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ADVANCED SUBSIDIARY (AS)  
General Certificate of Education  
2017

Centre Number

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Candidate Number

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## Chemistry

Assessment Unit AS 1  
*assessing*  
Basic Concepts in Physical  
and Inorganic Chemistry

[AC112]

FRIDAY 26 MAY, MORNING

MV18

### Time

1 hour 30 minutes, plus your additional time allowance.

### Instructions to Candidates

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

Answer **all fifteen** questions.

Answer **all ten** questions in **Section A**. Record your answers by marking the appropriate letter on the answer sheet provided. Use only the spaces numbered 1 to 10. Keep in sequence when answering.

Answer **all five** questions in **Section B**. **You must answer the questions in the spaces provided.**

Complete in black ink only.

## Information for Candidates

The total mark for this paper is 100.

Quality of written communication will be assessed in Question **11(d)(ii)**.

In Section A all questions carry equal marks, i.e. **two** marks for each question.

In Section B the figures in brackets printed at the end of each question indicate the marks awarded to each question or part question.

A Periodic Table of Elements, containing some data, is included in this question paper.

## Section A

For each of the following questions only **one** of the lettered responses (A–D) is correct.

**Select the correct response in each case and mark its code letter by connecting the dots as illustrated on the answer sheet.**

- 1 Which one of the following compounds contains the greatest number of ions in 1 kg?
- A NaCl
  - B Na<sub>2</sub>O
  - C MgCl<sub>2</sub>
  - D MgO
- 2 The atomic radius of elements
- A decreases down a group and decreases across a period.
  - B decreases down a group and increases across a period.
  - C increases down a group and decreases across a period.
  - D increases down a group and increases across a period.

3 The table below gives successive ionisation energies for the elements X and Y.

electron removed	1	2	3	4	5	6	7	8
X/ $\text{kJ mol}^{-1}$	577	1820	2740	11 600	14 800	18 400	23 400	27 500
Y/ $\text{kJ mol}^{-1}$	1680	3370	6040	8410	11000	15100	17900	91600

Which one of the following is the formula of the compound formed between X and Y?



4 Which one of the following molecules is **not** polar?

A Ammonia

B Hydrogen fluoride

C Hydrogen sulfide

D Methane

5 Some relative isotopic masses are given in the table below.

isotope	$^1\text{H}$	$^2\text{H}$	$^{12}\text{C}$	$^{14}\text{N}$	$^{16}\text{O}$
relative isotopic mass	1.0078	2.0141	12.0000	14.0031	15.9949

Which one of the following can have a relative mass of 19.0168?

- A  $\text{CH}_4$
- B  $\text{H}_2\text{O}$
- C  $\text{NH}_3$
- D  $\text{NH}_4^+$

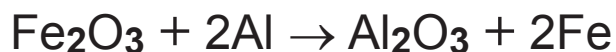
6 The intermolecular forces present in liquid ammonia are

- A hydrogen bonds.
- B hydrogen bonds and van der Waals forces.
- C permanent dipole attractions.
- D van der Waals forces.

7 A white solid gives a green colour in a flame test. A solution of the solid gives a cream precipitate when silver nitrate solution is added. Which one of the following is the white solid?

- A Barium bromide
- B Barium chloride
- C Copper(II) bromide
- D Copper(II) chloride

8 The thermite reaction is as follows:



What is the maximum mass of iron formed from 1 kg of iron(III) oxide and 0.5 kg of aluminium?

- A 0.35 kg
- B 0.52 kg
- C 0.70 kg
- D 1.04 kg

9 The melting points of the elements in the third period are shown in the table below.

Which one of the elements is silicon?

element	A			B	C			D
melting point / °C	-189	-101	44	98	113	650	660	1410

**10** Which one of the following does **not** have the same number of electrons as a sodium ion,  $\text{Na}^+$ ?



## Section B

Answer **all five** questions in this section.

**11** Calcium is found in Group II of the Periodic Table.

**(a)** Explain which block of the Periodic Table contains calcium. [2 marks]

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**(b) (i)** Write the electronic configuration of a calcium atom. [1 mark]

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**(ii)** Draw the shapes of an s and a p orbital. [2 marks]

(c) The relative atomic mass of calcium can be calculated from the abundance of its isotopes.

(i) Explain what is meant by the term **relative atomic mass**. [2 marks]

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(ii) Use the information in the table below to calculate the relative atomic mass of calcium to two decimal places. [2 marks]

isotope	$^{40}\text{Ca}$	$^{42}\text{Ca}$	$^{43}\text{Ca}$	$^{44}\text{Ca}$	$^{48}\text{Ca}$
relative abundance (%)	96.94	0.65	0.13	2.09	0.19

(d) Calcium compounds can be identified by their flame colour.

(i) What is the flame colour of the calcium ion? [1 mark]

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**(ii)** Explain how the flame colour of the calcium ion arises. [3 marks]

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Quality of written communication [2 marks]

**12** Lithium is the first metallic element in the Periodic Table.

**(a) (i)** Draw a labelled diagram to show the bonding present in lithium metal. [3 marks]

**(ii)** Explain why lithium can conduct electricity. [2 marks]

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**(iii)** Explain why magnesium is a better conductor of electricity than lithium. [1 mark]

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**(b)** Lithium reacts with oxygen to form lithium oxide.

- (i)** Draw a dot and cross diagram for the formation of lithium oxide from lithium and oxygen atoms showing outer electrons only. [3 marks]

(ii) State **two** physical properties you would expect lithium oxide to have. [2 marks]

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(c) Graphite, a non-metal, is an electrical conductor whereas diamond is not.

(i) Explain why the structure of graphite allows it to conduct electricity. [1 mark]

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(ii) Explain why the structure of diamond prevents it from conducting electricity. [1 mark]

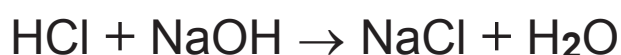
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**13** Barium carbonate,  $\text{BaCO}_3$ , is found in the mineral Witherite. The percentage of barium carbonate in a sample of Witherite can be found by back titration. The Witherite is reacted with an excess of hydrochloric acid.



The excess hydrochloric acid is titrated with standard sodium hydroxide solution.



**(a)** Explain what is meant by the term **standard solution**.  
[1 mark]

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**(b)** Suggest a suitable indicator for the titration and state the colour change at the end point. [3 marks]

Indicator: \_\_\_\_\_

Colour change: from \_\_\_\_\_ to \_\_\_\_\_

(c) 20.0 cm<sup>3</sup> of 2.0 mol dm<sup>-3</sup> hydrochloric acid were added to 1.85 g of Witherite. The solution formed was made up to 250 cm<sup>3</sup> in a volumetric flask. A 25.0 cm<sup>3</sup> portion of this solution required 22.4 cm<sup>3</sup> of 0.1 mol dm<sup>-3</sup> sodium hydroxide solution for complete reaction.

How many moles of hydrochloric acid were added to the Witherite?

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How many moles of sodium hydroxide reacted with the 25.0 cm<sup>3</sup> portion of solution?

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How many moles of hydrochloric acid were in the 25.0 cm<sup>3</sup> portion?

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How many moles of hydrochloric acid were in 250 cm<sup>3</sup> of the solution?

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How many moles of hydrochloric acid reacted with the Witherite?

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How many moles of barium carbonate were present in the sample of Witherite?

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What mass of barium carbonate was present in the Witherite?

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What is the percentage mass of barium carbonate in the sample of Witherite? [6 marks]

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**(d)** What assumption about impurities in the Witherite has been made in the back titration? [1 mark]

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**14** The table below gives some information about the halogens.

	<b>fluorine</b>	<b>chlorine</b>	<b>bromine</b>	<b>iodine</b>
<b>appearance at room temperature</b>	yellow gas			
<b>boiling point/°C</b>	-188	-34	59	sublimes*
<b>first ionisation energy/ kJ mol<sup>-1</sup></b>	1680	1251	1140	1008

\*changes directly from solid to gas

**(a) (i)** Complete the table by describing the appearance of each halogen. [3 marks]

**(ii)** Explain the change in the boiling points of the halogens. [2 marks]

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**(iii)** Explain the change in the first ionisation energies of the halogens. [2 marks]

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**(b)** Iodine undergoes different reactions with solutions of cold dilute hydroxide ions and hot concentrated hydroxide ions.

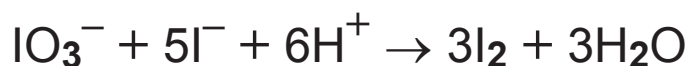
**(i)** Write the ionic equation for the reaction of cold dilute hydroxide ions with iodine to give iodate(I) ions.  
[2 marks]

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**(ii)** Write the ionic equation for the reaction of hot concentrated hydroxide ions with iodine to give iodate(V) ions. [2 marks]

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**(c)** Iodide ions react with iodate ions as follows:



Using oxidation numbers explain why this is described as a redox reaction. [3 marks]

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(d) Iron(III) ions are reduced to iron(II) ions by iodide ions.

(i) Write an ionic equation for the reaction. [1 mark]

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(ii) State the colour change which is observed in the reaction. [2 marks]

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(e) Solid potassium iodide reacts with concentrated sulfuric acid to produce a variety of products. Give **three** observations which could be made during the reaction. [3 marks]

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(f) Some public water supplies are fluoridated.

(i) Explain what is meant by the term **fluoridation**. [1 mark]

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(ii) Give **one** advantage and **one** disadvantage of fluoridation. [2 marks]

Advantage: \_\_\_\_\_

\_\_\_\_\_

Disadvantage: \_\_\_\_\_

\_\_\_\_\_

**15** The name flerovium, symbol Fl, was assigned to element 114 in 2012.

**(a)** Flerovium has three isotopes.

**(i)** Explain what is meant by the term **isotopes**.  
[1 mark]

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**(ii)** Complete the table below showing the number of protons, neutrons and electrons present in each isotope of flerovium. [2 marks]

	$^{287}\text{Fl}$	$^{289}\text{Fl}$	$^{292}\text{Fl}$
protons			
neutrons			
electrons			

**(iii)** Explain why there is no difference in the chemical properties of the isotopes of flerovium. [1 mark]

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(b) The table below shows the number of electrons in each of flerovium's shells.

electron shell	1	2	3	4	5	6	7
number of electrons	2	8	18	32	32	18	4

(i) Suggest in which period of the Periodic Table flerovium is found. [1 mark]

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(ii) Suggest in which group of the Periodic Table flerovium is found. [1 mark]

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(c) Flerovium forms a number of compounds and ions, including  $\text{FlF}_4$ ,  $\text{FlH}_4$ ,  $\text{FlO}_2^{2-}$  and  $\text{FlF}_6^{2-}$ .

(i) Write an equation for the formation of  $\text{FlF}_4$  from its elements. [1 mark]

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(ii)  $\text{FlH}_4$  is unstable and decomposes to form  $\text{FlH}_2$ . Write an equation for the decomposition. [1 mark]

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(iii)  $\text{FIO}_2^{2-}$  is formed when  $\text{FIO}$  reacts with water. Write an equation for the reaction. [1 mark]

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(iv) Draw dot and cross diagrams, using only the outer electrons, for  $\text{FIF}_4$  and  $\text{FIF}_6^{2-}$ . [2 marks]

(v) Suggest the shapes of the  $\text{FIF}_4$  molecule and the  $\text{FIF}_6^{2-}$  ion. [2 marks]

$\text{FIF}_4$  \_\_\_\_\_

$\text{FIF}_6^{2-}$  \_\_\_\_\_

(d) The first ionisation energy of flerovium is  $823.9 \text{ kJ mol}^{-1}$ .

(i) Write an equation for the first ionisation of flerovium.  
[2 marks]

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(ii) Calculate the frequency of the light associated with the value of the first ionisation energy of flerovium.  
[3 marks]

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<b>For Examiner's use only</b>	
<b>Question Number</b>	<b>Marks</b>
<b>Section A</b>	
1–10	
<b>Section B</b>	
11	
12	
13	
14	
15	
<b>Total Marks</b>	

Examiner Number

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