

Thursday 10 January 2013 – Morning

AS GCE CHEMISTRY A

F321/01 Atoms, Bonds and Groups

Candidates answer on the Question Paper.

OCR supplied materials:

- *Data Sheet for Chemistry A* (inserted)

Other materials required:

- Scientific calculator

Duration: 1 hour




Candidate forename		Candidate surname	
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Centre number						Candidate number				
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INSTRUCTIONS TO CANDIDATES

- The Insert will be found in the centre of this document.
- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [] at the end of each question or part question.
-  Where you see this icon you will be awarded marks for the quality of written communication in your answer.
This means for example you should:
 - ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear;
 - organise information clearly and coherently, using specialist vocabulary when appropriate.
- You may use a scientific calculator.
- A copy of the *Data Sheet for Chemistry A* is provided as an insert with this question paper.
- You are advised to show all the steps in any calculations.
- The total number of marks for this paper is **60**.
- This document consists of **12** pages. Any blank pages are indicated.

2

Answer **all** the questions.

- 1 Tungsten metal is used in the manufacture of some types of steel.

Tungsten has an atomic number of 74.

- (a) Tungsten has many isotopes.

- (i) Explain what is meant by *isotopes*.

.....

 [1]

- (ii) The mass number of one isotope of tungsten is 184.

Complete the table below to show the atomic structure of this tungsten isotope.

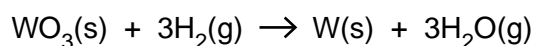
Protons	Neutrons	Electrons

[1]

- (iii) What is used as the standard measurement of relative isotopic mass?

..... [1]

- (b) In the manufacture of tungsten metal, an oxide of tungsten, WO_3 , is reacted with hydrogen gas.



- (i) Using **oxidation numbers**, show what has been oxidised and what has been reduced in this reaction.

oxidised

.....

reduced

..... [2]

3

(ii) A chemist reacts 11.59 g of WO_3 with hydrogen gas.

Calculate the volume of hydrogen gas, in dm^3 , required to completely react with this mass of WO_3 at room temperature and pressure.

volume of hydrogen gas = dm^3 [3]

[Total: 8]

4

2 Simple molecules are covalently bonded.

(a) State what is meant by the term *covalent bond*.

.....
 [1]

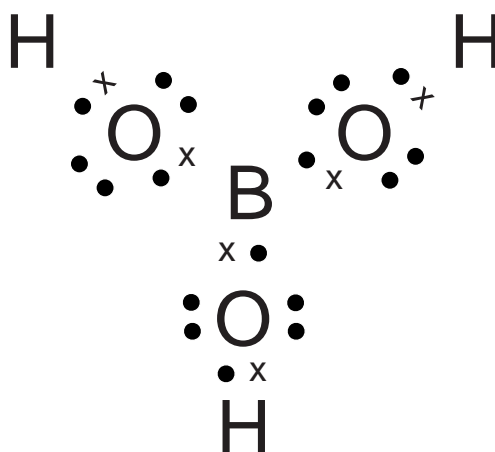
(b) Chemists are able to predict the shape of a simple covalent molecule from the number of electron pairs surrounding the central atom.

(i) Explain how this enables chemists to predict the shape.

.....

 [2]

(ii) The 'dot-and-cross' diagram of the simple covalent molecule, H_3BO_3 , is shown below.



Predict the O–B–O and B–O–H bond angles in a molecule of H_3BO_3 .

O–B–O =° B–O–H =° [2]

(c) Give an example of a simple covalent molecule which has all bond angles equal to 90° .

..... [1]

[Total: 6]

5

3 Successive ionisation energies provide evidence for the existence of different shells in atoms.

(a) Define, in words, the term *first ionisation energy*.

.....

.....

.....

..... [3]

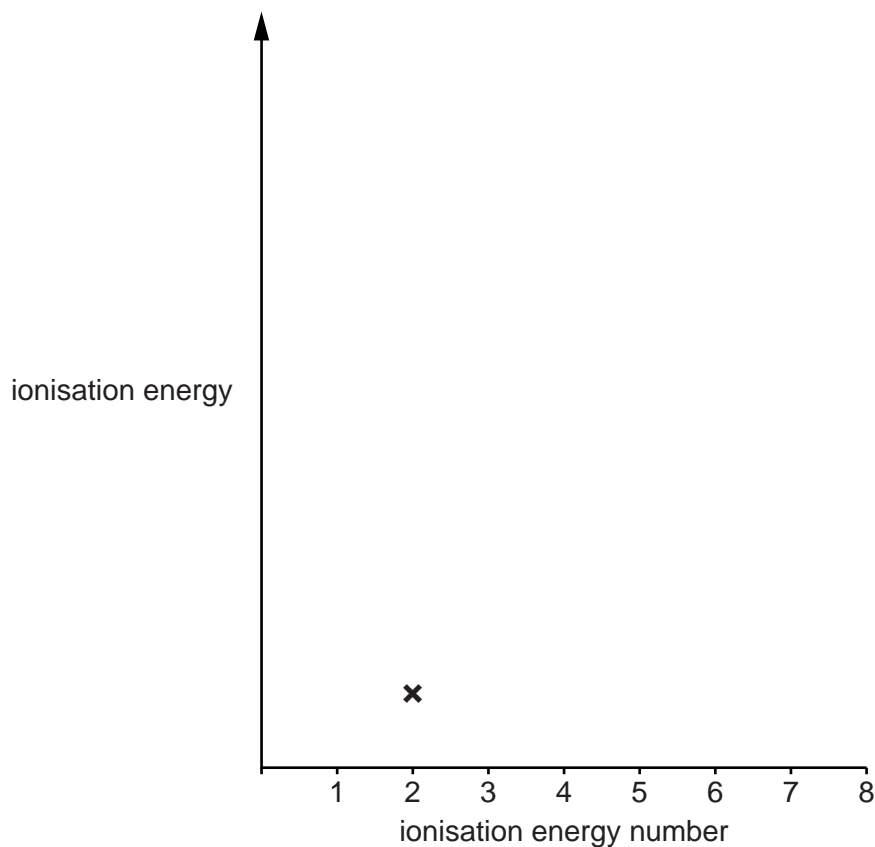
(b) (i) Write an equation to represent the **second** ionisation energy of oxygen.

Include state symbols.

..... [1]

(ii) On the axes below, add crosses to estimate the successive ionisation energies of oxygen. The second ionisation energy has been added for you.

It is **not** necessary to join your points.



[2]

7

(iii) Aluminium nitrate(V) can be made by reacting a base with an acid.

For this reaction, name a suitable base and write the formula of the acid.

name of base

formula of the acid [2]

[Total: 16]

8

4 The Group 2 element barium was first isolated by Sir Humphrey Davy in 1808.

Barium has a giant metallic structure and a melting point of 725 °C.

(a) Describe, with the aid of a labelled diagram, the structure and bonding in barium and explain why barium has a high melting point.

Include the correct charges on the metal particles in your diagram.



In your answer, you should use appropriate technical terms, spelled correctly.

.....

 [3]

(b) A chemist reacts barium with water. A solution is formed which conducts electricity.

(i) Write the equation for the reaction of barium with water. Include state symbols.

..... [2]

(ii) Predict a value for the pH of the resulting solution.

..... [1]

(iii) Give the **formula** of the negative ion responsible for the conductivity of the solution formed.

..... [1]

(c) Heartburn is a form of indigestion caused by an excess of stomach acid.

State a compound of magnesium that could be used to treat heartburn.

..... [1]

(d) In an experiment, a student makes a solution of strontium chloride, SrCl_2 , by adding excess dilute hydrochloric acid to strontium carbonate.

(i) Describe what the student would observe and write the equation for the reaction.

observations

.....

equation [2]

(ii) Draw a 'dot-and-cross' diagram to show the bonding of strontium chloride. Show **outer** electrons only.

[2]

(e) In another experiment, a student attempts to make a solution of strontium chloride by adding chlorine water to aqueous strontium bromide.

(i) Describe what the student would observe.

..... [1]

(ii) Write the ionic equation for the reaction which takes place.

..... [1]

(iii) Chlorine is more reactive than bromine. Explain why.

.....

.....

.....

.....

.....

.....

.....

..... [4]

[Total: 18]

Turn over

11

- (c) Borax, $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$, can be used to determine the concentration of acids such as dilute hydrochloric acid.

A student prepares 250cm^3 of a 0.0800mol dm^{-3} solution of borax in water in a volumetric flask.

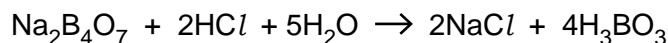
Calculate the mass of borax crystals, $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$, needed to make up 250cm^3 of 0.0800mol dm^{-3} solution.

answer = g [3]

Question 5 continues on page 12

12

- (d) The student found that 22.50 cm^3 of $0.0800\text{ mol dm}^{-3}$ $\text{Na}_2\text{B}_4\text{O}_7$ reacted with 25.00 cm^3 of dilute hydrochloric acid.



- (i) Calculate the amount, in mol, of $\text{Na}_2\text{B}_4\text{O}_7$ used.

amount = mol [1]

- (ii) Calculate the amount, in mol, of HCl used.

amount = mol [1]

- (iii) Calculate the concentration, in mol dm^{-3} , of the HCl .

concentration = mol dm^{-3} [1]

[Total: 12]

END OF QUESTION PAPER



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