

Friday 15 June 2012 – Afternoon

**GCSE GATEWAY SCIENCE
CHEMISTRY B**

B642/02 Unit 2 Modules C4 C5 C6 (Higher Tier)

Candidates answer on the Question Paper.
A calculator may be used for this paper.

OCR supplied materials:
None

Other materials required:

- Pencil
- Ruler (cm/mm)

Duration: 1 hour



Candidate
forename

Candidate
surname

Centre number

Candidate number

MODIFIED LANGUAGE

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is **60**.
- The Periodic Table is printed on the back page.
- This document consists of **28** pages. Any blank pages are indicated.

Answer **all** the questions.

Section A – Module C4

- 1 This question is about fertilisers.

The picture shows a farmer spreading fertiliser on a field.



- (a) Fertilisers help crops to grow bigger and faster.

This increases crop yield.

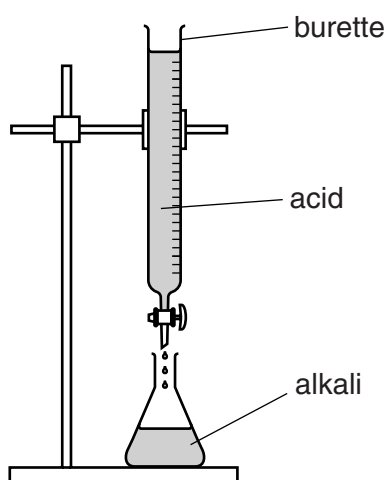
Explain how the use of fertilisers increases crop yield.

.....
.....
..... [2]

- (b) Fertilisers can be made by neutralisation.

Jenny makes some ammonium sulfate.

Look at the diagram. It shows the apparatus she uses.



- (i) Write down the names of the **acid** and **alkali** she uses to make ammonium sulfate.

..... and [1]

- (ii) Jenny adds the acid to the alkali in the flask.

The pH number of the solution decreases.

Explain why.

.....
 [1]

- (c) The formula of ammonium sulfate is $(\text{NH}_4)_2\text{SO}_4$.

Calculate the relative formula mass, M_r , of ammonium sulfate.

Use this to calculate the percentage by **mass** of **nitrogen** in the fertiliser, ammonium sulfate.
 Relative atomic mass, A_r :

N = 14, H = 1, S = 32, O = 16.

.....

relative formula mass, M_r =

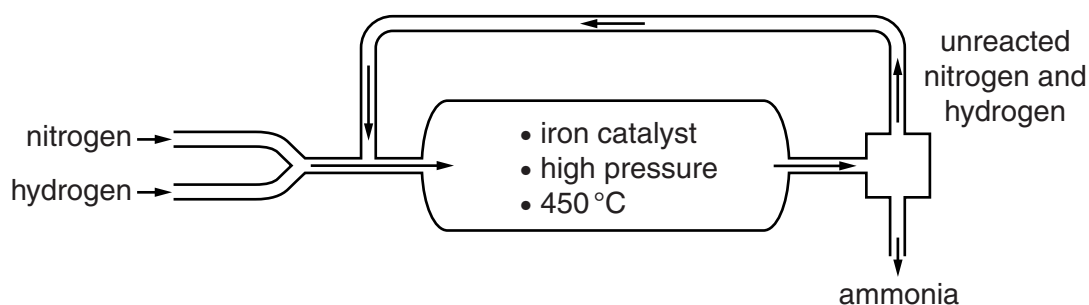
.....

percentage by mass =% [2]

[Total: 6]

2 This question is about ammonia.

The diagram shows how ammonia is made by the Haber process.



(a) Some of the nitrogen and hydrogen does not react.

What happens to the unreacted nitrogen and hydrogen?

..... [1]

(b) The table shows the percentage yield of ammonia made at different temperatures and pressures.

pressure in atmospheres	percentage yield of ammonia at 350 °C	percentage yield of ammonia at 450 °C	percentage yield of ammonia at 550 °C
100	16	12	6
200	30	22	12
300	40	28	16
400	50	36	20
500	56	42	24

(i) How does **increasing** the **temperature** change the percentage yield?

.....
 [1]

(ii) Write down the conditions that give the **greatest** yield of ammonia.

pressure atmospheres

temperature °C

[1]

(c) It is important that the Haber process has

- a high rate of reaction
- as high a percentage yield as possible
- costs that are kept to a minimum.

(i) Describe how the iron **catalyst** reduces costs.

.....
..... [1]

(ii) Describe how **automation** reduces costs.

.....
..... [1]

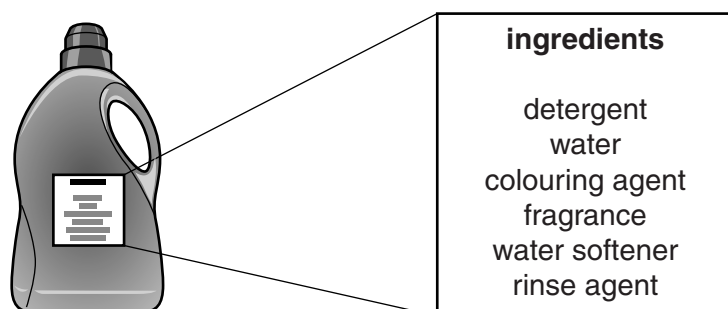
(iii) Explain why a **high pressure** is used in the Haber process.

.....
..... [1]

[Total: 6]

3 This question is about cleaning materials.

(a) The picture shows a bottle of washing up liquid used to wash plates.



The main cleaning agent is a detergent.

Look at the diagram. It shows a detergent molecule.



Detergent molecules help to remove oil and grease from plates.

Explain how.

You may draw a labelled diagram.

.....

.....

..... [2]

- (b) Jamie's shirt needs washing.

He uses a washing powder that works at a low temperature of 30°C.

One advantage of washing clothes at low temperatures is that it is cheaper.

Write down **two other** advantages of washing clothes at low temperatures.

.....

.....

..... [2]

- (c) Jamie needs to clean his suit.

He reads the clothes label. It says 'dry clean only'.

What does **dry cleaning** mean?

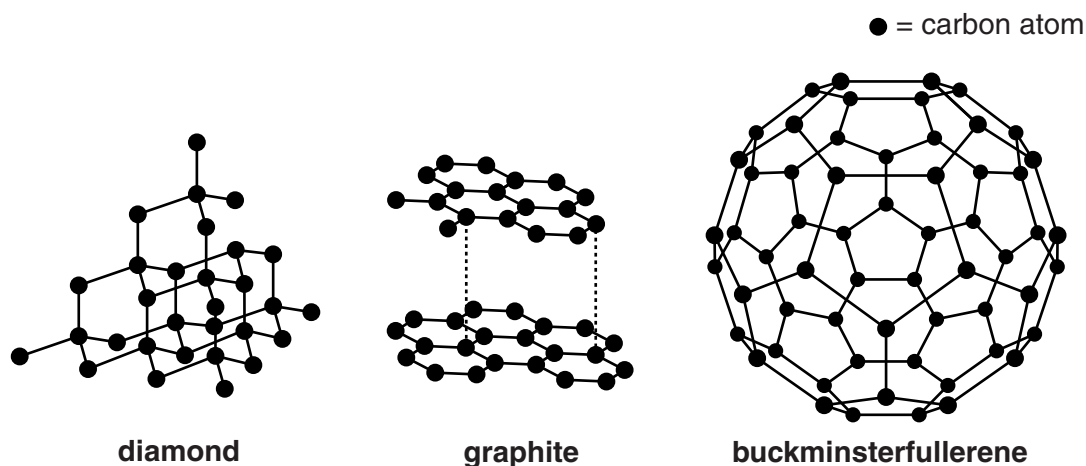
..... [1]

[Total: 5]

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- 4 Diamond, graphite and buckminsterfullerene are three forms of carbon.



- (a) What is the formula of buckminsterfullerene?

Choose from this list.

C_{20}

C_{40}

C_{60}

C_{80}

answer

[1]

- (b) Graphite is used as an electrode because it **conducts electricity**.

Explain how graphite conducts electricity.

Use the diagram of the structure of graphite to help you.

.....
 [1]

- (c) Buckminsterfullerene can be made into nanotubes.

Nanotubes are used as catalysts.

Explain how nanotubes can be used as catalysts.

.....

 [1]

[Total: 3]

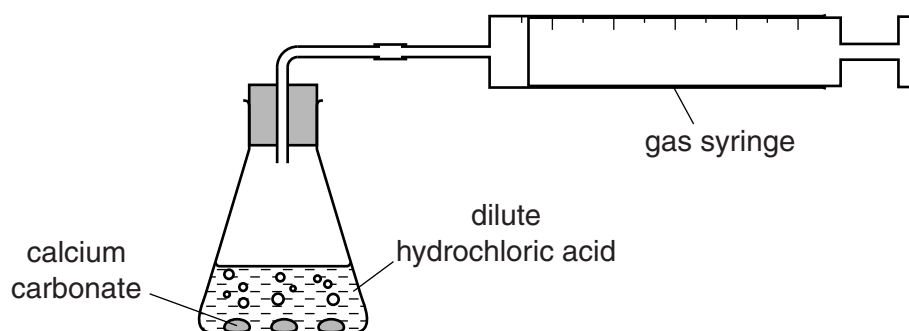
Section B – Module C5

- 5 Sophie investigates the reaction between calcium carbonate and hydrochloric acid.

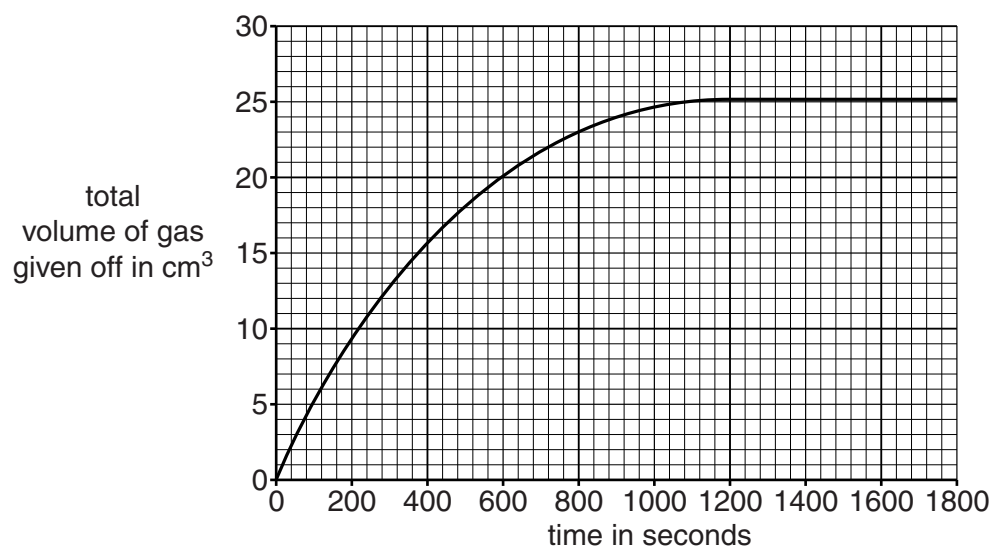
Carbon dioxide is made.

The diagram shows the apparatus Sophie uses.

Every 200 seconds she measures the total volume of carbon dioxide in the gas syringe.



Look at the graph of Sophie's results.



- (a) How long does it take to make **12 cm³** of gas?

answer seconds

[1]

- (b) Sophie does the reaction at room temperature and pressure.

The total volume of carbon dioxide gas made after 500 seconds is 18 cm^3 .

Calculate the total **number of moles** of carbon dioxide in 18 cm^3 of gas.

One mole of carbon dioxide gas occupies a volume of 24 dm^3 ($24\,000\text{ cm}^3$) at room temperature and pressure.

.....
.....

answer moles [1]

- (c) Hydrochloric acid is the **limiting reactant**.

What does **limiting reactant** mean?

.....
..... [1]

- (d) Sophie repeats her experiment using a **weak** acid, ethanoic acid.

She uses the same volume and concentration of ethanoic acid as hydrochloric acid.

The reaction is much slower with ethanoic acid.

Explain why.

Use ideas about particles.

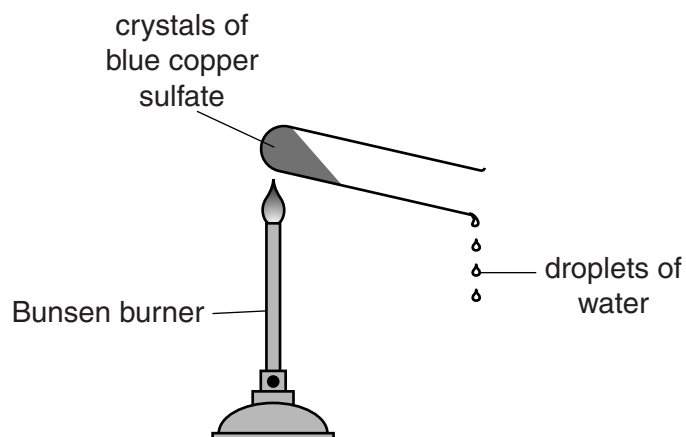
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.....
.....
..... [3]

[Total: 6]

- 6 Coleen heats blue copper sulfate in a test tube.

Water and a white solid are made.

Look at the apparatus Coleen uses.



At the end of the experiment Coleen finds out how much white solid she has made.

Look at her table of results.

substance	mass in grams
mass of blue copper sulfate at the start	1.25
mass of white solid made	0.80
mass of water made	0.45

- (a) Coleen repeats the experiment.

This time she heats **2.50 g** of blue copper sulfate instead of **1.25 g**.

Predict how much white solid she should make.

.....

.....

mass of white solid = g

[1]

- (b) Calculate the number of **moles** of water in **0.45 g** of water, H_2O .

The relative atomic mass of H = 1 and of oxygen = 16.

.....
..... [1]

- (c) The relative atomic mass of oxygen is 16.

Complete the sentence about relative atomic mass.

Choose from this list.

carbon-12

carbon-14

hydrogen-1

nitrogen-14

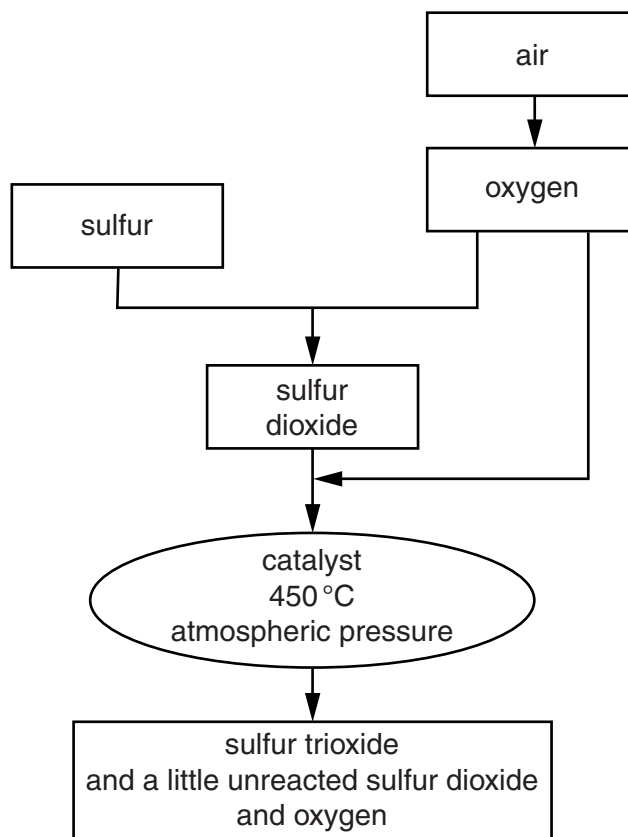
oxygen-16

The relative atomic mass of oxygen is the average mass of an atom of oxygen compared to the mass of 1/12th of an atom of [1]

[Total: 3]

7 Sulfuric acid is made in the Contact Process.

Look at the diagram. It shows part of the Contact Process.



- (a) Sulfur dioxide, SO_2 , reacts with oxygen, O_2 , to make sulfur trioxide, SO_3 .

Write the **balanced symbol** equation for this reaction.

..... [2]

- (b) The reaction between sulfur dioxide and oxygen to make sulfur trioxide is a **reversible** reaction.

In this reversible reaction what is the effect of the catalyst on the **position of equilibrium**?

.....
 [1]

- (c) In this reaction an **optimum temperature** of 450°C is used.

Look at the following statements.

One of the statements explains why this temperature is used.

Put a tick (✓) next to the correct statement.

A lower temperature decreases yield and decreases rate of reaction.

☐

A lower temperature increases yield but decreases rate of reaction.

☐

A higher temperature increases yield and increases rate of reaction.

☐

A higher temperature decreases yield and decreases rate of reaction.

☐

A higher temperature increases yield but decreases rate of reaction.

☐

[1]

[Total: 4]

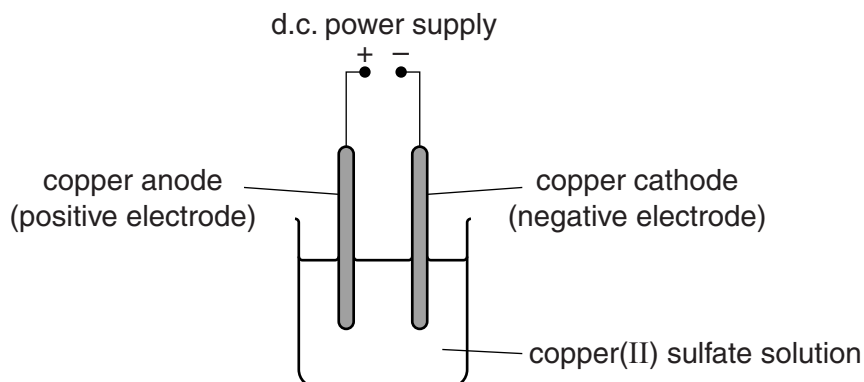
8 This question is about electrolysis.

(a) Jean electrolyses copper(II) sulfate solution.

She does three experiments.

Look at the diagram.

It shows the apparatus Jean uses.



After each experiment she records the mass of copper deposited at the cathode.

She uses a different time or a different current for each experiment.

The table shows her results.

experiment number	current used in amps	time taken in minutes	mass of copper deposited at the cathode in grams
1	0.15	40	0.12
2	0.30	40	0.24
3	0.15	80	0.24

(i) In experiment 1 the mass of the anode before electrolysis is **2.20 g**.

Predict the mass of the **anode** at the end of the electrolysis.

Use information from the table.

Choose your answer from this list.

0.12 g 2.08 g 2.20 g 2.32 g

answer

[1]

- (ii) The quantity of electric charge, Q , transferred in each experiment is calculated using the equation

$$Q = I \times t$$

- I is the current in amps.
- t is the time in seconds.
- Q is the quantity of charge in coulombs.

Calculate the quantity of **charge** needed to increase the mass of the cathode by **0.48 g**.

.....

.....

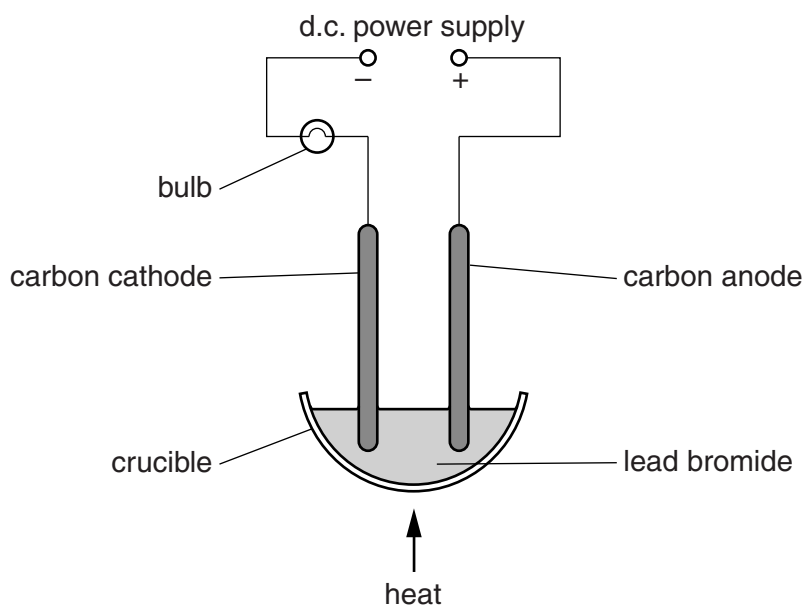
.....

charge = coulombs [2]

- (b) Jean watches her teacher electrolyse lead bromide.

Lead bromide is an ionic compound.

Look at the diagram. It shows the equipment her teacher uses.



The bulb does not light until the lead bromide melts.

- (i) Explain why **solid** lead bromide does not conduct electricity.

Use ideas about particles.

.....

 [2]

- (ii) At the positive electrode bromide ions, Br^- , lose electrons to make bromine molecules.

Look at the equation. It is not balanced.

In this equation e^- represents an electron.

Complete the equation.



[2]

[Total: 7]

Section C – Module C6

- 9 This question is about rusting.

One disadvantage of making ships from iron is that iron rusts.



- (a) Oxygen and water are needed for iron to rust.

Hydrated iron(III) oxide is made.

Write a **word equation** for the rusting of iron.

..... [1]

- (b) Iron can be painted to stop it from rusting.

Explain **how** painting stops iron from rusting.

.....
..... [1]

- (c) The rusting of iron is an example of a **redox** reaction.

What is meant by a redox reaction?

.....
..... [1]

[Total: 3]

10 This question is about fuel cells.

This new car uses hydrogen fuel cells.

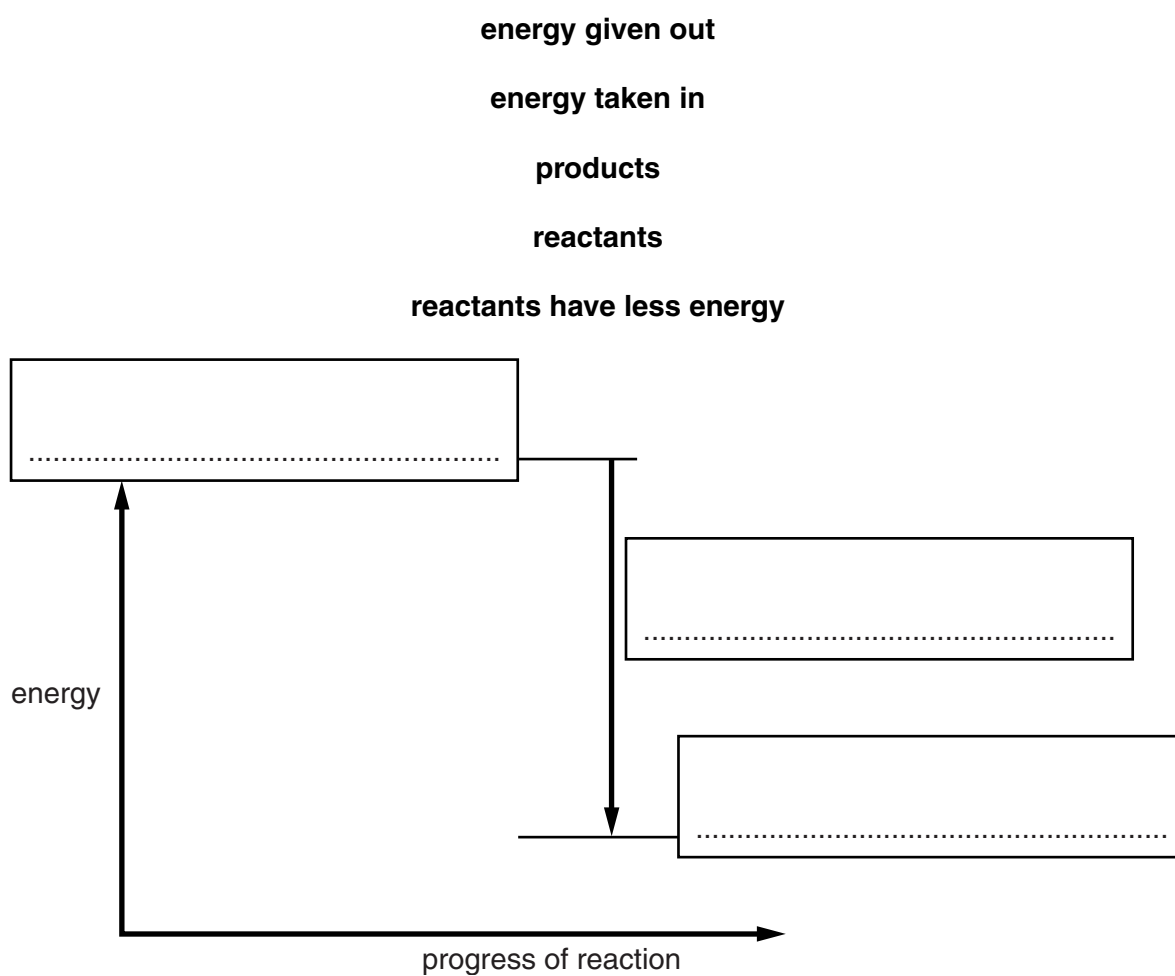


(a) Fuel cells use hydrogen and oxygen to make water.

Look at the energy level diagram for the reaction between hydrogen and oxygen.

Complete the labels on the diagram.

Choose from this list.



[2]

(b) Hydrogen gas, H_2 , reacts at one electrode in a fuel cell.

The reaction makes hydrogen ions, H^+ , and electrons.

Write a **balanced symbol** equation for this reaction. Use e^- to show an electron.

..... [2]

(c) Fuel cells are also used in spacecraft because

- there is no pollution
- they are low cost.

Write about **two other** advantages of using fuel cells in manned spacecraft.

.....
.....
.....
.....
..... [2]

[Total: 6]

11 Fred lives in a hard water area.

There are two types of hardness in water

- temporary hardness
- permanent hardness.

(a) The water where Fred lives contains **temporary** hardness.

Which substance present in the water causes the temporary hardness?

Choose from this list.

calcium carbonate

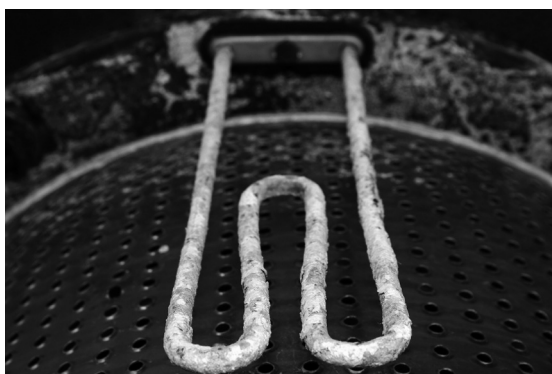
calcium hydrogencarbonate

calcium sulfate

sodium carbonate

answer [1]

(b) The heater element in Fred's washing machine is covered in limescale.



Fred uses a **weak** acid to remove the limescale.

Suggest why Fred does not use a **strong** acid to remove the limescale.

.....
..... [1]

- (c) Fred uses an ion-exchange resin to soften the water.

Explain how the ion-exchange resin softens the water.

.....

.....

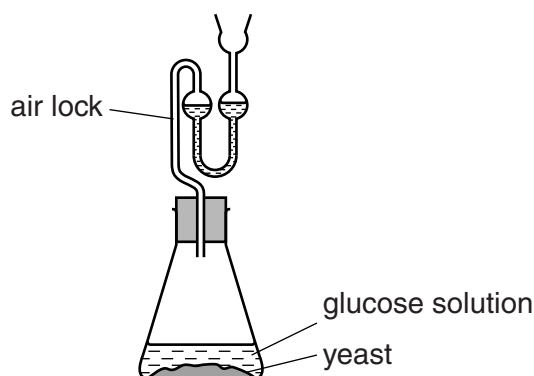
.....

..... [2]

[Total: 4]

12 Ann-Marie and David investigate fermentation.

Look at the diagram. It shows the apparatus they use.



Ethanol (alcohol) is made when glucose ferments.

(a) The ethanol made by fermentation is dilute.

What process can they use to obtain the ethanol?

Choose from this list.

dehydration

displacement

distillation

saponification

answer [1]

(b) Ethanol can also be made by hydration of ethene.



Write about the **advantages** and **disadvantages** of making ethanol by

- fermentation
- hydration of ethene.

.....

.....

.....

.....

.....

..... [3]

13 Sodium chloride (salt) is an important raw material in the chemical industry.

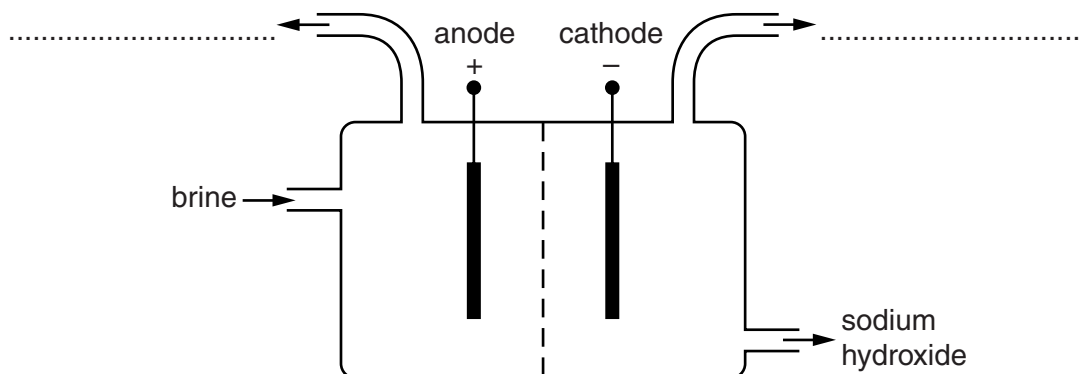
Salt is mined in Northwich, in Cheshire.

(a) What problem can mining for salt cause?

..... [1]

(b) Look at the diagram.

It shows the apparatus used for the electrolysis of sodium chloride solution (brine).



Complete the diagram to show the names of the gases made at the anode and cathode. [2]

[Total: 3]

END OF QUESTION PAPER

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*The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.