

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					

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.

2

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.

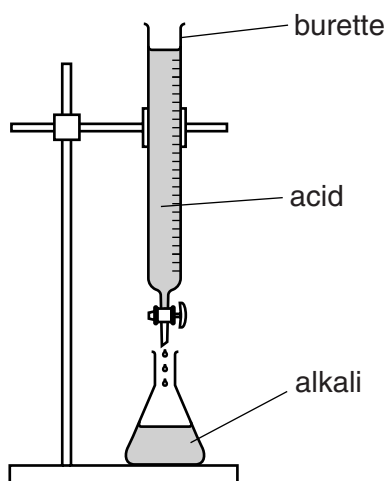
Explain how the use of fertilisers increases crop yield.

.....
.....
..... [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]

3

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

The pH number of the solution in the flask 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 =

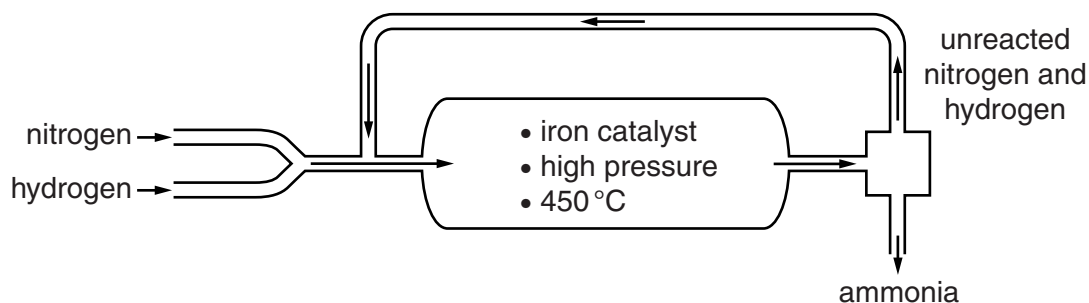
.....

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]

5

(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.

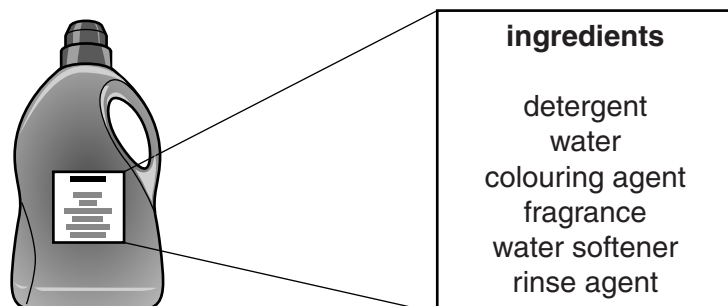
.....
..... [1]

[Total: 6]

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.

A labelled diagram may help you.

.....

.....

..... [2]

(b) Jamie's shirt needs washing.

He uses a washing powder designed to wash 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 is meant by **dry cleaning**?

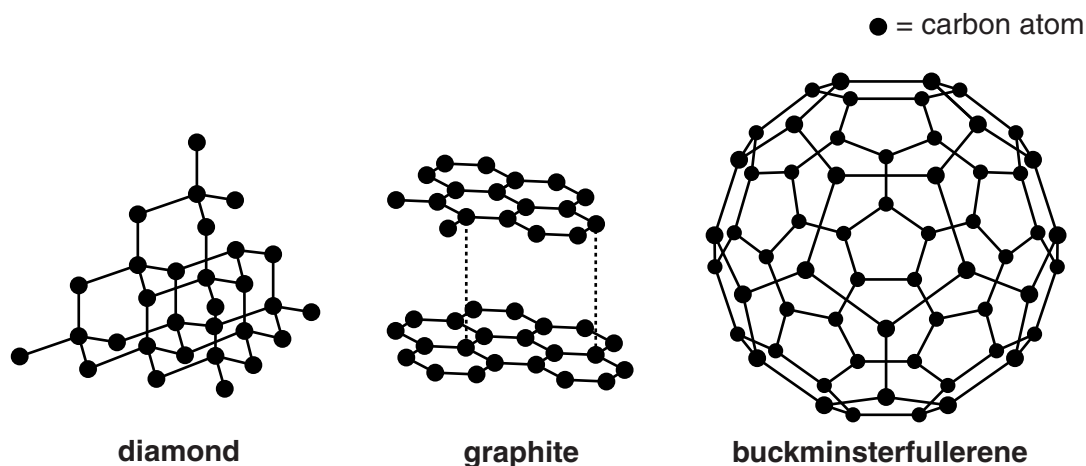
..... [1]

[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]

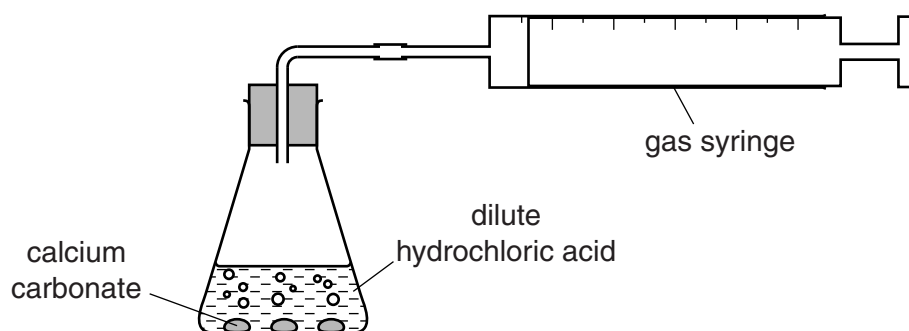
Section B – Module C5

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

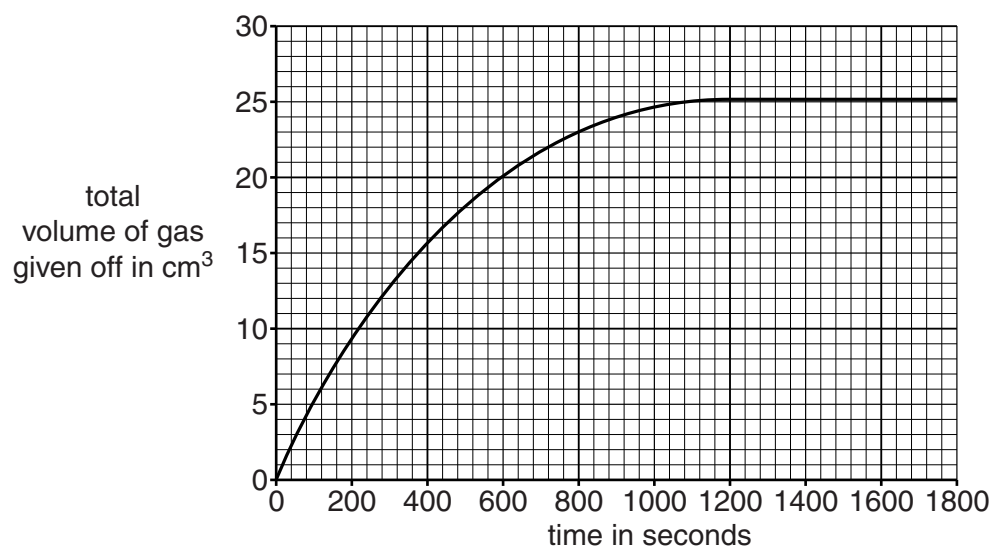
Carbon dioxide is made.

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 is meant by limiting reactant?

.....

..... [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.

She finds that the reaction is much slower with ethanoic acid.

Explain why.

Use ideas about particles.

.....

.....

.....

..... [3]

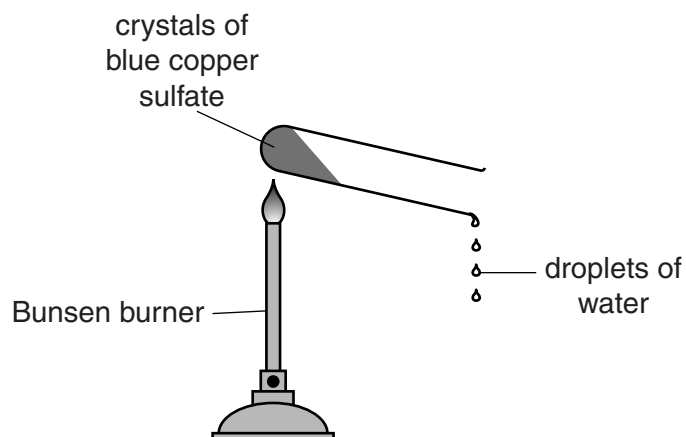
[Total: 6]

12

- 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]

13

- (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

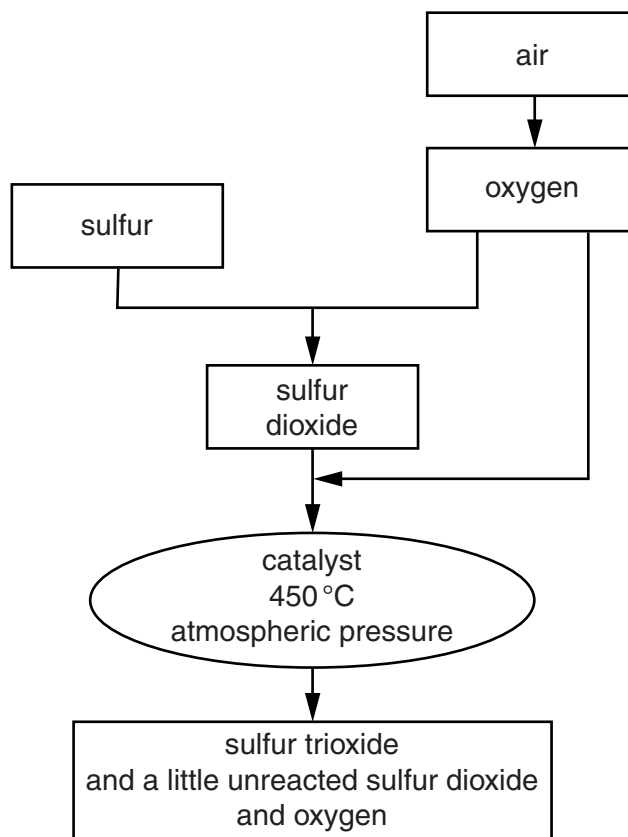
oxygen-16

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.

What is the effect of the catalyst on the **position of equilibrium** in this reversible reaction?

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

15

(c) An **optimum temperature** of 450 °C is used in this reaction.

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]

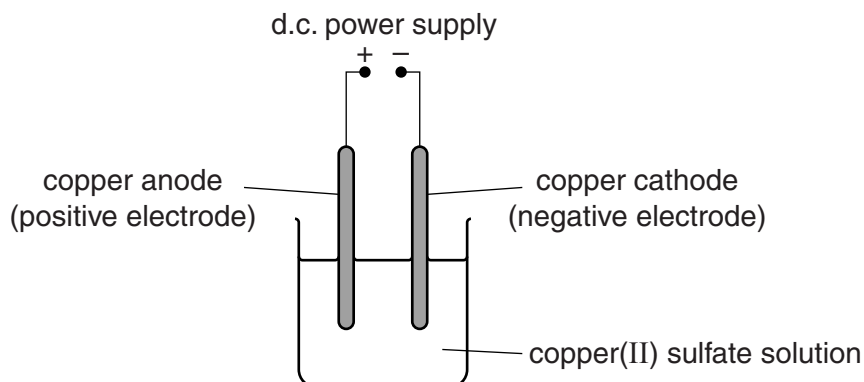
8 This question is about electrolysis.

(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]

17

- (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**.

.....

.....

.....

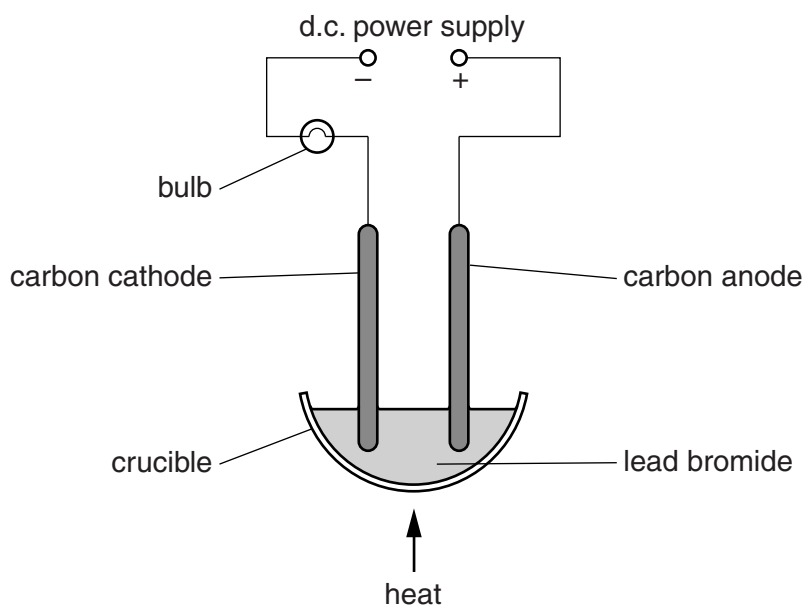
charge = coulombs [2]

18

(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.

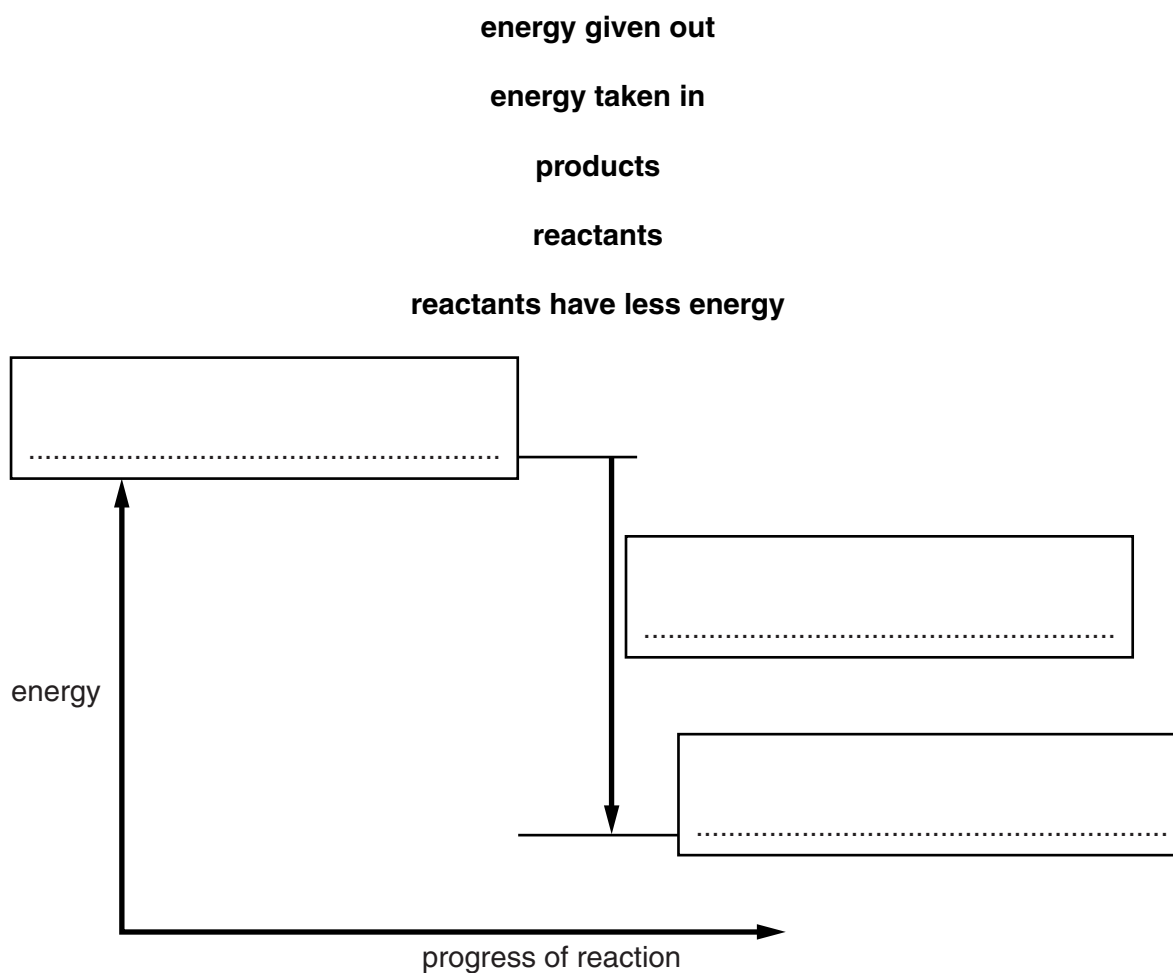


(a) Fuel cells use hydrogen and oxygen to make water.

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

Complete the labels on the diagram.

Choose from this list.



[2]

21

(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

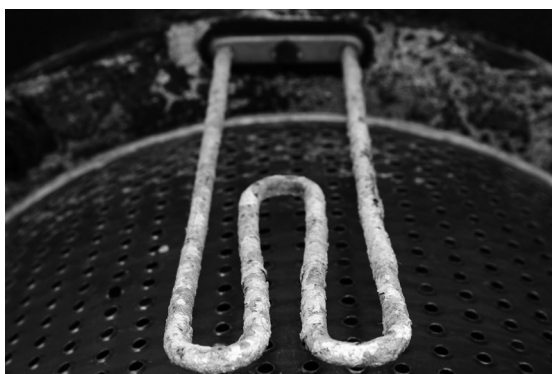
calcium hydrogencarbonate

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]

23

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

Explain how the ion-exchange resin softens the water.

.....

.....

.....

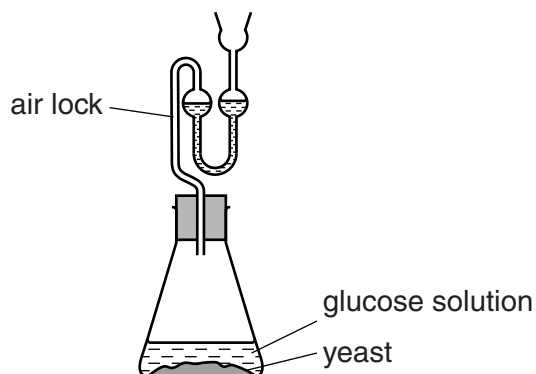
..... [2]

[Total: 4]

24

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]

[Total: 4]

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

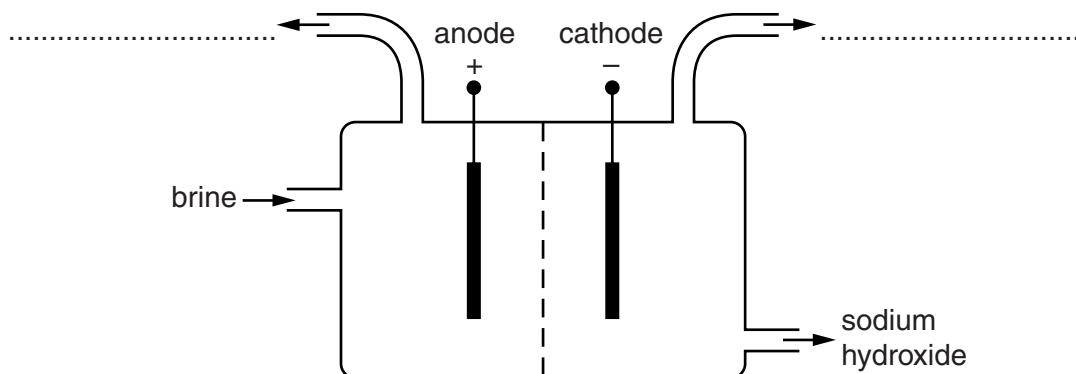
Salt is mined in Northwich, in Cheshire.

(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 Periodic Table of the Elements

28

1	2	Key										3	4	5	6	7	0
1 H hydrogen 1		relative atomic mass atomic symbol name atomic (proton) number															
7 Li lithium 3	9 Be beryllium 4											11 B boron 5	12 C carbon 6	14 N nitrogen 7	16 O oxygen 8	19 F fluorine 9	20 Ne neon 10
23 Na sodium 11	24 Mg magnesium 12											27 Al aluminium 13	28 Si silicon 14	31 P phosphorus 15	32 S sulfur 16	35.5 Cl chlorine 17	40 Ar argon 18
39 K potassium 19	40 Ca calcium 20	45 Sc scandium 21	48 Ti titanium 22	51 V vanadium 23	52 Cr chromium 24	55 Mn manganese 25	56 Fe iron 26	59 Co cobalt 27	59 Ni nickel 28	63.5 Cu copper 29	65 Zn zinc 30	70 Ga gallium 31	73 Ge germanium 32	75 As arsenic 33	79 Se selenium 34	80 Br bromine 35	84 Kr krypton 36
85 Rb rubidium 37	88 Sr strontium 38	89 Y yttrium 39	91 Zr zirconium 40	93 Nb niobium 41	96 Mo molybdenum 42	[98] Tc technetium 43	101 Ru ruthenium 44	103 Rh rhodium 45	106 Pd palladium 46	108 Ag silver 47	112 Cd cadmium 48	115 In indium 49	119 Sn tin 50	122 Sb antimony 51	128 Te tellurium 52	127 I iodine 53	131 Xe xenon 54
133 Cs caesium 55	137 Ba barium 56	139 La* lanthanum 57	178 Hf hafnium 72	181 Ta tantalum 73	184 W tungsten 74	186 Re rhenium 75	190 Os osmium 76	192 Ir iridium 77	195 Pt platinum 78	197 Au gold 79	201 Hg mercury 80	204 Tl thallium 81	207 Pb lead 82	209 Bi bismuth 83	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86
[223] Fr francium 87	[226] Ra radium 88	[227] Ac* actinium 89	[261] Rf rutherfordium 104	[262] Db dubnium 105	[266] Sg seaborgium 106	[264] Bh bohrium 107	[277] Hs hassium 108	[268] Mt meitnerium 109	[271] Ds darmstadtium 110	[272] Rg roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

28

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

* 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.