1	2	3	4
Relative formula mass (M_r)	45.4	51.5	46.3	45.8

2 (c) (i) Calculate the mean value for these results.

....

Mean = ...

(2 marks)

2 (c) (ii) The four results are different.
The students thought this was because of experimental error.

Suggest **two** causes of experimental error in this experiment.

....

....

....

....

(2 marks)

2 (c) (iii) It was important for the students to repeat the experiment.
Suggest why.

....

....

(1 mark)

2 (d) The teacher told the students that the formula of the gas is C_3H_8

Calculate the relative formula mass (M_r) of this gas. You should show your working.

Relative atomic masses: H = 1; C = 12.

....

....

Relative formula mass = ...

(2 marks)

9

Turn over ▶

3 (a) Calcium chloride is made from limestone. The limestone used contains mainly calcium carbonate and a small amount of magnesium carbonate.
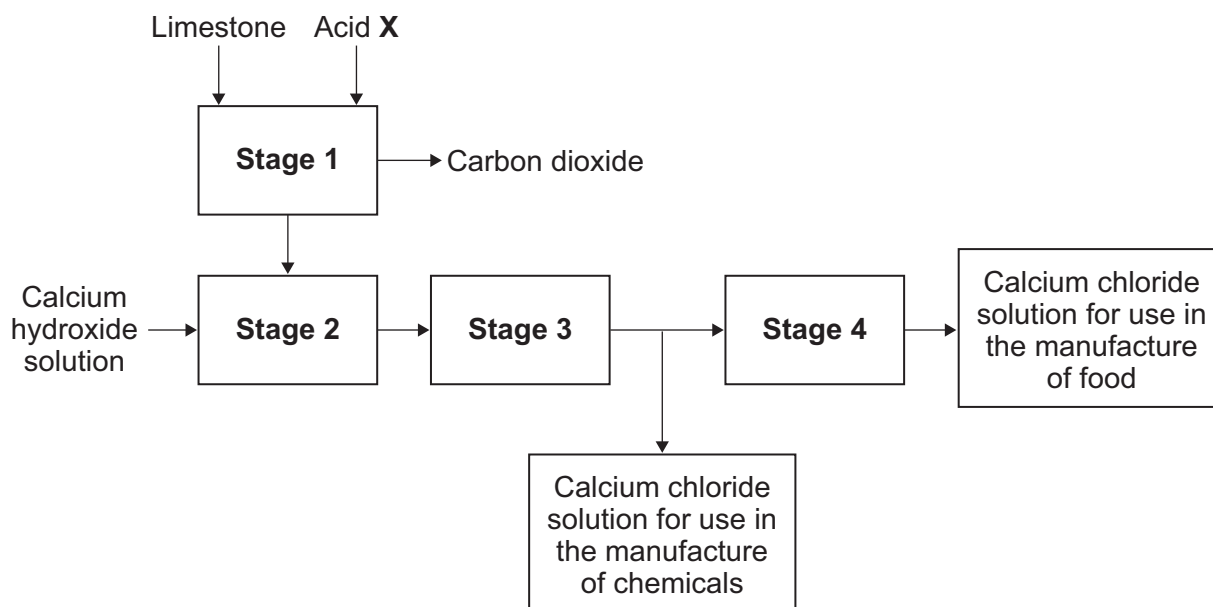
3 (a) (i) In **stage 1** calcium carbonate reacts with acid **X** to form calcium chloride.

Name acid **X**.

....

(1 mark)

3 (a) (ii) **Stage 1** produces a concentrated solution of calcium chloride.
The solution also contains magnesium chloride.

Calcium hydroxide solution is added to remove the magnesium chloride:

$$MgCl_2(aq) + Ca(OH)_2(aq) \rightarrow Mg(OH)_2(s) + CaCl_2(aq)$$
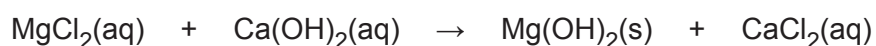
This is an example of a *precipitation* reaction.

What is the meaning of the term *precipitation* reaction?

....

....

(1 mark)

3 (a) (iii) The magnesium hydroxide can be separated from the calcium chloride solution.

State how.

....

....

(1 mark)

3 (a) (iv) Suggest why **stage 4** is needed.

....

....

(1 mark)

3 (a) (v) Name a method that can be used to change calcium chloride solution into solid calcium chloride.

....

(1 mark)

3 (b) Calcium chloride can also be made by reacting calcium with chlorine.

Calcium chloride is an ionic compound. It contains calcium ions (Ca^{2+}).

3 (b) (i) Complete the equation for the formation of calcium ions.

$$Ca \quad \rightarrow \quad Ca^{2+} \quad + \quad ....$$

(1 mark)

3 (b) (ii) Why can the formation of calcium ions from calcium atoms be described as oxidation?

....

....

(1 mark)

7

Turn over for the next question

Turn over ▶

4 Diamonds are used as abrasives.
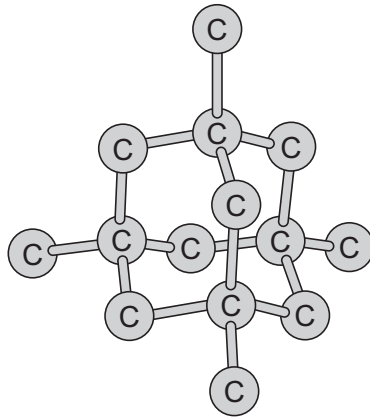
Model of part of the diamond structure

Diamonds are very hard.
Explain why.

A good answer will include information on the structure and bonding in diamonds.

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(3 marks)

3

5 Ammonia is made using the Haber process.

Nitrogen   Hydrogen

Pump

Unreacted
nitrogen and
hydrogen gases

Reactor contains iron.
Temperature is 450 °C.
Pressure is 200 atmospheres.

Ammonia, nitrogen and
hydrogen gases

Separator

Liquid ammonia
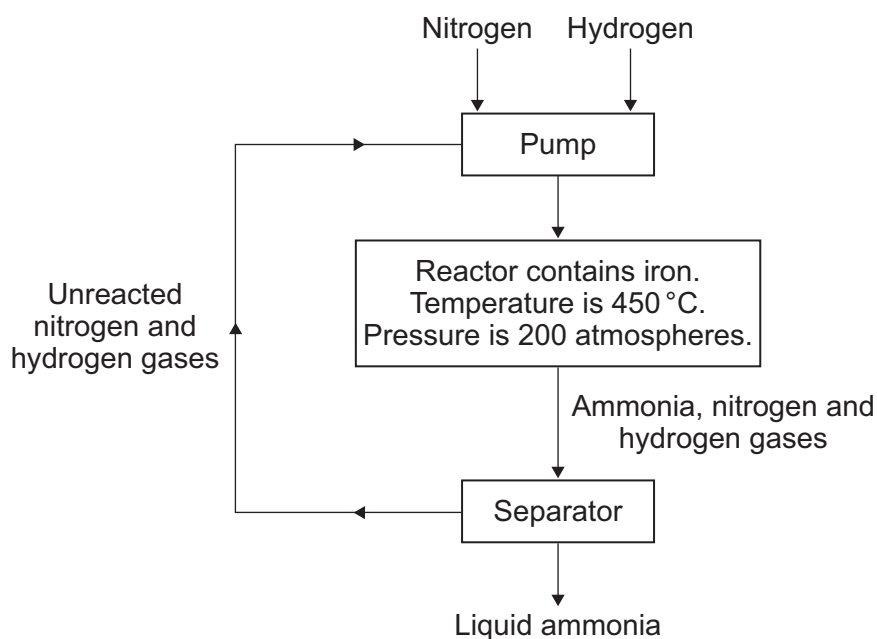
5 (a) How is ammonia separated from unreacted nitrogen and hydrogen in the separator?

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....

....

....
(2 marks)

5 (b) The equation shows the reaction which takes place in the reactor:

$$N_2(g) \quad + \quad 3H_2(g) \quad \rightleftharpoons \quad 2NH_3(g)$$
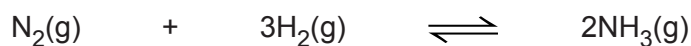
5 (b) (i) Why does the yield of ammonia at equilibrium increase as the temperature is decreased?

....

....
(1 mark)

Question 5 continues on the next page

Turn over ▶

5 (b) (ii) A temperature of 450 °C is used in the reactor to make the reaction take place quickly.

Explain, in terms of particles, why increasing the temperature makes a reaction go faster.

....

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(2 marks)

5 (b) (iii) Why does the yield of ammonia at equilibrium increase as the pressure is increased?

....

....

(1 mark)

5 (b) (iv) The pressure used in the reactor is 200 atmospheres.
Suggest why a much higher pressure is **not** used.

....

....

(1 mark)

5 (c) Use the equation for the reaction in the reactor to help you to answer these questions.

$$N_2(g) \quad + \quad 3H_2(g) \quad \rightleftharpoons \quad 2NH_3(g)$$
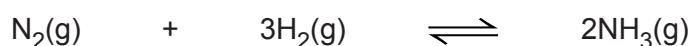
5 (c) (i) It is important to mix the correct amounts of hydrogen and nitrogen in the reactor.

$20 \, m^3$ of nitrogen is reacted with hydrogen.

What volume of hydrogen (measured at the same temperature and pressure as the nitrogen) is needed to have the correct number of molecules to react with the nitrogen?

Volume of hydrogen needed = ... m^3

(1 mark)

5 (c) (ii) Calculate the maximum mass of ammonia that can be made from 2 g of nitrogen.

Relative atomic masses: H = 1; N = 14.

....

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Maximum mass of ammonia = ... g

(3 marks)

5 (d) The expected maximum mass of ammonia produced by the Haber process can be calculated.

5 (d) (i) In one process, the maximum mass of ammonia should be 80 kg.

The actual mass of ammonia obtained was 12 kg.

Calculate the percentage yield of ammonia in this process.

....

....

Percentage yield of ammonia = ... %

(1 mark)

5 (d) (ii) Give **two** reasons why it does **not** matter that the percentage yield of ammonia is low. Use the flow diagram at the start of this question to help you.

....

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....

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(2 marks)

14

Turn over for the next question

Turn over ▶

6 High quality connectors are used to connect a satellite box to a television.
The connectors should conduct electricity very well and should not corrode.

Scart lead

Gold plated
connectors

The connectors on this scart lead are coated with gold.

6 (a) Gold is a typical metal.

6 (a) (i) Describe the structure and bonding of gold.

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(3 marks)

6 (a) (ii) Why is gold a good conductor of electricity?

....

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(1 mark)

6 (b) The surface of some metals, such as iron, corrode when exposed to the air.

Suggest why this reduces the electrical conductivity of the metal.

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(2 marks)

6

END OF QUESTIONS

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