

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

Harnessing Chemicals (Higher Tier)

WEDNESDAY 18 JUNE 2008

Afternoon
 Time: 45 minutes

Candidates answer on the question paper.

Additional materials (enclosed):

None

Calculators may be used.

Additional materials: Pencil
 Ruler (cm/mm)



Candidate
 Forename

Candidate
 Surname

Centre
 Number

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Candidate
 Number

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INSTRUCTIONS TO CANDIDATES

- Write your name in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use blue or 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.

INFORMATION FOR CANDIDATES

- The number of marks for each question is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is **36**.

FOR EXAMINER'S USE

Qu.	Max.	Mark
1	10	
2	4	
3	9	
4	13	
TOTAL	36	

This document consists of **12** printed pages.

Answer **all** the questions.

1 Esters are chemicals with sweet, often fruity, smells.

They are used to make the ink in scented pens.

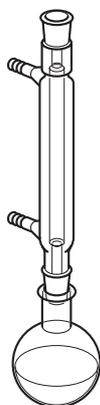


Brogan works as a technician for a manufacturer of scented inks.

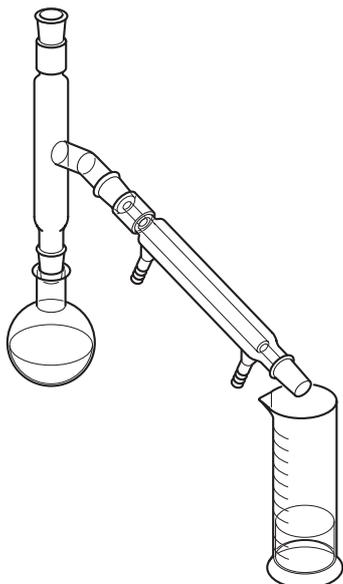
He follows a standard procedure to make the esters.

The diagrams show the steps in the procedure.

Step 1



- add 10 cm³ of alcohol to 10 cm³ of carboxylic acid in a distillation flask
- add 2 cm³ of concentrated sulfuric acid to the flask
- swirl the flask to mix
- add the condenser and heat gently for 10 minutes

Step 2

- rearrange the equipment for distillation
- heat the mixture up to 82 °C and collect the distillate

(a) Sulfuric acid helps speed up the reaction and is not used up in the process.

What is this **type** of chemical called?

..... [1]

(b) The distillate is poured into a beaker of sodium carbonate solution.

This is to remove the sulfuric acid and any unreacted carboxylic acid.

Name the **gas** released in this process.

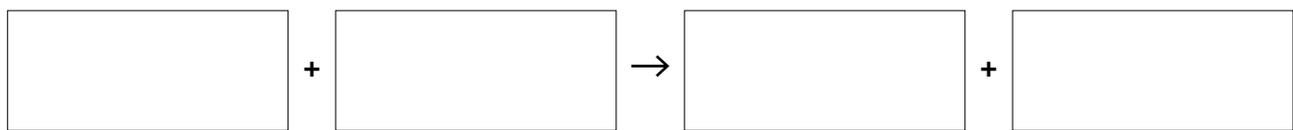
..... [1]

(c) The ester found in an apple-scented pen is pentyl pentanoate.

Pentyl pentanoate is made by reacting pentanol with pentanoic acid.

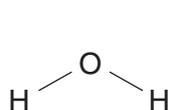
Water is also made in this reaction.

(i) Write the **word** equation for this reaction.

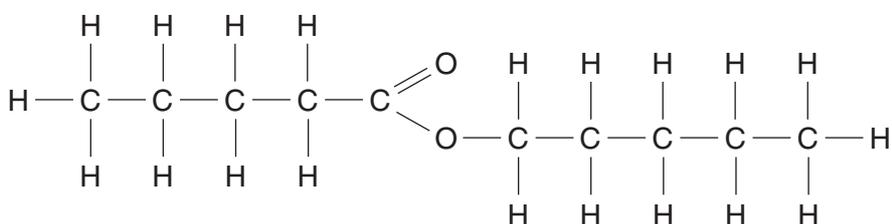


[2]

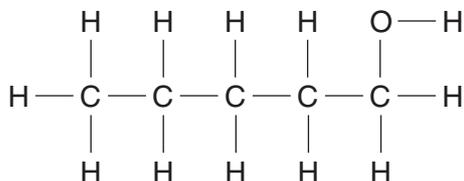
The formulae of the chemicals present in this reaction are shown below.



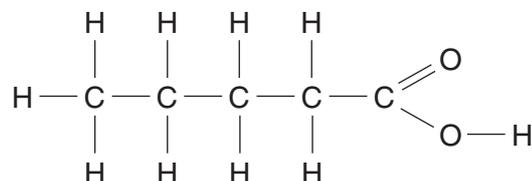
A



B



C



D

(ii) What is the formula of the alcohol **functional group**?

..... [1]

(iii) What is the relative formula mass of **D**?

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

(relative atomic masses: H=1, C=12, O=16)

relative formula mass of **D** = [2]

(d) Esters are produced as fine chemicals using a batch process.

(i) What is meant by the term **fine**?

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

(ii) Explain **one** advantage and **one** disadvantage of a batch process.

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

[Total: 10]

2 Most products we use in our homes are made from a mixture of ingredients.

They are combined according to a fixed formula, called a formulation.

The table below shows the different types of formulation, their description and examples.

type of formulation	description	example
emulsion	an oily liquid dispersed in a watery liquid	salad dressing
solid mixture	two or more ingredients mixed together	
solution	a soluble solid dissolved in a liquid	eye drops
	an insoluble solid dispersed in a liquid	milk of magnesia

(a) Complete the table.

(i) Write the name of the missing formulation. [1]

(ii) Give **one** example of a solid mixture. [1]

(b) Why is an emulsifying agent added to an emulsion?

.....

 [2]

[Total: 4]

- 3 An aqueous solution of potassium chloride is prepared using the following steps.

The steps are in the wrong order.

- A Dissolve the potassium chloride in the smallest amount of water possible.
- B Rinse the beaker with water and add to the graduated flask.
- C Stopper the graduated flask and mix well.
- D Transfer the potassium chloride solution into a 100 cm³ graduated flask.
- E Accurately weigh 1.5 g of the solid potassium chloride and transfer into a beaker.
- F Add water drop by drop until the solution is up to the 100 cm³ mark.

- (a) Write down the correct order of the statements.

The first one has been done for you.

..... **E** [4]

- (b) It is important that the chemicals are transferred from one container to another with minimum loss.

Describe **two** ways of transferring the potassium chloride solution to the graduated flask **without spillage**.

.....

 [2]

- (c) Name the **solute** used in this procedure.

..... [1]

(d) 100 cm³ of the solution contains 1.5 g of potassium chloride.

Calculate the concentration of the solution in grams per litre (g/l).

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

$$\text{concentration (g/l)} = \frac{\text{mass (g)}}{\text{volume (l)}}$$

$$100 \text{ cm}^3 = 100 \text{ ml}$$

concentration = g/l [2]

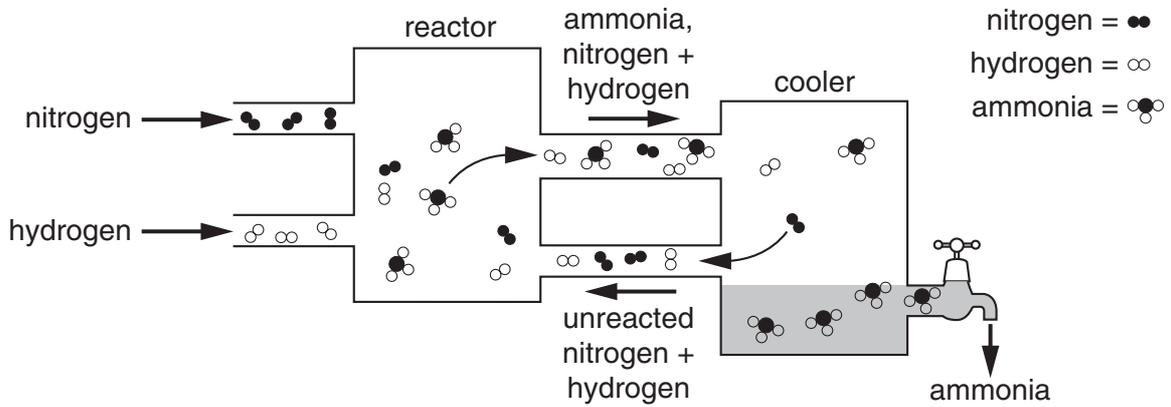
[Total: 9]

4 Nitrogen, N_2 and hydrogen, H_2 are used to make ammonia, NH_3 .

(a) Write a balanced equation for this reaction.

..... [2]

(b) Ammonia is made using a continuous process.



(i) The hydrogen needed for this process is obtained from natural gas, from the North Sea.

This method of obtaining hydrogen is **not** sustainable.

Explain why.

.....

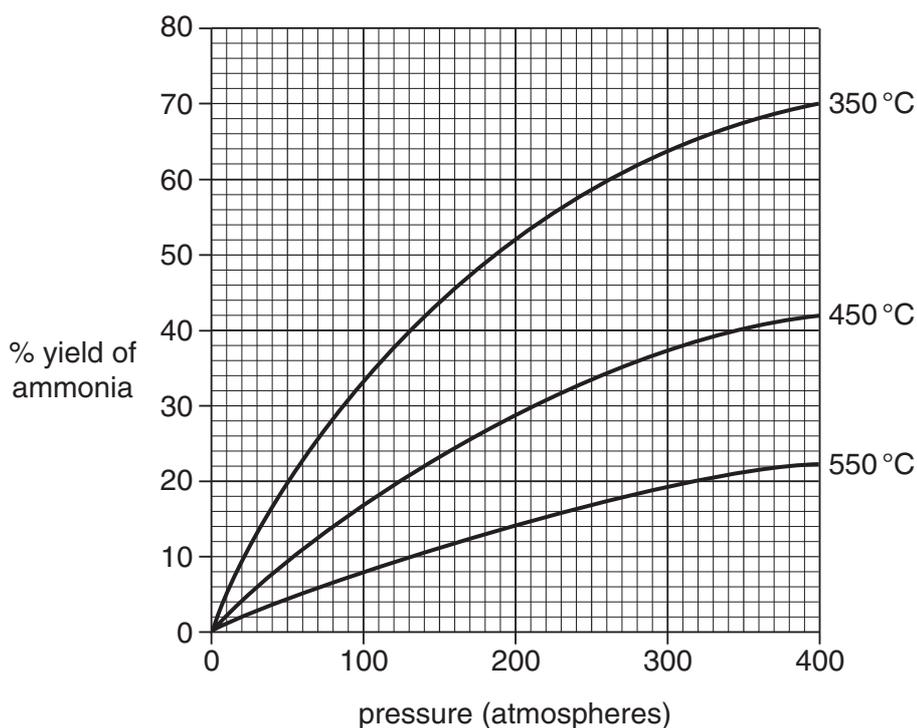
 [2]

(ii) Not all the nitrogen and hydrogen reacts to make ammonia in the reactor.

What happens to the nitrogen and hydrogen which hasn't reacted?

.....
 [1]

(c) The graph below shows the amount of ammonia produced under different conditions.



(i) Look at the graph. Which **two** conditions produce more ammonia?

.....
 [2]

(ii) At 300°C and a pressure of 100 atmospheres:

percentage yield for ammonia is 40%;
actual yield for ammonia is 5000 g.

Calculate the **theoretical** yield for ammonia under these conditions.

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

$$\text{theoretical yield} = \frac{\text{actual yield}}{\text{percentage yield}} \times 100$$

theoretical yield = g [2]

- (d) It is important to protect the health and safety of people who work in the chemical industry. Which organisation in the UK does this?

..... [1]

- (e) The ammonia produced has many uses.

- (i) A small amount of the ammonia produced is used to make nitric acid.

What is the **chemical formula** of nitric acid?

..... [1]

- (ii) Ammonia can be reacted with nitric acid to form the soluble salt ammonium nitrate which is used in fertilisers.

The table shows the solubility of some common salts.

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

Put a **ring** around the **two** soluble salts in the list below.



[2]

[Total: 13]

END OF QUESTION PAPER

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