UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

5048513202

CHEMISTRY **0620/22**

Paper 2 **October/November 2013**

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.
Electronic calculators may be used.
A copy of the Periodic Table is printed on page 16.
You may lose marks if you do not show your working or if you do not use appropriate units.

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.

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

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For Examiner's Use

1 **(a)** Choose from the list of compounds below to answer the following questions.

ammonia
ammonium chloride
calcium carbonate
calcium oxide
copper(II) sulfate
ethane
iron(II) chloride
methane
water

Each compound can be used once, more than once or not at all.

Which compound:

(i) is an alkaline gas, ... [1]

(ii) is a gas contributing to climate change, ... [1]

(iii) is a salt containing only non-metals, ... [1]

(iv) turns blue cobalt chloride paper pink, ... [1]

(v) reacts with an acid to release carbon dioxide, ... [1]

(vi) gives a light blue precipitate when aqueous sodium hydroxide is added to a solution of its aqueous ions? ..... [1]

(b) What is the meaning of the term *compound*?

.....

..... [1]

(c) Complete the following symbol equation for the complete combustion of methane in oxygen.

$$CH_4 + ...O_2 \rightarrow ..... + 2H_2O$$

[2]

[Total: 9]

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2 **(a)** The table describes the reactivity of some metals with hydrochloric acid.

metal	observations
calcium	Many bubbles produced. Reaction mixture may boil.
magnesium	Steady stream of bubbles produced. Reaction mixture gets hot.
sodium	Many bubbles produced. May explode.
zinc	Slow stream of bubbles produced. Reaction mixture rises slightly in temperature.

Put these metals in order of their reactivity.

least reactive ⟶ most reactive

[2]

(b) Complete the word equation for the reaction of magnesium with hydrochloric acid.

magnesium + hydrochloric acid → ..... + ...

.....

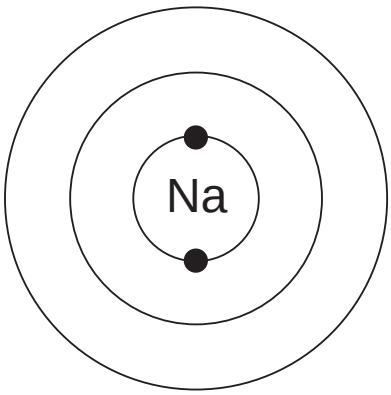
[2]

(c) When magnesium reacts with hydrochloric acid, magnesium atoms lose electrons.
What type of magnesium particle is formed?
Put a ring around the correct answer.

covalent **ion** **molecule** **proton**

[1]

(d) Complete the diagram to show the electronic structure of a sodium atom.



[2]

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(e) A student added large lumps of zinc to 20 cm^3 of 2 mol/dm^3 hydrochloric acid.
She carried out the reaction at 15 °C.
She measured the volume of gas given off at various time intervals.

(i) Draw a labelled diagram of the apparatus she could use for this experiment.

[3]

(ii) Describe **three** different things she could do to increase the rate of this reaction.

1. .....

2. .....

3. ..... [3]

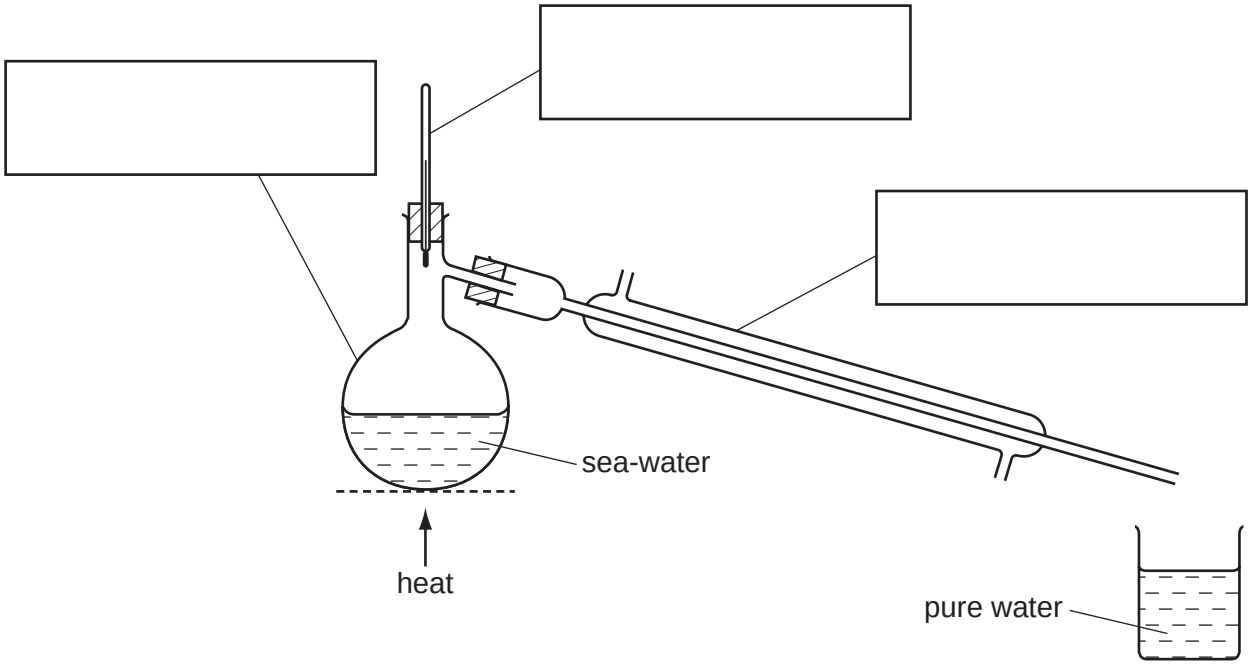
[Total: 13]

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[Turn over

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3 The diagram below shows the apparatus which can be used to obtain pure water from sea-water.



(a) State the name of this process.

..... [1]

(b) Label the boxes on the diagram above with the correct names of the pieces of apparatus shown. [3]

(c) Complete the following sentences using words from the list below.

boils	**condenses**	**cools**	**freezes**
higher	**lower**	**melts**	

Water has a ..... boiling point than salt. When a solution of salt is heated strongly, the water ..... and escapes as steam. When the steam cools, it ..... back to liquid water. [3]

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(d) The table shows the concentration of the seven most abundant compounds in sea-water.

compound	ions present	concentration in g/m^3
calcium carbonate	Ca^{2+} and CO_3^{2-}	100
calcium sulfate	Ca^{2+} and SO_4^{2-}	1 800
magnesium chloride	Mg^{2+} and Cl^-	6 800
magnesium sulfate		5 700
potassium bromide	K^+ and Br^-	100
potassium chloride	K^+ and Cl^-	800
sodium chloride	Na^+ and Cl^-	28 000

(i) Which negative ion is present in the greatest concentration in sea-water?

..... [1]

(ii) Which positive ion is present in the lowest concentration in sea-water?

..... [1]

(iii) Write the formulae of the **two** ions present in magnesium sulfate.

..... [2]

[Total: 11]

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[Turn over

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4 **(a)** Match the compounds on the left with the statements on the right.
The first one has been done for you.

butane	a hydrocarbon containing four carbon atoms
poly(ethene)	it decolourises bromine water
ethene	it is the main constituent of natural gas
methane	it contains a –COOH functional group
ethanoic acid	it has a very long chain of carbon atoms

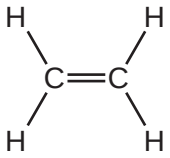
[4]

(b) Methane and ethene are hydrocarbons.

(i) What is meant by the term *hydrocarbon*?

..... [1]

(ii) The structure of ethene is shown below.



Use this structure to explain why ethene is an unsaturated hydrocarbon.

..... [1]

(c) Molecules of ethene react together at high temperature and pressure to form poly(ethene).

Which **one** of the following words best describes the molecules of ethene in this reaction?
Put a ring around the correct answer.

acids **alkanes** **monomers** **polymers**

[1]

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(d) Ethanoic acid can be made by the oxidation of ethanol.

(i) What is meant by the term *oxidation*?

..... [1]

(ii) Ethanol can be made by fermentation.
Complete the word equation for fermentation.

$$\text{.....} \xrightarrow{\text{yeast}} \text{.....} + \text{ethanol}$$

..... [2]

[Total: 10]

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5 **(a)** Explain why metals are often used in the form of alloys.
In your answer, write about

- the structure of an alloy,
- why alloys are often more useful than pure metals.

.....

.....

.....

.....

..... [3]

(b) Iron is a transition element.

(i) Which two of the following statements about iron are correct?
Tick **two** boxes.

A freshly-cut surface of iron is green in colour.	☐
Iron exists in only one oxidation state in its compounds.	☐
Iron has a high density.	☐
Iron has a giant covalent structure.	☐
Iron has a high melting point.	☐

[2]

(ii) Describe **one** method of rust prevention and explain how it works.

method .....

how this works .....

..... [2]

(c) Iron is used as a catalyst in the Haber process for making ammonia.

(i) What does the term *catalyst* mean?

..... [1]

(ii) Describe a test for ammonia.

test .....

result ..... [2]

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(iii) Ammonia is used to make fertilisers.
Explain why farmers need to add fertilisers to the soil.

.....

.....

..... [2]

[Total: 12]

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6 **(a)** Garlic is a vegetable that is often used in cooking. It has a strong smell.
A student is cutting up garlic in the kitchen.



After a time, the smell of the garlic travels all over the house even though there are no currents of air.
Use the kinetic particle theory to explain why the smell of garlic travels all over the house.

.....

.....

.....

..... [3]

(b) The smell of garlic is due to a compound containing sulfur.
The structure of this compound (compound **A**) is shown below.

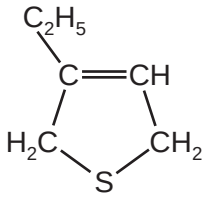
$$CH_2{=}CH{-}CH_2{-}S{-}S{-}CH_2{-}CH{=}CH_2$$

compound **A**

(i) Write the molecular formula for this compound.

..... [1]

(ii) Another organic sulfur compound (compound **B**) is shown below.



compound **B**

By comparing the formulae of compound **A** and compound **B**, how can you tell that compound **A** has the higher relative molecular mass?
You are not required to do any mathematical calculations.

.....

..... [2]

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(c) An isotope of sulfur has a nucleon number of 34 and an atomic number of 16.

(i) How many neutrons are there in one atom of this isotope of sulfur?

..... [1]

(ii) What is meant by the terms

isotope, ...

..... [1]

nucleon number? ..... [1]

(iii) Some fuels contain sulfur as a contaminating substance.
Complete the following sentences using words from the list below.

coal	**dioxide**	**hydrogen**	**monoxide**
nitrogen	**oxidised**	**reduced**	**water**

Fuels such as ..... contain sulfur.

When these fuels burn, the sulfur is ..... to sulfur ..... .

This reacts with ..... in the atmosphere to form an acidic solution. [4]

(iv) Describe and explain the effect of acid rain on buildings made of limestone.

.....

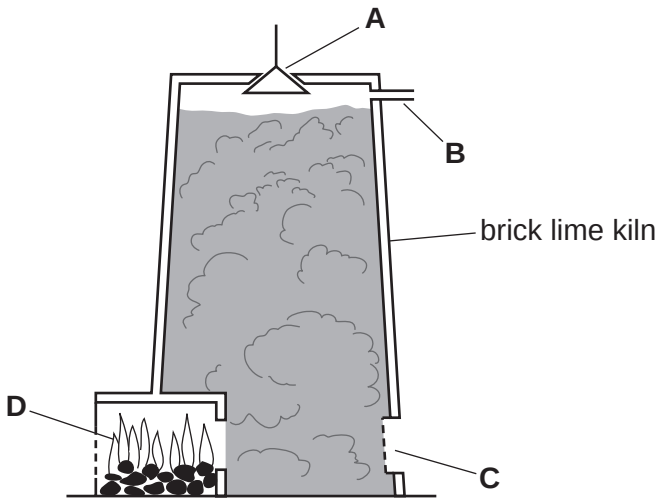
.....

..... [2]

[Total: 15]

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7 The diagram shows a kiln for making lime (calcium oxide) from limestone (calcium carbonate).



(a) (i) Which letter on the diagram above shows

where the limestone is added, ...

where the waste gases exit from the kiln? ..... [2]

(ii) Complete the symbol equation for the decomposition of limestone.

$$CaCO_3 \rightarrow CaO + ...$$

[1]

(iii) When 50 g of calcium carbonate is decomposed, 28 g of calcium oxide is formed. Calculate the minimum mass of calcium carbonate needed to produce 8.4 g of calcium oxide.

[1]

(b) The table below shows the temperatures at which some Group II carbonates decompose.

Group II carbonate	temperature at which Group II carbonates decompose / °C
beryllium carbonate	100
magnesium carbonate	350
calcium carbonate	900

(i) Describe the pattern in the ease of decomposition of Group II carbonates.

..... [1]

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(ii) Predict the decomposition temperature of barium carbonate.

..... °C [1]

(c) Lime is calcium oxide.

(i) State **one** use of lime.

..... [1]

(ii) What type of oxide is calcium oxide?

..... [1]

(iii) Calculate the relative formula mass of calcium oxide.
Use your Periodic Table to help you.

[1]

(d) Calcium is extracted from its compounds by electrolysis.
Suggest why calcium is extracted by electrolysis rather than by reduction with carbon.

..... [1]

[Total: 10]

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DATA SHEET
The Periodic Table of the Elements

																	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	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	204 **Tl** Thallium 81	207 **Pb** Lead 82	209 **Bi** Bismuth 83	**Po** Polonium 84	**At** Astatine 85	**Rn** Radon 86
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						
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.).

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