UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

0026964373

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.

UNIVERSITY of CAMBRIDGE International Examinations

For Examiner's Use

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'.

$Cu + Sn^{2+} \rightarrow$ .....

$Fe + Sn^{2+} \rightarrow$ .....

$Sn + Zn^{2+} \rightarrow$ ..... [4]

(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]

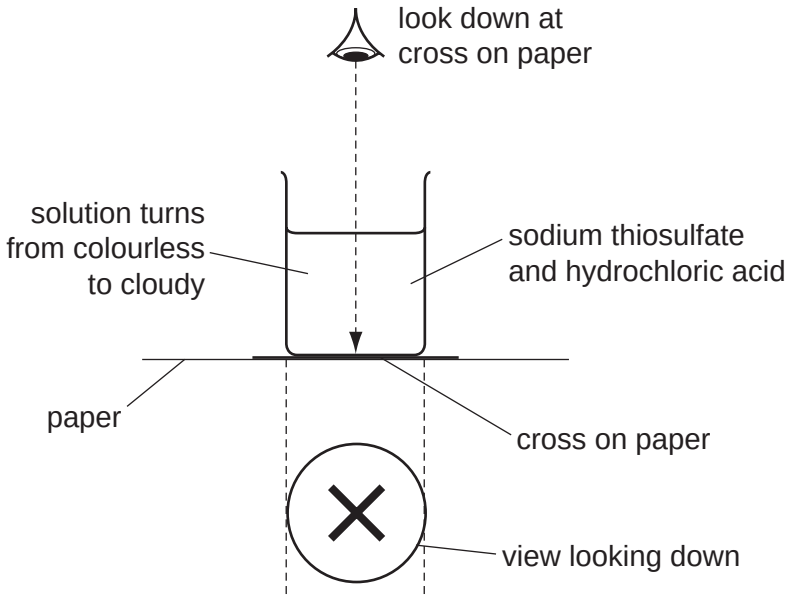
[Total: 14]

For Examiner's Use

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

$$Na_2S_2O_3(aq) + 2HCl(aq) \rightarrow 2NaCl(aq) + S(s) + SO_2(g) + H_2O(l)$$

The speed of this reaction was investigated using the following experiment. A beaker containing 50 cm^3 of 0.2 mol / dm^3 sodium thiosulfate was placed on a black cross. 5.0 cm^3 of 2.0 mol / dm^3 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 cm^3 of 0.2 mol / dm^3 sodium thiosulfate and 25 cm^3 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

.....

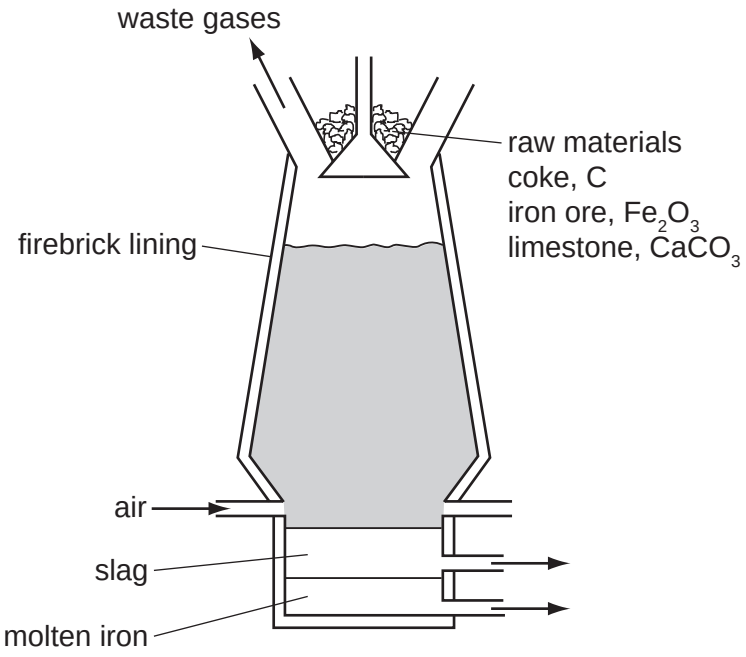
.....

.....

..... [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.

.....

.....

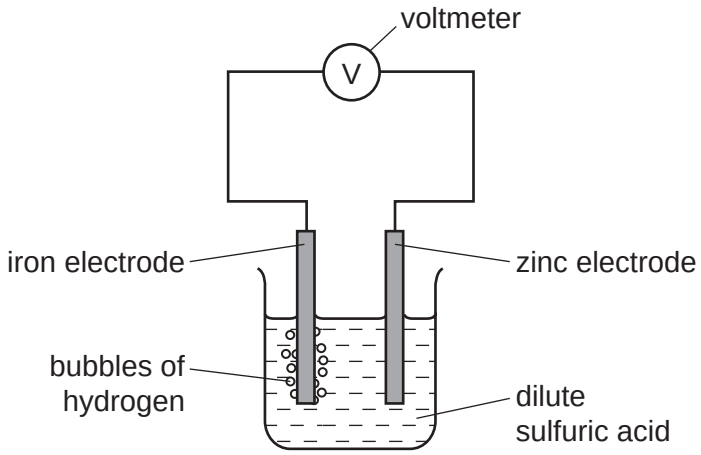
.....

.....

..... [5]

[Total: 5]

5 The diagram shows a simple cell.



(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.

$$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$$

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]

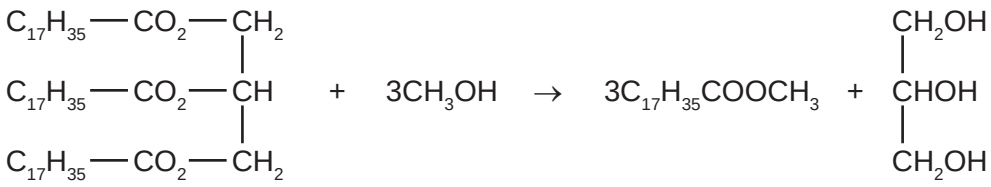
(iii) How would the conditions used in practice compare with those given in **(ii)**? Give an explanation of any differences.

.....

.....

..... [2]

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



vegetable oil methanol biodiesel glycerol

(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.

$$PCl_3 + ...H_2O \rightarrow .....HCl + H_3PO_3$$

[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 cm^3 of a gaseous hydrocarbon was burned in 120 cm^3 of oxygen, which is in excess. After cooling, the volume of the gases remaining was 90 cm^3. Aqueous sodium hydroxide was added to remove carbon dioxide, 30 cm^3 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 = ...cm^3

volume of oxygen used = ...cm^3

volume of carbon dioxide formed = ...cm^3 [2]

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

$$\text{.....}C_xH_y(g) + \text{.....}O_2(g) \rightarrow \text{.....}CO_2(g) + \text{.....}H_2O(l)$$

hydrocarbon formula = ... [2]

For Examiner's Use

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

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

$$CH_3—CH_2—CH_2—CH_3 + Cl_2 \rightarrow CH_3—CH_2—CH_2—CH_2—Cl + HCl$$

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
																4 He Helium 2
				1 H Hydrogen 1												
7 Li Lithium 3	9 Be Beryllium 4										11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12										27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57 *	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	Po Polonium 84	At Astatine 85	Rn Radon 86
Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89 †															

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	Pa Protactinium 91	238 U Uranium 92	Np Neptunium 93	Pu Plutonium 94	Am Americium 95	Cm Curium 96	Bk Berkelium 97	Cf Californium 98	Es Einsteinium 99	Fm Fermium 100	Md Mendelevium 101	No Nobelium 102	Lr Lawrencium 103

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

Key

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

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).