OCR
RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE

CHEMISTRY B (SALTERS)

Chemistry for Life

F331

Candidates answer on the question paper.

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

Other materials required:
- Scientific calculator

Monday 23 May 2011
Afternoon

Duration: 1 hour 15 minutes

F3187061

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 **16** pages. Any blank pages are indicated.

Answer **all** the questions.

1 Olympic torches have used a variety of fuels since the first Olympic games in 776 B.C. Propane gas was the fuel chosen for the Beijing Olympics in 2008.

(a) (i) Balance the equation for the complete combustion of propane, C_3H_8.

$$C_3H_8 \quad + \quad .....O_2 \quad \rightarrow \quad .....CO_2 \quad + \quad .....H_2O$$

[1]

(ii) Calculate a value for the enthalpy change of combustion of propane from the average bond enthalpy data below.

bond	average bond enthalpy / kJ mol^{-1}
C–C	+347
C–H	+413
O=O	+498
C=O	+805
O–H	+464

ΔH_c propane = ...kJ mol^{-1} **[3]**

(iii) A value for ΔH_c propane can be determined **experimentally** by burning a known mass of propane gas and allowing the energy to be transferred to water.

Suggest **two** different practical limitations or difficulties with this experiment.

.....

.....

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

(b) One problem with using propane is that the flame is not very visible. In 1996, the fuel used was a mixture of propene, C_3H_6, and propane gases which made the Olympic flame brighter with a more visible yellow flame.

(i) Draw the **skeletal** formulae for propane and propene in the boxes below.

propane	propene

[2]

(ii) The percentage by mass of carbon in propane is 82%.

Calculate the percentage by mass of carbon in propene to show that it is larger than 82%.

answer = ...% **[1]**

(iii) Use the information from **(ii)** to suggest why the 1996 torch produced a much more visible yellow flame compared to the Beijing torch.

.....

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

(c) The Beijing torch was made of an alloy of aluminium and magnesium.

(i) The strength of metals is due to the nature of metallic bonding.

Draw a **labelled** diagram to represent a simple model of metallic bonding.

[3]

(ii) The structure of the atom is an example of a model used in chemistry which has gradually become more sophisticated as new experimental evidence has become available.

What feature of modern atomic structure does the occurrence of emission spectra support?

.....

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

[Total: 15]

2 One concern linked to global climate change is that the sea level may rise, leading to flooding. Oxygen isotope ratios, determined from geological material, have varied over time and can be used to interpret past sea level changes.

(a) The two oxygen isotopes used are ^{18}O and ^{16}O.

Complete the table below to show the atomic structure of these isotopes.

isotope	number of protons	number of electrons	number of neutrons
^{18}O			
^{16}O			

[1]

(b) A time-of-flight mass spectrometer can be used to calculate the relative abundance of these isotopes in suitable geological material.

(i) Explain how a time-of-flight mass spectrometer works. You should include the following terms in your answer.

detector **drift region** **ions** **kinetic energy**

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..... **[5]**

(ii) The mass spectrum of a sample of material showed the abundance of the two isotopes as ^{16}O, 99.64% and ^{18}O, 0.3600%.

Calculate a value for the relative atomic mass of oxygen based on these figures.

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

relative atomic mass = ... **[3]**

(c) The oxygen isotope ratio of some fossilised shells has been determined.

Such shells are mainly calcium carbonate but occasionally magnesium replaces some of the calcium in carbonate shells. Use your knowledge of the Periodic Table to suggest and explain why magnesium can replace calcium in carbonate shells.

.....

.....

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

(d) Oxygen is the third most abundant element in the Universe. It is produced in some stars by the 'carbon burning process'. This process involves a series of nuclear fusion reactions.

(i) Complete the equation for the following nuclear fusion process.

$$^{12}_{6}C + {}^{12}_{6}C \longrightarrow {}^{16}_{8}O + 2$$ **[2]**

(ii) Describe **and** explain the conditions necessary for nuclear fusion to occur.

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

[Total: 16]

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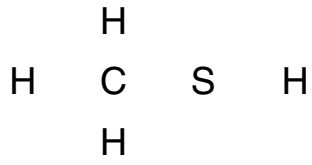
TURN OVER FOR QUESTIONS 3 AND 4

PLEASE DO NOT WRITE ON THIS PAGE

3 Sulfur is a vital element in living organisms and a key industrial chemical. However, many covalent compounds of sulfur smell particularly bad.

(a) Methanethiol, CH_3SH, one of the molecules causing bad breath, is particularly smelly.

(i) Complete a '*dot-and-cross*' diagram below for methanethiol.



[2]

(ii) Methanethiol can be detected at only 0.02 micrograms per dm^3 of air (1 microgram = 1×10^{-6}g).

Calculate the number of moles of methanethiol in 0.02 micrograms.

number of moles = ...mol **[2]**

(b) The strong smell of cut onions is the result of volatile sulfur compounds getting into the atmosphere. One of these compounds also makes you cry. Its structure is given in **Fig. 3.1** with two bond angles indicated by '**a**' and '**b**'.

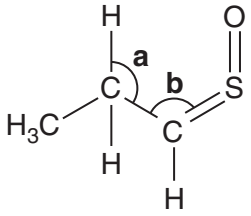


Fig. 3.1

(i) What is the molecular formula of the compound shown in **Fig 3.1**?

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

(ii) The bond angle indicated by '**a**' in **Fig. 3.1** is 109° whereas '**b**' is about 120°.

Explain these bond angles.

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

(c) Coal contains sulfur compounds. This has serious consequences for society in making decisions whether to use coal as an energy source for generating electricity.

Suggest **one** advantage and **two** disadvantages of the choice of coal as an energy source compared to 'cleaner fossil fuels' such as methane.

one advantage .....

two disadvantages .....

.....

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

(d) The combustion of coal can be investigated in the laboratory.

An experiment found that 10 g of coal raised the temperature of 200 cm^3 water by 25 °C.

Calculate the heat transferred to the water.

Specific heat capacity of water = 4.2 $J\,g^{-1}\,K^{-1}$

Heat transferred = ...J **[2]**

(e) Use the positions of carbon and sulfur in the Periodic Table and your knowledge of periodic trends to suggest how the melting point of sulfur would differ from that of carbon.

State why in terms of structure type.

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.....

.....

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

[Total: 16]

4 Millions of tyres are used and disposed of every year.

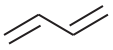
Fires involving tyres are a serious problem, as toxic chemicals are released into the atmosphere.

(a) Some of the chemicals released when tyres burn include benzene and buta-1,3-diene.

(i) Name the group of hydrocarbons of which benzene is a member.

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

(ii) The skeletal formula of buta-1,3-diene is shown below.



Draw the **full** structural formula for buta-1,3-diene.

[1]

(b) Under carefully controlled conditions, tyres can be burned as a fuel. This is known as tyre-derived fuel, TDF.

(i) TDF combustion produces less oxides of nitrogen, NO_x, than coal or oil.

Suggest why this is so.

.....

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

(ii) Suggest another toxic gas that could be produced from TDF combustion, apart from benzene and buta-1,3-diene.

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

(c) Pyrolysis (heating in the absence of oxygen) is another method of dealing with waste tyres. Pyrolysis yields useful products such as alkenes and high molecular mass alkanes.

(i) Name the term used to describe alkenes, that refers to their molecules containing fewer hydrogen atoms than alkanes.

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

(ii) High molecular mass alkanes are subjected to processes such as isomerisation and reforming.

What **type** of hydrocarbon is produced from the reforming of alkanes?

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

(iii) What is the other product of a reforming reaction?

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

(d) (i) Catalysts called zeolites can be used in the processes of reforming and isomerisation. Zeolites are heterogeneous catalysts.

Explain the terms *heterogeneous* **and** *catalyst*.

.....

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

(ii) Describe in **four** stages a simple model to explain how a heterogeneous catalyst works.

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

1. .....

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2. .....

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3. .....

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4. .....

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[4]

[Total: 13]

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

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