



ADVANCED SUBSIDIARY GCE
CHEMISTRY (SALTERS)
 Chemistry for Life

2850/01

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

OCR Supplied Materials:

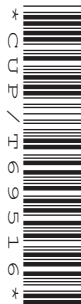
- *Data Sheet for Chemistry (Salters)*
 (Inserted)

Other Materials Required:

- Scientific calculator

Friday 9 January 2009
Afternoon

Duration: 1 hour 15 minutes



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.
- The total number of marks for this paper is **75**.
- You may use a scientific calculator.
- A copy of the *Data Sheet for Chemistry (Salters)* is provided as an insert with this question paper.
- You are advised to show all the steps in any calculations.
- This document consists of **12** pages. Any blank pages are indicated.

FOR EXAMINER'S USE

Qu.	Max.	Mark
1	14	
2	25	
3	19	
4	17	
TOTAL	75	

Answer **all** the questions.

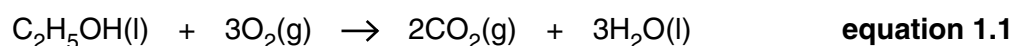
1 Oxygenate is the term given to certain molecules which can be added to petrol to improve its octane rating. Ethanol is an example of an oxygenate.

(a) Data books quote the standard enthalpy change of combustion of ethanol (ΔH_c^\ominus) at a particular temperature.

(i) What is this standard temperature?

..... [1]

(ii) The equation represents the complete combustion of ethanol at this temperature.

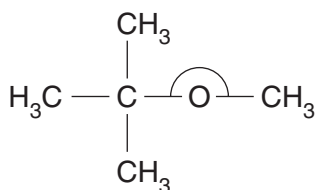


Use **equation 1.1**, together with values selected from the table to calculate the standard enthalpy change of combustion of ethanol.

compound	$\Delta H_f^\ominus/\text{kJ mol}^{-1}$
$\text{C}_2\text{H}_5\text{OH(l)}$	−278
$\text{C}_2\text{H}_5\text{OH(g)}$	−235
$\text{H}_2\text{O(g)}$	−242
$\text{H}_2\text{O(l)}$	−286
$\text{CO}_2\text{(g)}$	−394

standard enthalpy change of combustion =kJ mol^{−1} [4]

- (b) Another oxygenate that has been added to petrol is MTBE. The structure of MTBE is shown below.



- (i) Give the COC bond angle in the MTBE molecule.

Bond angle = ° [1]

- (ii) Explain your answer to (i) in terms of electron pair repulsion.

.....

 [4]

- (iii) What homologous series does MTBE belong to?

..... [1]

- (iv) Give the molecular formula of MTBE.

..... [1]

- (v) MTBE has a high octane rating. Explain why it is desirable for a fuel to have a high octane rating.

.....

 [2]

[Total: 14]

2 Iron is formed in some stars by a series of nuclear fusion processes.

- (a) (i) An isotope of iron can be formed by the fusion of an isotope of magnesium, ^{26}Mg , and the silicon isotope, ^{28}Si . Use this information and your *Data Sheet* to complete the nuclear equation for the formation of iron from these elements.



- (ii) The most abundant isotope of iron has a mass number of 56.

Complete the following table to show the atomic structure of this isotope.

isotope	^{56}Fe
number of protons	
number of electrons	
number of neutrons	

[1]

- (iii) The relative atomic mass of iron is 55.9. Explain why the relative atomic mass of iron is **not** a whole number.

.....

 [2]

- (b) Draw a labelled diagram to show the metallic bonding occurring in iron. Explain how the structure is held together.

[4]

(c) On Earth, iron at the surface has become oxidised to form various compounds.

- (i) In its compounds iron is normally found as either the Fe^{2+} or Fe^{3+} ion.

Write the equation for the **third** ionisation enthalpy of iron in the space below.

[3]

- (ii) One of these compounds is an oxide of iron, found in the ore magnetite. 2.32 g of a pure sample of this oxide were found to contain 1.68 g of iron.
Calculate the empirical formula of this oxide.

A_r : Fe, 56; O, 16

empirical formula = [3]

- (iii) Another ore, haematite, contains an oxide of iron, Fe_2O_3 .
In a blast furnace Fe_2O_3 reacts with carbon monoxide to produce molten iron and carbon dioxide.

Write a balanced equation for this reaction.
Include state symbols.

[2]

- (d) Silicon dioxide, SiO_2 , is usually present as an acidic impurity in haematite.

Limestone, naturally occurring calcium carbonate, is added to remove this impurity.

- (i) The calcium carbonate decomposes in a blast furnace to produce calcium oxide and carbon dioxide.

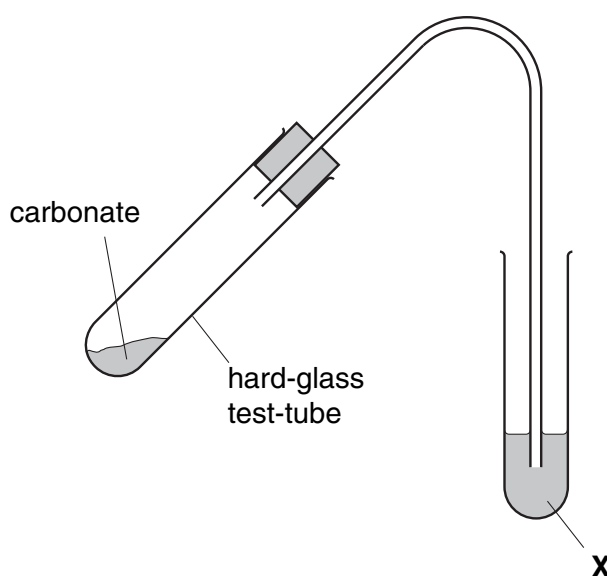
The calcium oxide reacts with the silicon dioxide to form a salt.

What property of calcium oxide enables it to form a salt with the silicon dioxide?

..... [1]

- (ii) The carbonate of another Group 2 metal, magnesium, will also decompose on heating.

Identify **X** and explain how the following apparatus could be used to show the difference in thermal stability of magnesium carbonate and calcium carbonate.



.....

.....

.....

.....

..... [4]

- (e) Some steel structures are radioactive. Radioisotopes in the steel decay, emitting ionising radiation.

(i) Name the **three main** types of ionising radiation.

..... [1]

(ii) Explain, giving your reasons, why workers should not be exposed to this radioactive steel for long periods of time.

.....

.....

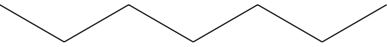
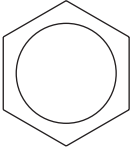
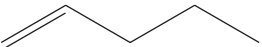
.....

..... [2]

[Total: 25]

3 Petrol is a blend of many different organic molecules, most of which are hydrocarbons.

(a) Complete the table below showing some of the hydrocarbons found in petrol.

molecular formula	skeletal formula	type of hydrocarbon	name
			
C_6H_6			benzene
C_5H_{10}			pent-1-ene

[5]

(b) Oil companies use processes such as cracking, reforming and isomerisation to meet the demand for high octane fuels.

(i) In the box below, draw the **full** structural formula of a branched isomer of hexane, C_6H_{12} , which contains **two methyl** branches.

Name the isomer you have drawn.

name:

[3]

(ii) Which of the processes, cracking, isomerisation and reforming are most likely to have produced the molecules below from hexane?

Your isomer in (i)

pent-1-ene

benzene..... [3]

- (c) Cracking can be carried out in the laboratory by heating petroleum jelly (a mixture of long chain alkane molecules) and passing the vapour over a hot catalyst.
The gaseous products of the reaction can be collected by displacing water in a test-tube.

Draw a labelled diagram of the apparatus you would use.

[4]

- (d) Nitrogen monoxide (NO) gas is formed when hydrocarbons combust in a car engine.

- (i) Where does the nitrogen in the NO come from?

..... [1]

- (ii) What conditions are required for the formation of NO to occur?

..... [1]

- (e) Carbon monoxide is also produced in a car engine.

Write a balanced chemical equation for the combustion of hexane, C_6H_{14} , to give CO.

[2]

[Total: 19]

4 Propellants are used to make rockets fly up into the atmosphere.

(a) The Chinese were the first to use gunpowder as a propellant.
Gunpowder contains potassium nitrate, sulphur and carbon.

(i) One of the main products of the explosion of gunpowder is potassium sulphide, K_2S .

Draw a dot-cross diagram for the ionic compound potassium sulphide. Include the charges on the ions.

[3]

(ii) Gunpowder burns with a lilac (purple) flame.
Analysis of the emitted lilac light showed it to be made up of a set of lines of specific frequencies – a line emission spectrum.

Explain:

- how a line in the emission spectrum forms;
- why a set of lines of specific frequencies are formed.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [5]

- (b) All propellants contain a fuel and an oxidiser. In the Saturn V rocket, which took man to the Moon, the third stage used liquid hydrogen as the fuel and liquid oxygen as the oxidiser. These react to form steam as in the equation below:



- (i) The mass of liquid hydrogen carried by the rocket was $1.7 \times 10^7 \text{ g}$. Calculate the volume of steam produced in dm^3 . Assume complete combustion takes place.

Assume one mole of any gas occupies 250 dm^3 under the reaction conditions.

A_r : H, 1.0

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

volume of steam produced = dm^3 [3]

- (ii) Suggest **three** reasons why the reaction in **equation 4.1** makes a mixture of liquid hydrogen and oxygen a good propellant.

.....

 [3]

- (iii) In the reaction in **equation 4.1**, does the entropy increase, decrease or stay the same? Explain your answer.

.....

 [3]

[Total: 17]

END OF QUESTION PAPER

PLEASE DO NOT WRITE ON THIS PAGE