UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

* 2 9 9 8 8 7 2 0 9 *

CHEMISTRY **0620/22**

Paper 2 **October/November 2012**

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.

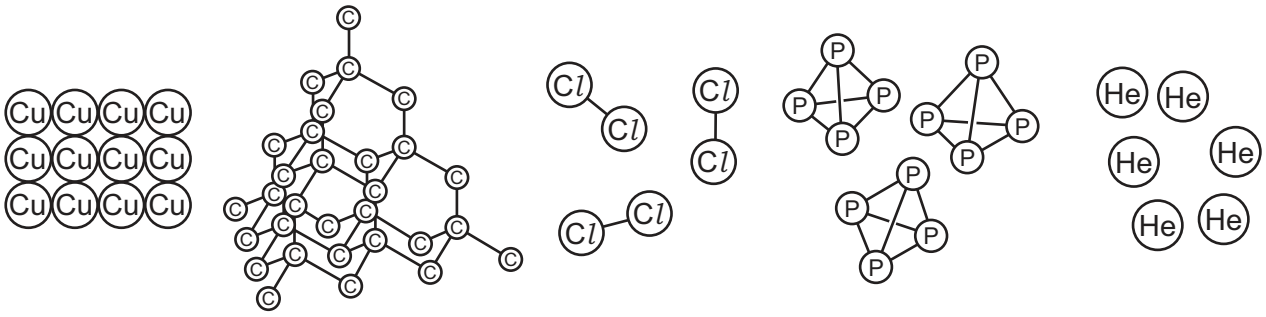
At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
7	
Total	

This document consists of **14** printed pages and **2** blank pages.

1 The diagram shows the structures of five elements, **A**, **B**, **C**, **D** and **E**.

A **B** **C** **D** **E**



(a) Answer these questions using the letters **A**, **B**, **C**, **D** or **E**.
Each element can be used once, more than once or not at all.

Which one of these elements

(i) is in Group V of the Periodic Table, ... [1]

(ii) is used to fill weather balloons, ... [1]

(iii) is a diatomic gas at room temperature, ... [1]

(iv) conducts electricity, ... [1]

(v) is a transition element? ..... [1]

(b) Which **two** of the elements **A**, **B**, **C**, **D** or **E** are simple molecules?

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

(c) Which **two** of the words or phrases in the list below describe the structure of element **B**?

covalent	**giant**	**ionic**
metallic	**simple atomic**	**simple molecular**

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

(d) What do you understand by the term *element*?

..... [1]

[Total: 10]

2 Ammonia, NH_3, is an alkaline gas.

(a) Describe a test for ammonia.

test .....

result ..... [2]

(b) What is the pH of an aqueous solution of ammonia?
Put a ring around the correct answer.

pH 1 **pH 3** **pH 5** **pH 7** **pH 9**

[1]

(c) Ammonia reacts with hydrochloric acid.

(i) Complete the symbol equation for this reaction.

$$NH_3 + HCl \rightarrow .....$$

[1]

(ii) Hydrochloric acid can be made by dissolving hydrogen chloride, HCl, in water.
Draw a diagram to show the arrangement of electrons in hydrogen chloride.
Show only the outer electrons.

Show a hydrogen electron as ●
Show a chlorine electron as **x**

[2]

(d) Aqueous ammonia reacts with sulfuric acid to form a solution of ammonium sulfate.

$$2NH_3(aq) + H_2SO_4(aq) \rightarrow (NH_4)_2SO_4(aq)$$

(i) Ammonium sulfate is a colourless salt. Describe how you could use a titration method to make a colourless solution of ammonium sulfate.

.....

.....

.....

.....

.....

..... [4]

(ii) How can crystals of ammonium sulfate be obtained from a solution of ammonium sulfate?

.....

..... [1]

[Total: 11]

For Examiner's Use

3 The table below shows the properties of some halogens.

halogen	colour	state at room temperature	melting point / °C
fluorine	yellow		–220
chlorine	light green	gas	
bromine	brownish-red	liquid	–7
iodine	grey-black	solid	+114

(a) (i) What is the trend in the colour of the halogens down the Group?

..... [1]

(ii) Predict the state of fluorine at room temperature.

..... [1]

(iii) Predict the melting point of chlorine.

..... [1]

(b) The reactivity of three different halogens was compared by reacting them with solutions of sodium halides.
The results are shown in the table below.

reaction mixture	observations
astatine + sodium iodide	colour of reaction mixture remains unchanged
bromine + sodium iodide	mixture turns dark brown
chlorine + sodium bromide	mixture turns brownish-red

(i) Use the results in the table to suggest the order of reactivity of astatine, bromine, chlorine and iodine.

most reactive ⟶ least reactive

[2]

(ii) Predict whether bromine will react with sodium chloride solution.
Explain your answer.

.....

..... [1]

(c) Chlorine reacts with excess cold dilute sodium hydroxide. The products of the reaction are sodium chloride, sodium chlorate(I) and water.
The formula of sodium chlorate(I) is NaClO.

Complete the equation for this reaction.

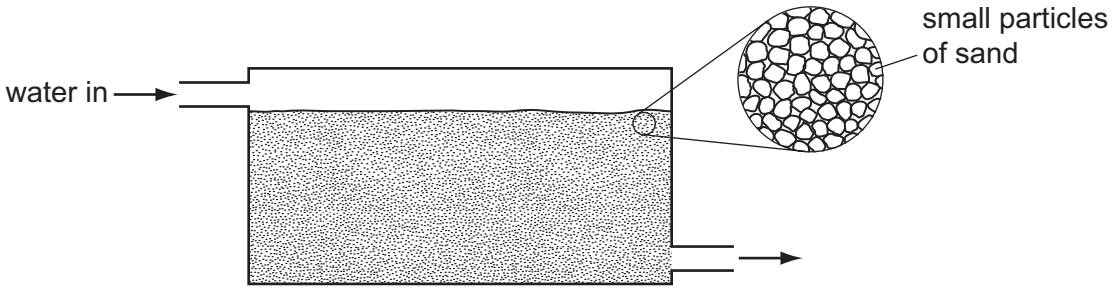
$$Cl_2 + ...NaOH \rightarrow NaCl + NaClO + ...$$

[2]

(d) (i) Explain why chlorine is used in water purification.

..... [1]

(ii) Impure water contains particles of minerals and remains of dead plants and animals.
One stage in water purification is the removal of these particles by filtration.
The diagram below shows a water filter.



Explain how this water filter works.

.....

.....

..... [2]

[Total: 11]

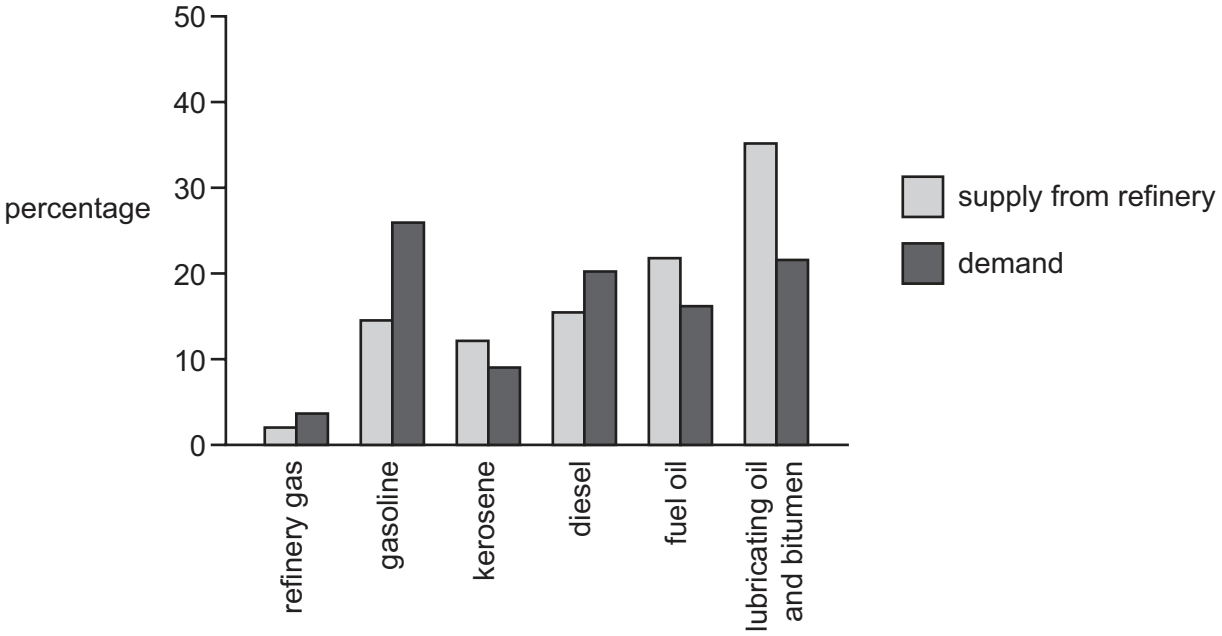
4 The process of distillation is used in an oil refinery to separate petroleum into different fractions.

(a) What do you understand by the term *petroleum fraction*?

.....

..... [2]

(b) Some petroleum fractions are more useful than others. There is a greater demand for these fractions.
The diagram shows the demand from customers and the ability of an oil refinery to supply these fractions by fractional distillation alone.



(i) State the name of **two** fractions for which demand is greater than supply.

..... [2]

(ii) State **one** use for each of the following fractions.

refinery gas .....

bitumen ..... [2]

(c) More gasoline can be made by cracking long-chain hydrocarbons.

State the conditions needed for cracking.

.....

..... [2]

(d) Dodecane, $C_{12}H_{26}$, can be cracked to form smaller hydrocarbons.

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

..... [1]

(ii) Complete the equation for the cracking of dodecane.

$$C_{12}H_{26} \rightarrow C_8H_{18} + ...$$

[1]

(e) Ethene, C_2H_4, can be formed by cracking.

(i) Draw the full structure of ethene showing all atoms and bonds.

[1]

(ii) Poly(ethene) can be made from ethene.
Complete the following sentences using words from the list below.

addition **atoms** **condensation** **dimers**

monomers **polymers** **subtraction**

The small ethene molecules which join together to form poly(ethene) are called ethene ..... . The process of joining the ethene molecules together is an example of an ..... reaction. The long-chain molecules which are formed are called ..... . [3]

[Total: 14]

5 Aluminium is in Group III of the Periodic Table. Iron is a transition element.

(a) Both aluminium and iron have high melting points and boiling points.
State **two** differences in the physical properties of aluminium and iron.

.....

..... [2]

(b) State **one** use of aluminium.

..... [1]

(c) Sodium hydroxide is used to test for aluminium ions.
Describe what happens when you add a solution of sodium hydroxide to a solution of aluminium ions until the sodium hydroxide is in excess.

.....

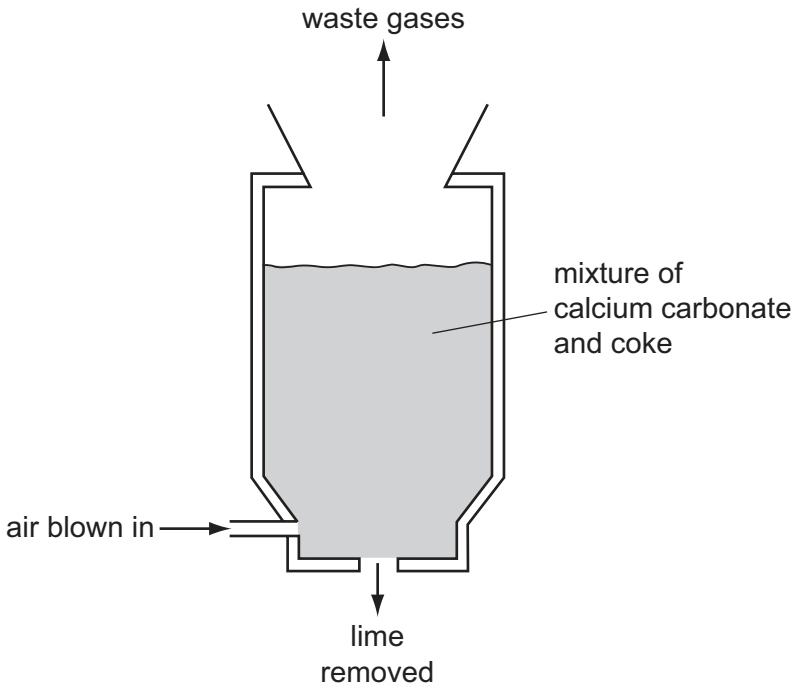
.....

..... [3]

[Total: 6]

For Examiner's Use

6 The diagram below shows a kiln used for manufacturing lime.



The reaction taking place in the kiln is

$$\text{calcium carbonate} \rightarrow \underset{\text{(lime)}}{\text{calcium oxide}} + \text{carbon dioxide}$$

(a) (i) State the name of a rock which is largely calcium carbonate.

..... [1]

(ii) Explain why, at the end of the reaction, there is only lime left in the lime kiln.

..... [1]

(b) (i) Coke is mainly carbon.
Combustion of coke provides the heat for the reaction in the lime kiln.
Write a symbol equation for the complete combustion of carbon in oxygen.

..... [2]

(ii) Complete these sentences using words from the list below.

air	**dioxide**	**harmless**	**hydrogenated**
limited	**monoxide**	**poisonous**	**water**

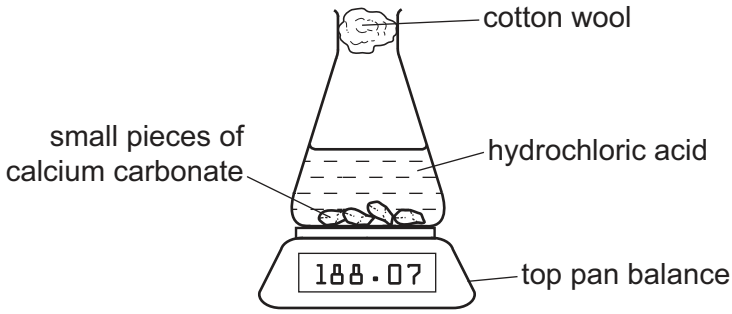
When carbon burns in a ..... supply of ....., carbon ..... is formed. This is a colourless gas which has no smell and is ..... . [4]

(c) Calcium carbonate reacts with hydrochloric acid to form carbon dioxide. Complete the word equation for this reaction.

calcium carbonate + hydrochloric acid → ..... + ... + carbon dioxide

[2]

(d) The speed of reaction of calcium carbonate with hydrochloric acid can be found using the apparatus shown below.



(i) Suggest how this apparatus can be used to find the speed of this reaction.

.....

.....

..... [2]

(ii) State how the speed of this reaction changes when

the concentration of acid is increased, ...

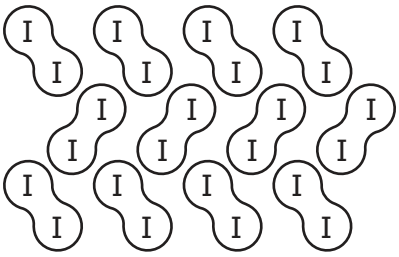
larger pieces of calcium carbonate are used, ...

the temperature is increased. ..... [3]

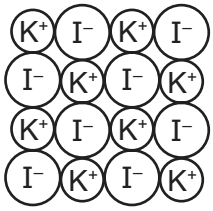
[Total: 15]

For Examiner's Use

7 The structures of iodine and potassium iodide are shown below.



iodine



potassium iodide

(a) Iodine is a solid at room temperature. Its melting point is +114 °C.

(i) Describe what happens to the arrangement and movement of iodine molecules when iodine is gradually heated from 20 °C to 120 °C.

.....

.....

.....

.....

..... [4]

(ii) Calculate the relative molecular mass of iodine.

..... [1]

(b) **(i)** What type of bonding is present in potassium iodide?

..... [1]

(ii) Write the simplest formula for potassium iodide.

..... [1]

(c) Complete the table below to show the solubility in water and electrical conductivity of solid iodine and solid potassium iodide.

substance	solubility in water	electrical conductivity of solid
iodine		
potassium iodide		

[4]

(d) Predict the product formed at each electrode when molten potassium iodide is electrolysed.

at the positive electrode .....

at the negative electrode ..... [2]

[Total: 13]

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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.).