UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

7888284967

CHEMISTRY **0620/23**

Paper 2 **October/November 2010**

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 in the spaces at the top of this page.
Write in dark blue or black pen.
You may need to 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 16.

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	
Total	

This document consists of **15** printed pages and **1** blank page.

UNIVERSITY of CAMBRIDGE International Examinations

For Examiner's Use

1 Choose from the following list of oxides to answer the questions below.
You can use each oxide once, more than once or not at all.

carbon dioxide
carbon monoxide
magnesium oxide
nitrogen dioxide
sulfur dioxide
water

(a) Which **one** of these oxides is a basic oxide?

..... [1]

(b) Which **two** oxides cause acid rain?

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

(c) Which **two** oxides are formed when a hydrocarbon undergoes complete combustion?

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

(d) Which **one** of these oxides turns white copper(II) sulfate blue?

..... [1]

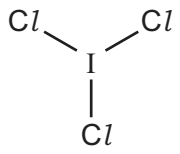
(e) Which oxide is formed when calcium carbonate undergoes thermal decomposition?

..... [1]

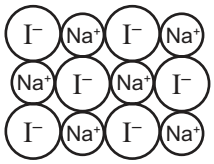
[Total: 7]

2 The diagram shows the structure of some compounds containing iodine.

A

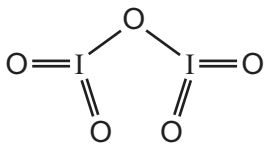


B



C

D



(a) (i) What do you understand by the term *compound*?

.....

..... [1]

(ii) Which **one** of these compounds, **A**, **B**, **C** or **D**, has a high melting point? Explain your answer.

compound .....

explanation ..... [2]

(iii) Which **one** of these compounds is similar in structure to hydrogen chloride?

..... [1]

(b) Compound **B** is sodium iodide.

(i) Which statement about the electrical conductivity of sodium iodide is correct? Tick **one** box.

It conducts electricity when molten.	☐
It conducts electricity when solid.	☐
It does not conduct electricity when molten.	☐
It does not conduct electricity in aqueous solution.	☐

[1]

(ii) Describe a test for iodide ions.

test .....

result ..... [2]

(c) Compound **D** is iodine(V) oxide. It is an acidic oxide.
Suggest why iodine(V) oxide is an acidic oxide.

..... [1]

[Total: 8]

3 Some properties of the Group I elements are given in the table.

element	melting point / °C	boiling point / °C	density in g / cm^3
lithium	181	1342	0.53
sodium	98	883	0.97
potassium	63		0.86
rubidium	39	686	1.53
caesium	29	669	1.88

(a) (i) Predict the boiling point of potassium.

..... [1]

(ii) Which Group I elements are liquids at 50 °C?

..... [2]

(iii) How, in general, does the density of the Group I elements change down the group?

..... [1]

(b) Complete the following sentences about the Group I elements using words from the list below.

crystallising **decreases** **hard** **increases**

melting **similarity** **soft**

The Group I elements are relatively ..... metals which show a trend in ..... point and reaction with water.

The reactivity with water ..... down the group. [3]

(c) The equation for the reaction of sodium with water is given below.

$$2Na + 2H_2O \rightarrow 2NaOH + H_2$$

Write a word equation for this reaction.

[2]

(d) Chlorine reacts with sodium to form sodium chloride.

(i) Complete the equation for this reaction.

.....Na + Cl_2 → .....NaCl

[2]

(ii) Chlorine is a diatomic gas.
What do you understand by the term *diatomic*?

..... [1]

(iii) Describe the arrangement and motion of the molecules in chlorine gas.

arrangement .....

motion ..... [2]

(iv) Draw a diagram to show the arrangement of the electrons in a molecule of chlorine.
Show only the outer electrons.

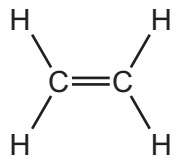
[2]

[Total: 16]

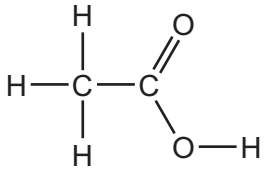
[Turn over

4 The formulae of four organic compounds are shown below.

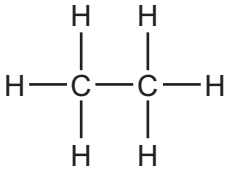
A



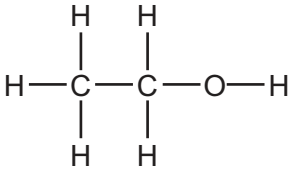
B



C



D



(a) (i) State the name of the type of bonding between the atoms in these four compounds.

..... [1]

(ii) Which **one** of these compounds, **A**, **B**, **C** or **D**, is a saturated hydrocarbon?

..... [1]

(iii) Which **one** of these compounds is acidic?

..... [1]

(iv) State the name of compound **D**.

..... [1]

(v) Compound **A** contains a C=C double bond.
Describe a test for a C=C double bond.

test .....

result ..... [2]

(b) Compound **C** is a member of the alkane homologous series.

(i) State **two** features of an homologous series.

1. .....

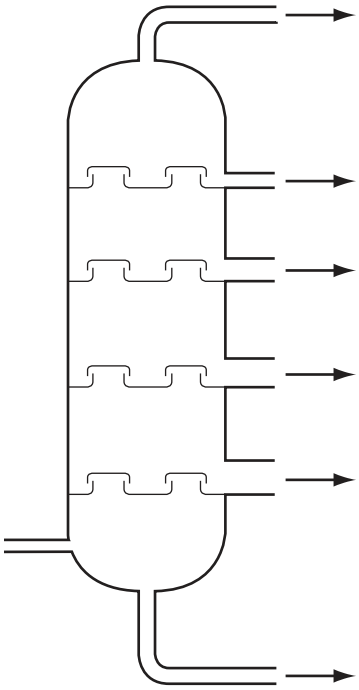
2. .....[2]

(ii) State the formula and name of another alkane in the same homologous series as compound **C**.

formula

name ..... [2]

(c) The alkanes present in petroleum can be separated by fractional distillation. The diagram below shows a fractional distillation column.



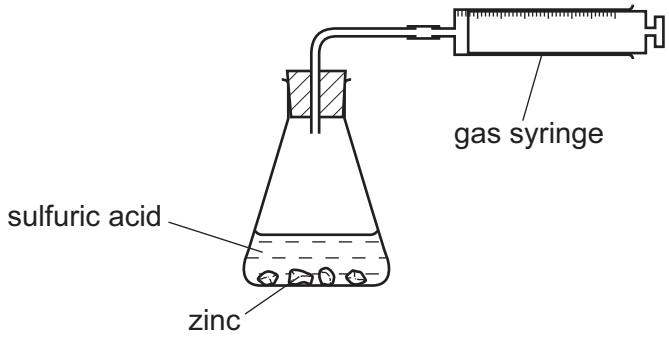
(i) On the diagram, label where the temperature in the column is the lowest. Mark this with the letter **X**. [1]

(ii) On the diagram, label where the bitumen fraction is collected. Mark this with the letter **Y**. [1]

[Total: 12]

5 A student used the apparatus shown below to investigate the speed of reaction when large lumps of zinc reacted with excess sulfuric acid.

$$\text{zinc} + \text{sulfuric acid} \rightarrow \text{zinc sulfate} + \text{hydrogen}$$



(a) As the reaction proceeds, describe what happens to

(i) the mass of the zinc lumps.

..... [1]

(ii) the concentration of zinc sulfate in the solution in the flask.

..... [1]

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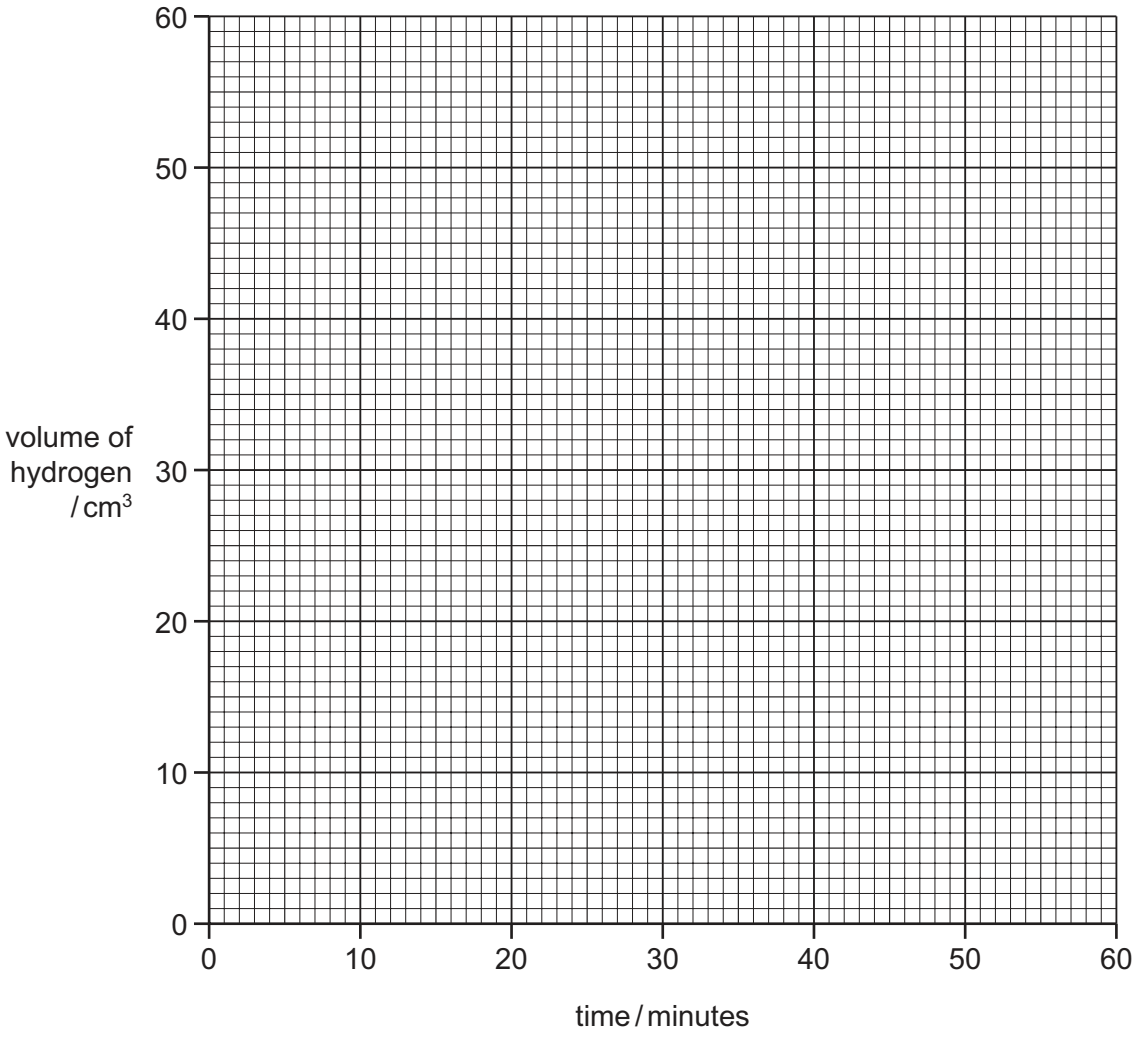
(b) The student's results are shown below.

time / minutes	0	10	20	30	40	50	60
volume of hydrogen / cm^3	0	24	39	48	53	55	55

(i) Plot a graph of volume of hydrogen against time. Use the axes below.



[3]

(ii) Use your graph to calculate the volume of hydrogen given off after 25 minutes.

volume of hydrogen ..... [1]

(iii) Explain why no more hydrogen was given off after 50 minutes.

..... [1]

(iv) Describe a test for hydrogen.

test .....

result ..... [2]

(c) What happens to the speed of the reaction when

(i) smaller pieces of zinc are used?

..... [1]

(ii) some water is added to the sulfuric acid?

..... [1]

(d) The reaction between zinc and sulfuric acid is catalysed by copper(II) sulfate solution. What do you understand by the term *catalyst*?

..... [1]

[Total: 12]

6 Iron is a transition element.

(a) State **three** properties of transition elements which are not shown by the Group I elements.

1. .....

2. .....

3. ..... [3]

(b) The symbols for two isotopes of iron are shown below.

$^{54}_{26}Fe$ $^{57}_{26}Fe$

(i) How do these two isotopes differ in their atomic structure?

..... [1]

(ii) State the number of nucleons present in one atom of the isotope $^{57}_{26}Fe$.

..... [1]

(iii) How many electrons are there in one atom of the isotope $^{54}_{26}Fe$?

..... [1]

(c) Pure iron rusts very easily.

(i) State the **two** conditions that are needed for rusting to take place.

1. .....

2. ..... [2]

(ii) Describe and explain **one** method of preventing rusting.

method .....

explain why this method works .....

..... [2]

(d) In the blast furnace, iron(III) oxide reacts with carbon monoxide.

$$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$$

Which substance gets reduced in this reaction?
Explain your answer.

substance .....

explanation .....

..... [2]

(e) **(i)** Carbon monoxide is a pollutant gas produced in motor car engines.
Explain why carbon monoxide is formed.

..... [1]

(ii) State **one** harmful effect of carbon monoxide.

..... [1]

[Total: 14]

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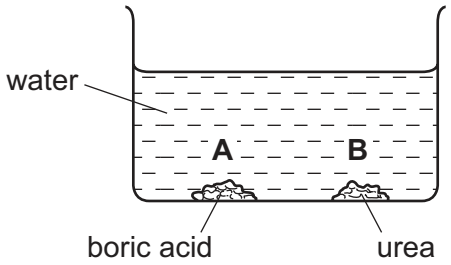
7 Boric acid is an acid. Urea is a base. Both compounds are crystalline.
A student placed some crystals of boric acid and urea in a large beaker of water. The pH value of the water at the start of the experiment was pH 7.



(a) After 15 minutes the pH at point **A** in the beaker was pH 6.2.

(i) Suggest why the pH at point **A** had decreased.

..... [1]

(ii) What was the most likely pH at point **B** in the beaker after 15 minutes?
Put a ring around the correct answer.

pH 1 **pH 6** **pH 7** **pH 8** [1]

(iii) The particles of boric acid and urea diffuse throughout the solution.
What do you understand by the term *diffusion*?

.....

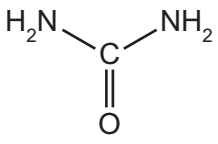
..... [1]

(iv) After 24 hours the pH throughout the whole solution was pH 7.
Use your knowledge of acids and alkalis to explain why the pH returned to pH 7.

.....

..... [1]

(b) The structure of urea is shown below.



(i) Write the simplest formula for urea.

[1]

(ii) Calculate the relative molecular mass of urea.
Use your Periodic Table to help you.

[1]

(c) Urea is used as a fertiliser.

(i) Which element present in urea is an essential part of most fertilisers?

..... [1]

(ii) Explain why farmers put fertilisers on their fields.

.....

..... [2]

(d) Describe how you can obtain pure, dry crystals of urea from an aqueous solution of urea.

.....

.....

..... [2]

[Total: 11]

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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							11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
7 Li Lithium 3	9 Be Beryllium 4										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
23 Na Sodium 11	24 Mg Magnesium 12										70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
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	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
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	231 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 = relative atomic mass; X = atomic symbol; b = proton (atomic) number

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