OCR
RECOGNISING ACHIEVEMENT

Friday 13 January 2012 – Afternoon

AS GCE CHEMISTRY B (SALTERS)

F331 Chemistry for Life

F31450112

Candidates answer on the Question Paper.

OCR supplied materials:
- *Data Sheet for Chemistry B (Salters)* (inserted)

Other materials required:
- Scientific calculator

Duration: 1 hour 15 minutes

F331

Candidate forename		Candidate surname	

Centre number						Candidate number				

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. Pencil may be used for graphs and diagrams only.
- 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. If additional space is required, you should use the lined pages at the end of this booklet. The question number(s) must be clearly shown.
- Answer **all** the questions.
- 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 B (Salters)* 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.

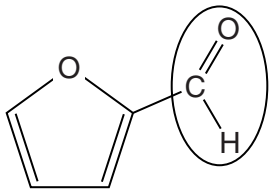
Answer **all** the questions.

1 'Second generation' biofuels are now produced from the non-food parts of current food crops, such as stems, leaves and husks.

(a) Suggest **one** reason why the use of the non-food parts of crop plants is desirable for the production of biofuels.

..... **[1]**

(b) One 'second generation' biofuel is furfural. Its structure is shown below. The circled group of atoms is the aldehyde functional group.



furfural

(i) In addition to the aldehyde group, name **two** other functional groups in furfural.

..... and ..... **[2]**

(ii) The molecular formula of furfural is $C_5H_4O_2$.

Write an equation for the complete combustion of furfural in excess oxygen.

[2]

(c) **(i)** A student tried to measure the enthalpy change of combustion of furfural, which he knew to be $C_5H_4O_2$. He burnt the liquid fuel in a spirit burner and used the burning fuel to heat up water in a copper calorimeter.

The student measured the mass of furfural burnt and the temperature rise of the water.

Give **three** other pieces of information the student needed in order to calculate the enthalpy change of combustion of furfural.

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..... **[3]**

(ii) The student also calculated a value for the enthalpy change of combustion, ΔH_c, of furfural using average bond enthalpies.

The results calculated by the student for the balanced equation are shown below.

To break all bonds in the reactants, enthalpy change = 7521 kJ

To make all bonds in the products, enthalpy change = 9906 kJ

Use these results to calculate a value for the enthalpy change of combustion of furfural.

enthalpy change of combustion, ΔH_c = ... kJ mol^{-1} **[1]**

(iii) The value obtained for the enthalpy change of combustion of furfural using average bond enthalpies is very different from the value the student obtained by the experimental method described in **(c)(i)**.

Suggest **three** reasons for this difference, apart from heat losses.

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..... **[3]**

[Total: 12]

2 The characteristic noise produced when Christmas crackers are pulled apart is caused by a small amount of gunpowder.

Gunpowder typically contains 10 percent sulfur, 15 percent carbon and 75 percent potassium nitrate, KNO_3, by mass.

(a) (i) Calculate the number of moles of KNO_3 in 100 g of gunpowder.

number of moles ..... **[1]**

(ii) The **mole** ratio of carbon atoms to sulfur atoms in gunpowder is about 4 to 1.

- State, in terms of the *Avogadro constant*, what is meant by 'a mole'.
- Explain why the mole ratio is greater than the mass ratio.

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..... **[3]**

(b) A particular type of gunpowder explodes to produce a mixture of nitrogen gas, carbon dioxide gas and solid potassium sulfide, K_2S.

(i) Complete and balance **equation 2.1** below to show this reaction.

$KNO_3(s) + C(s) + S(s) \rightarrow K_2S(s) +$ ..... (g) + ... (g) **equation 2.1**

[2]

(ii) Potassium sulfide is an ionic compound.

Draw a '*dot-and-cross*' diagram for K_2S.

Show the outermost electron shells only.

[3]

(c) The reaction represented by **equation 2.1** is accompanied by a large increase in entropy.

(i) Explain what is meant by the term *entropy*.

.....

..... **[1]**

(ii) Explain why there is an increase in entropy in the reaction represented by **equation 2.1**.

.....

.....

..... **[2]**

(d) Sulfur and carbon are both covalently bonded elements, but sulfur has a simple molecular structure whereas carbon has a giant covalent network.

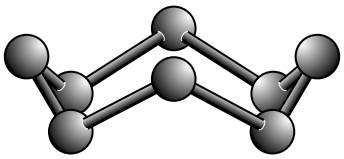
Some of the physical properties of carbon and sulfur are very different because of this difference in structure type.

(i) Name **one** physical property, apart from electrical conductivity, that will be very different **and** state how it will differ for the two elements.

.....

..... **[1]**

(ii) In solid sulfur, the molecules are in the form of 'puckered' S_8 rings as shown below.



sulfur

Suggest a value for the  bond angle in the S_8 molecule.

Give your reasoning.

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..... **[4]**

[Total: 17]

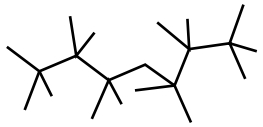
3 Engine lubricating oils are produced from crude oil by several different refining processes.

(a) One lubricating oil contains the four hydrocarbons listed below.

Compound A $C_{22}H_{44}$

Compound B $CH_3(CH_2)_{17}C(CH_3)_3$

Compound C $CH_3(CH_2)_{20}CH_3$

Compound D 

(i) Name the **type** of structural formula represented in compound **D**.

..... **[1]**

(ii) Give the molecular formula of compound **D**.

..... **[1]**

(iii) Give the letter of the compound in the above list that could be a cycloalkane.

..... **[1]**

(iv) Give the letters of **two** compounds in the above list that are structural isomers of each other.

..... **[1]**

(v) Give the letter of **one** compound in the above list that is a non-cyclic, unbranched, saturated hydrocarbon.

..... **[1]**

(b) Cracking is used to produce hydrocarbons suitable for use in lubricating oils.

(i) Give **two** ways in which molecules formed by the cracking of a straight chain alkane molecule differ from the original molecule.

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..... **[2]**

(ii) This cracking process uses a zeolite as a solid catalyst.

- Explain the term *catalyst* and name the **type** of catalysis used in cracking.
- Describe and explain the structural feature of zeolites that make them effective catalysts for the cracking process.

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

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..... **[4]**

(c) Low viscosity lubricating oils contain a high proportion of branched chain hydrocarbons.

Name the oil refining process used to convert straight chain alkanes into branched chain alkanes with the same number of carbon atoms.

..... **[1]**

(d) Engine lubricating oils must be changed on a regular basis because they gradually lose their efficiency.

One method of disposing of the used oils is to burn them. However, this produces atmospheric pollution in the form of a dense black cloud of carbon particulates.

Suggest and explain how these particulates are formed.

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..... **[2]**

[Total: 14]

4 Old-fashioned tungsten light bulbs are being phased out in the UK and replaced by low energy bulbs. The use of low energy bulbs is causing some concern as they contain small amounts of mercury vapour.

(a) One type of low energy bulb contains 3.0×10^{-3} g of mercury, Hg.

Calculate the volume, **in cm^3**, occupied by this mass of gaseous mercury at room temperature and pressure.

Give your answer to **two** significant figures.

One mole of any gas occupies 24 dm^3 at room temperature and pressure.

volume = ... cm^3 **[3]**

(b) The electrons in the gaseous atoms of mercury in a low energy bulb are excited when the bulb is switched on. Energy is then emitted as UV and visible light.

Analysis of the UV radiation shows it to be an atomic emission spectrum.

(i) Describe the main features of an atomic **emission** spectrum.

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..... **[3]**

(ii) Passing UV and visible light through a cool sample of mercury vapour produces an atomic **absorption** spectrum.

Describe **one** difference between an atomic absorption spectrum and an atomic emission spectrum.

.....

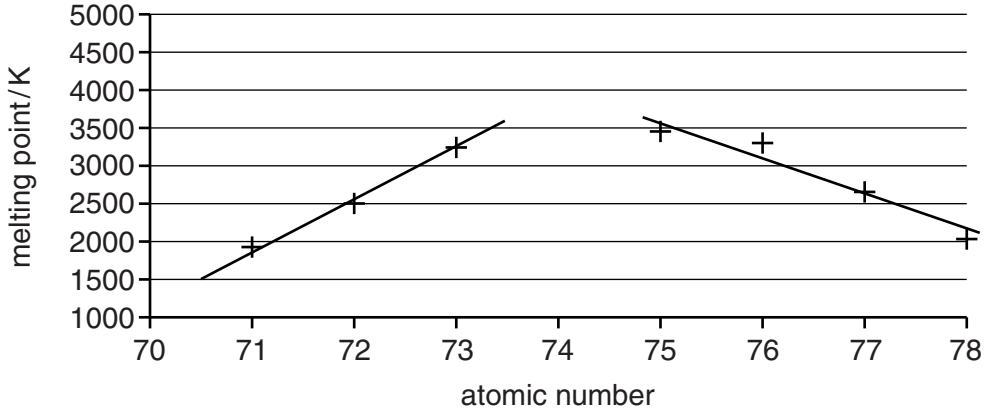
..... **[1]**

(c) 'Old fashioned' light bulbs use tungsten metal as a filament which glows white hot when an electric current is passed through it.

(i) Tungsten is used because it has a very high melting point.

The graph below shows the melting points of some of the elements on either side of tungsten in Period 6 of the Periodic Table.

melting points of some elements in Period 6



A student attempts to use the graph to estimate a value for the melting point of tungsten by using the two lines of best fit shown.

Estimate a value for the melting point of tungsten.

Clearly show **on the graph** how you arrived at your answer.

melting point of tungsten = ... K **[2]**

(ii) There is a pattern (or trend) shown in the melting points of the elements as this part of Period 6 is crossed. A similar pattern is shown in Period 5.

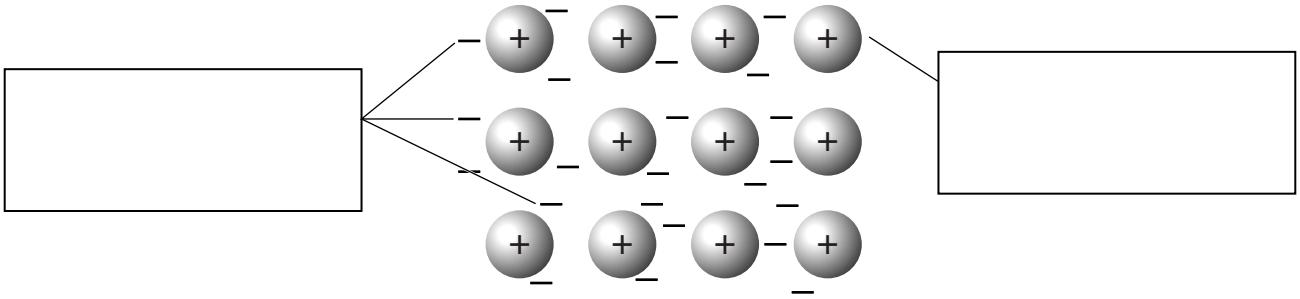
Describe this pattern in the melting points of the elements.

.....

..... **[1]**

(d) The high melting point of tungsten is a result of very strong metallic bonding.

The diagram below illustrates a model of metallic bonding.



Write appropriate labels in the two boxes which help explain this model of metallic bonding. **[3]**

(e) Tungsten is in the same column as chromium in the Periodic Table.

Suggest a similarity that you would expect in the **atomic** structures of tungsten and chromium.

..... **[1]**

(f) Mendeleev was one of the first scientists to arrange the known elements into groups according to their properties.

(i) By what property did Mendeleev order the elements?

..... **[1]**

(ii) Mendeleev realised that, when he had arranged the elements, some elements' properties did not fit with those above and below them in the table.

Give **one** change that Mendeleev made to solve this problem.

..... **[1]**

(iii) The elements in a modern Periodic Table are arranged by atomic number.

Explain the meaning of the term *atomic number*.

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..... **[1]**

[Total: 17]

END OF QUESTION PAPER

ADDITIONAL PAGE

If additional space is required, you should use the lined pages below. The question number(s) must be clearly shown.

ADDITIONAL PAGE