UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER | | | | | |

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**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.

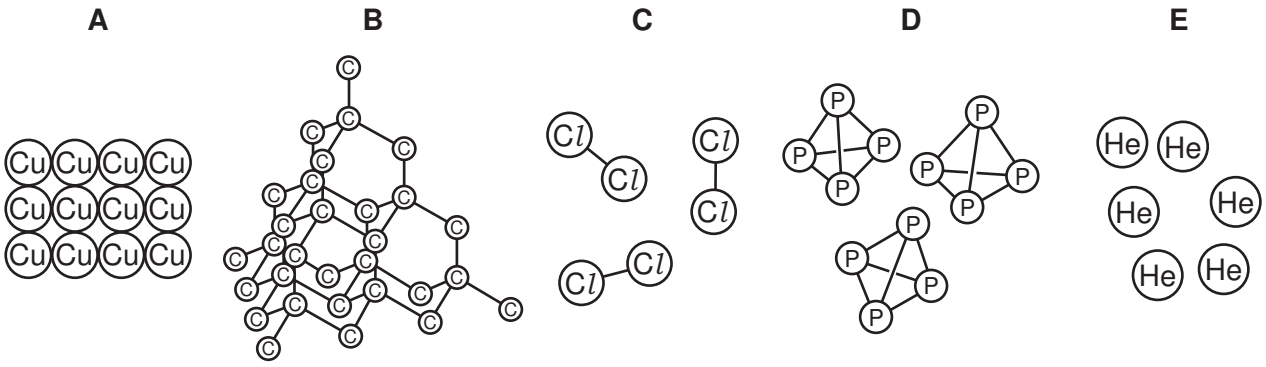
Answer **all** questions.
A copy of the Periodic Table is printed on page 16.

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)** 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]

**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.

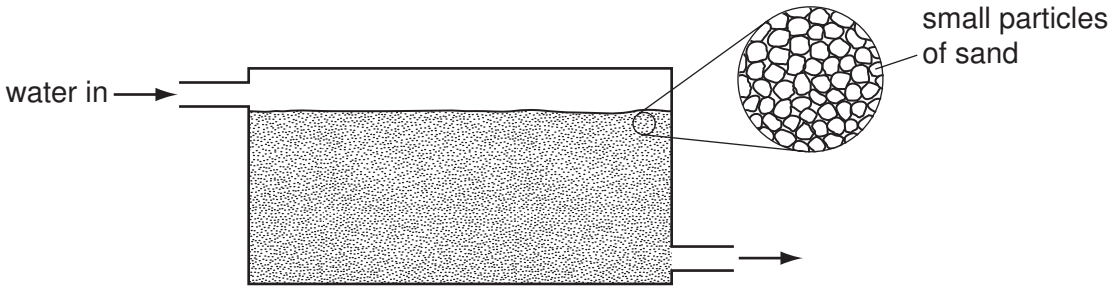
$$Cl_2 + \text{.....NaOH} \rightarrow \text{NaC}l + \text{NaC}l\text{O} + \text{.....}$$

[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]

For Examiner's Use

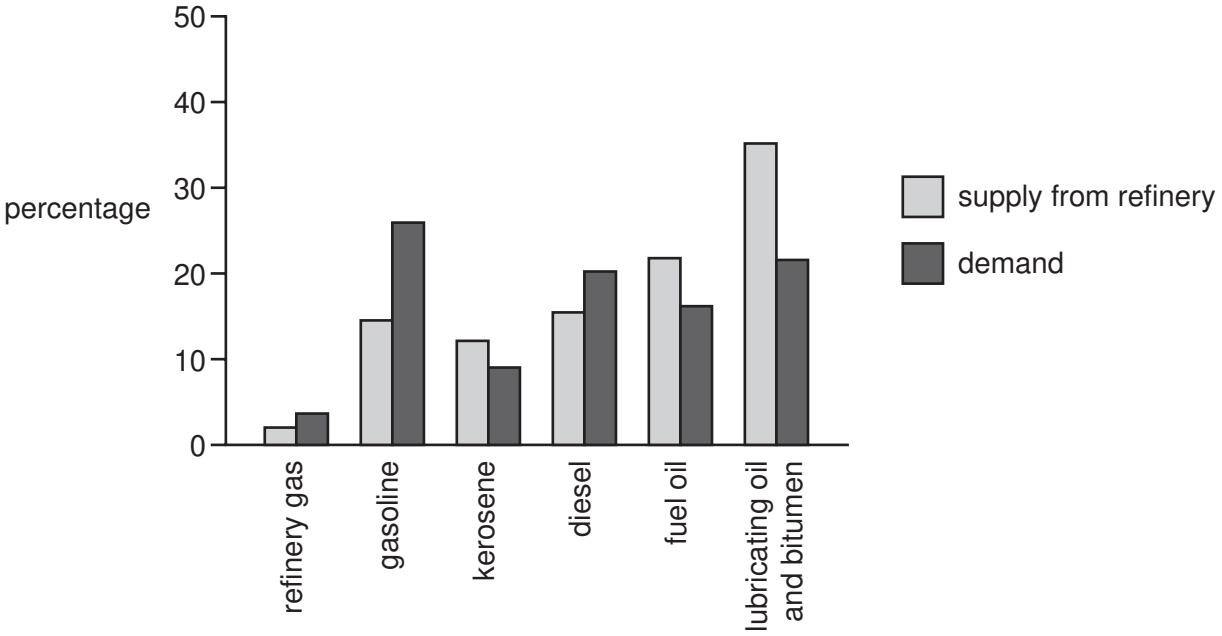
**4** The process of distillation is used in an oil refinery to separate petroleum into different fractions.

**(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.

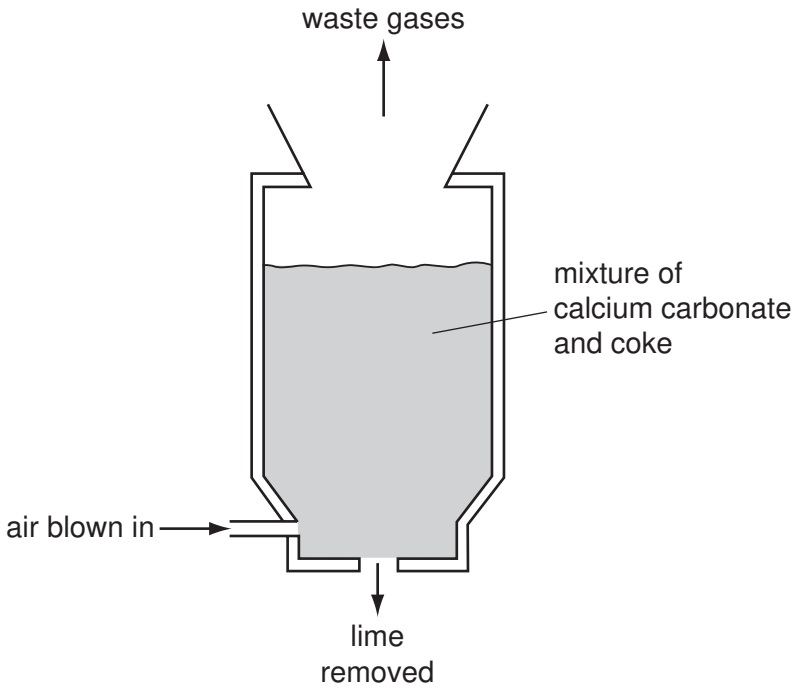
.....

.....

..... [3]

[Total: 6]

**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** |

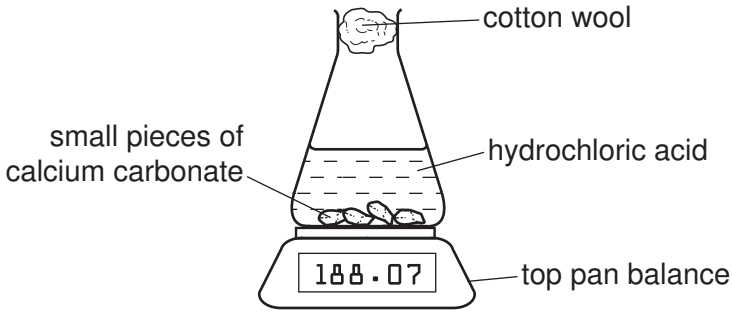
When carbon burns in a ..... supply of ....., carbon ..... is formed. This is a colourless gas which has no smell and is ..... . [4]

**(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, .....

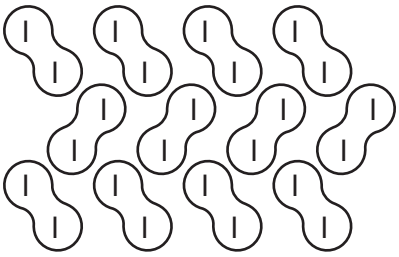
larger pieces of calcium carbonate are used, .....

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

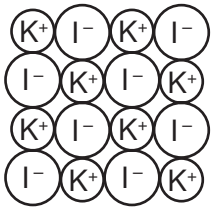
[Total: 15]

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 |
| | | | | | | | 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 = 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.).