

**GENERAL CERTIFICATE OF SECONDARY EDUCATION
TWENTY FIRST CENTURY SCIENCE
ADDITIONAL APPLIED SCIENCE A**

A335/02

Harnessing Chemicals
(Higher Tier)

**Thursday 15 January 2009
Afternoon**

Duration: 45 minutes

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)



Candidate Forename		Candidate Surname	
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Centre Number						Candidate Number				
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INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

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 **36**.
- This document consists of **12** pages. Any blank pages are indicated.

FOR EXAMINER'S USE		
Qu.	Max.	Mark
1	11	
2	4	
3	4	
4	8	
5	9	
TOTAL	36	

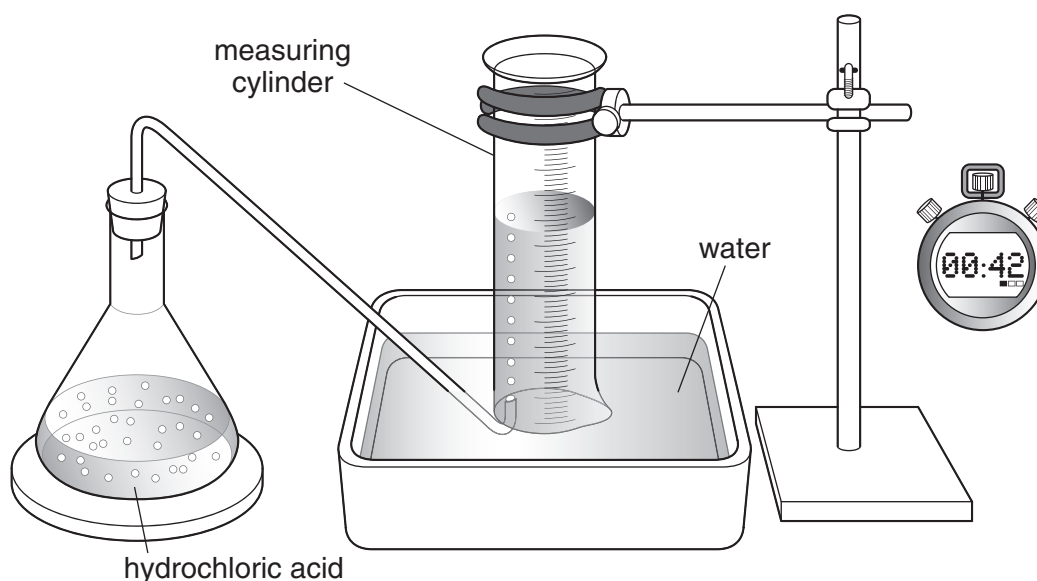
Answer **all** the questions.

- 1 Yemi follows a standard procedure to find the rate of reaction between marble chips and hydrochloric acid.
Marble is calcium carbonate.

step 1 Add approximately 50 cm³ of hydrochloric acid to a conical flask.

step 2 Weigh out approximately 3 g of medium-sized marble chips.

step 3 Set up the apparatus as shown in the diagram.



step 4 Transfer the marble chips to the conical flask. Start the stopwatch and quickly replace the bung and delivery tube.

step 5 Record the volume of gas collected in the measuring cylinder every minute until the reaction stops.

- (a) Calcium chloride, water and carbon dioxide are produced when hydrochloric acid reacts with calcium carbonate.

Finish the equation for this reaction.



[2]

(b) Why is it important that the bung is replaced quickly once the marble chips have been added to the conical flask?

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

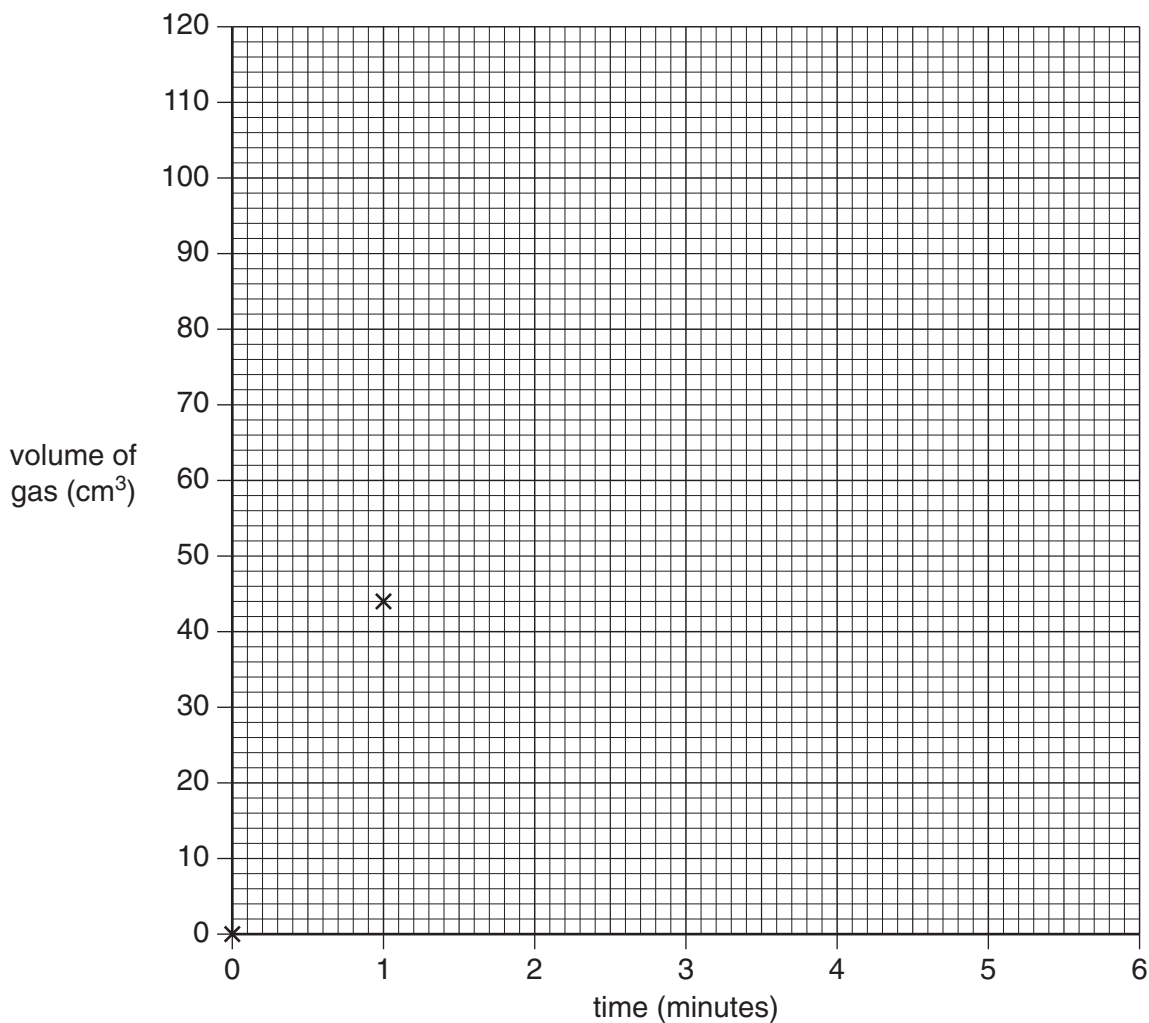
(c) How will Yemi know when the reaction has stopped?

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

(d) The results that Yemi collected from this experiment are shown in the table below.

time (minutes)	0	1	2	3	4	5	6
volume of gas (cm ³)	0	44	70	87	98	102	102

(i) Plot these results on this grid. The first two have been done for you.



[2]

(ii) Finish the graph by drawing the line or curve of best fit through the points.

[1]

(iii) State what happens to the **rate** of the reaction as the time increases.

Explain why this happens in terms of particles.

what happens

explanation

.....[2]

5

- (iv) The experiment was repeated using 3 g of **powdered** calcium carbonate with the same volume of acid, at the same temperature.

On your graph draw the line or curve that you would expect for this reaction.

Label this **B**.

[2]

[Total: 11]

- 2 Some people avoid food containing sugar.
They choose food containing artificial sweeteners.

The table below compares two artificial sweeteners.

	Saccharin	Sucralose
formula	$C_7H_5NO_3S$	$C_{12}H_{19}O_8Cl_3$
raw materials needed to make the sweetener	coal or crude oil	sugar cane
how many times sweeter than sugar	300	600
energy in kCal	none	none

- (a) Saccharin has been in use for over 100 years.
Sucralose was discovered in 1976.

Use the table to suggest why Sucralose is a good alternative to Saccharin.

.....

 [2]

- (b) Sucralose has only been in use since 1998.

Suggest why it was not permitted for use in food until several years later.

.....
 [1]

- (c) What type of chemicals are artificial sweeteners?

Put a **ring** around the correct answer below.

batch

bulk

fine

small

[1]

[Total: 4]

- 3 Bryony finds out about some important chemicals used in industry. She summarises her findings in the table below.

chemical name	chemical formula
ammonia	NH_3
ethanoic acid	CH_3COOH
ethanol	$\text{C}_2\text{H}_5\text{OH}$
nitric acid	HNO_3
calcium carbonate	CaCO_3

Choose chemicals from the table to answer the following questions.

Each chemical may be used once, more than once, or not at all.

- (a) Which chemical is an **alcohol**?

.....[1]

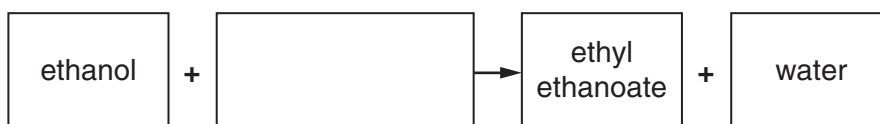
- (b) What is the relative formula mass of calcium carbonate?

(relative atomic masses: C = 12, Ca = 40, O = 16)

You are advised to show how you work out your answer.

answer [2]

- (c) Complete the word equation for the formation of the **ester**, ethyl ethanoate.

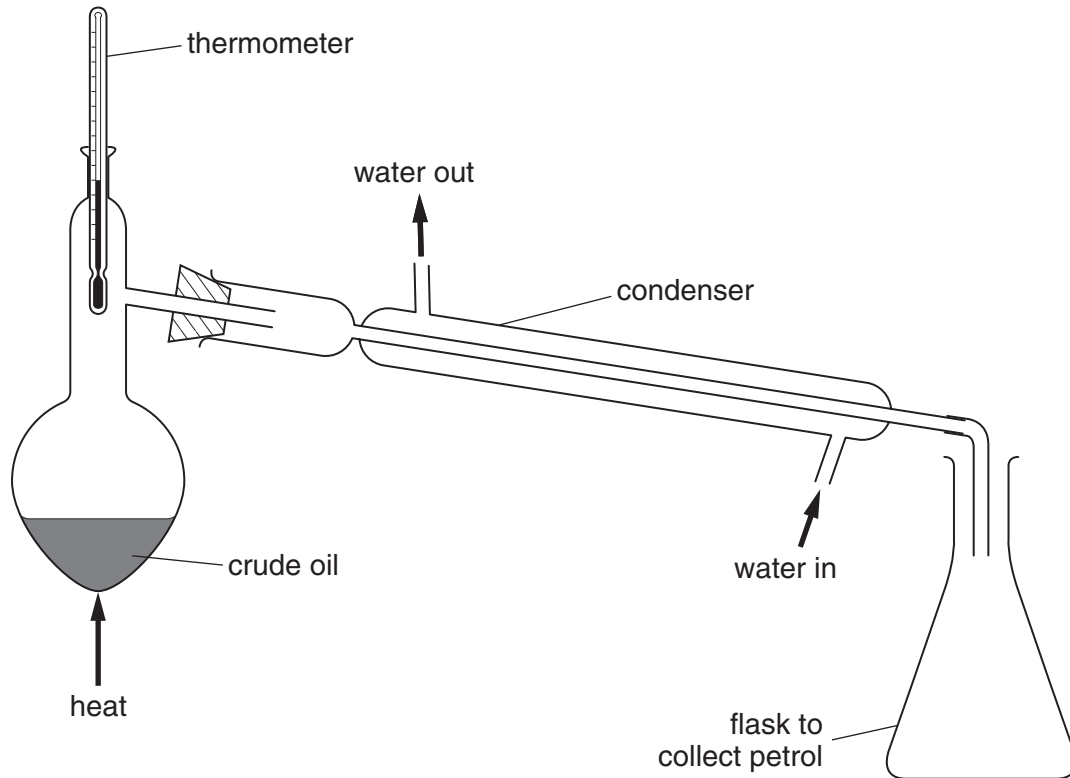


[1]

[Total: 4]

- 4 Crude oil is a mixture of different hydrocarbons. Petrol can be separated from this mixture using the process of distillation.

(a) In the laboratory a **batch** process is used. The mixture is heated and the petrol collected at a temperature of 40 – 100°C.



(i) What is meant by a **batch** process?

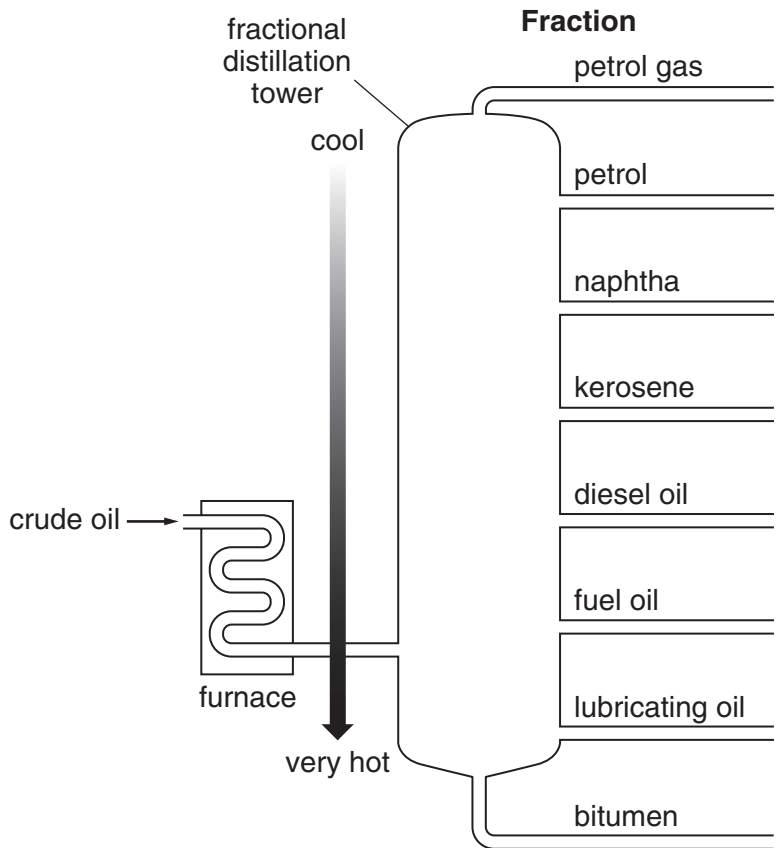
.....
[1]

(ii) Explain how this process of distillation works to separate petrol from crude oil.

.....

[3]

- (b) In an oil refinery the distillation process has to be **scaled up**.
 A fractional distillation tower is used to separate the crude oil into its different components.



One advantage of this process is that several other useful chemicals can be separated at the same time.

Give **two other advantages** of distilling crude oil in this way.

.....

 [2]

- (c) The Health and Safety Executive has set up regulations which aim to protect people at work.

(i) Suggest a **precaution** that workers at the oil refinery should take to keep themselves safe.
 [1]

(ii) Suggest a **precaution** that workers at the oil refinery should take that also keeps others safe.
 [1]

[Total: 8]

- 5 Natural mineral water is formed when water filters through rocks. The label below shows the minerals present in one type of sparkling mineral water.

<p>Ingredients Natural Mineral Water, Carbon dioxide</p> <hr/> <p>Typical Mineral Analysis</p> <table style="width: 100%;"> <thead> <tr> <th></th> <th style="text-align: right;">mg/litre</th> </tr> </thead> <tbody> <tr> <td>Calcium</td> <td style="text-align: right;">55</td> </tr> <tr> <td>Magnesium</td> <td style="text-align: right;">4</td> </tr> <tr> <td>Sodium</td> <td style="text-align: right;">30</td> </tr> <tr> <td>Potassium</td> <td style="text-align: right;">8</td> </tr> <tr> <td>Chloride</td> <td style="text-align: right;">19</td> </tr> <tr> <td>Fluoride</td> <td style="text-align: right;">0</td> </tr> <tr> <td>Nitrate</td> <td style="text-align: right;">0</td> </tr> <tr> <td>Sulfate</td> <td style="text-align: right;">46</td> </tr> <tr> <td>Dry residue</td> <td style="text-align: right;">162</td> </tr> <tr> <td>pH (at source)</td> <td style="text-align: right;">8</td> </tr> </tbody> </table>		mg/litre	Calcium	55	Magnesium	4	Sodium	30	Potassium	8	Chloride	19	Fluoride	0	Nitrate	0	Sulfate	46	Dry residue	162	pH (at source)	8	
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- (a) Mineral water is an example of a solution.

What is meant by a **solution**? You should refer to the terms solvent and solute in your answer.

.....

.....

.....[2]

- (b) Mineral water contains elements which combine to make different salts.

Using the information from the label, give the formula of **one** possible **salt** that the mineral water contains.

Put a tick (✓) in the box next to the **correct** answer.

$\text{Ca}(\text{NO}_3)_2$	
MgF_2	
KCl	
NaNO_3	

[1]

- (c) At its source the water has a pH of 8. Adding carbon dioxide to make the water sparkling lowers the pH.

Suggest why.

.....

.....[1]

(d) Edward buys a 250 ml bottle of the sparkling mineral water.

- (i) Use the label to find out how much **sodium** the water in this bottle contains. You are advised to show how you work out your answer.

sodium =mg [2]

- (ii) Edward wants to check if the label is correct. He adds silver nitrate to his mineral water to find out how much chloride it actually contains.

The table below shows the solubility of some salts.

soluble	insoluble
all nitrates	
most chlorides	silver chloride lead chloride
most sulfates	barium sulfate lead sulfate calcium sulfate
sodium carbonate potassium carbonate	most carbonates

Which salt forms as a precipitate when he adds the silver nitrate to the mineral water?

.....[1]

- (iii) Edward needs to weigh the precipitate. He filters to collect the precipitate.

What must he do before he can weigh it?

.....[1]

- (iv) Edward's experiment showed less chloride than the label indicated.

Suggest why.

.....

[1]

[Total: 9]

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