

Surname	Centre Number	Candidate Number
First name(s)		2



GCE AS

B410U10-1



O20-B410U10-1



TUESDAY, 6 OCTOBER 2020 – AFTERNOON

CHEMISTRY – AS component 1

The Language of Chemistry, Structure of Matter and Simple Reactions

1 hour 30 minutes

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
Section A 1. to 7.	10	
Section B 8.	16	
9.	10	
10.	12	
11.	9	
12.	11	
13.	12	
Total	80	

B410U101
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.

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.8(b)**.

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

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

1. Complete the electronic configuration of the Se^{2-} ion. [1]

$1s^2 2s^2$

2. What is the oxidation state of sulfur in the SO_4^{2-} ion? [1]

.....

3. Under certain conditions the following equilibrium exists.



- (a) Write the expression for the equilibrium constant, K_c , for this equilibrium. [1]

$K_c =$

- (b) State the unit, if any, for K_c in this equilibrium. [1]

.....

4. A radioactive isotope has a half-life of 4 hours. Calculate the time needed for 4.0 g of the isotope to decay to 0.5 g. [1]

Time = hours

5. Water gas is a mixture of carbon monoxide and hydrogen that is made by passing steam over heated carbon.



Calculate the atom economy of this process as a method for the production of hydrogen gas. [2]

Atom economy = %

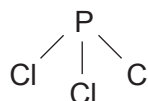
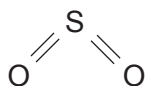
6. Balance the following equation. [1]



7. (a) State the meaning of the term *electronegativity*. [1]

.....

- (b) On the diagrams below mark any permanent dipoles. [1]



- (c) A line in a spectrum has a wavelength of 550 nm.

Calculate the energy change, in kJ mol^{-1} , that corresponds to this line.

[4]

Energy change = kJ mol^{-1}

- (d) The table shows the first ionisation energy for some elements.

Element	First ionisation energy/ kJ mol^{-1}
sodium, Na	496
magnesium, Mg	738
potassium, K	419

- (i) Explain the difference in the values for sodium and magnesium.

[2]

.....

.....

.....

.....

- (ii) Explain the difference in the values for sodium and potassium.

[2]

.....

.....

.....

.....

9. Hydrazine, N_2H_4 , is a liquid that can be used as a rocket fuel. It reacts with oxygen in an exothermic reaction.



- (a) (i) A molecule of hydrazine contains single bonds only.

Draw a dot and cross diagram to show the arrangement of the electrons in hydrazine. You should show outer electrons only. [2]

- (ii) Suggest the bond angle for the $\text{H}-\text{N}-\text{H}$ bonds in hydrazine. Explain your suggestion. [3]

.....

.....

.....

.....

- (b) Calculate the volume of nitrogen produced by the reaction of 20.0 cm^3 of liquid hydrazine with excess oxygen.

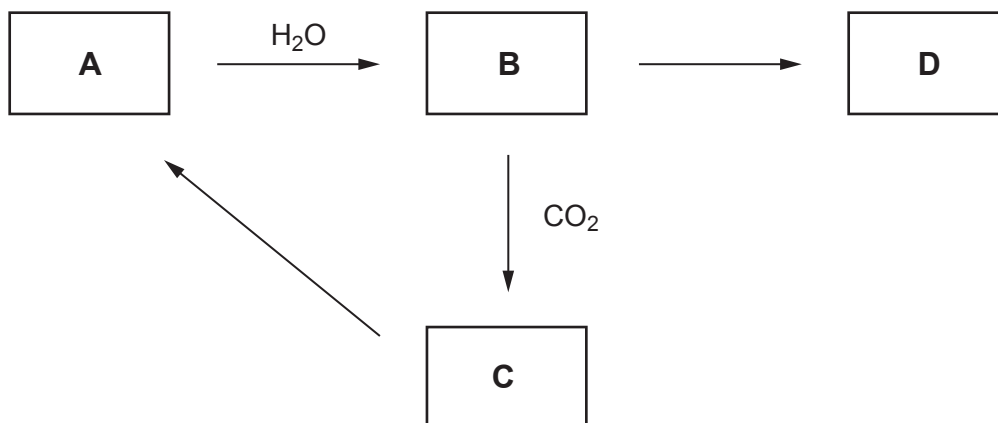
Assume that all measurements are taken at 273 K and 1 atm pressure, that the density of hydrazine is 1.02 g cm^{-3} and that the process has a 35% yield. [4]

Volume = dm^3

- (c) Methane also reacts with oxygen in an exothermic reaction and could be used as a rocket fuel. Apart from conservation of fossil fuel reserves, suggest an environmental advantage of using hydrazine. [1]

.....
.....

10. Some reactions of compounds of the same s-block metal are shown below.



A is a compound that reacts with water to give an aqueous solution of the sparingly soluble compound **B**.

B reacts with carbon dioxide to give a white precipitate of compound **C**.

D is an aqueous solution that gives a white precipitate with aqueous silver nitrate.

(a) Give the names of compounds **A** to **D**. [4]

A

B

C

D

(b) Suggest a reagent that would convert **B** into **D**. [1]

.....

(c) State how the conversion of **C** into **A** could be carried out. [1]

.....

- (d) Write the **ionic** equation for the conversion of **A** into **B**. Include state symbols. [2]

.....

- (e) What would be observed, if anything, if aqueous sodium hydroxide were added dropwise and then to excess to solution **D**? [2]

Dropwise

Excess

- (f) Suggest a test that would confirm the cation present in compounds **A** to **D**. Include the test and the expected result. [2]

Test

Result

12

11. Explain the following statements.

(a) Bromine is a liquid at room temperature and iodine is a solid.

[3]

.....

.....

.....

.....

.....

.....

(b) Graphite conducts electricity but diamond does not.

[3]

.....

.....

.....

.....

.....

.....

(c) The molecular ion peaks are at m/z 158, 160 and 162 in the mass spectrum of bromine, Br_2 . The areas of these peaks are in the ratio of 1 : 2 : 1.

[3]

.....

.....

.....

.....

.....

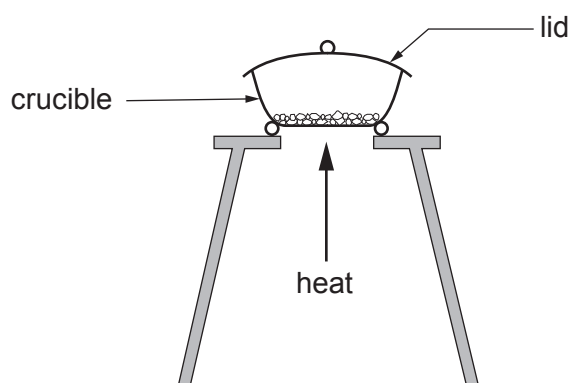
.....

BLANK PAGE

12. Barium chloride exists as a hydrated salt, $\text{BaCl}_2 \cdot x\text{H}_2\text{O}$, where x is the number of molecules of water of crystallisation. To determine the value of x , the hydrated salt is heated to remove the water of crystallisation.

The following method was carried out.

- Weigh an empty crucible with its lid.
- Place about 2.00 g of hydrated barium chloride in the crucible and re-weigh, with its lid.
- Place the lid on the crucible and heat gently at first, then remove the lid and heat strongly for about 2 minutes.



- Place the lid on the crucible and allow it to cool.
- Weigh the cooled crucible with its lid and residue.

The following results were recorded.

Mass of crucible + lid = 10.24 g

Mass of crucible + lid + hydrated barium chloride = 12.25 g

Mass of crucible + lid + residue after heating = 11.97 g

- (a) Calculate the mass of hydrated barium chloride and the mass of residue. Hence determine the value of x . [5]

$x =$

- (b) (i) Suggest why the crucible was heated initially with the lid in place. [1]

.....
.....

- (ii) Suggest why the lid was placed on the crucible when it was left to cool. [1]

.....
.....

- (c) (i) When this experiment is carried out the value of x obtained is often less than the theoretical value. Suggest a reason for this, assuming that the compound contains no impurities. [1]

.....
.....

- (ii) State an improvement that could be made to the practical procedure to overcome the problem you have identified in (c)(i). [1]

.....
.....

- (d) If the error in each balance reading is ± 0.05 g, calculate the percentage error in the mass of hydrated barium chloride used in the experiment. [1]

Percentage error = %

- (e) Apart from the improvement you identified in (c)(ii), suggest another change that could be made to improve the accuracy of the experiment. [1]

.....
.....

BLANK PAGE

**TURN OVER FOR
QUESTION 13**

13. (a) A compound of carbon, hydrogen and oxygen contains 40.0% carbon and 6.7% hydrogen by mass.

1.52 g of the gaseous compound has a volume of 1.76 dm³ at a temperature of 150 °C and a pressure of 1 atm.

Use the data to determine the empirical formula and the molecular formula of this compound. You **must** show clearly how you carried out your calculations. [5]

Empirical formula

Molecular formula

- (b) (i) State what is meant by an acid. [1]

.....

- (ii) Describe how ammonia, NH₃, is able to act as a base. [2]

.....

.....

.....

- (iii) Calculate the pH of 0.43 mol dm⁻³ hydrochloric acid. [2]

pH =

- (c) In the table below name the type of structure and bonding present in magnesium oxide, MgO, and chlorine dioxide, ClO₂. [2]

Examiner
only

Compound	Structure	Bonding
MgO
ClO ₂

12

END OF PAPER

BLANK PAGE