Surname	Centre Number	Candidate Number
Other Names		2

GCE AS

B410U10-1

S18-B410U10-1

CHEMISTRY – AS component 1
The Language of Chemistry, Structure of Matter and Simple Reactions

TUESDAY, 22 MAY 2018 – MORNING

1 hour 30 minutes

	For Examiner's use only		
	Question	**Maximum Mark**	**Mark Awarded**
Section A	**1. to 7.**	**10**	
Section B	**8.**	**9**	
	9.	**10**	
	10.	**13**	
	11.	**12**	
	12.	**14**	
	13.	**12**	
	Total	**80**	

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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.

Section A Answer **all** questions in the spaces provided.
Section B Answer **all** questions in the spaces provided.

Candidates are advised to allocate their time appropriately between **Section A (10 marks)** and **Section B (70 marks)**.

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 80.

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.9***(a)*.

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.

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SECTION A

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

1. Complete the electronic structure of a bromine atom, Br. [1]

$1s^2\ 2s^2\ 2p^6$ .....

2. Give the oxidation state of chromium in the dichromate ion, $Cr_2O_7^{2-}$. [1]

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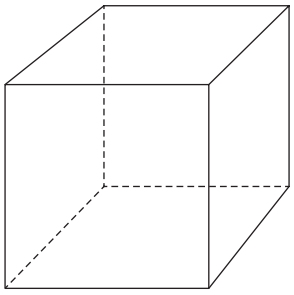
3. Complete the diagram to show the structure of caesium chloride, CsCl. [1]



4. Using the formula of calcium sulfate, calculate the number of **oxygen** atoms present in 0.1 mol of calcium sulfate. [2]

Number of oxygen atoms = ...

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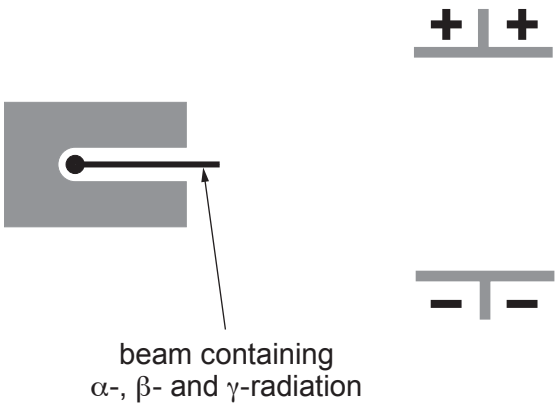
5. Complete the diagram to show how α-, β- and γ-radiation are affected by an electric field. [2]



6. Complete the equation. [1]

..... CH_3COOH + ... ZnO ⟶ ..... $(CH_3COO)_2Zn$ + ...

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7. Ethanol, C_2H_5OH, can be made by the fermentation of glucose, $C_6H_{12}O_6$.

$$C_6H_{12}O_6 \longrightarrow 2C_2H_5OH + 2CO_2$$

Calculate the atom economy of this reaction. [2]

Atom economy = ... %

10

Turn over.

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SECTION B

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

8. Using ideas that you have studied in your Chemistry course comment on and explain the following observations.

(a) Ice floats on water. [3]

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(b) The mass spectrum of naturally-occurring chlorine, Cl_2, contains three lines of different heights in the molecular ion region. [3]

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(c) Universal indicator is red when placed in 0.1 mol dm^{-3} hydrochloric acid and it is orange when placed in 0.1 mol dm^{-3} propanoic acid, C_2H_5COOH. [3]

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9

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9. *(a)* A student was studying the boiling temperatures of different substances including those listed in the table.

Substance	Boiling temperature / °C
hydrogen, H_2	–253
bromine, Br_2	59
hydrogen bromide, HBr	–66

The student suggested that the boiling temperature could be predicted by considering the strength of the covalent bonds in the molecules.

State why the student is **incorrect**. Explain your reasoning and the factors that govern the boiling temperatures of these substances. [6 QER]

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(b) (i) Silicon and hydrogen can form a series of compounds called silanes.

Draw a dot and cross diagram to show the electron arrangement in the silane, Si_2H_6. Show outer electrons only. [2]

(ii) Predict the H—Si—H bond angle in Si_2H_6. Explain your answer. [2]

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10

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10. Cerrusite is a naturally-occurring crystalline ore that contains a high percentage of insoluble lead(II) carbonate, $PbCO_3$.

(a) One method of finding the percentage of lead in the ore is by forming lead ions in solution and then precipitating them as lead(II) sulfate.

(i) Suggest how the ore could be treated to form lead(II) ions in solution. [1]

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(ii) Name a solution which could be added to the lead(II) solution to form lead(II) sulfate. [1]

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(iii) Write an **ionic** equation for the reaction used to form lead(II) sulfate. Include state symbols. [2]

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(iv) Describe how the lead(II) sulfate precipitate should be treated to obtain results for quantitative analysis. Explain your answer. [3]

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Examiner only

(b) (i) 4.52 g of cerrusite were investigated by the method outlined in part *(a)* and the following results were obtained.

	Mass / g
Empty container	21.47
Container + lead(II) sulfate	25.03

Calculate the percentage by mass of **lead** in the cerrusite. [3]

Percentage = ... %

(ii) The balance used in the experiment could be read to 2 decimal places. **Two** weighings were made to find the mass of lead(II) sulfate. Calculate the maximum percentage error in the mass of lead(II) sulfate. Show your working. [1]

Maximum percentage error = ... %

(c) Some samples of cerrusite are thought to contain other carbonates in addition to the lead(II) carbonate. Suggest how this hypothesis could be investigated in a school or college laboratory. [2]

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13

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11. Limewater is a saturated solution of calcium hydroxide, $Ca(OH)_2$. A student carried out an experiment to find the concentration of calcium hydroxide in a sample of limewater. The student had access to the apparatus and chemicals usually available in a school or college laboratory.

The teacher told the student that he needed to carry out a titration using 0.050 mol dm^{-3} hydrochloric acid.

(a) Describe how the student could prepare 0.050 mol dm^{-3} hydrochloric acid from 2.0 mol dm^{-3} hydrochloric acid. You should include details of any apparatus required. [3]

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(b) The student carried out the titration and used 19.60 cm^3 of the 0.050 mol dm^{-3} hydrochloric acid to neutralise 25.0 cm^3 of the calcium hydroxide solution.

Calculate the concentration of the calcium hydroxide solution in g dm^{-3}. [4]

Concentration = ... g dm^{-3}

(c) The student left the bottle of calcium hydroxide solution overnight without its stopper in place. Explain what he observed when he returned next day. [2]

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(d) The student decided to repeat the titration using a saturated solution of barium hydroxide, $Ba(OH)_2$.

How would the volume of hydrochloric acid used in the titration be different? Explain your answer. [1]

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(e) The student did not label the solutions of calcium hydroxide and barium hydroxide. Describe a test he could use to determine which solution is which. Include the result of the test in each case. [2]

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12

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12. Carboxylic acids react with alcohols to make esters, using sulfuric acid as a catalyst. These reactions are reversible.

$$CH_3COOH + C_2H_5OH \rightleftharpoons CH_3COOC_2H_5 + H_2O$$

ethanoic acid ethanol ethyl ethanoate

(a) State what is meant by a *reversible* reaction. [1]

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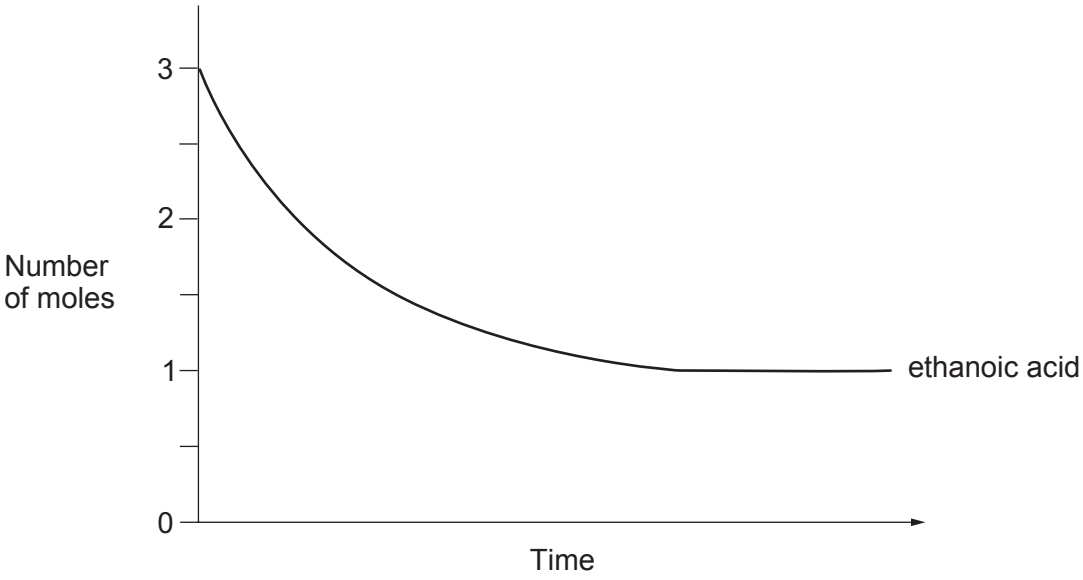
(b) In an experiment to prepare ethyl ethanoate, 3.0 mol of ethanoic acid were mixed with 2.5 mol of ethanol and a small amount of concentrated sulfuric acid. Water was added to make a total volume of 1.0 dm^3.

The number of moles of ethanoic acid present was measured as the reaction proceeded until equilibrium was reached. The results were then plotted.



On the grid sketch:

- the line that shows the number of moles of ethanol as the reaction proceeds to equilibrium. Label this line **A**.
- the line that shows the number of moles of ethyl ethanoate as the reaction proceeds to equilibrium. Label this line **B**. [3]

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(c) (i) Write the expression for the equilibrium constant, K_c, for the esterification reaction. Include the unit, if any. [2]

Unit .....

(ii) Under certain conditions the value of K_c was found to be 4. At a higher temperature, with all other factors being kept constant, this value remained almost the same. Explain what can be deduced from this information. [2]

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(d) Esterification is catalysed by the addition of concentrated sulfuric acid. In an esterification the final pH of the solution was 2.4. Calculate the concentration of hydrogen ions present, in mol dm^{-3}. [2]

$[H^+]$ = ... mol dm^{-3}

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(e) 2.94 g of ethanoic acid were mixed with 2.07 g of ethanol and allowed to react. 2.73 g of ethyl ethanoate were produced. Calculate the percentage yield of this reaction. [4]

Percentage yield = ... %

14

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13. Compound **X** contains **only** carbon, hydrogen and oxygen. 6.57 g of **X** was burned in excess oxygen to form carbon dioxide and water. 12.57 g of carbon dioxide and 7.74 g of water were collected.

(a) Suggest how the mass of carbon dioxide and the mass of water could be measured in this experiment. [2]

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(b) Find the percentage by mass of each element in **X**. [3]

Percentage carbon = ... %

Percentage hydrogen = ... %

Percentage oxygen = ... %

(c) Calculate the empirical formula of **X**. [2]

Empirical formula .....

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(d) 9.20 g of **X**, measured at a pressure of 103 kPa and a temperature of 100 °C, had a volume of 6.02×10^3 cm^3. Calculate the relative molecular mass, M_r, of **X**. [4]

Relative molecular mass = ...

(e) Use your answers to parts *(c)* and *(d)* to deduce the molecular formula of **X**. [1]

Molecular formula .....

12

END OF PAPER

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For continuation only.