



Rewarding Learning

ADVANCED SUBSIDIARY (AS)  
General Certificate of Education  
2011

Centre Number

71

Candidate Number

## Chemistry

### Assessment Unit AS 1

*assessing*

Basic Concepts in Physical  
and Inorganic Chemistry

[AC112]



WEDNESDAY 15 JUNE, AFTERNOON

#### TIME

1 hour 30 minutes.

#### INSTRUCTIONS TO CANDIDATES

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

Answer **all sixteen** 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 six** 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 **15(f)**.

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

In Section B the figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

A Periodic Table of Elements (including some data) is provided.

For Examiner's  
use only

Question Number	Marks
Section A	
1-10	
Section B	
11	
12	
13	
14	
15	
16	

Total  
Marks

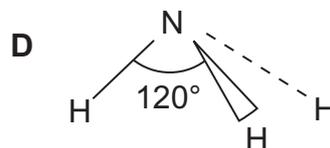
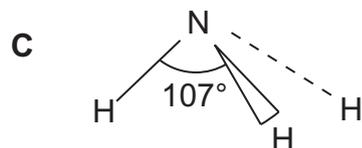
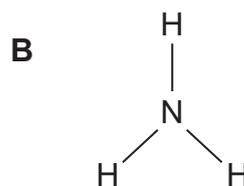
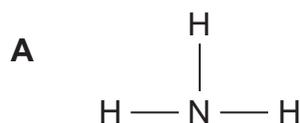
## Section A

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 An element which forms an ion smaller than its atom is
- A chlorine.
  - B potassium.
  - C oxygen.
  - D sulfur.
- 2 A compound which does **not** consist of individual molecules is
- A beryllium chloride.
  - B calcium chloride.
  - C hydrogen chloride.
  - D phosphorus trichloride.
- 3 Which one of the following elements contains the same number of electrons as an ion of magnesium,  $\text{Mg}^{2+}$ ?
- A calcium
  - B fluorine
  - C neon
  - D sodium
- 4 Which one of the following is the mass of calcium carbonate which will exactly neutralise  $500\text{ cm}^3$  of 0.1 M hydrochloric acid?
- A 1.25 g
  - B 2.50 g
  - C 12.50 g
  - D 25.0 g

5 Which one of the following is the shape of the ammonia molecule?



6 If 30 g of water were completely converted into hydrogen and oxygen which one of the following would be the total mass of gases produced?

- A 10 g
- B 30 g
- C 45 g
- D 90 g

7 Which one of the following can **not** be used to obtain hydrogen chloride in the laboratory?

- A burning hydrogen in chlorine
- B heating concentrated hydrochloric acid
- C the reaction of chlorine with methane
- D bubbling chlorine through hexane at room temperature

8 The element europium reacts with hydrogen to form europium hydride. Atoms of europium have their outer electrons in levels 5 and 6 i.e.  $5s^2 5p^6 6s^2$ . Which one of the following formulae resembles europium hydride?

- A  $AsH_3$
- B  $CH_4$
- C  $CaH_2$
- D  $SnH_4$

9 Which one of the following atoms in the ground state contains **no** unpaired electrons?

- A argon
- B fluorine
- C potassium
- D sulfur

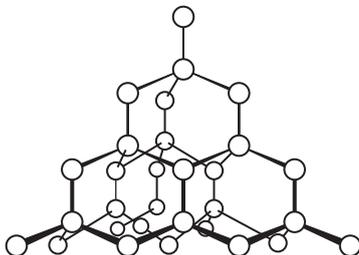
10 Which one of the following species contains a coordinate bond?

- A  $\text{NH}_3$
- B  $\text{NH}_4^+$
- C  $\text{NH}_2^-$
- D  $\text{NH}^{2-}$

**Section B**

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

- 11** The molecule drawn below is that of a giant covalent structure. All the atoms are of the same element.



- (a)** Name the substance.

\_\_\_\_\_ [1]

- (b)** Explain whether the substance is hard or soft.

\_\_\_\_\_  
\_\_\_\_\_ [2]

- (c)** Explain whether the substance conducts electricity or not.

\_\_\_\_\_  
\_\_\_\_\_ [2]

**Examiner Only****Marks Remark**

**12** Barium chloride crystallises from water to form a hydrate with the formula  $\text{BaCl}_2 \cdot x\text{H}_2\text{O}$ . On heating, the hydrate loses water to form anhydrous barium chloride. A solution of barium chloride is colourless.

**(a)** Barium chloride solution reacts with aqueous silver nitrate to form silver chloride.

**(i)** Write the equation for the reaction.

\_\_\_\_\_ [1]

**(ii)** Write the ionic equation for the reaction.

\_\_\_\_\_ [1]

**(iii)** Describe what is observed during the reaction.

\_\_\_\_\_ [1]

**(b)** 3.05 g of  $\text{BaCl}_2 \cdot x\text{H}_2\text{O}$  were dissolved in water to make  $250\text{ cm}^3$  of solution in a graduated flask.  $20\text{ cm}^3$  of this solution were titrated with 0.1 M silver nitrate solution. It was found that  $20.0\text{ cm}^3$  were required.

**(i)** How many moles of silver ions were added during the titration?

\_\_\_\_\_ [1]

**(ii)** How many moles of chloride ions were there in  $20\text{ cm}^3$  of the barium chloride solution?

\_\_\_\_\_ [1]

**(iii)** How many moles of anhydrous barium chloride were there in  $250\text{ cm}^3$  of the solution?

\_\_\_\_\_ [1]

**(iv)** What is the relative formula mass of the hydrated barium chloride?

\_\_\_\_\_ [1]

Examiner Only

Marks

Remark

(v) What is the relative formula mass of anhydrous barium chloride?

\_\_\_\_\_ [1]

(vi) Calculate the value of x in  $\text{BaCl}_2 \cdot x\text{H}_2\text{O}$

\_\_\_\_\_ [1]

(c) Write the equation for the action of heat on the hydrated barium chloride.

\_\_\_\_\_ [1]

Examiner Only

Marks Remark

13 Astatine, the last element of the halogen group, was synthesised in 1940. Since then it has been stated that it is the rarest naturally occurring element on Earth with an estimated 30g of astatine existing at any one time. It was named from the Greek word for “unstable”.

(a) The longest living isotope of astatine is astatine-210,  $^{210}\text{At}$ . However, half of this isotope disappears after about 8 hours.

(i) Define the meaning of the term **isotope**.

\_\_\_\_\_ [2]  
\_\_\_\_\_

(ii) Name and calculate the numbers of the individual sub-atomic particles in one atom of astatine-210.

\_\_\_\_\_ [3]  
\_\_\_\_\_

(b) Using Avogadro's number calculate the number of astatine atoms that exist in 30g of astatine. Assume that all of the atoms are of astatine-210.

\_\_\_\_\_ [2]  
\_\_\_\_\_

(c) Astatine was predicted to exist by Mendeleev in his original Periodic Table and was given the name eka-iodine.

Complete the table below by predicting some of the properties of astatine.

Property	Result for Astatine
formula of an astatine molecule	
physical state at room temperature	
colour of astatine at room temperature	
colour of astatine vapour/gas	
solubility in water (yes or no)	
solubility in hexane (yes or no)	

[6]

Examiner Only

Marks Remark

(d) Write the equation for the reaction of iodine with sodium astatide.

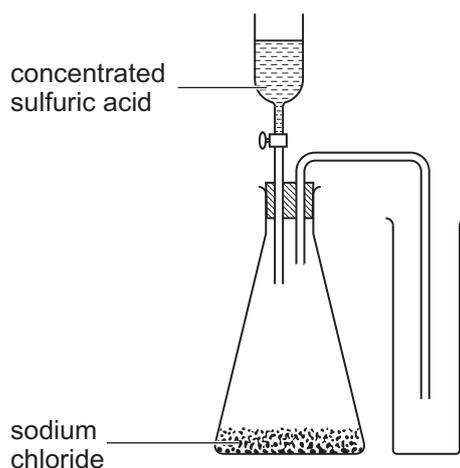
\_\_\_\_\_ [1]

(e) Astatine was first made by bombarding bismuth with alpha particles. Explain how you would show, using mass spectrometry, that astatine had actually been formed.

\_\_\_\_\_  
\_\_\_\_\_ [1]

Examiner Only	
Marks	Remark

- 14 The diagram below shows a common method of preparing hydrogen chloride gas in the laboratory.



- (a) Write the equation for the reaction of sodium chloride with concentrated sulfuric acid.

\_\_\_\_\_ [2]

- (b) The hydrogen chloride is collected by “downward delivery” in which air, a mixture of oxygen and nitrogen, is displaced upwards.

- (i) Calculate the relative molecular masses of oxygen, nitrogen and hydrogen chloride.

oxygen \_\_\_\_\_

nitrogen \_\_\_\_\_

hydrogen chloride \_\_\_\_\_ [2]

- (ii) Use the values of the calculated relative molecular masses to explain why hydrogen chloride is collected by downward delivery.

\_\_\_\_\_

\_\_\_\_\_ [2]

Examiner Only

Marks Remark

(c) Sometimes dry hydrogen chloride gas is required.

(i) Explain why sodium hydroxide would be inappropriate to use as a drying agent.

\_\_\_\_\_ [1]

(ii) Suggest the name of a substance which could be used.

\_\_\_\_\_ [1]

(d) Explain whether concentrated sulfuric acid could be reacted with sodium bromide in the preparation of hydrogen bromide using this method.

\_\_\_\_\_ [1]

(e) Which one of the following acids, hydrogen chloride, hydrogen bromide and hydrogen iodide is the strongest?

\_\_\_\_\_ [1]

(f) How could you prove that a gas jar you believed contained hydrogen chloride actually contained the gas.

\_\_\_\_\_  
\_\_\_\_\_ [2]

Examiner Only

Marks Remark

- 15 Some properties of the Group I elements from sodium to caesium are shown in the table below.

metal	ionic radius/nm	first ionisation energy/kJ mol <sup>-1</sup>	melting point/K
sodium	0.102	496	371
potassium	0.138	419	336
rubidium	0.149	403	312
caesium	0.170	376	302

- (a) Explain why all of the Group I elements are described as being s-block elements.

\_\_\_\_\_ [1]

- (b) Explain why the ionic radius increases down the group.

\_\_\_\_\_  
 \_\_\_\_\_ [1]

- (c) The first ionisation energy of the Group I elements may be determined using spectroscopic methods.

- (i) If the frequency of the radiation needed to remove the outermost electron from a sodium atom is  $1.25 \times 10^{15} \text{ s}^{-1}$  calculate the first ionisation energy of sodium in kJ per mole.

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_ [3]

- (ii) Write the equation, using state symbols, for the first ionisation energy of sodium.

\_\_\_\_\_ [2]

Examiner Only	
Marks	Remark





16 Carbon dioxide is the most frequently found oxide of carbon in nature. It is a colourless gas with a faint taste and smell. The structure of the molecule can be readily deduced by the application of the octet rule. Even though carbon and oxygen have different electronegativities the molecule does not have a permanent dipole.

(a) Explain the term **octet rule**.

\_\_\_\_\_  
\_\_\_\_\_ [2]

(b) Explain the term **electronegativity**.

\_\_\_\_\_  
\_\_\_\_\_ [2]

(c) (i) Using outer electrons only draw the dot and cross structure of carbon dioxide.

[2]

(ii) Draw and name the shape of a carbon dioxide molecule.

\_\_\_\_\_ [2]

(iii) Explain why carbon dioxide has the shape you have drawn.

\_\_\_\_\_  
\_\_\_\_\_ [2]

Examiner Only

Marks Remark

- (d) Carbon and oxygen have different electronegativities and form a polar bond.

Explain why a carbon dioxide molecule does not have a permanent dipole.

\_\_\_\_\_ [1]  
\_\_\_\_\_

- (e) Although carbon dioxide does not have a dipole it is very soluble in water. Using intermolecular forces explain this extreme solubility.

\_\_\_\_\_ [2]  
\_\_\_\_\_

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**THIS IS THE END OF THE QUESTION PAPER**

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Examiner Only	
Marks	Remark







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