

Surname	Centre Number	Candidate Number
Other Names		2

GCE A LEVEL



A410U30-1



WEDNESDAY, 19 JUNE 2019 – MORNING

CHEMISTRY – A level component 3 Chemistry in Practice

1 hour 15 minutes

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	5	
2.	15	
3.	17	
4.	6	
5.	17	
Total	60	

A410U301
01

ADDITIONAL MATERIALS

In addition to this examination paper, you will need a:

- calculator;
- **Data Booklet** supplied by WJEC.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions in the spaces provided.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

The maximum mark for this paper is 60.

Your answers must be relevant and must make full use of the information given to be awarded full marks for a question.

The assessment of the quality of extended response (QER) will take place in **Q.4**.

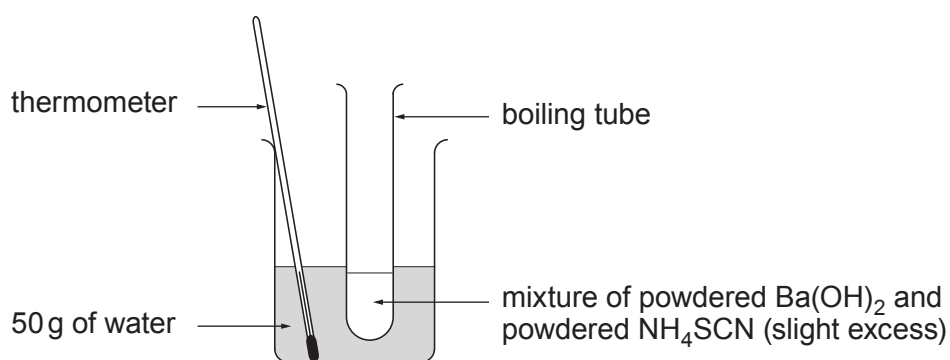
If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

Answer **all** questions in the spaces provided.

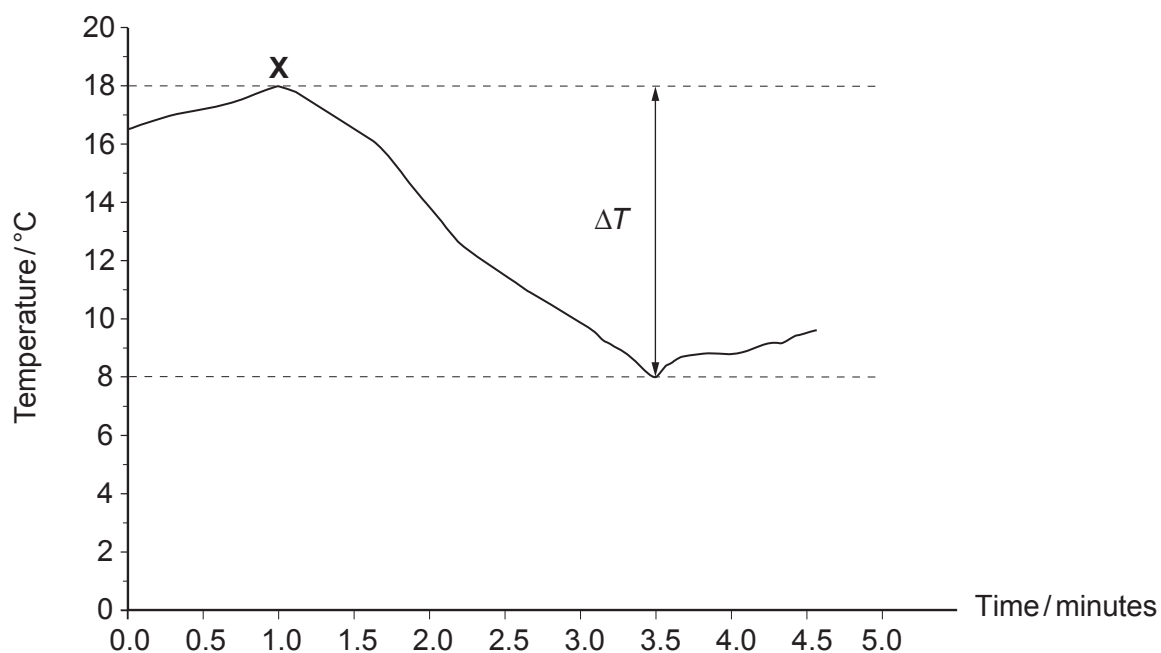
1. The reaction between solid barium hydroxide and solid ammonium thiocyanate is endothermic. The equation for the reaction is shown below.



A student carries out an experiment to determine the enthalpy change of reaction using the apparatus below.



The temperature / time curve shown below was plotted. A slight excess of ammonium thiocyanate was added to the barium hydroxide at point **X**.



- (a) The value of ΔT obtained was much lower than expected.

Briefly indicate **three** possible sources of error in the ΔT measurement from the information provided. [2]

Possible sources of error
1.
2.
3.

- (b) The student measured a 10.0°C temperature change on mixing both solids and used this value to calculate the enthalpy change of reaction as $+10.5\text{ kJ mol}^{-1}$.

Calculate the mass of powdered $\text{Ba}(\text{OH})_2$ used in the experiment. [2]

Mass = g

- (c) Deduce the maximum temperature change if the experiment were repeated using 100 g of water rather than the 50 g used in the first experiment, with all other factors kept the same. Give a reason for your answer. [1]

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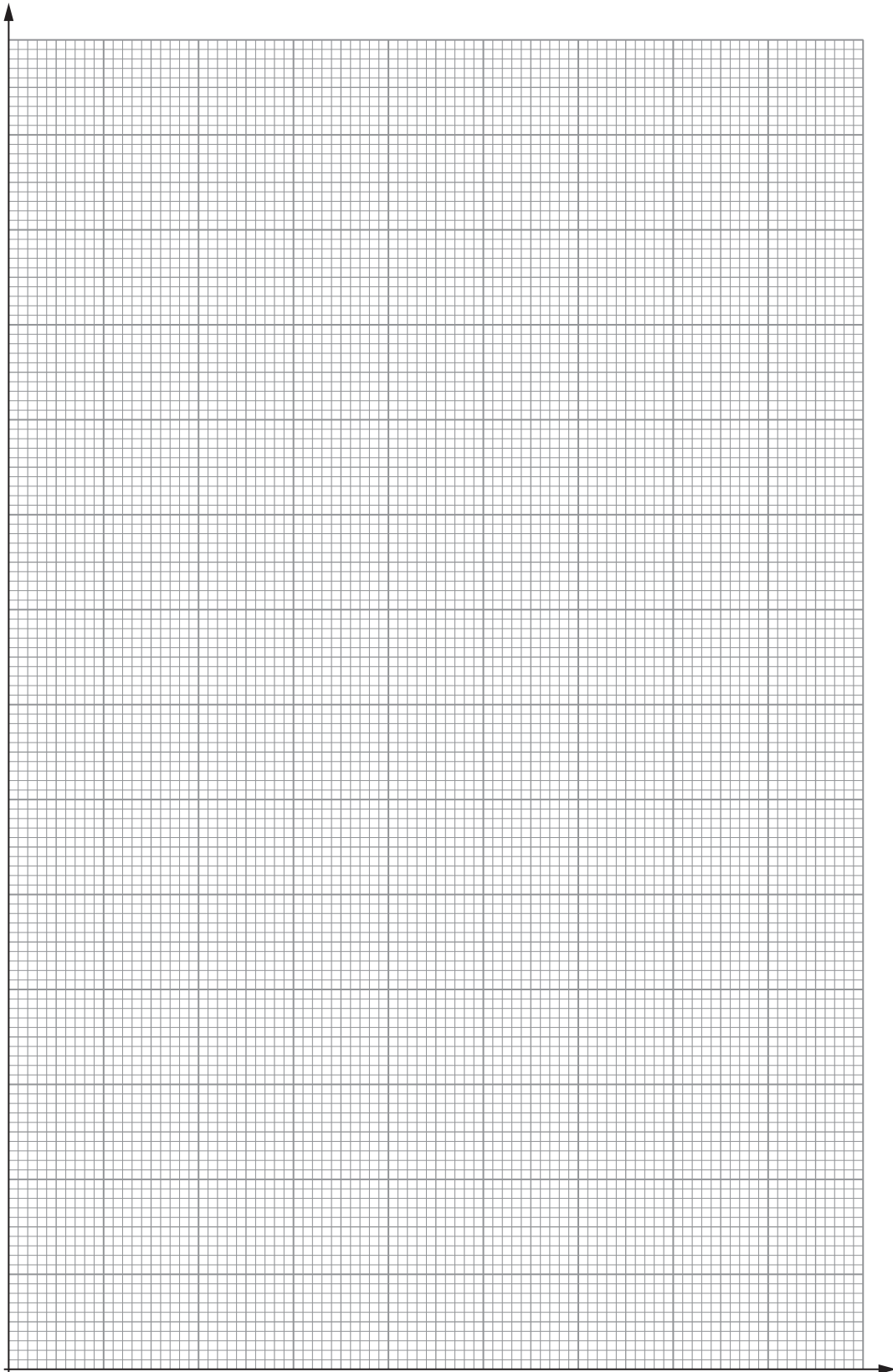
2. (a) The following pH values were measured during the titration of 25.0 cm^3 of aqueous ethanoic acid, of approximate concentration 0.1 mol dm^{-3} , with aqueous sodium hydroxide of concentration $0.0962\text{ mol dm}^{-3}$.

Volume of sodium hydroxide added/ cm^3	pH
0.0	2.9
5.0	4.1
10.0	4.5
15.0	4.9
20.0	5.3
22.0	5.5
24.0	5.8
25.0	6.1
26.0	6.6
27.0	11.2
28.0	11.4
29.0	11.7
30.0	11.8

(i) Plot the titration curve on the grid, clearly labelling the axes.

[4]

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A410U301
05

(ii) Use information from the titration curve in answering parts I-III.

I. Calculate the concentration, in mol dm^{-3} , of the aqueous ethanoic acid. [3]

Concentration = mol dm^{-3}

II. Determine the pH of the sodium ethanoate solution formed at the equivalence point. [1]

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III. Calculate the acid dissociation constant, K_a , of the ethanoic acid. [2]

K_a = mol dm^{-3}

- (b) State the colour obtained if a few drops of the acid-base indicator methyl red are added to a sodium ethanoate solution. Give a reason for your answer. [1]

pH	Methyl red indicator colour
≤ 4.8	yellow
≥ 6.0	red

- (c) Aqueous propanoic acid and sodium propanoate can form a buffer solution.

A student requires a buffer of pH 4.46 for an experiment. He adds solid sodium propanoate to 500 cm^3 of aqueous propanoic acid of concentration 0.210 mol dm^{-3} . Calculate the mass of sodium propanoate needed assuming no change in volume. [4]

(K_a for propanoic acid is $1.35 \times 10^{-5}\text{ mol dm}^{-3}$)

Mass = g

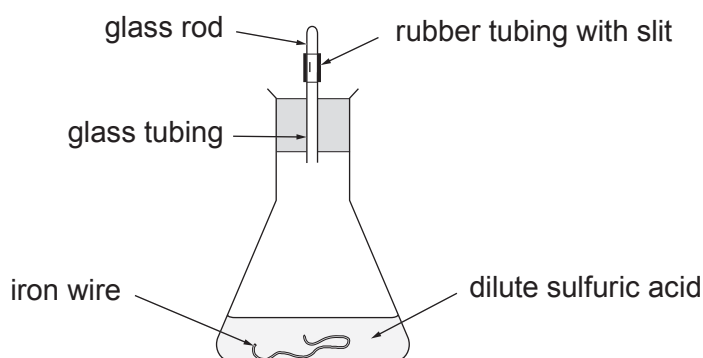
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3. A student carried out the following experiment to determine the percentage of iron in a wire.

Step 1 Preparation of a solution of iron(II) ions

2.78 g of the wire was placed in a conical flask. 100 cm³ of dilute sulfuric acid (an excess) was added and the flask was warmed in order to maintain a steady reaction.

The diagram shows the apparatus used. The piece of rubber tubing with a slit in it lets hydrogen escape but stops any air entering the flask.



When all the iron had reacted the solution was transferred to a volumetric flask and made up to 500 cm³ with deionised water.

- (a) (i) Give the ionic equation for the reaction of iron with dilute acid. [1]

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- (ii) Describe a chemical test to show that the solution contains iron(II) ions. [3]

Reagent(s)

Observation(s)

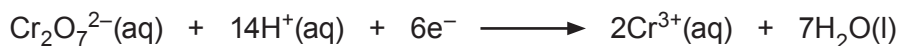
Ionic equation

- (b) Suggest why it was necessary to prevent any air from entering the flask. [1]

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Step 2 Titration of the iron(II) solution against a standard solution of potassium dichromate(VI)

Unlike manganate(VII), dichromate(VI) titrations require an indicator. One indicator that may be used is diphenylamine sulfonate. At the end-point, the indicator colour changes from green to violet on addition of one drop of the dichromate(VI) solution.



- (c) (i) The student was asked to prepare a $0.0200 \text{ mol dm}^{-3}$ standard solution of potassium dichromate(VI), $\text{K}_2\text{Cr}_2\text{O}_7$. Calculate the mass of potassium dichromate(VI) needed to prepare 250 cm^3 of this solution. [2]

Mass = g

- (ii) The student pipetted 25.0 cm^3 of the iron(II) solution into a conical flask. He added 25 cm^3 of dilute sulfuric acid and titrated against the $0.0200 \text{ mol dm}^{-3}$ potassium dichromate(VI) solution.

Describe how the student should perform **one** titration to find the volume of potassium dichromate(VI) needed for complete reaction. You can assume that the dichromate(VI) solution is already in the burette. [4]

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(d) Four 25.0cm^3 samples of the iron(II) solution were acidified and titrated against the dichromate(VI) solution. The mean volume of dichromate(VI) required for complete reaction was 19.85cm^3 .

(i) Why did the student carry out several titrations and then calculate a mean volume of potassium dichromate(VI) used? [1]

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(ii) Write the equation for the reaction of iron(II) ions with dichromate(VI) ions in acid solution. [1]

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 (iii) Calculate the percentage of iron in the wire. [3]

Percentage = %

(iv) The balance used in weighing the wire has an uncertainty for each reading of $\pm 0.005\text{g}$. Estimate the maximum percentage error in weighing the wire. Show your working. [1]

Percentage error = %

5. You are given solutions of six organic compounds, labelled **A-F**, and the following reagents.

Reagent	Name
1	red litmus paper
2	I ₂ (aq) / NaOH(aq) or KI(aq) / NaClO(aq)
3	2,4-dinitrophenylhydrazine (2,4-DNPH)
4	dilute sodium hydroxide solution
5	sodium hydrogencarbonate solution

- (a) Answer parts (i) and (ii) by completing the table opposite.

(i) Name compounds **D** and **F**. [2]

(ii) Give the results you would expect to observe on addition of reagents **2** and **3** to **each** of the compounds. Write 'NR' if there is no reaction.

Three of the compounds do not react with either of the reagents. [3]

Compound		Reagent: 2	Reagent: 3
		Conditions: room temperature / gentle heat	Conditions: room temperature
A	CH ₃ CH ₂ CH ₂ CH ₂ NH ₂ butylamine		
B	CH ₃ CH ₂ CH ₂ COOH butanoic acid		
C	CH ₃ CH ₂ CH ₂ CHO butanal		
D	CH ₃ CH ₂ CH ₂ CONH ₂		
E	CH ₃ COCH ₂ CH ₃ butanone		
F	CH ₃ CH(OH)CH ₂ CH ₃		

(b) Explain the results observed for compound F.

[1]

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(c) Devise a scheme of **three** further tests, using only reagents **1, 4** and **5**, that would allow you to positively identify each of the **remaining** compounds.

(i) Complete the table below giving the reagent(s) and briefly describing each test. Give the observations made for each compound. Any test you suggest **must** lead to some observable result.

You do **not** need to include observations for compounds identified by a previous test. [4]

Compound	Reagent:	Reagent:	Reagent:
	Description of test:	Description of test:	Description of test:
	Observations		

(ii) Explain each of the positive results observed. [3]

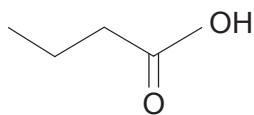
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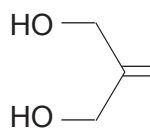
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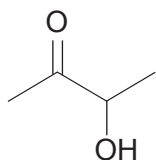
(d) $C_4H_8O_2$ has a number of different isomers, four of which are shown below.



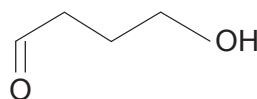
butanoic acid
compound **B**



2-methylenepropane-1,3-diol
compound **H**



3-hydroxybutanone
compound **I**



compound **J**

(i) Name compound **J**.

[1]

Do not use any of the reagents used in parts (a)-(c) [shown below] in your answers to parts (ii)-(iv).

red litmus paper
$I_2(aq)/NaOH(aq)$ or $KI(aq)/NaClO(aq)$
2,4-dinitrophenylhydrazine (2,4-DNPH)
dilute sodium hydroxide solution
sodium hydrogencarbonate solution

- (ii) Give a chemical test which gives a positive result for compounds **H**, **I** and **J** but not for compound **B**. [1]

Reagent(s)

Observation(s)

- (iii) Give a chemical test which gives a positive result for compound **J** but not for compounds **B**, **H** and **I**. [1]

Reagent(s)

Observation(s)

- (iv) Give a chemical test which gives a positive result for compound **H** but not for compounds **B**, **I** and **J**. [1]

Reagent(s)

Observation(s)

END OF PAPER

