Surname	Centre Number	Candidate Number
Other Names		2

GCE AS

B410U10-1

S19-B410U10-1

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

MONDAY, 20 MAY 2019 – MORNING

1 hour 30 minutes

	For Examiner's use only		
	Question	**Maximum Mark**	**Mark Awarded**
Section A	**1. to 7.**	**10**	
Section B	**8.**	**12**	
	9.	**10**	
	10.	**10**	
	11.	**17**	
	12.	**8**	
	13.	**13**	
	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.8***(b)*(i).

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 for the Br^- ion. [1]

$1s^2 2s^2 2p^6 3s^2$ .....

2. Complete the equation to show what happens when $^{28}_{15}P$ decays by positron emission. [1]

$^{28}_{15}P \longrightarrow {}^{0}_{+1}\beta$ + ...

3. *(a)* State why some covalent bonds are polar but others are not. [1]

.....

.....

(b) On the formulae below show any dipoles. [1]

F — F F — Cl

4. Halogens and their compounds are used in water treatment.

State **one** halogen and **one** halide that are commonly used in water treatment. In **each** case give a reason for their use. [2]

Halogen .....

Reason for use .....

Halide .....

Reason for use .....

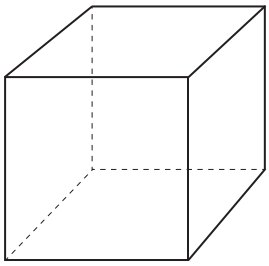
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5. An element absorbs green light with a wavelength of 500 nm. Another element absorbs red light. Suggest a value for the wavelength of this absorption. [1]

..... nm

6. Complete the diagram below to show the arrangement of ions in a sodium chloride lattice. [1]



7. A and B react according to the equation shown.

$$A(g) + 2B(g) \rightleftharpoons AB_2(g)$$

The equilibrium constant, K_c, for this reaction is 1.47 $dm^6 mol^{-2}$. At equilibrium the concentration of A was 0.2 mol dm^{-3}, and that of AB_2 was 0.4 mol dm^{-3}. Calculate the concentration of B. [2]

Concentration of B = ... mol dm^{-3}

10

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SECTION B

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

8. *(a)* A student said that the Periodic Table was a list of the elements arranged in order of increasing mass.

Another student said that this was not the case since it did not apply, for example, to argon and potassium.

Discuss whether the first student was correct and explain why the masses quoted in the Periodic Table for argon and potassium do not follow the general trend of increase in mass. [3]

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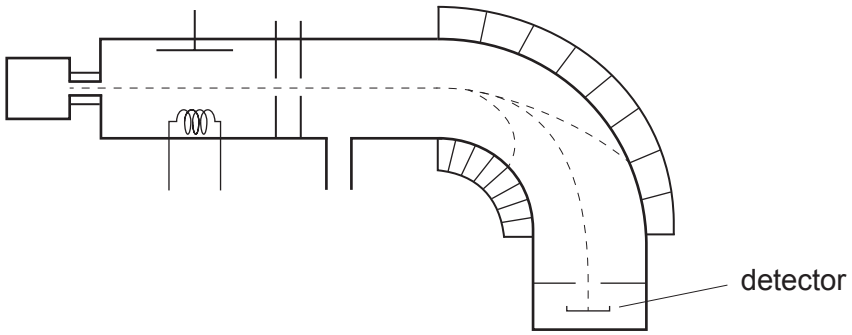
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(b) (i) The relative atomic mass of a sample of an element can be found using a mass spectrometer. The diagram shows the main parts of a mass spectrometer.



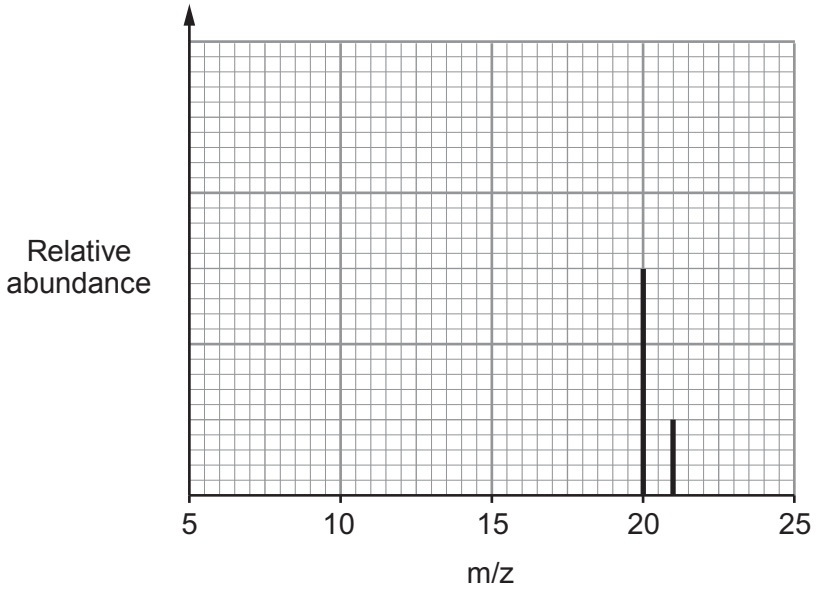
Use this diagram to explain what happens to a sample of the element as it travels through the mass spectrometer. [6 QER]

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(ii) The mass spectrum of an element **T** is shown.

Use this to calculate the relative atomic mass, A_r, of the sample of **T**. [2]



A_r = ...

(iii) The mass spectrum includes a very small peak at m/z 10 (not visible above). Suggest which particle is responsible for the presence of this peak. [1]

.....

12

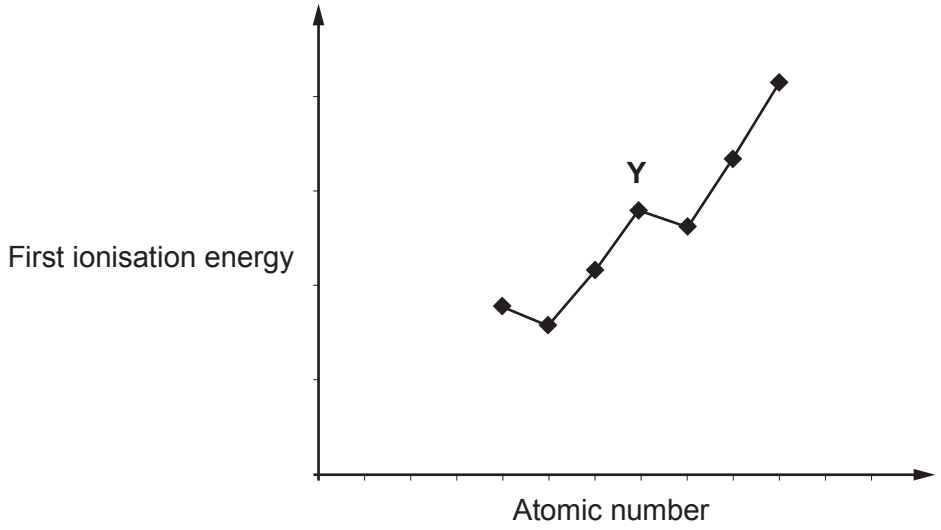
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9. *(a)* Write the equation that corresponds to the molar first ionisation energy of an element. Use **X** to represent the element. [1]

.....

(b) The graph shows the molar first ionisation energy for successive elements in part of the Periodic Table.



(i) Explain why first ionisation energies generally increase in value as a period is crossed from left to right. [2]

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(ii) In which group of the Periodic Table is the element shown as **Y**?

Explain how you reached this conclusion. [2]

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(iii) **On the graph** plot the expected molar first ionisation energy for the next element in the Periodic Table. Label this point **Z**. [1]

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(c) (i) What is meant by the Avogadro constant? [1]

.....

.....

(ii) Calculate the number of oxygen atoms in 34.23 g of aluminium sulfate, $Al_2(SO_4)_3$.

Show clearly how you carried out the calculation. [3]

Number of oxygen atoms = ...

10

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10. Use ideas that you have studied in your Chemistry course to comment on and explain the following observations.

(a) When dilute sulfuric acid is added to aqueous magnesium chloride no visible change occurs but when it is added to aqueous barium chloride a white precipitate is observed.

Include an equation for any reaction that you describe. [3]

(b) The bond angles in sulfur hexafluoride, SF_6, are 90°.

You should include a diagram in your explanation. [3]

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(c) Street lights containing sodium vapour emit yellow light. [4]

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11. *(a)* Both silicon oxide and silicon chloride are covalent compounds. Silicon has a valency of four in both compounds. At room temperature silicon chloride is a liquid whilst silicon oxide is a solid.

(i) Draw a dot and cross diagram to show the bonding in silicon chloride. Show outer electrons only. [2]

(ii) What is the bond angle in silicon chloride? [1]

.....

(iii) When silicon chloride is added to water, solid silicon oxide and a solution with a pH of less than 7 are formed.

Write the equation for this reaction. Include state symbols. [2]

.....

(iv) Suggest why silicon oxide is a solid with a very high melting temperature whereas silicon chloride is a liquid at room temperature. [4]

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(b) The acidity of solutions can be compared using the pH scale.

(i) Calculate the pH of 0.60 mol dm^{-3} nitric acid, HNO_3. [2]

pH = ...

(ii) A student was told that the pH of water is 7.0. The student tested a sample of hot water and found the pH to be 6.9.

Calculate, in mol dm^{-3}, the concentration of hydrogen ions present. [1]

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

(iii) The equilibrium for the dissociation of water is shown.

$$H_2O \rightleftharpoons H^+ + OH^-$$

Use the fact that the pH of the hot water in part (ii) was 6.9 to deduce whether this reaction is exothermic or endothermic. Explain your reasoning. [3]

.....

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(c) Magnesium reacts with hydrochloric acid.

$$Mg(s) + 2HCl(aq) \longrightarrow MgCl_2(aq) + H_2(g)$$

A sample of magnesium of mass 5.00 g was reacted with excess hydrochloric acid. 4.31 dm^3 of hydrogen, measured at 273 K and 1 atm pressure, were produced.

Calculate the percentage purity of the sample of magnesium. [2]

Percentage purity = ... %

17

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12. *(a)* Several different compounds containing sodium, chlorine and oxygen exist. One of these decomposes on heating as shown in the equation.

$$2NaClO_3(s) \longrightarrow 2NaCl(s) + 3O_2(g)$$

(i) What is the oxidation state of chlorine in $NaClO_3$? [1]

.....

(ii) Calculate the maximum volume of gas, measured at 600 K and 1 atm pressure, that can be made by heating 88.0 g of $NaClO_3$. Give your answer to an **appropriate** number of significant figures. [3]

Volume = ... dm^3

(b) The active component of bleach is sodium chlorate(I), NaClO. This is prepared by passing chlorine into aqueous sodium hydroxide.

$$2NaOH(aq) + Cl_2(g) \longrightarrow NaClO(aq) + NaCl(aq) + H_2O(l)$$

Calculate the atom economy of this process when used to prepare sodium chlorate(I). [2]

Atom economy = ... %

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(c) Another compound containing sodium, chlorine and oxygen has the following composition by mass.

Na 18.8 % Cl 29.0 % O 52.2 %

Calculate its empirical formula.

[2]

Empirical formula .....

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13. A sample of witherite, an ore of barium, contains barium carbonate, $BaCO_3$. A geologist investigated the ore to determine the percentage of barium carbonate present by adding a sample of ore to excess acid and then finding how much acid had been neutralised.

He followed these instructions.

Stage 1

Add a known mass of ore to about 100 cm^3 of 0.500 mol dm^{-3} hydrochloric acid in a beaker. Stir until no further reaction occurs.

The geologist used 19.15 g of ore.

Stage 2

Filter and then add more acid to make the total volume of the solution up to exactly 250 cm^3.

Stage 3

Titrate 25.0 cm^3 samples of this solution against 0.100 mol dm^{-3} sodium hydroxide using a suitable indicator.

The geologist used a mean volume of 27.80 cm^3 of the sodium hydroxide to neutralise the acid.

(a) Explain why the geologist filtered the mixture in **Stage 2** of the process. [1]

.....

(b) State which piece of apparatus the geologist would use to make exactly 250 cm^3 of solution in **Stage 2**. [1]

.....

(c) State why an indicator is used in **Stage 3**. [1]

.....

.....

(d) State how many titrations the geologist should carry out in **Stage 3**.
Give a reason for your choice. [1]

.....

.....

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(e) Write the equation for the reaction of barium carbonate with hydrochloric acid. [1]

.....

(f) Calculate the total number of moles of hydrochloric acid **added** to the sample of ore. [1]

Number of moles added = ... mol

(g) Calculate the number of moles of hydrochloric acid neutralised in each titration and hence the number of moles neutralised by the original sample of ore. [3]

Number of moles neutralised by ore = ... mol

QUESTION 13 CONTINUES ON PAGE 18.

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(h) State the number of moles of barium carbonate present in the original sample of ore and hence calculate the percentage by mass of barium in the ore. [3]

Percentage barium in the ore = ... %

(i) The true value for the percentage of barium present in the ore is higher than that calculated in part *(h)*. Suggest a possible reason for this. [1]

.....

.....

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END OF PAPER

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Additional page.