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Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2011

Chemistry

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

[AC112]

WEDNESDAY 15 JUNE, AFTERNOON

AC112

For Examiner's use only	
Question Number	Marks
Section A	
1-10	
Section B	
11	
12	
13	
14	
15	
16	
Total Marks	

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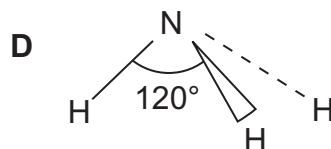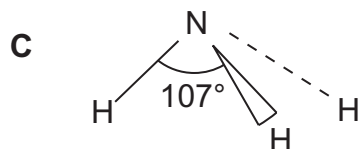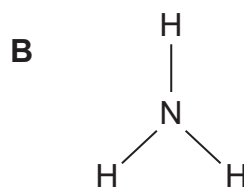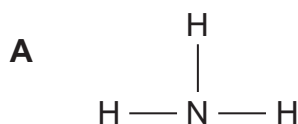A Periodic Table of Elements (including some data) is provided.

6898

Section A

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

Select the correct response in each case and mark its code letter by connecting the
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, 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
     $500 \, cm^3$ 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?

A
$$H - N - H$$
with H above N

B
N with three H bonds (H above, two H below)

C
N with 107° angle, three H atoms

D
N with 120° angle, three H atoms

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

3

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

    A   argon
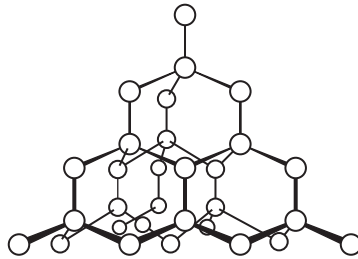   B   fluorine
    C   potassium
    D   sulfur

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

    A NH_3
    B NH_4^+
    C NH_2^-
    D 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]

12 Barium chloride crystallises from water to form a hydrate with the formula $BaCl_2.xH_2O$. 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 $BaCl_2.xH_2O$ were dissolved in water to make 250 cm³ of solution in a graduated flask. 20 cm³ of this solution were titrated with 0.1 M silver nitrate solution. It was found that 20.0 cm³ 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 cm³ of the barium chloride solution?

_____ [1]

(iii) How many moles of anhydrous barium chloride were there in 250 cm³ of the solution?

_____ [1]

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

_____ [1]

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

_____ [1]

(vi) Calculate the value of x in $BaCl_2.xH_2O$

_____ [1]

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

_____ [1]

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 30 g 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}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 30 g 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]

(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]

[Turn over

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

concentrated
sulfuric acid
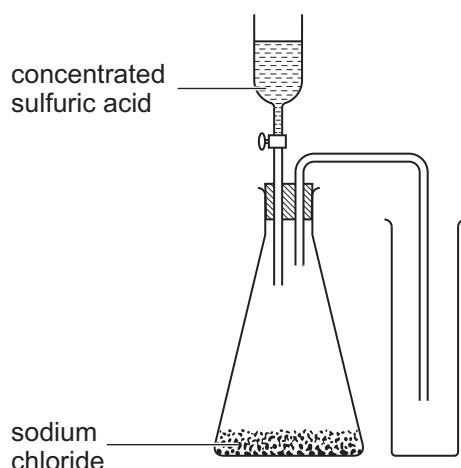
sodium
chloride

(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]

(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]

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^{-1}	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 1.25×10^{15} 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]

(iii) Give **two** reasons to explain why potassium has a lower first ionisation energy than sodium.

_____

_____

_____ [2]

(iv) Why is the second ionisation energy of all the Group I metals very much higher than the first?

_____

_____ [1]

(d) All of the Group I metals exhibit metallic bonding.

(i) Using a labelled diagram, explain what is meant by the term **metallic bonding**.

_____

_____ [3]

(ii) Suggest why the melting point of the metals decreases from sodium to caesium.

_____

_____ [1]

(iii) Using the concept of metallic bonding suggest why calcium should be a better electrical conductor than potassium.

_____

_____ [1]

(e) All of the Group I metals react with halogens to form ionic metal halides. Using outer electrons only draw diagrams to explain the formation of caesium chloride from caesium atoms and chlorine atoms.

[3]

(f) All of the Group I elements produce characteristic flame colours in a Bunsen burner flame which can be used to identify them.

(i) Describe how you would carry out a flame test.

_____

_____

_____

_____

_____ [4]

Quality of written communication [2]

(ii) How would you distinguish between sodium chloride and potassium chloride using a flame test?

_____

_____ [1]

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]

(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]

THIS IS THE END OF THE QUESTION PAPER

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