Write your name here

Surname	Other names

Edexcel GCSE

Centre Number	Candidate Number

Chemistry

Unit C3: Chemistry in Action

Higher Tier

Sample Assessment Material
Time: 1 hour

Paper Reference
5CH3H/01

You do not need any other materials.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
  – *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

S39961A

S 3 9 9 6 1 A 0 1 1 6

edexcel
advancing learning, changing lives

Answer ALL questions

Some questions must be answered with a cross in a box ☒.
If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Alcohols

1 Ethanol C_2H_5OH, is an alcohol.
It can be produced by the fermentation of sugars.
Fermentation takes place at a controlled temperature.

(a) During fermentation, bubbles of a gas are formed.
Which gas is formed in this reaction?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** carbon dioxide

☒ **B** ethene

☒ **C** hydrogen

☒ **D** oxygen

(b) Explain why the temperature of the fermentation of sugars has to be controlled.

(2)

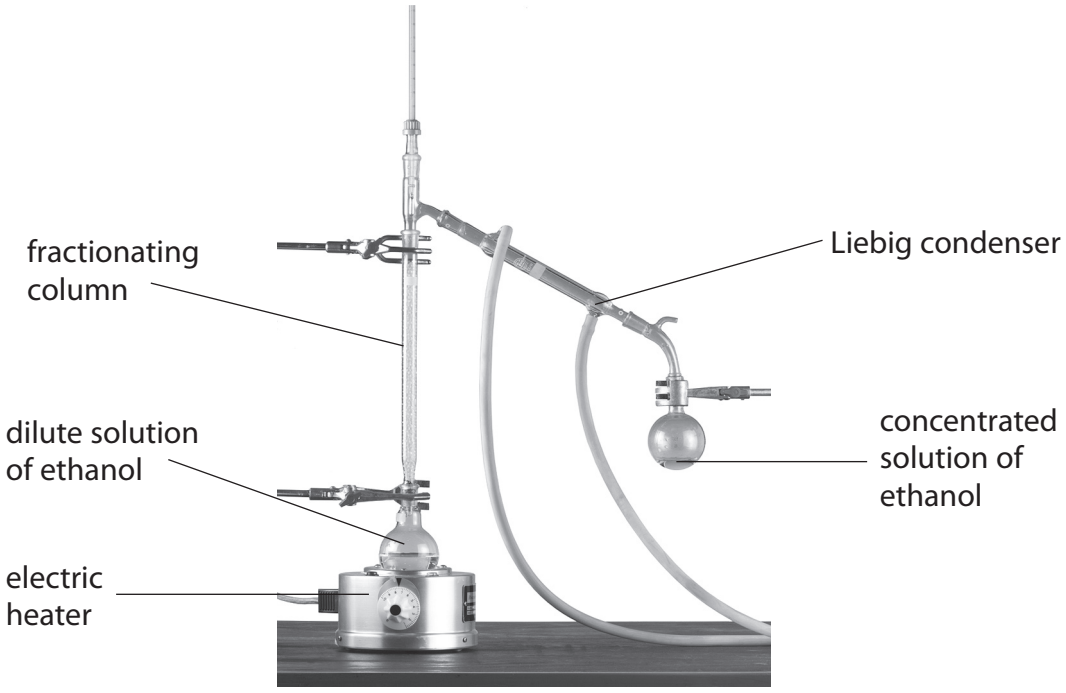
.....

.....

.....

.....

(c) Fermentation produces a dilute solution of ethanol.
This solution can be concentrated using the apparatus shown in the photograph.



What process is shown in the photograph?

(1)

.....

.....

(d) Ethanol belongs to the homologous series of alcohols.

What is meant by the term **homologous series**?

(2)

.....

.....

.....

.....

(e) Ethanol can also be produced commercially from ethene as well as by the fermentation of sugars.

A factory needs a large quantity of pure ethanol to make antifreeze for cars.

Explain which method of manufacturing ethanol would be most useful for the factory.

(2)

.....

.....

.....

.....

(Total for Question 1 = 8 marks)

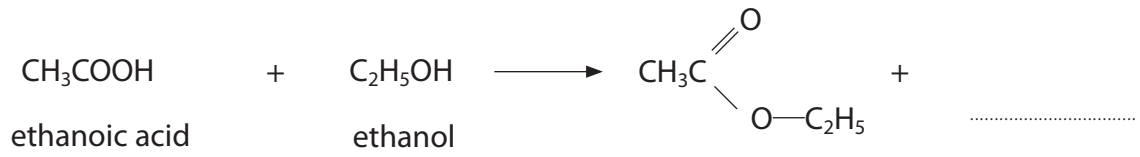
Carboxylic acids and esters

2 An ester is a compound formed when an alcohol reacts with a carboxylic acid.

(a) Ethanoic acid is one of the simplest carboxylic acids that can be used to make esters.

(i) Complete the equation for the reaction of ethanoic acid with ethanol to form an ester.

(1)



(ii) What is the name of the ester formed in this reaction?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** ethanol carboxylate

☒ **B** ethyl carboxylate

☒ **C** ethanol ethanoate

☒ **D** ethyl ethanoate

(iii) Ethanoic acid reacts with metal carbonates.

Describe what you would **see** when ethanoic acid reacts with sodium carbonate.

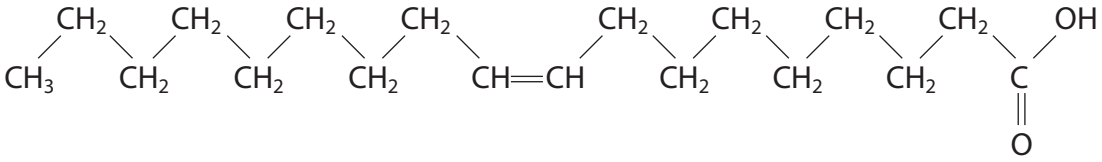
(2)

(b) Some naturally-occurring esters are oils obtained from plants.
One example is olive oil.

(i) Describe how oils can be used to make soap.

(2)

(ii) Olive oil is an ester of oleic acid. Oleic acid contains a carbon–carbon double bond.



Describe how olive oil could be converted into a solid fat to make margarine.

(2)

(Total for Question 2 = 8 marks)

Electrolysis

3 Isobel investigated what happened when copper chloride was electrolysed.

She discovered that solid copper chloride did not conduct electricity, but that a solution of copper chloride did.

(a) Explain why copper chloride solution conducts electricity, but solid copper chloride does not conduct electricity.

(2)

After passing electricity through copper chloride solution for 5 minutes, Isobel took this photograph of her apparatus.

During electrolysis, copper ions move towards the cathode.
These ions form copper metal on the cathode.

(b) (i) Why do copper ions move towards the cathode during electrolysis?

(1)

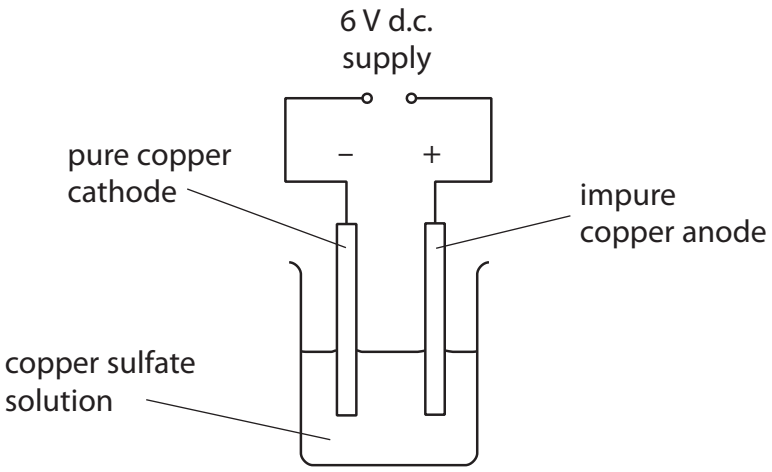
(ii) Name the gas produced at the anode and write an equation to show its formation.

(3)

Name of gas

Equation

(c) Copper can be purified by electrolysis using a pure copper cathode and an impure copper anode.



Describe how copper can be purified using this process.

(4)

(Total for Question 3 = 10 marks)

Fertilisers and ammonia

4 Many farmers spread fertilisers onto their fields.

The photograph shows how farmers carefully control the amount of fertiliser used on the land.

Russ Munn/Agstockusa/Science Photo Library

(a) Describe the environmental problems caused by using too much fertiliser.

(3)

(b) Most artificial fertilisers are made from ammonia, NH_3.

Ammonia is made by the reaction of nitrogen with hydrogen.

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

Under suitable conditions, the gases react and the reaction can reach a dynamic equilibrium.

(i) What is meant by the term **dynamic equilibrium**?

(2)

(ii) A factory makes 100 moles of ammonia gas.
What volume would this gas occupy at room temperature and pressure?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** 24 dm^3

☒ **B** 100 dm^3

☒ **C** 240 dm^3

☒ **D** 2400 dm^3

(iii) In the manufacture of ammonia, NH_3, a pressure of 200 atm is used.
Using a higher pressure would mean that more ammonia would be formed at equilibrium.

Give **two** reasons why a higher pressure is not used in industry?

(2)

1 .....

.....

2 .....

.....

(iv) The forward reaction producing ammonia is exothermic.

Explain what would happen to the yield of ammonia at equilibrium if the temperature was increased.

(2)

.....

.....

.....

.....

(Total for Question 4 = 10 marks)

Analysis of solutions

5 Salts can be identified by carrying out different tests.
The following tables contain the formulae of some ions present in salts.

ion	formula
ammonium	NH_4^+
copper(II)	Cu^{2+}
iron(II)	Fe^{2+}
iron(III)	Fe^{3+}

ion	formula
chloride	Cl^-
bromide	Br^-
iodide	I^-

(a) In a test to identify the ammonium ion, a salt is heated with sodium hydroxide solution.
An alkaline gas is given off.

(i) Name this gas.

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** ammonia

☒ **B** carbon dioxide

☒ **C** hydrogen

☒ **D** oxygen

(ii) How would you show that this gas was alkaline?

(1)

.....

.....

(iii) This test for the ammonium ion is a qualitative test.

What is a **qualitative** test?

(1)

.....

.....

(b) Hussein carried out an experiment to find the concentration of a solution of sodium nitrate.

Hussein weighed an empty 400 cm^3 beaker.
He then added 250 cm^3 of sodium nitrate solution to the beaker and reweighed it.

He heated the beaker gently over a Bunsen flame until all the water in the solution had evaporated and solid sodium nitrate remained.

He let the beaker cool and reweighed it again.

Hussein recorded his results in a table.

mass of empty 400 cm^3 beaker	112.54 g
mass of beaker + 250 cm^3 of sodium nitrate solution	364.29 g
mass of beaker + solid sodium nitrate at the end	114.29 g

Use these results to calculate the concentration of the sodium nitrate solution in g dm^3.

(3)

.....

.....

.....

.....

concentration = ... g dm^3

*(c) Your teacher gives you three salts and asks you to carry out tests to show the ions present in **one** of the salts.

The three salts you are given are: copper bromide, iron(II) iodide and iron(III) chloride.

Explain, using relevant tests and equations where necessary, how you would confirm the ions present in **one** of these salts.

(6)

Salt chosen

.....

Explanation

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for Question 5 = 12 marks)

Titrations

6 The photograph shows a student carrying out a titration.

Science photo library

The student was trying to find out the volume of hydrochloric acid required to neutralise 25.0 cm^3 of 0.500 mol dm^{-3} sodium hydroxide solution, NaOH.

The student obtained the following results:

volume of sodium hydroxide solution used for each titration		25.0 cm^3
volume of hydrochloric acid added	trial titration	25.30 cm^3
	1st titration	24.90 cm^3
	2nd titration	24.70 cm^3

The student used these results to calculate the concentration of the hydrochloric acid.

The equation for the reaction between sodium hydroxide solution and hydrochloric acid is

$$NaOH(aq) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l)$$

(a) Suggest why universal indicator is not used in a titration.

(1)

.....

.....

(b) Give **one** reason why it is necessary to carry out two further titrations after the trial titration.

(1)

.....

.....

(c) What volume of the hydrochloric acid should be used in a calculation to determine the concentration of the acid?

Put a cross (☒) in the box next to your answer.

(1)

☐ **A** 24.80 cm^3

☐ **B** 24.97 cm^3

☐ **C** 25.00 cm^3

☐ **D** 25.30 cm^3

(d) Calculate the concentration, in mol dm^{-3}, of the hydrochloric acid, HCl.

(3)

.....

.....

.....

.....

concentration = ... mol dm^3

*(e) Bernard is given instructions to carry out the titration labelled '1st titration'.

His instructions say:

- clean a pipette with water and then rinse it with sodium hydroxide solution
- clean a burette with water and then rinse it with dilute hydrochloric acid
- use the pipette to transfer 25 cm^3 of sodium hydroxide solution into a conical flask
- add a few drops of acid-base indicator
- fill the burette with dilute hydrochloric acid and take the reading on the burette
- add hydrochloric acid from the burette to the alkali in the conical flask, swirling the contents all the time
- add the acid drop-by-drop near the end-point until the colour changes
- take the final burette reading.

Explain why these steps help to ensure that Bernard's results are accurate.

(6)

(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 60 MARKS

Sample Mark Scheme

Unit C3: Chemistry in Action (Higher Tier)

Question number	Answer	Mark
1(a)	**A**	**(1)**

Question number	Answer	Acceptable answers	Mark
1(b)	an explanation linking **two** of the following: optimum temperature for maximum rate (1) (because) if temperature too high, enzyme denatures/temperature too low, rate is slow (1)	 Do not accept enzyme being killed	 **(2)**

Question number	Answer	Acceptable answers	Mark
1(c)	fractional distillation/fractionation	not just distillation	**(1)**

Question number	Answer	Acceptable answers	Mark
1(d)	similar (same) chemical properties /trend in physical properties (1) same general formula/neighbouring members differ by CH_2 (1)	 examples of general/molecular formulae to illustrate	 **(2)**

Question number	Answer	Acceptable answers	Mark
1(e)	an explanation linking the following: production from ethene (1) (because) continuous/produces large volumes/product is of high purity (1)	 if candidates choose fermentation, credit one relevant point, e.g. cost/renewable	 **(2)**

TOTAL: 8 MARKS

Question number	Answer	Mark
2(a)(i)	H_2O	**(1)**

Question number	Answer	Mark
2(a)(ii)	**D**	**(1)**

Question number	Answer	Acceptable answers	Mark
2(a)(iii)	a description including the following: effervescence/fizzing/bubbling (1) solid sodium carbonate disappears (1)	 colourless solution remains	 **(2)**

Question number	Answer	Acceptable answers	Mark
2(b)(i)	a description including the following: add sodium hydroxide/potassium hydroxide (1) boil mixture (1)	 mention of fatty acid salts	 **(2)**

Question number	Answer	Mark
2(b)(ii)	a description including the following: reacts with hydrogen/H_2 (1) in the presence of a catalyst (1)	 **(2)**

TOTAL: 8 MARKS

Question number	Answer	Acceptable answers	Mark
3(a)	an explanation linking the following: ions can move in solution (1) (therefore) can carry current (1)	 ions in solid are held in place and not free to move/conduct	 **(2)**

Question number	Answer	Acceptable answers	Mark
3(b)(i)	positive copper ions attracted (to the negative electrode)	accept opposite charges attract	**(1)**

Question number	Answer	Acceptable answers	Mark
3(b)(ii)	chlorine (1) $2Cl^- \rightarrow Cl_2 + 2e^-$ species (1) balance (1)	 allow 1 mark for correct formula of chlorine gas	 **(3)**

Question number	Answer	Acceptable answers	Mark
3(c)	a description containing three of the following: anode decreases in size/dissolves (1) (copper) (atoms) lose electrons / form (copper) ions (1) copper ions attracted to cathode (1) where they gain electrons/form atoms/are discharged (1) cathode increases in size/gains copper (metal) (1) impurities fall to bottom/anode sludge collects underneath (1)	 a correct equation a correct equation	 **(4)**

TOTAL: 10 MARKS

Question number	Answer	Acceptable answers	Mark
4(a)	a description including **three** of the following: washed into rivers/leached from soil (1) algal blooms in lakes (1) microorganisms use up oxygen when decomposing this material (1) death of other organisms in the water (1)	pollute rivers/water table excess plant growth in lakes/rivers eutrophication	**(3)**

Question number	Answer	Mark
4(b)(i)	both (forward and back) reactions occur at same time (1) at same rate (1)	**(2)**

Question number	Answer	Mark
4(b)(ii)	**D**	**(1)**

Question number	Answer	Acceptable answers	Mark
4(b)(iii)	any **two** of the following: uses more energy (1) requires more powerful pumps (1) thicker-walled pipes needed (1) risk of explosion (1)	accept increased cost of production	**(2)**

Question number	Answer	Mark
4(b)(iv)	an explanation linking the following: yield decreases (1) (because) equilibrium moves to left-hand side/endothermic direction (1)	**(2)**

TOTAL: 10 MARKS

Question number	Answer	Mark
5(a)(i)	**A**	**(1)**

Question number	Answer	Mark
5(a)(ii)	(damp) full-range indicator/universal indicator/litmus paper turns blue	**(1)**

Question number	Answer	Acceptable answers	Mark
5(a)(iii)	a qualitative test finds out what is present	tells you if the ion is present or not	**(1)**

Question number	Answer	Acceptable answers	Mark
5(b)	mass of sodium nitrate = 1.75 g mass of water = 250 g (1) concentration = $\frac{1.75 \times 1000}{250}$ (1) = 7 (g dm^{-3}) (1)	both masses need to be evident for the first mark accept any equivalent calculation that gives these correct masses	**(3)**

Question number		Indicative content	Mark
***5(c) QWC**		an explanation including some of the following: dissolve chosen salt in water **test for cation:** add drops of sodium hydroxide solution blue ppt = Cu^{2+}/green ppt = Fe^{2+}/brown ppt = Fe^{3+} (allow flame test for copper ion) **test for anion:** add drops of dilute nitric acid add drops of silver nitrate solution white ppt = Cl^-/cream ppt = Br^-/yellow ppt = I^- **suitable equations:** word equations or balanced equations e.g. for cation: $CuBr_2 + 2NaOH \rightarrow Cu(OH)_2 + 2NaBr$ e.g. for anion: $CuBr_2 + 2AgNO_3 \rightarrow 2AgBr + CuBr_2$ ionic equations: e.g. for cation: $Cu^{2+} + 2OH^- \rightarrow Cu(OH)_2$ e.g. for anion: $Ag^+ + Br^- \rightarrow AgBr$	**(6)**
Level	**0**	No rewardable material	
1	**1–2**	• a basic explanation of how this experiment would be carried out, with very little detail or accuracy in the reagents used or the results • little or no attempt to explain observations or include equations • communicates ideas using simple language and some scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3–4**	• an explanation of how this experiment would be carried out, with some inaccuracies or omissions of the reagents or results • an attempt to explain observations or include relevant equations • communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy and organisation	
3	**5–6**	• a clear explanation of how this experiment would be carried out with very few inaccuracies or omissions • observations are explained and equations are used for at least one of the tests • communicates ideas clearly and uses a range of scientific terminology appropriately • spelling, punctuation and grammar are used with few errors	

TOTAL: 12 MARKS

Question number	Answer	Acceptable answers	Mark
6(a)	no sharp change in colour	continuous range of colours	**(1)**

Question number	Answer	Acceptable answers	Mark
6(b)	to achieve concordant results/to make sure results are reliable	not to achieve precise results/to take an average	**(1)**

Question number	Answer	Mark
6(c)	**A**	**(1)**

Question number	Answer	Acceptable answers	Mark
6(d)	moles of sodium hydroxide = $\frac{25.0 \times 0.500}{1000}$ = 0.0125 (1) moles NaOH = moles HCl / moles HCl = 0.0125 (1) $0.0125 = \frac{24.80 \times \text{conc HCl}}{1000}$ conc HCl = $\frac{1000 \times 0.125}{24.80}$ = 0.5040 (mol dm^{-3}) (1)	accept bald answer of 0.504 for full marks accept TE throughout accept 0.504 accept TE from answer to 6(c) 24.97 → 0.501 25.00 → 0.500	**(3)**

Question number		Indicative content	Mark
***6(e) QWC**		an explanation including some of the following: • apparatus rinsed to ensure that the concentrations are not affected by any other substances that might interfere with the results • using a pipette increases accuracy • the conical flask is used because it allows swirling without spilling • an indicator to determine the end point of the titration precisely • the initial reading enables Bernard to know how much acid was in the burette at the start • swirling ensures that the reactants mix/react together • drop-by-drop ensures an accurate value for the volume of acid needed • the colour change occurs when just enough alkali has been added to react with all the alkali • taking the final burette reading enables the volume of acid used to be calculated	**(6)**
Level	**0**	No rewardable material	
1	**1–2**	• a limited explanation of the titration process, with few comments about how these steps improve the accuracy • communicates ideas using simple language and some scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3–4**	• an explanation is given of some of the steps in the titration, with some indication of how the accuracy is improved by this process • communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy and organisation	
3	**5–6**	• a clear explanation of the steps in the titration and a good indication of how these steps contribute to accuracy • communicates ideas clearly and uses a range of scientific terminology appropriately • spelling, punctuation and grammar are used with few errors	

TOTAL: 12 MARKS

