



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--



CHEMISTRY

0620/33

Paper 3 (Extended)

May/June 2011

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams, graphs or rough working.

Do not use staples, paper clips, highlighters, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Answer **all** questions.

A copy of the Periodic Table is printed on page 12.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

For Examiner's Use

1	
2	
3	
4	
5	
6	
7	
8	
Total	

This document consists of **12** printed pages.



1 Choose an element from the list below which best fits the description.

Rb Fe Si I P Sr

- (a) An element which reacts with cold water. [1]
- (b) It is a solid at room temperature and exists as diatomic molecules, X_2 [1]
- (c) It can form two oxides, XO and X_2O_3 [1]
- (d) This element has a hydride of the type XH_3 [1]
- (e) It has a macromolecular structure similar to that of carbon. [1]

[Total: 5]

2 Tin is an element in Group IV.

(a) The position of tin in the reactivity series is:

zinc
iron
tin
copper

(i) For each of the following, decide if a reaction would occur. If there is a reaction, complete the equation, otherwise write 'no reaction'.



(ii) Name the **three** products formed when tin(II) nitrate is heated.

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

(b) Aqueous tin(II) sulfate is electrolysed using carbon electrodes. This electrolysis is similar to that of aqueous copper(II) sulfate using carbon electrodes.

(i) What is the product at the negative electrode (cathode)?

..... [1]

(ii) Write the equation for the reaction at the positive electrode (anode).

..... [2]

(iii) Name the acid formed in this electrolysis.

..... [1]

- (c) Steel articles can be plated with tin or zinc to prevent rusting. When the zinc layer is damaged exposing the underlying steel, it does not rust, but when the tin layer is broken the steel rusts. Explain.

.....

.....

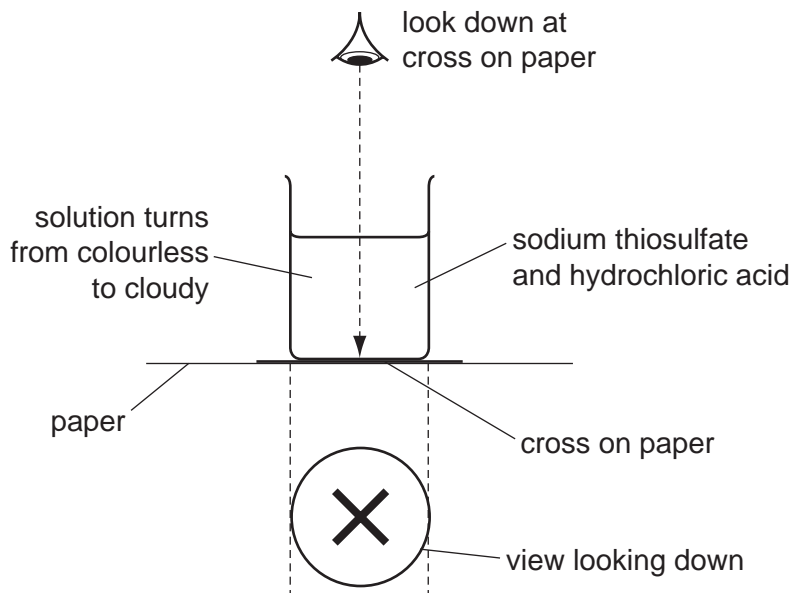
..... [4]

[Total: 14]

- 3 The equation for the reaction between sodium thiosulfate and hydrochloric acid is given below.



The speed of this reaction was investigated using the following experiment. A beaker containing 50 cm³ of 0.2 mol/dm³ sodium thiosulfate was placed on a black cross. 5.0 cm³ of 2.0 mol/dm³ hydrochloric acid was added and the clock was started.



Initially the cross was clearly visible. When the solution became cloudy and the cross could no longer be seen, the clock was stopped and the time recorded.

- (a) The experiment was repeated with 25 cm³ of 0.2 mol/dm³ sodium thiosulfate and 25 cm³ of water. Typical results for this experiment and a further two experiments are given in the table.

experiment	1	2	3	4
volume of thiosulfate/cm ³	50	40	25	10
volume of water/cm ³	0	10	25	40
volume of acid/cm ³	5	5	5	5
total volume/cm ³	55	55	55	55
time/s	48	60	96

- (i) Explain why it is necessary to keep the total volume the same in all the experiments.

.....

 [2]

- (ii) Complete the table. [1]

(iii) How and why does the speed of the reaction vary from experiment 1 to 4?

.....

.....

..... [3]

(b) The idea of collisions between reacting particles is used to explain changes in the speed of reactions. Use this idea to explain the following results.

volume of sodium thiosulfate / cm ³	25	25
volume of water / cm ³	25	25
volume of acid / cm ³	5	5
temperature / °C	20	42
time / s	96	40

.....

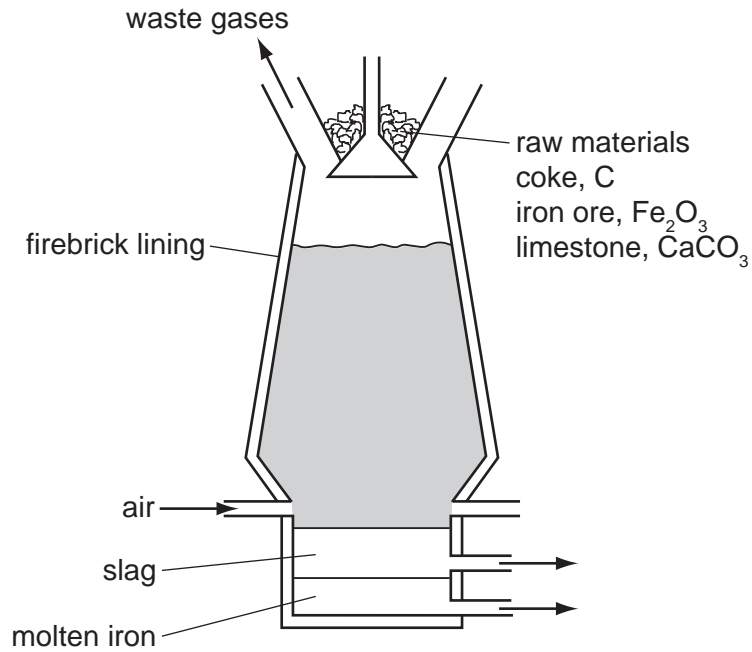
.....

.....

..... [4]

[Total: 10]

- 4 Iron is extracted from its ore, hematite, in the blast furnace.



Describe the reactions involved in this extraction. Include in your description an equation for a redox reaction and one for an acid/base reaction.

.....

.....

.....

.....

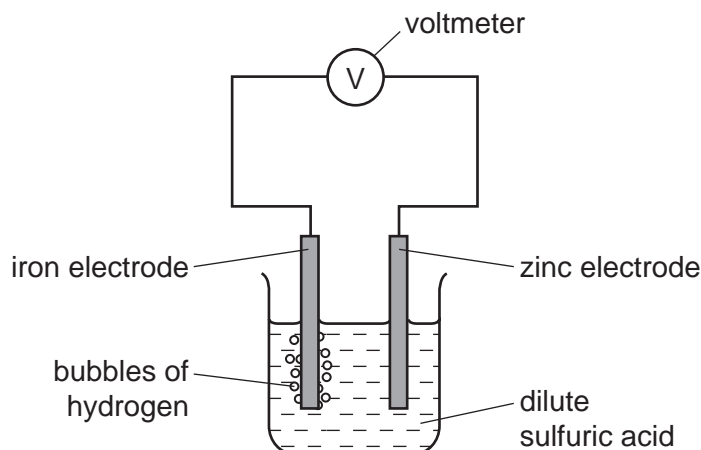
.....

..... [5]

[Total: 5]

- 5 The diagram shows a simple cell.

For
Examiner's
Use



- (a) Write an equation for the overall reaction occurring in the cell.

..... [2]

- (b) Explain why all cell reactions are exothermic and redox.

.....

 [3]

- (c) Which electrode, zinc or iron, is the negative electrode? Give a reason for your choice.

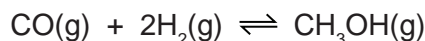
.....
 [2]

- (d) Suggest **two** ways of increasing the voltage of this cell.

.....
 [2]

[Total: 9]

- 6 (a) Methanol can be made from a mixture of carbon monoxide and hydrogen.



The forward reaction is exothermic.

- (i) Explain why the concentration of methanol at equilibrium does not change.

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

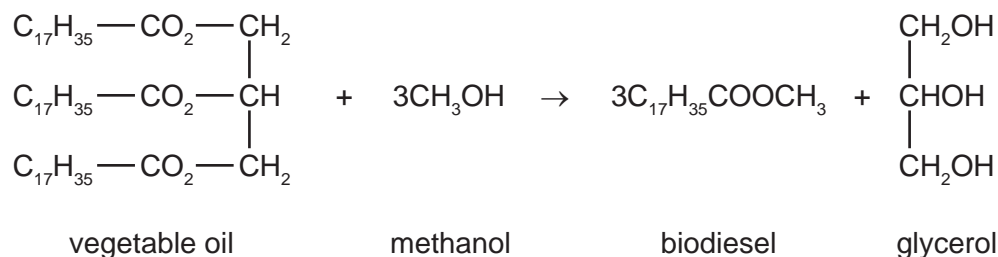
- (ii) Suggest conditions, in terms of temperature and pressure, which would give a high yield of methanol.

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

- (iii) How would the conditions used in practice compare with those given in (ii)? Give an explanation of any differences.

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

- (b) Biodiesel is made from a vegetable oil by the following reaction.



- (i) What type of compound are vegetable oil and biodiesel?

..... [1]

- (ii) What other useful product is made from vegetable oil by heating it with aqueous sodium hydroxide?

..... [1]

- (iii) Suggest an explanation why making and using biodiesel has a smaller effect on the percentage of carbon dioxide in the atmosphere than using petroleum-based diesel.

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

(c) Petroleum-based diesel is a mixture of hydrocarbons, such as octane and octene.

(i) 'Oct' means eight carbon atoms per molecule. Draw a structural formula of an octene molecule.

[1]

(ii) Describe a test which would distinguish between octane and octene.

test

result with octane

result with octene [3]

[Total: 14]

7 Chlorine reacts with phosphorus to form phosphorus trichloride.

(a) Draw a diagram showing the arrangement of the **valency** electrons in one molecule of the covalent compound, phosphorus trichloride.

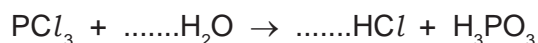
Use x to represent an electron from a phosphorus atom.

Use o to represent an electron from a chlorine atom.

[2]

(b) Phosphorus trichloride reacts with water to form two acids.

(i) Balance the equation for this reaction.



[1]

(ii) Describe how you could show that phosphorus acid, H_3PO_3 , is a weaker acid than hydrochloric acid.

.....

.....

..... [3]

- (iii) Two salts of phosphorus acid are its sodium salt, which is soluble in water, and its calcium salt which is insoluble in water. Suggest a method of preparation for each of these salts from aqueous phosphorus acid. Specify any other reagent needed and briefly outline the method.

sodium salt

.....

.....

..... [2]

calcium salt

.....

.....

..... [2]

[Total: 10]

8 Hydrocarbons are compounds which contain only carbon and hydrogen.

- (a) 20 cm³ of a gaseous hydrocarbon was burned in 120 cm³ of oxygen, which is in excess. After cooling, the volume of the gases remaining was 90 cm³. Aqueous sodium hydroxide was added to remove carbon dioxide, 30 cm³ of oxygen remained. All volumes were measured at r.t.p..

- (i) Explain why it is essential to use excess oxygen.

.....

..... [2]

- (ii) Carbon dioxide is slightly soluble in water. Why does it dissolve readily in the alkali, sodium hydroxide?

..... [1]

- (iii) Complete the following.

volume of gaseous hydrocarbon =cm³

volume of oxygen used =cm³

volume of carbon dioxide formed =cm³ [2]

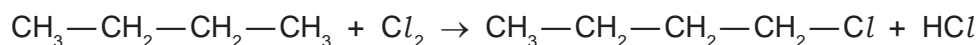
- (iv) Use the above volume ratio to find the mole ratio in the equation below and hence find the formula of the hydrocarbon.



hydrocarbon formula = [2]

(b) Alkanes are hydrocarbons and are generally unreactive. Their reactions include combustion, substitution and cracking.

(i) Chlorine reacts with butane in a substitution reaction.



Give the structural formula of another possible product of this reaction.

[1]

(ii) What is the essential condition for this reaction?

..... [1]

(iii) Explain what is meant by *cracking*. Give an example of a cracking reaction and explain why the process is used.

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

[Total: 13]

DATA SHEET
The Periodic Table of the Elements

Group		I	II	III	IV	V	VI	VII	0							
		1 H Hydrogen 1							2 He Helium 2							
3	4	7 Li Lithium	9 Be Beryllium		11 B Boron	12 C Carbon	13 Al Aluminium	14 Si Silicon	15 P Phosphorus	16 S Sulfur	17 Cl Chlorine	18 Ar Argon				
11	12	23 Na Sodium	24 Mg Magnesium		27 Fe Iron	28 Ni Nickel	29 Cu Copper	30 Zn Zinc	31 Ga Gallium	32 Ge Germanium	33 As Arsenic	34 Se Selenium	35 Br Bromine	36 Kr Krypton		
19	20	39 K Potassium	40 Ca Calcium		44 Ru Ruthenium	45 Rh Rhodium	46 Pd Palladium	47 Ag Silver	48 Cd Cadmium	49 In Indium	50 Sn Tin	51 Sb Antimony	52 Te Tellurium	53 I Iodine	54 Xe Xenon	
37	38	85 Rb Rubidium	88 Sr Strontium		101 Ru Ruthenium	102 Rh Rhodium	103 Pd Palladium	104 Ag Silver	105 Cd Cadmium	106 In Indium	107 Sn Tin	108 Sb Antimony	109 Te Tellurium	110 I Iodine	111 Xe Xenon	
55	56	133 Cs Caesium	137 Ba Barium		186 Re Rhenium	187 Os Osmium	188 Pt Platinum	189 Au Gold	190 Hg Mercury	191 Tl Thallium	192 Pb Lead	193 Bi Bismuth	194 Po Polonium	195 At Astatine	196 Rn Radon	
87	88	226 Fr Francium	226 Ra Radium		227 Ac Actinium	227 Ac Actinium	227 Ac Actinium	227 Ac Actinium	227 Ac Actinium	227 Ac Actinium	227 Ac Actinium	227 Ac Actinium	227 Ac Actinium	227 Ac Actinium	227 Ac Actinium	227 Ac Actinium

140 Ce Cerium	141 Pr Praseodymium	144 Nd Neodymium	150 Sm Samarium	152 Eu Europium	157 Gd Gadolinium	162 Dy Dysprosium	165 Ho Holmium	167 Er Erbium	169 Tm Thulium	173 Yb Ytterbium	175 Lu Lutetium
58	59	60	62	63	64	66	67	68	69	70	71
90	91	92	94	95	96	98	99	100	101	102	103
Th Thorium	Pa Protactinium	U Uranium	Pu Plutonium	Am Americium	Cm Curium	Cf Californium	Es Einsteinium	Fm Fermium	Md Mendelevium	No Nobelium	Lr Lawrencium
90	91	92	94	95	96	98	99	100	101	102	103

a	X	b
Key	X	b

*58-71 Lanthanoid series
†90-103 Actinoid series

a = relative atomic mass
X = atomic symbol
b = proton (atomic) number

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included the publisher will be pleased to make amends at the earliest possible opportunity.

University of Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.