UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

2698872094

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.

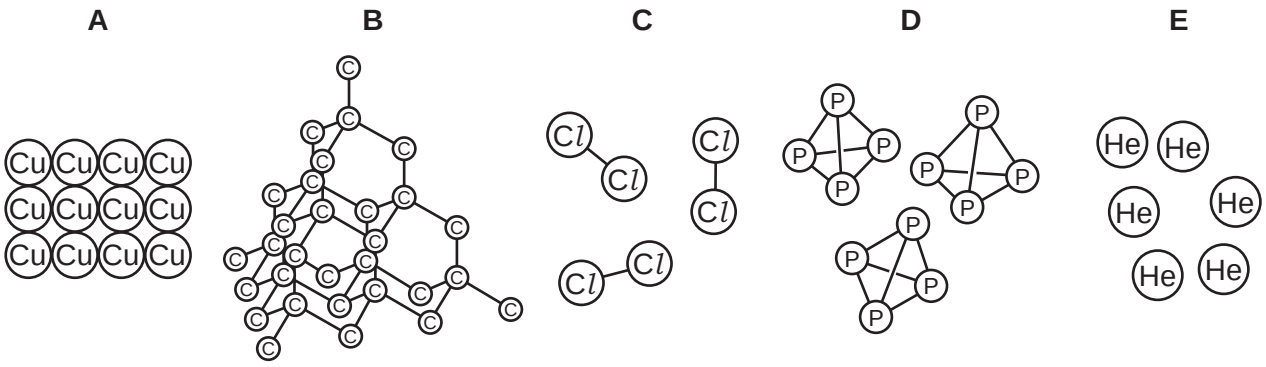
At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

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

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

UNIVERSITY of CAMBRIDGE International Examinations

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

For Examiner's Use

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]

[Turn over

(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]

[Turn over

(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 NaC*l*O.

Complete the equation for this reaction.

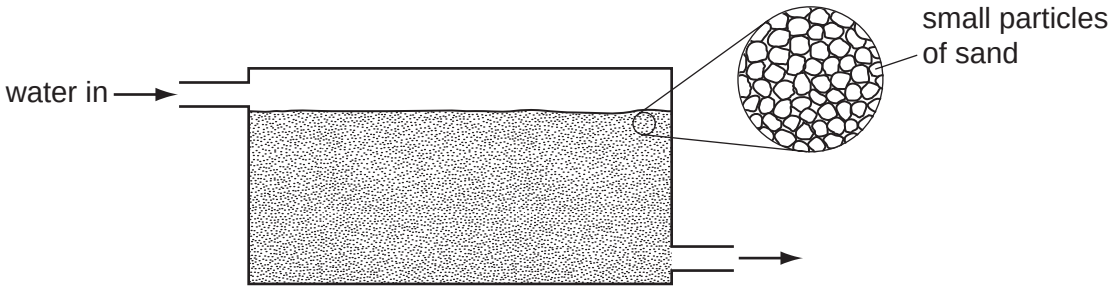
$$Cl_2 + ...NaOH \rightarrow NaCl + NaClO + ...$$

[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]

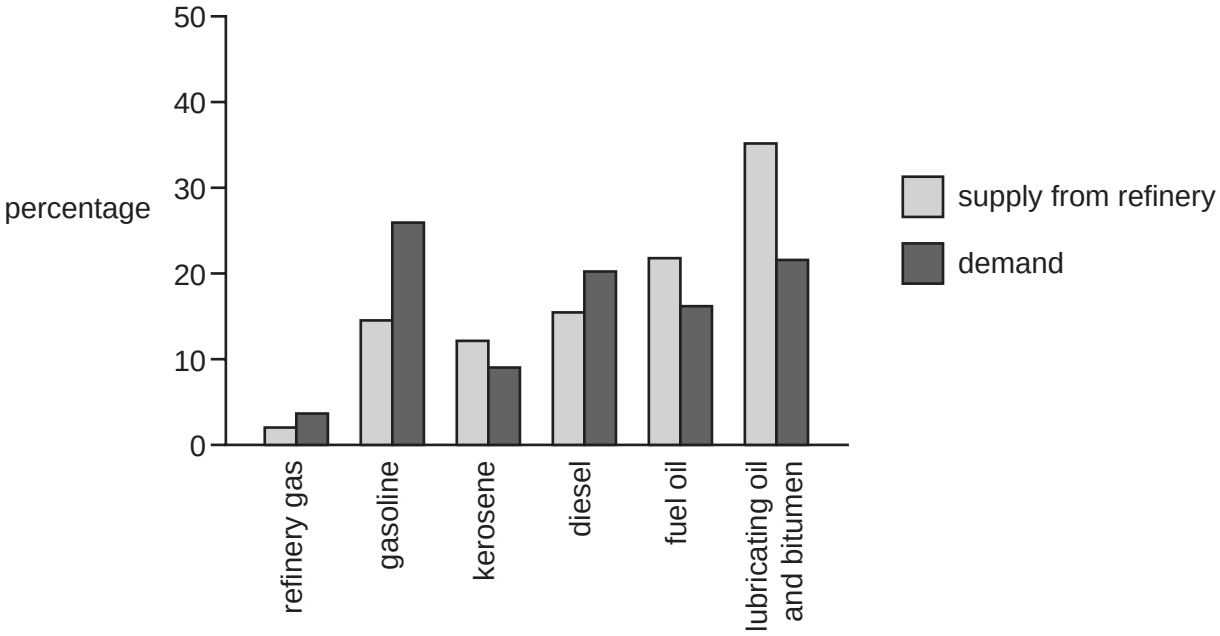
4 The process of distillation is used in an oil refinery to separate petroleum into different fractions.

(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]

For Examiner's Use

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.

.....

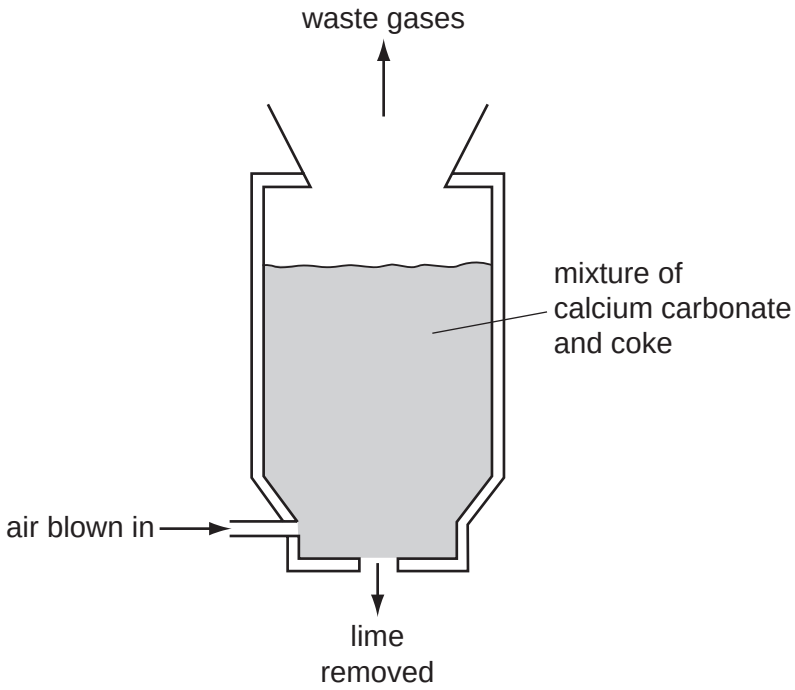
.....

..... [3]

[Total: 6]

[Turn over

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**

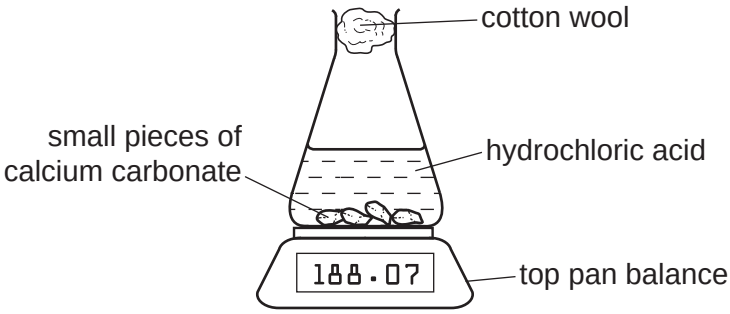
When carbon burns in a ..... supply of ....., carbon ..... is formed. This is a colourless gas which has no smell and is ..... . [4]

(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

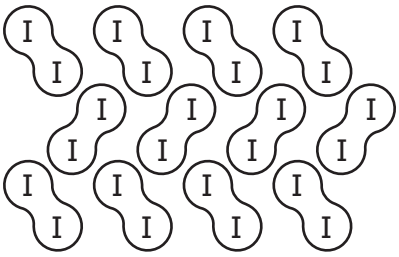
the concentration of acid is increased, ...

larger pieces of calcium carbonate are used, ...

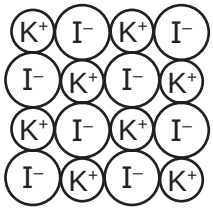
the temperature is increased. ..... [3]

[Total: 15]

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
							1 **H** Hydrogen 1										4 **He** Helium 2
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 / **X** / b
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.).