



ADVANCED SUBSIDIARY GCE
CHEMISTRY (SALTERS)
 Chemistry of Natural Resources

2848/01

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

OCR Supplied Materials:

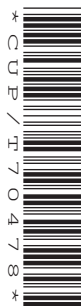
- *Data Sheet for Chemistry (Salters)* (Inserted)

Other Materials Required:

- Scientific calculator

Friday 9 January 2009
Afternoon

Duration: 1 hour 30 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.

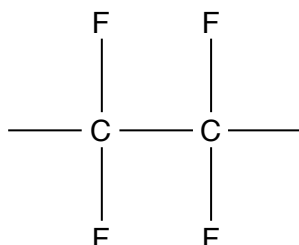
INFORMATION FOR CANDIDATES

- 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 **90**.
- You will be awarded marks for the quality of written communication where this is indicated in the question.
- 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	24	
2	14	
3	31	
4	21	
TOTAL	90	

Answer **all** the questions.

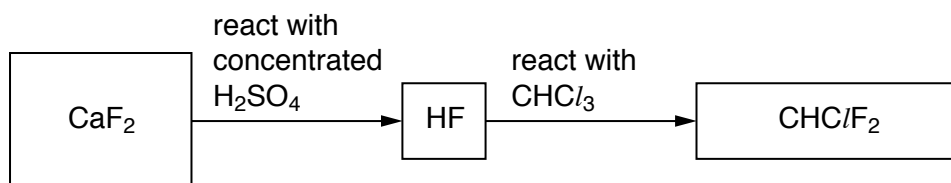
- 1 The roof of London's Millennium Dome is made from glass fibre fabric coated with poly(tetrafluoroethene), PTFE. The PTFE provides a self-cleaning surface to the roof, because PTFE is one of the most slippery materials in existence. The repeat unit of PTFE is shown below.



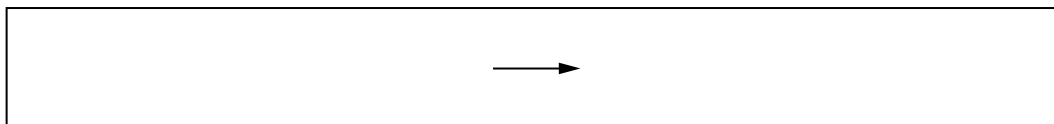
- (a) Draw the structure of the monomer from which PTFE is made.

[1]

- (b) The first stage in the manufacture of PTFE from calcium fluoride is summarised below.



- (i) Suggest a balanced equation for the reaction that produces hydrogen fluoride gas from calcium fluoride and concentrated sulphuric acid.



[2]

- (ii) Name the **type** of reaction that occurs when HF reacts with CHCl_3 .

..... [1]

- (iii) Give the systematic name for CHClF_2 .

..... [1]

- (iv) In this question, one mark is available for the quality of use and organisation of scientific terms.

CHClF_2 was used as a refrigerant, but this is now restricted because it has ozone depleting properties.

Explain how the release of CHClF_2 at the Earth's surface damages the ozone layer.

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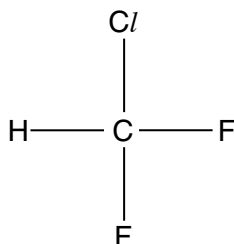
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..... [5]

Quality of Written Communication [1]

Question 1(b) continues on the next page

- (v) The C–Cl and C–F bonds in CHClF_2 are polar. Show this by marking the partial charges on the C, F and Cl atoms on the diagram below.



[1]

- (vi) Explain why the atoms in the molecule of CHClF_2 have the partial charges you have shown in (v).

.....

.....

..... [2]

- (vii) Draw a diagram to represent the **shape** of a molecule of CHClF_2 . Indicate the bond angle.

[2]

- (viii) Explain whether the CHClF_2 molecule is polar or non-polar.

.....

..... [1]

- (ix) Name the strongest type of intermolecular force between the molecules of CHClF_2 .

..... [1]

- (c) The fluorinated polymer FEP is produced from tetrafluoroethene and hexafluoropropene. FEP has an advantage over PTFE in that it is a true thermoplastic.

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

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

(ii) Draw the structure of a molecule of hexafluoropropene.

[1]

(iii) Draw out a section of the FEP polymer chain, including one unit of tetrafluoroethene and one unit of hexafluoropropene.

[3]

(iv) What term is used to describe a polymer that is made from more than one type of monomer?

..... [1]

[Total: 24]

2 Squalene is an unsaturated hydrocarbon present in olive oil.

(a) The degree of unsaturation of squalene can be determined by reacting it with hydrogen.

(i) What **type** of reaction occurs when hydrogen reacts with squalene?

..... [1]

(ii) What reaction conditions would be required for the reaction of squalene with hydrogen?

.....

..... [2]

(b) 288 cm^3 of hydrogen, measured at room temperature and pressure, react with a 0.002 mol sample of squalene to form a saturated hydrocarbon, $\text{C}_{30}\text{H}_{62}$.

(i) Calculate the number of moles of hydrogen, H_2 , in 288 cm^3 of hydrogen gas.

You should assume that one mole of gas occupies 24 dm^3 under the conditions of this experiment.

moles of H_2 = [2]

(ii) How many moles of hydrogen molecules have reacted with one mole of squalene?

answer = [1]

(iii) Suggest the molecular formula of squalene.

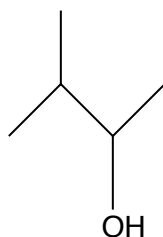
Explain how you arrived at your answer.

.....

.....

..... [2]

- (c) Squalene reacts with water. The skeletal formula of part of the product is shown below.



Classify the alcohol group as primary, secondary or tertiary. Explain your answer.

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

- (d) The alcohol group shown in (c) can be oxidised to a carbonyl group, C=O.

- (i) Underline the name of the functional group that the oxidised product would contain.

aldehyde **carboxylic acid** **ketone** [1]

- (ii) Give the reagents and conditions that would be required for this oxidation reaction.

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

[Total: 14]

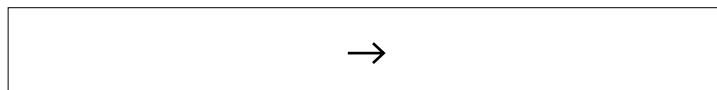
- 3 Copper-containing minerals include cuprite, Cu_2O , azurite, $\text{Cu}_3(\text{CO}_3)_2(\text{OH})_2$, and chalcopyrite, CuFeS_2 .

(a) (i) Give the systematic name for cuprite.

..... [1]

- (ii) Azurite reacts with dilute hydrochloric acid to produce carbon dioxide, because it contains carbonate ions.

Write the **ionic** equation for the reaction that occurs between carbonate ions, CO_3^{2-} , and acid.



[2]

- (iii) The carbonate ion in this reaction is acting as a base.
Explain the meaning of the term *base*.

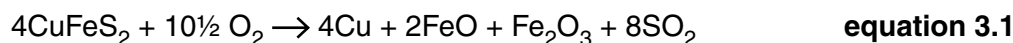
.....

..... [1]

- (iv) In the reaction of azurite with an acid, the Cu^{2+} ions are hydrated in solution. Draw a diagram to show how water molecules surround a Cu^{2+} ion, showing any full and partial charges.

[3]

- (b) Chalcopyrite, CuFeS_2 , can be smelted to produce copper. The overall equation for the smelting process is shown below.



- (i) Complete the table to show the oxidation states of the atoms.

element	initial oxidation state	final oxidation state
Cu	0
Fe	+2	(in Fe_2O_3) =
S	-2

[3]

- (ii) Use your answer to (i) to identify an element that has been reduced during the reaction shown in **equation 3.1**. Explain your answer.

Reduced element:

Explanation: [2]

- (iii) Calculate the maximum mass of copper, in kilograms, which could be obtained from 1000 kg of chalcopyrite.

A_r : Cu, 63.5; Fe, 56; S, 32

mass of copper = kg [3]

- (iv) The smelting process produces copper as atoms. Complete the electron configuration of a copper atom.

$1s^2 2s^2 2p^6 3s^2 3p^6$

[2]

- (c) In this question, one mark is available for the quality of spelling, punctuation and grammar.

One problem associated with the smelting process is that it produces sulphur dioxide. This can cause the formation of acid rain if it escapes into the air.

Explain how acid rain forms from sulphur dioxide and write an account of the environmental problems that sulphur dioxide and acid rain can cause.

.....

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.....

.....

..... [5]

Quality of Written Communication [1]

- (d) A student was given a sample of acid rain and was told it was a dilute solution of sulphuric acid. He decided to analyse the solution to find out the concentration of the acid by carrying out a titration.

(i) Name a suitable indicator for the titration.

..... [1]

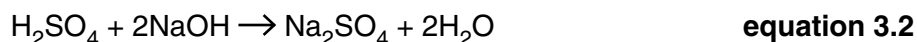
(ii) 20.00 cm³ of sodium hydroxide solution was put into a conical flask and the sulphuric acid was added to it from a burette. Name the piece of equipment used to measure out the sodium hydroxide solution.

..... [1]

(iii) Each titration used 20.00 cm³ of 0.0100 mol dm⁻³ sodium hydroxide solution. Calculate the number of moles of sodium hydroxide that were used.

moles sodium hydroxide = mol [2]

(iv) The equation for the reaction occurring during the titration is shown below.



Use **equation 3.2** and your answer to (iii) to work out the number of moles of sulphuric acid that reacted with the sodium hydroxide.

moles sulphuric acid = mol [1]

(v) The average volume of sulphuric acid used in the titration was 25.20 cm³. Use this information and your answer to (iv) to calculate the concentration of the acid. Give your answer to **three** significant figures.

concentration of sulphuric acid = mol dm⁻³ [3]

[Total: 31]

- 4 Over the last century, there have been changes to the composition of the Earth's atmosphere as a result of human activity. Concerns have arisen about changes in the amounts of ozone and carbon dioxide in the air.

(a) A sample of tropospheric air was analysed to find the concentration of the different gases it contained.

(i) The air must be dried before it can be analysed. Suggest a suitable drying agent.

..... [1]

(ii) In the table below, give the names of the three most abundant gases in dry tropospheric air.

name of gas	% by volume
	78
	21
	1

[3]

(b) The amount of carbon dioxide in the Earth's atmosphere is increasing.

(i) Give **two** different processes that are causing an increase in the amount of carbon dioxide in the atmosphere.

.....

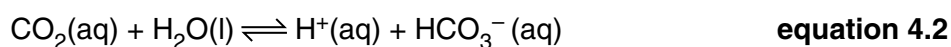
 [2]

(ii) The Earth emits infrared radiation. What happens to carbon dioxide molecules when they absorb the infrared radiation emitted from the Earth? Explain how this results in the warming of the atmosphere.

.....

 [3]

- (c) The amount of carbon dioxide in the atmosphere is affected by the fact that it can dissolve in ocean water. The following equations describe the main reactions that occur.



- (i) Use Le Chatelier's principle to explain the effect that increased carbon dioxide levels in the troposphere will have on the HCO_3^- concentration in the oceans.

.....

 [3]

- (ii) Suggest why the balance between gaseous CO_2 in the atmosphere and $\text{CO}_2(\text{aq})$ in the oceans cannot be regarded as a true dynamic equilibrium.

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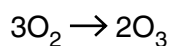
 [1]

- (d) There have also been concerns about the amount of ozone in the atmosphere.

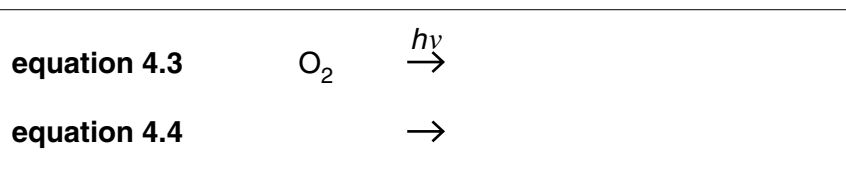
- (i) Problems can arise if there is too much ozone in the troposphere. Suggest an example of **one** of these problems.

.....
 [1]

- (ii) The overall equation for the formation of ozone is shown below.



Complete and balance **two** equations to show how oxygen is converted into ozone in the stratosphere.



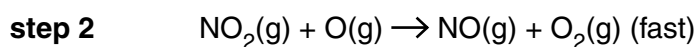
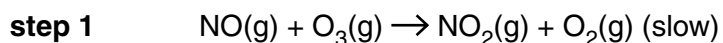
[2]

- (iii) Explain why the formation of ozone you have described in (ii) takes place in the stratosphere but not usually in the troposphere.

.....

 [2]

- (e) Ozone can be destroyed by nitrogen monoxide. The mechanism for this process is shown below.



- (i) How does the activation enthalpy for **step 1** compare to that for **step 2**?

.....
 [1]

- (ii) In the mechanism shown above for the destruction of ozone, NO is acting as a homogeneous catalyst.
 Explain what is meant by the term *homogeneous* and how you can tell from the equations for **step 1** and **step 2** that NO is a catalyst.

homogeneous:

 NO is a catalyst because:
 [2]

[Total: 21]

END OF QUESTION PAPER

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