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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 Na₂O

C MgCl₂

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/ kJ mol^{-1}	577	1820	2740	11 600	14 800	18 400	23 400	27 500
Y/ 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?

- A XY_2
 - B XY_3
 - C X_2Y
 - D X_3Y
- 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	^1H	^2H	^{12}C	^{14}N	^{16}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 CH_4
- B H_2O
- C NH_3
- D NH_4^+

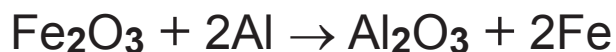
6 The intermolecular forces present in liquid ammonia are

- 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, 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]

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

(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]

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

isotope	^{40}Ca	^{42}Ca	^{43}Ca	^{44}Ca	^{48}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]

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

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]

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

(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]

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

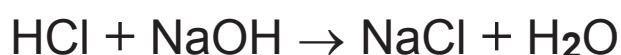
- (i) Explain why the structure of graphite allows it to conduct electricity. [1 mark]

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

- 13** Barium carbonate, 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]

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

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

How many moles of sodium hydroxide reacted with the 25.0 cm^3 portion of solution?

How many moles of hydrochloric acid were in the 25.0 cm^3 portion?

How many moles of hydrochloric acid were in 250 cm^3 of the solution?

How many moles of hydrochloric acid reacted with the Witherite?

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

What mass of barium carbonate was present in the Witherite?

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

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

14 The table below gives some information about the halogens.

	fluorine	chlorine	bromine	iodine
appearance at room temperature	yellow gas			
boiling point/°C	−188	−34	59	sublimes*
first ionisation energy/ kJ mol^{−1}	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]

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

(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]

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

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



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

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

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

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

(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]

(f) Some public water supplies are fluoridated.

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

(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]

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

	^{287}Fl	^{289}Fl	^{292}Fl
protons			
neutrons			
electrons			

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

- (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]

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

- (c) Flerovium forms a number of compounds and ions, including FlF_4 , FlH_4 , FlO_2^{2-} and FlF_6^{2-} .

- (i) Write an equation for the formation of FlF_4 from its elements. [1 mark]

- (ii) FlH_4 is unstable and decomposes to form FlH_2 . Write an equation for the decomposition. [1 mark]

(iii) FIO_2^{2-} is formed when FIO reacts with water. Write an equation for the reaction. [1 mark]

(iv) Draw dot and cross diagrams, using only the outer electrons, for FIF_4 and FIF_6^{2-} . [2 marks]

(v) Suggest the shapes of the FIF_4 molecule and the FIF_6^{2-} ion. [2 marks]

FIF_4 _____

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]

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

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For Examiner's use only	
Question Number	Marks
Section A	
1–10	
Section B	
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14	
15	
Total Marks	

Examiner Number

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