UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

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]

[Turn over

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 → ..... + ...

.....

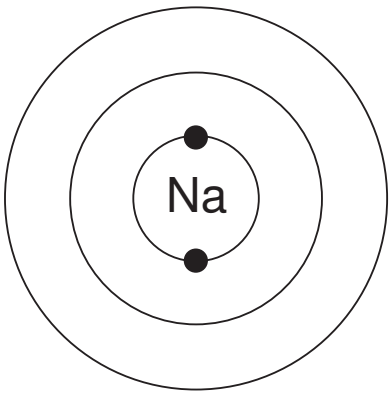
[2]

(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]

For Examiner's Use

(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. .....

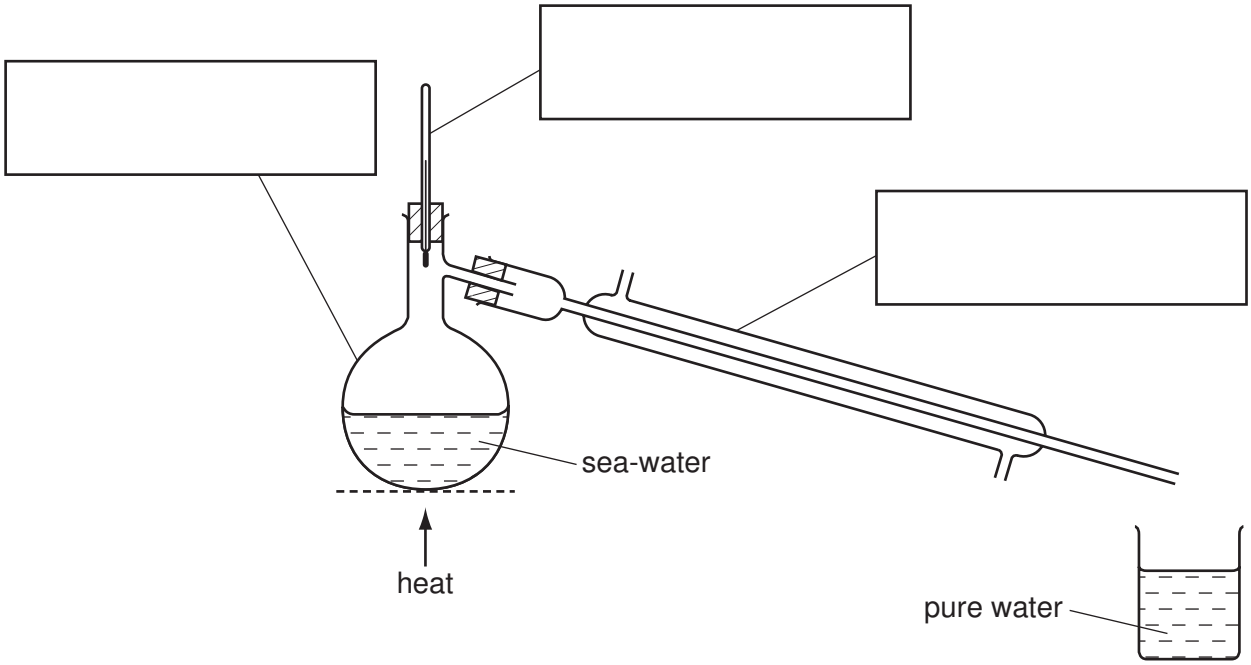
3. ..... [3]

[Total: 13]

[Turn over

For Examiner's Use

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]

(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]

[Turn over

For Examiner's Use

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

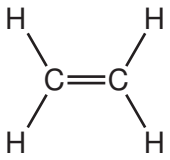
[4]

(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]

For Examiner's Use

(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]

For Examiner's Use

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]

For Examiner's Use

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

.....

.....

..... [2]

[Total: 12]

For Examiner's Use

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.

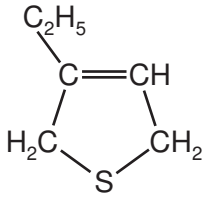
$$CH_2{=}CH{-}CH_2{-}S{-}S{-}CH_2{-}CH{=}CH_2$$

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]

(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.

.....

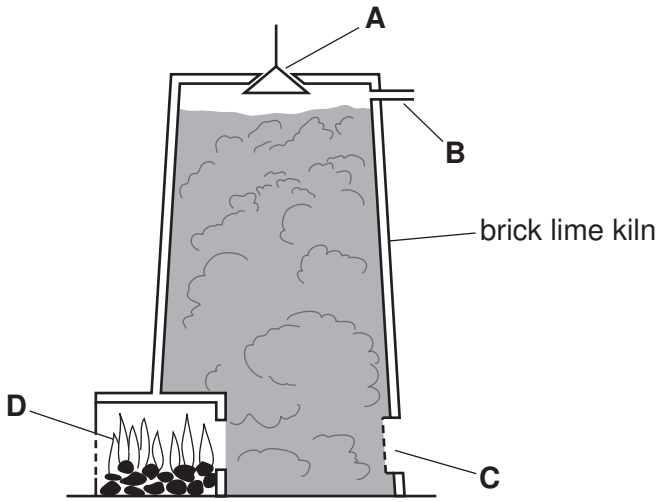
.....

..... [2]

[Total: 15]

For Examiner's Use

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]

For Examiner's Use

(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]

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.).