



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:

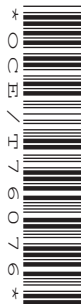
- *Data Sheet for Chemistry (Salters)* (inserted)

Other Materials Required:

- Scientific calculator

Wednesday 3 June 2009
Morning

Duration: 1 hour 15 minutes



Candidate Forename		Candidate Surname	
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Centre Number						Candidate Number				
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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 **16** pages. Any blank pages are indicated.

FOR EXAMINER'S USE

Qu.	Max.	Mark
1	21	
2	12	
3	22	
4	20	
TOTAL	75	

Answer **all** the questions.

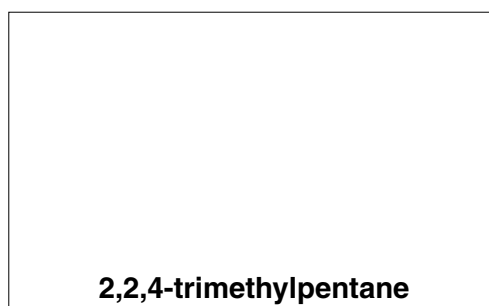
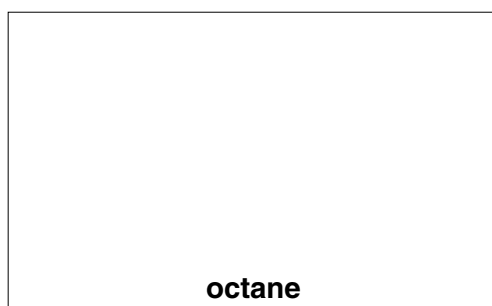
- 1 To produce maximum power in a car engine, the fuel must ignite at the correct stage of the engine cycle. Auto-ignition causes a loss in power.

(a) What name is given to the number which is used as a measure of the tendency of a fuel to auto-ignite?

..... [1]

(b) The branched hydrocarbon 2,2,4-trimethylpentane is an isomer of octane and has a low tendency to auto-ignite.

(i) Draw the **skeletal** formulae for octane and 2,2,4-trimethylpentane.



[2]

(ii) Explain why octane and 2,2,4-trimethylpentane are structural isomers.

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

(iii) Draw the **full** structural formula of **one other** isomer of octane.

Name the isomer you have drawn.

name [2]

- (c) The process of reforming produces cycloalkanes such as cyclooctane as the main products. Cyclooctane is **not** an isomer of octane.

(i) Give the molecular formula for octane and cyclooctane.

octane..... cyclooctane..... [2]

(ii) Reforming can also produce benzene. What type of hydrocarbon is benzene?

..... [1]

(iii) Reforming reactions take place in the presence of a heterogeneous catalyst.

Describe the **four** main stages by which heterogeneous catalysis works.

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

(d) Molecules that contain an oxygen atom, such as alcohols, also have a low tendency to auto-ignite and can be added to petrol blends.

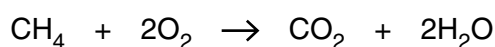
(i) What is the general name given to oxygen-containing molecules added to petrol blends?

..... [1]

(ii) In the box below, write a balanced equation to show the **complete** combustion of methanol, CH_3OH .

[2]

(iii) The equation for the complete combustion of methane is shown below.



In the combustion chamber of a car engine, alcohols burn more completely than alkanes that contain the same number of carbon atoms.

Use the equation above and your answer to (ii) to suggest why alcohols burn more completely in the combustion chamber.

.....

 [2]

(iv) Name a product of incomplete combustion of alkanes and say why it is a polluting gas.

.....
 [2]

(v) Another oxygen-containing compound, $(\text{CH}_3)_3\text{C}-\text{O}-\text{CH}_3$, was used in petrol blends until recently. Name the functional group in this compound.

..... [1]

[Total: 21]

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TURN OVER FOR QUESTION 2

- 2 Radioactive isotopes are used in a wide variety of industrial applications.

Radioactive isotopes decay to form new elements. There are three types of radioactive emission: alpha (α), beta (β) and gamma (γ).

- (a) Complete the following table to show the type of emission described.

description	type of emission (α , β or γ)
The atomic number of the decaying atom increases by one	
Radiation of a very short wavelength	
The particle emitted has a negative charge	
The particle emitted has a mass of four units	
The particle emitted is strongly deflected in an electric field	

[5]

- (b) The radioactive isotope of thallium (Tl), thallium-204, is used to monitor the thickness of thin films.

- (i) Thallium-204 undergoes beta decay.

Write a nuclear equation for this process.

[3]

- (ii) In the above application the beta particles pass through the film and cause a small current to flow in a detector.

Suggest why an alpha emitter would **not** be suitable for monitoring the thickness of thin films.

..... [1]

- (c) Nuclear fusion reactions occur in the Sun.

Suggest why it is very difficult to reproduce fusion reactions here on Earth.

.....

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..... [3]

[Total: 12]

- 3 Until recently, solder containing lead was used to join metals together. Chemists can use mass spectrometry to distinguish between various types of solder by the ratio of the isotopes of lead they contain.

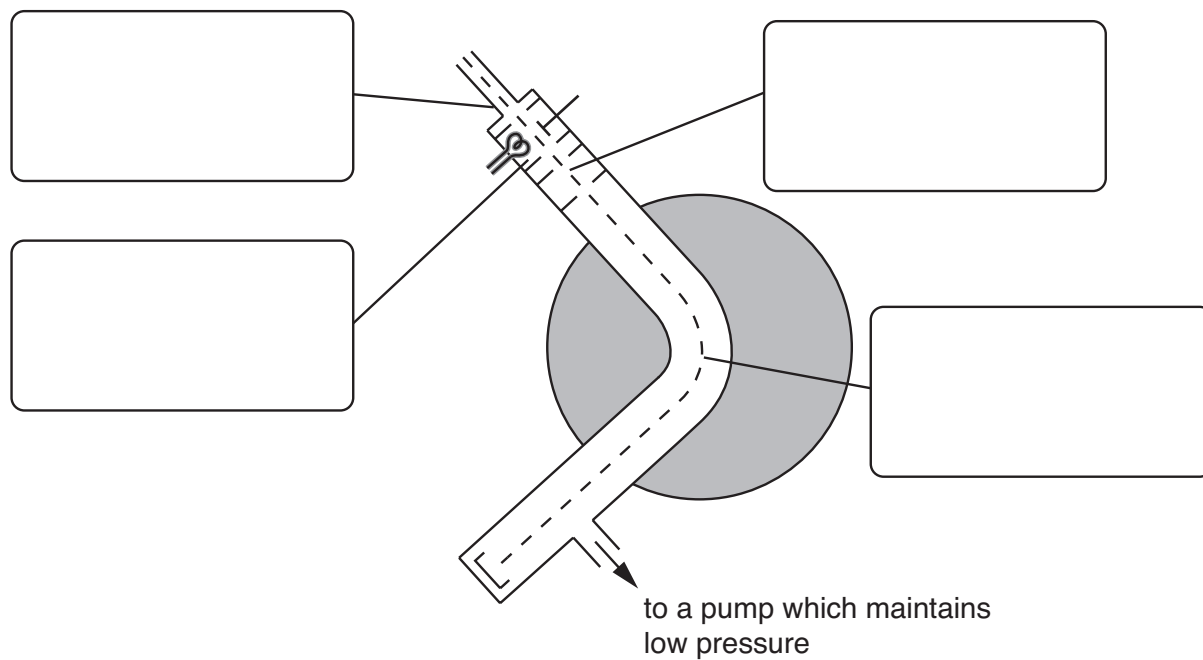
(a) (i) Use the following terms to label the diagram of the mass spectrometer below.

electric field

ionisation chamber

magnetic field

sample inlet

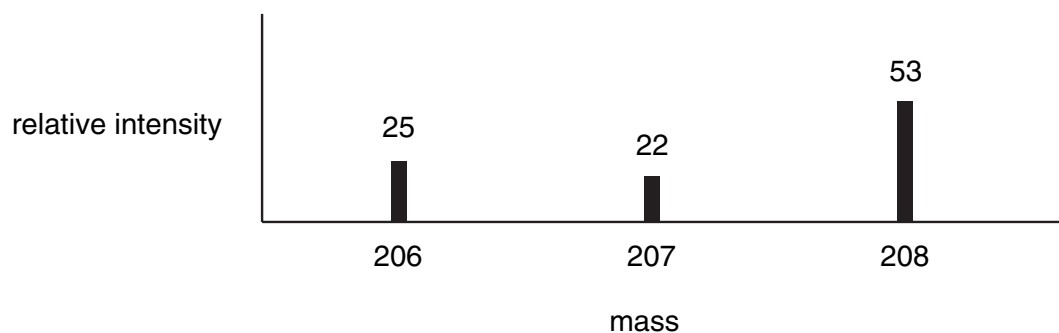


[4]

- (ii) The analysis of one sample of solder showed the existence of three isotopes of lead. The mass spectrum is shown below.

Calculate the relative atomic mass, A_r , for this sample of lead from the data on the spectrum.

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



$A_r = \dots\dots\dots$ [4]

- (iii) Complete the following table, with the help of your *Data Sheet*, to show the number of protons, neutrons and electrons in the three isotopes.

isotope	number of protons	number of neutrons	number of electrons
lead-206			
lead-207			
lead-208			

[3]

- (b) In the past, solder was an alloy of tin and lead. 100 g of one type of solder contained 0.500 mol of tin. Calculate the mass of lead in 100 g of the solder.

A_r : Sn, 119

mass of lead = $\dots\dots\dots$ g [2]

- (c) Solder can be used for electrical connections because both lead and tin are good conductors of electricity. This is because of the nature of metallic bonding.

(i) Draw a labelled diagram below to illustrate metallic bonding.

[3]

- (ii) Use your diagram to suggest how metals conduct electricity.

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

- (d) Tin and lead are in the same group of the Periodic Table.

For the metals in **Group 2** of the Periodic Table, explain the similarities and trends in the way the elements react, in terms of their electronic configurations.

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

[Total: 22]

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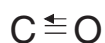
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TURN OVER FOR QUESTION 4

- 4 Known crude oil reserves are likely to be exhausted long before coal reserves. Methods of obtaining a variety of hydrocarbons from coal are increasing in importance.

(a) The first stage of one process involves the reaction of the carbon in coal with steam and oxygen. The products are carbon monoxide and hydrogen in the ratio 3:1 by moles. Write a balanced equation for this reaction. Include state symbols.

[3]

(b) The bonding in carbon monoxide can be represented as shown.



Name the bond represented by the arrow in this formula and explain how it arises.

[2]

- (c) The equation for the production of heptane from carbon monoxide and hydrogen is given below.

- (i) Complete the enthalpy cycle by filling in the box.

Use the following enthalpy changes of formation to calculate the enthalpy change for this reaction.

compound	$\Delta H_f / \text{kJ mol}^{-1}$
CO(g)	-111
C ₇ H ₁₆ (g)	-224
H ₂ O(g)	-242



elements:

Enthalpy change = kJ mol⁻¹ [5]

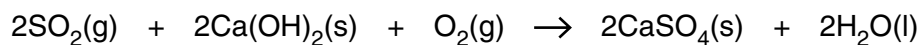
- (ii) Explain why this reaction is accompanied by a decrease in **entropy**.

.....

..... [2]

- (d) Coal is used as a fuel in some power stations. Sulphur impurities present in coal react and produce the toxic gas sulphur dioxide, SO_2 .

The sulphur dioxide can be removed by reacting it with calcium hydroxide in the presence of oxygen, as shown below.



Calculate the volume of sulphur dioxide (in dm^3) at room temperature and pressure that could be removed by reaction with 1.0 kg of calcium hydroxide in the presence of excess oxygen.

1 mol of any gas at room temperature and pressure occupies 24 dm^3 .

A_r : Ca, 40; O, 16; H, 1.0

volume = dm^3 [3]

- (e) At the high temperatures generated when coal is burnt in a power station, nitrogen in the air reacts with oxygen to form nitrogen oxides. The high temperature is needed because of the large bond enthalpy of N_2 .

- (i) Explain the term *bond enthalpy*.

.....
 [2]

- (ii) Describe the bond-breaking and bond-making processes that occur when nitrogen reacts with oxygen to form nitrogen oxides.

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..... [3]

[Total: 20]

END OF QUESTION PAPER

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