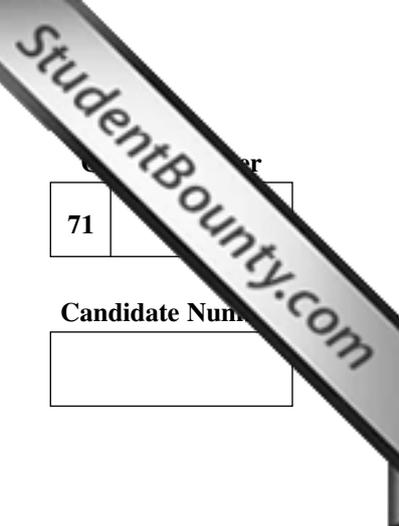




Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2009



71	
Candidate Number	
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Chemistry

Assessment Unit AS 1

assessing

Module 1: General Chemistry

[ASC11]



WEDNESDAY 3 JUNE, MORNING

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 seventeen** 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 seven** 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 **16(e)**. 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	
17	
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 illustrated on the answer sheet.

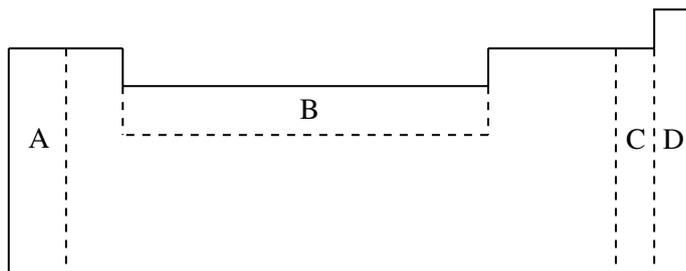
- 1 20 cm³ of 0.3 mol dm⁻³ potassium hydroxide solution is exactly neutralised by
- A 10 cm³ of 0.3 mol dm⁻³ sulphuric acid.
 - B 10 cm³ of 0.6 mol dm⁻³ sulphuric acid.
 - C 20 cm³ of 0.3 mol dm⁻³ sulphuric acid.
 - D 20 cm³ of 0.6 mol dm⁻³ sulphuric acid.
- 2 A positively charged particle with the electron configuration 1s²2s²2p⁶ is
- A an aluminium ion.
 - B a fluoride ion.
 - C an oxide ion.
 - D a potassium ion.
- 3 Which one of the following molecules contains a triple bond?
- A C₂H₄
 - B CO₂
 - C N₂
 - D NF₃
- 4 Which one of the following sodium compounds produces a gas when treated with dilute sulphuric acid?
- A sodium carbonate
 - B sodium chloride
 - C sodium fluoride
 - D sodium iodide

- 5 Which one of the following contains the name of the reagent and that of the indicator used in an iodine titration?
- A sodium sulphate and starch
 - B sodium sulphate and methyl orange
 - C sodium thiosulphate and starch
 - D sodium thiosulphate and methyl orange

- 6 Which one of the following electron configurations has two unpaired electrons?

- A $1s^2 2s^2$
- B $1s^2 2s^2 2p^3$
- C $1s^2 2s^2 2p^4$
- D $1s^2 2s^2 2p^6 3s^2 3p^5$

- 7 Which area of the Periodic Table contains elements which have only s electrons in their outer shells?



- 8 Which one of the following chloro-compounds is non-polar?

- A HCl
- B CCl_4
- C CH_3Cl
- D $CHCl_3$

9 Which one of the following contains a coordinate bond?

- A N_2
- B NH_3
- C NH_2^-
- D NH_4^+

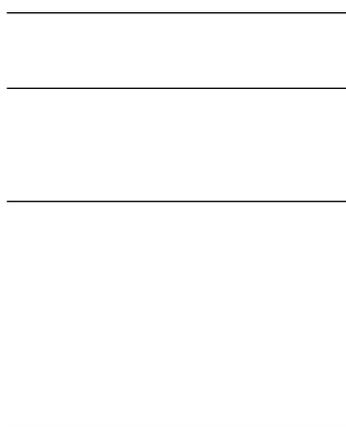
10 The enthalpy of neutralisation when an acid reacts with an alkali is, by definition, the number of kilojoules released by

- A the formation of one mole of salt.
- B the formation of one mole of water.
- C the neutralisation of one mole of acid.
- D the neutralisation of one mole of alkali.

Section B

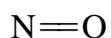
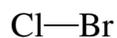
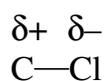
Answer all **seven** questions in the spaces provided.

- 11 The electronic energy levels of atomic hydrogen are shown below. Draw an arrow on the diagram which represents the energy change associated with the lowest frequency line in the ultraviolet emission spectrum.



[3]

- 12 The electronegativity of atoms causes bonds to be polar. Indicate the polarity of the following bonds. The first one has been completed for you.



[3]

- 13 The female of the American cockroach (*Periplaneta americana*) secretes a chemical (pheromone) of molecular formula, $C_{11}H_{18}O_2$, to which the male of the species is attracted. It is reported that the male may respond to as few as 60 molecules of the pheromone.

What is the mass, in grams, of these 60 molecules?

Use the following headings to assist you in your calculation.

relative molecular mass

mass of one mole

mass of one molecule

mass of sixty molecules in grams

[4]

14 Boron forms giant covalent structures with other elements, for example, boron nitride, BN. It is claimed that boron nitride is as hard as diamond.

(a) (i) Explain why diamond is so hard.

[2]

(ii) Explain why graphite is so soft.

[2]

(iii) State **one** other physical property, apart from hardness, which you would expect boron nitride to possess.

[1]

(b) Both boron and carbon combine with fluorine. Boron forms boron trifluoride (BF_3) and carbon forms carbon tetrafluoride, (CF_4).

(i) Write an equation for the formation of boron trifluoride from boron and fluorine.

_____ [2]

(ii) Write an equation for the formation of carbon tetrafluoride from methane and fluorine, the other product being hydrogen fluoride.

_____ [2]

(iii) Use dot and cross notation to draw the structures of boron trifluoride and carbon tetrafluoride, showing outer electrons only.

[2]

(iv) Explain the octet rule and comment on its application to boron trifluoride and carbon tetrafluoride.

_____ [4]

(v) Draw the shapes of BF_3 and CF_4 and explain them in terms of their electron structure.

_____ [4]

- 15** Calcium fluoride, CaF_2 , occurs naturally as fluorite or fluorspar. Impurities give a blue variety known as Blue John. Fluorspar is the major source of hydrogen fluoride and fluorine.

It can be prepared in the laboratory by precipitation or direct combination of the elements.

- (a) What is the colour of pure calcium fluoride?

_____ [1]

- (b) Explain the formation of calcium fluoride from calcium and fluorine atoms using dot and cross diagrams showing outer electrons only.

[4]

- (c) Write an equation for the precipitation of calcium fluoride by mixing solutions of calcium chloride and sodium fluoride.

_____ [1]

- (d) Calcium fluoride reacts with concentrated sulphuric acid to form hydrogen fluoride and calcium sulphate. Write an equation for the reaction.

_____ [2]

- (e) Calcium fluoride is sparingly soluble in water; 0.0025 g dissolves in 100 cm³ of water at 18°C.

Calculate the concentration of fluoride ions in moles per litre using the following headings:

- (i) relative formula mass of calcium fluoride

- (ii) number of moles of calcium fluoride in 0.0025 g

- (iii) number of moles of fluoride ion in 0.0025 g of calcium fluoride

- (iv) number of moles of fluoride ion in 100 cm³ of water

- (v) number of moles of fluoride ion in 1000 cm³ of water

_____ [5]

- (f) The presence of fluoride ions in domestic water supplies is regarded as beneficial by some, but the deliberate addition of fluoride ions is controversial.

- (i) State **one** benefit of fluoride ions in drinking water.

_____ [1]

- (ii) Explain why some people object to the addition of fluoride ions to drinking water.

_____ [1]

16 All naturally occurring sodium atoms have a relative atomic mass of 23 i.e. the atoms are represented by the symbol ^{23}Na . However, radioactive isotopes of sodium, e.g. ^{24}Na , may be prepared.

(a) (i) State the number of electrons, protons and neutrons in an atom of ^{23}Na .

[2]

(ii) Explain why ^{23}Na and ^{24}Na are regarded as isotopes.

[2]

(b) A sample of sodium from a nuclear reactor contains 2.00% of ^{24}Na and 98.00% of ^{23}Na by mass. Calculate the relative atomic mass of the sample to **two** decimal places.

[2]

- (c) (i) A major use of sodium metal is in street lamps. The lamp contains mercury vapour which conducts electricity at high voltages. Sodium within the lamp vaporises and the electrical energy causes yellow (orange) light to be given out. When the light from the sodium lamp is analysed, the spectrum shows two bright yellow lines at wavelengths of 589 nm and 589.6 nm.

$$(1 \text{ nm} = 1 \times 10^{-9} \text{ m})$$

	589	589.6
	λ	\rightarrow

Using the equations $E = h\nu$ and $c = \nu\lambda$, calculate the energy change (in joules) associated with the line at 589 nm. ($c = 3 \times 10^8 \text{ m s}^{-1}$).

[3]

- (ii) Explain how you could carry out a flame test and a test for chloride ions to identify a white solid as sodium chloride. Write equations for any reactions taking place.

[5]

(d) If larger amounts of energy are supplied to sodium vapour (gas) it ionises.

(i) Write the equation which represents the first ionisation energy of sodium including state symbols.

_____ [2]

(ii) The value of the first ionisation energy for sodium is 500 kJ mol^{-1} . The second ionisation energy has a value of 4513 kJ mol^{-1} . Explain why this is a much higher value.

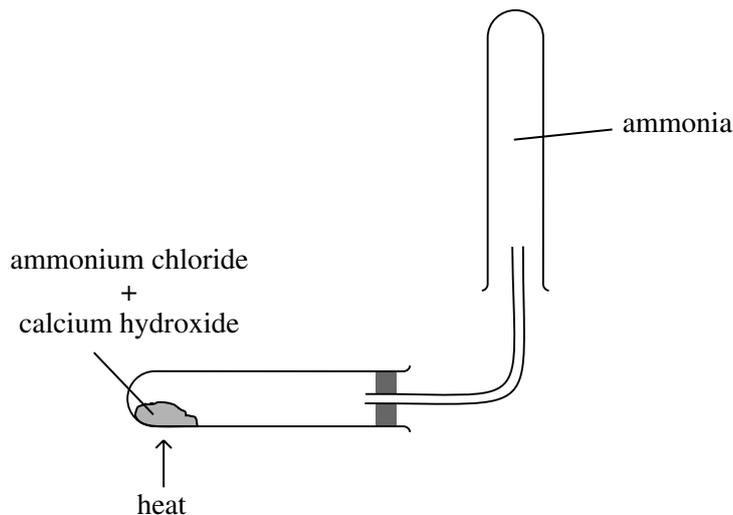
_____ [2]

(e) Using diagrams, explain why sodium is able to conduct electricity whether solid or molten, while sodium chloride conducts only when molten or dissolved in water.

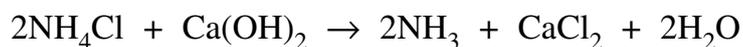
_____ [5]

Quality of written communication [2]

17 In the laboratory, ammonia can be prepared by heating a mixture of ammonium chloride and calcium hydroxide as shown in the diagram below.



The equation for the reaction is:



(a) The ammonia gas is collected upwards. Calculate the relative molecular masses of ammonia, NH_3 , oxygen, O_2 and nitrogen, N_2 , and use them to explain why ammonia is collected in this way.

ammonia _____

oxygen _____

nitrogen _____

explanation _____

_____ [2]

(b) Calculate the volume of ammonia produced, at 20°C and one atmosphere pressure, if 1.07 g of ammonium chloride are heated with excess calcium hydroxide.

_____ [3]

(c) Ammonia gas is alkaline.

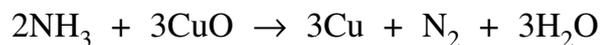
(i) Describe the effect of ammonia on moist Universal Indicator paper.

_____ [1]

(ii) Ammonia may be detected using concentrated hydrochloric acid. Write the equation for the reaction and describe what is observed.

_____ [2]

(d) Ammonia can act as a reducing agent. When passed over heated copper(II) oxide, the following reaction occurs:



Deduce the oxidation numbers of nitrogen and copper in the reactants and products and use them to explain the redox change.

_____ [3]

THIS IS THE END OF THE QUESTION PAPER
