THIS IS A NEW SPECIFICATION

OCR
RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE

CHEMISTRY B (SALTERS)

Chemistry for Life

F331

Candidates answer on the Question Paper
A calculator may be used for this paper

OCR Supplied Materials:
- *Data Sheet for Chemistry B (Salters)* (inserted)

Other Materials Required:
- Scientific calculator

Thursday 14 January 2010
Morning

Duration: 1 hour 15 minutes

OCE/19278

B331

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

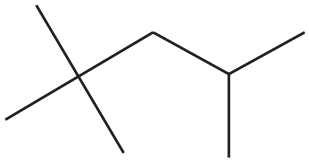
INFORMATION FOR CANDIDATES

- 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 Octane is a component of petrol and the 'octane number' of a petrol is a measure of the tendency of the petrol to auto-ignite. The structure of an **isomer** of octane is given below.



(a) (i) What **type** of formula is represented by the structure above?

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

(ii) Give the systematic name of this isomer of octane.

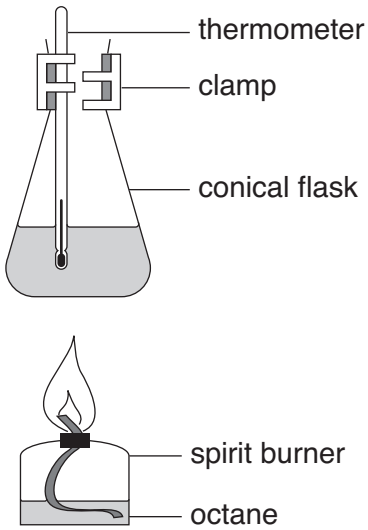
..... **[2]**

(iii) Branched chain hydrocarbons are useful in petrol because they have a low tendency to auto-ignite.

Name another structural feature of hydrocarbon molecules that also results in a lower tendency of the fuel to auto-ignite.

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

(b) A value for the enthalpy change of combustion of octane can be obtained from a simple experiment using the following apparatus.



(i) Describe how you could use this apparatus to obtain data from which you could calculate a value for the enthalpy change of combustion of octane. You should also explain how you would use your experimental results to calculate this value.

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

(ii) Results obtained using this apparatus give a much less negative value for the enthalpy change of combustion of octane than the data book value.

Suggest **two** limitations in the practical procedure which would result in a less negative value for the enthalpy change of combustion of octane than the data book value.

.....

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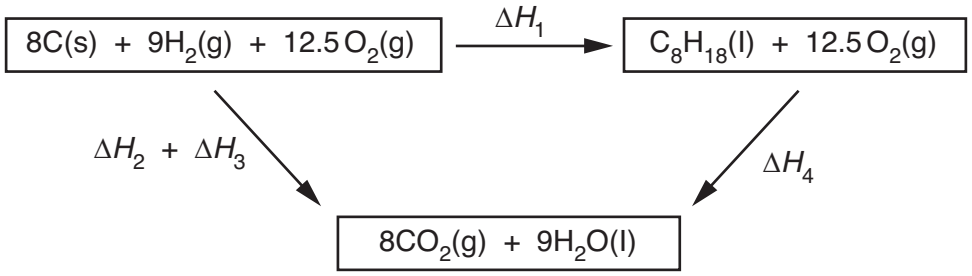
..... **[2]**

(c) ΔH_f values can be calculated for hydrocarbons using enthalpy changes of combustion in an enthalpy cycle.

The enthalpy cycle below can be used to calculate the standard enthalpy change of formation of octane.



(i) State the enthalpy changes represented by ΔH_1, ΔH_2, ΔH_3, and ΔH_4.

ΔH_1 = ...

.....

ΔH_2 = ...

.....

ΔH_3 = ...

.....

ΔH_4 = ...

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

(ii) You are given the following values:

$$\Delta H_2 + \Delta H_3 = -5718\,\text{kJ mol}^{-1};\quad \Delta H_4 = -5470\,\text{kJ mol}^{-1};$$

Calculate a value for ΔH_1.

ΔH_1 = ... kJ mol^{-1} **[1]**

[Total: 16]

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TURN OVER FOR QUESTIONS 2, 3 AND 4

2 'Radiopharmaceutical imaging' is a type of medical scan. Tiny amounts of radioactive materials are injected into the blood stream to allow an image of the various tissues to be obtained.

(a) Radioactive materials contain atoms that spontaneously break down. As the nuclei of atoms break down, they emit rays and particles called emissions. Three different types of emission have been identified, α, β and γ.

Complete the table to show the properties of these emissions. **[3]**

property	type of emission		
	α	β	γ
relative charge	+2		
relative mass		0.00055	
nature	helium nucleus		very high frequency electromagnetic radiation
range in air		few metres	very long
stopped by	tissue paper	metal foil	
deflection by an electric field	low		

(b) The most widely used radioisotope in radiopharmaceutical imaging is technetium-99. This is the product of the β-decay of molybdenum-99.

(i) Complete the nuclear equation for the β-decay of molybdenum-99.

$$^{99}_{42}\text{Mo} \rightarrow {}^{\ldots\ldots}_{\ldots\ldots}\beta + {}^{\ldots\ldots}_{\ldots\ldots}\text{Tc}$$

[2]

(ii) Molybdenum has several naturally occurring isotopes.

Explain the term *isotopes*.

.....

.....

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

(c) Another use of radioisotopes is for the dating of geological materials such as ancient lava flows from extinct volcanoes. One method involves measuring the amounts of potassium-40 (^{40}K) found in the lava compared with the amounts of its decay product argon-40 (^{40}Ar).

(i) The half-life of potassium-40 is approximately 12,000 **million** years.

Suggest and explain why this long half-life makes potassium-argon dating unreliable for determining the age of lavas that are only thousands of years old.

.....

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

(ii) A time-of-flight mass spectrometer is used to measure the amount of argon-40 present in a lava sample.

Give the symbol for the argon-40 **ion** formed in the mass spectrometer.

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

(iii) There are two other naturally occurring isotopes of argon, argon-36 and argon-38.

Describe how a mass spectrum of naturally occurring argon gas would show the presence of all three isotopes of argon **and** the relative abundance of each.

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

(iv) Argon was identified by its atomic emission spectrum.

Explain the occurrence of an atomic emission spectrum in terms of changes in electronic energy levels **and** explain why such spectra are unique for individual elements.

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

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

[Total: 15]

3 In 1860, Michael Faraday gave a series of lectures in London entitled 'The Chemical History of a Candle'. Paraffin wax was, and still is, one of the materials used to make candles.

(a) Paraffin wax is a mixture of aliphatic hydrocarbons with more than 20 carbon atoms per molecule. Hydrocarbons of this length can be obtained from crude oil.

(i) Explain the term *aliphatic*.

.....

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

(ii) What is the name of the process used to separate hydrocarbons of different chain lengths from crude oil?

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

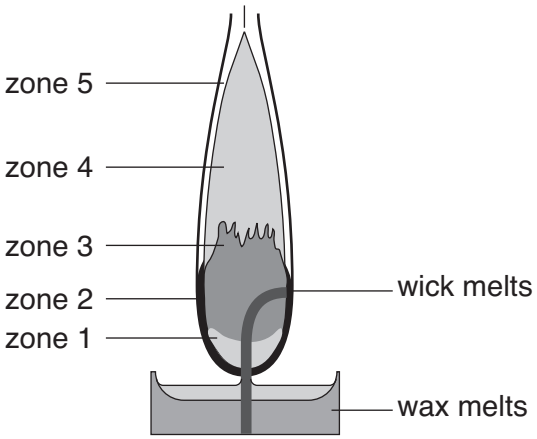
(iii) Paraffin wax can be represented by the formula $C_{25}H_{52}$.

Balance **equation 3.1** to represent the complete combustion of $C_{25}H_{52}$.

$$C_{25}H_{52} + ...O_2 \rightarrow 25\,CO_2 + 26\,H_2O$$ **equation 3.1** **[1]**

(b) The diagram below outlines some areas or zones in a candle flame.

Zone 2 represents the hottest part of the flame and **equation 3.1** represents the reaction taking place in this zone.



(i) Zone 1 is much cooler than the rest of the flame. If a glass tube is placed in the centre of this zone, the vapour coming out of the end of the tube can be ignited.

Suggest a substance, present in the vapour, that could be ignited.

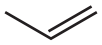
..... **[1]**

(ii) Incomplete combustion occurs in Zone 4. Suggest **two** products of incomplete combustion present in Zone 4.

.... **[2]**

(c) Oil refineries sometimes 'crack' paraffin waxes to produce more useful products.

The products formed from the cracking process always include an unsaturated compound such as the one shown in the diagram below.



(i) What is the molecular formula of the unsaturated molecule shown above?

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

(ii) Suggest a value for the bond angle shown in the structure below and explain your value.

Bond angle ..... °

.....

.....

.....

.....

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

(iii) Heterogeneous catalysts, such as zeolites, are often used in the cracking process.

Explain the term *heterogeneous* in the context of catalysts.

.....

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

(iv) Zeolites also can act as 'molecular sieves'. They separate any branched chain isomers formed in the cracking process from straight chain isomers.

Explain how the structure of zeolites allows them to act as 'molecular sieves.'

.....

.....

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

[Total: 14]

4 Beryllium is a Group 2 metal and has several modern day uses. It also played an important role in the development of ideas about the structure of the atom.

(a) In 1932, James Chadwick fired α-particles at beryllium metal and found that particles were emitted that were not deflected by electric fields.

Chadwick had discovered the neutron. Give the mass number and atomic number of this particle.

mass number = ... atomic number = ... **[2]**

(b) Alloys of beryllium and copper are used for aircraft parts because of their high strength and resistance to corrosion.

A typical copper–beryllium alloy contains 1.75% by mass of beryllium. Assume all the rest of the alloy is copper.

(i) Calculate the number of moles of beryllium and copper in 100 g of the alloy.

moles Be = ... moles Cu = ... **[2]**

(ii) Calculate the percentage of **atoms** of beryllium in the alloy.

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

% Be atoms = ... **[3]**

(c) The strength of metals and metal alloys is due to their strong metallic bonding.

Draw a labelled diagram to show a simple model of metallic bonding.

[3]

(d) Many beryllium compounds are covalent in character. An example is beryllium chloride. The left-hand box below shows the bonding in a beryllium chloride molecule in the vapour state.

Complete the '*dot-and-cross*' diagram for this molecule in the right-hand box. **[2]**

Cl — Be — Cl	

(e) The chlorides of the other Group 2 metals are all ionic.

Name **two** physical properties of ionic chlorides which you would expect to be different from those of simple covalent chlorides. State how the properties would differ.

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.....

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.....

.....

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

[Total: 15]

END OF QUESTION PAPER

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