



Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2012

Centre Number

71

Candidate Number

Chemistry

Assessment Unit AS 1

assessing

Basic Concepts in Physical
and Inorganic Chemistry

[AC112]

WEDNESDAY 13 JUNE, MORNING

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**. Write your answers in the spaces provided in this question paper.

INFORMATION FOR CANDIDATES

The total mark for this paper is 100.

Quality of written communication will be assessed in question **14(b)(i)**.

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 (including some data) is provided.

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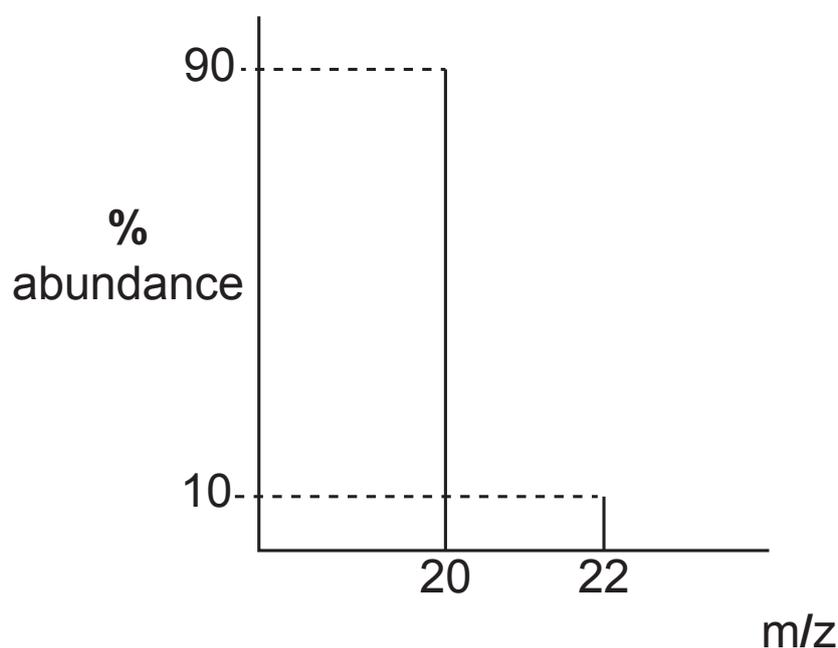
(Questions start overleaf)

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 Part of the mass spectrum for an element is shown below:



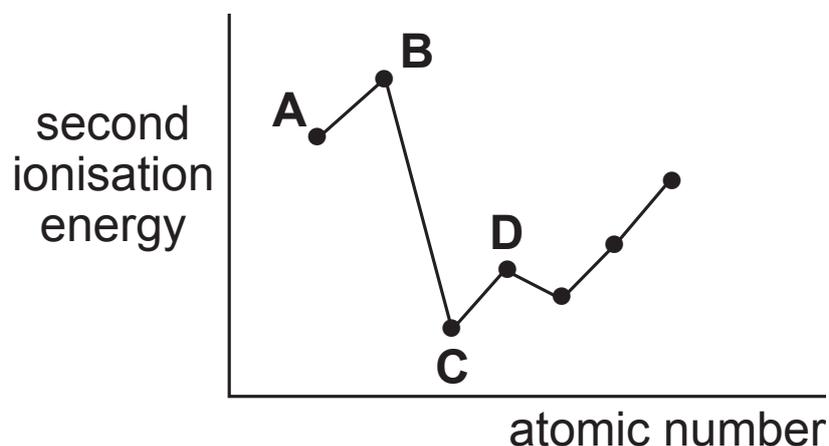
Which one of the following is the relative atomic mass of the element?

- A 20.0
- B 20.2
- C 21.0
- D 22.8

2 Which one of the following metal compounds will produce a lilac flame colour?

- A barium nitrate
- B calcium chloride
- C lithium chloride
- D potassium sulfate

3 The graph below shows how the **second** ionisation energy of elements varies across a period.



Which one of the elements is an alkali metal?

4 Which one of the following is the oxidation number of nitrogen in the nitrate ion, NO_3^- ?

- A -1
- B -3
- C +5
- D +7

- 5 Which one of the following molecules is the most polar?
- A BF_3
 - B CO_2
 - C F_2
 - D NH_3
- 6 Which one of the following m/z values will **not** appear when a sample of chlorine gas is injected into a mass spectrometer?
- A 35.0
 - B 35.5
 - C 37.0
 - D 74.0
- 7 Which one of the following molecules contains the smallest bond angle?
- A BeCl_2
 - B BF_3
 - C CH_4
 - D SF_6

8 5.30 g of anhydrous sodium carbonate was dissolved in water and made up to 250 cm^3 in a volumetric flask. Which one of the following is the concentration of **sodium ions** in mol dm^{-3} ?

- A 0.05
- B 0.10
- C 0.20
- D 0.40

9 Which block in the Periodic Table contains silver?

- A d block
- B f block
- C p block
- D s block

10 Which one of the following is involved in metallic bonding?

- A electron delocalisation
- B electron transitions
- C gaining electrons to form ions
- D sharing electron pairs

Section B

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

11 The elements magnesium and chlorine are characterised by their atomic numbers. Chlorine has two isotopes each with a different mass number.

(a) Define each of the following in terms of protons, neutrons and electrons.

(i) atomic number [1]

(ii) mass number [1]

(iii) isotopes [1]

(b) Magnesium reacts with chlorine to form magnesium chloride.

(i) How many protons, neutrons and electrons are present in each of the following ions? [2]

Ion	Numbers of		
	protons	neutrons	electrons
$^{24}\text{Mg}^{2+}$			
$^{35}\text{Cl}^{-}$			

(ii) Use the boxes below to complete the electronic configuration of the ions: [1]/[1]

	1s	2s	2p	3s	3p
$^{24}\text{Mg}^{2+}$	<input type="text"/>	<input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/>
$^{35}\text{Cl}^{-}$	<input type="text"/>	<input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/>

(iii) Use a dot and cross diagram to show, using outer electrons only, how magnesium atoms react with chlorine atoms to form magnesium chloride. [4]

(c) Magnesium forms ions with a double positive charge.

(i) Define the term **second ionisation energy**. [2]

(ii) Write an equation, including state symbols, which represents the second ionisation energy of magnesium. [2]

(iii) Give reasons why the third ionisation energy of magnesium is much larger than the second. [3]

(d) The Group II chloride, SrCl_2 , produces a characteristic red colour in a Bunsen flame. Explain, using energy levels, why this colour is observed. [3]

12 Avogadro's number has the value 6.02×10^{23} .

(a) Define the term **Avogadro's number**. [2]

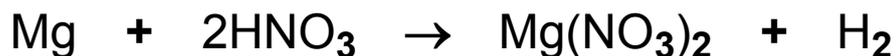
(b) X is an oxide of nitrogen.

(i) 2.30 g of X contains 3.01×10^{22} molecules of X.
Calculate the molar mass of X. [2]

(ii) Deduce the formula of X. [1]

(c) Dinitrogen tetroxide (N_2O_4) reacts with water to form nitric acid, (HNO_3) and nitrogen(II) oxide (NO). Write an equation for the reaction. [1]

(d) Dilute nitric acid reacts with magnesium:



(i) Calculate the volume, in cm^3 , of 2.0 mol dm^{-3} nitric acid required to react with 6.0 g of magnesium.

Number of moles of magnesium [1]

Number of moles of nitric acid [1]

Volume of nitric acid (in cm^3) [1]

(ii) Calculate the mass of magnesium nitrate produced.

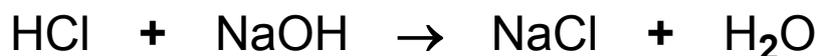
Number of moles of magnesium nitrate produced [1]

Mass of magnesium nitrate produced [1]

13 Calcium carbonate is present in eggshells. The percentage of calcium carbonate may be determined by a back titration method. The eggshells are crushed, weighed and then treated with excess dilute hydrochloric acid.



The unreacted acid is then titrated with standard sodium hydroxide solution.



(a) (i) Explain the term **standard solution**. [1]

(ii) Name a suitable indicator for the titration and state the colour change occurring at the end point. [1]/[2]

indicator _____

from _____

to _____

(b) A student weighed out 10.0 g of the crushed eggshells and added 100.0 cm³ of 2.0 mol dm⁻³ hydrochloric acid. The resultant solution was transferred to a 250 cm³ volumetric flask and made up to the mark with distilled water. 25.0 cm³ portions of the solution were titrated with 0.10 mol dm⁻³ sodium hydroxide solution. The average titre was found to be 18.0 cm³.

(i) Calculate the number of moles of sodium hydroxide used in the titration. [1]

(ii) Calculate the number of moles of hydrochloric acid present in the 25.0 cm³ portion. [1]

(iii) Calculate the number of moles of hydrochloric acid present in the 250 cm³ volumetric flask. [1]

(iv) Calculate the total number of moles of hydrochloric acid added to the crushed eggshells. [1]

(v) Calculate the number of moles of hydrochloric acid which reacted with the calcium carbonate in the crushed eggshells. [1]

(vi) Calculate the number of moles of calcium carbonate in the crushed eggshells. [1]

(vii) Calculate the mass of calcium carbonate in the crushed eggshells. [1]

(viii) Calculate the percentage, by mass, of calcium carbonate in the crushed eggshells. [1]

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(Questions continue overleaf)

14 The halogens are reactive non-metals which often react by gaining electrons to form halide ions.

(a) Complete the table to show the colours and physical states of chlorine, bromine and iodine at room temperature and pressure. [3]

Halogen	Colour	Physical State
Chlorine		
Bromine		
Iodine		

(b) Solutions of silver nitrate and ammonia can be used to test for the presence of aqueous halide ions.

(i) Describe how you would use these reagents to distinguish between solutions of sodium chloride, sodium bromide and sodium iodide. State the expected result for each solution. [6]

Quality of written communication [2]

- (ii) Give an ionic equation, including state symbols, for the reaction of aqueous sodium iodide with silver nitrate solution. [2]

(c) Solid samples of sodium chloride, sodium bromide and sodium iodide can be distinguished using concentrated sulfuric acid.

(i) Write an equation for the reaction of sodium chloride with concentrated sulfuric acid. [2]

(ii) Balance the following half-equation for the reduction of concentrated sulfuric acid to form hydrogen sulfide: [2]



(iii) Combine the reduction half-equation in (c)(ii) with the following oxidation half-equation to produce a balanced redox equation. [2]



(iv) Give **one** observation which indicates the formation of hydrogen sulfide. [1]

(v) Name **two** other reduction products which are formed when concentrated sulfuric acid is added to sodium iodide. [2]

(vi) Suggest why iodide ions are stronger reducing agents than chloride ions. [2]

(d) (i) Write the equation for the reaction of chlorine with hot concentrated sodium hydroxide solution. [2]

(ii) Name the type of redox reaction taking place. [1]

15 The bonding and shape of a water molecule determines the properties of water.

(a) Draw a dot and cross diagram to show the bonding in a water molecule. [2]

(b) (i) What is the bond angle in a water molecule? [1]

(ii) State the shape of a water molecule and explain why it adopts this shape. [3]

(iii) Why is the bond angle of water different to the bond angle in methane? [1]

(c) Why does water have a higher boiling point than hydrogen sulfide? [2]

THIS IS THE END OF THE QUESTION PAPER

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

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