



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

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CANDIDATE
NUMBER

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CHEMISTRY

0620/23

Paper 2

October/November 2010

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 **15** printed pages and **1** blank page.

- 1 Choose from the following list of oxides to answer the questions below.
You can use each oxide once, more than once or not at all.

carbon dioxide
carbon monoxide
magnesium oxide
nitrogen dioxide
sulfur dioxide
water

- (a) Which **one** of these oxides is a basic oxide?

..... [1]

- (b) Which **two** oxides cause acid rain?

..... and [2]

- (c) Which **two** oxides are formed when a hydrocarbon undergoes complete combustion?

..... and [2]

- (d) Which **one** of these oxides turns white copper(II) sulfate blue?

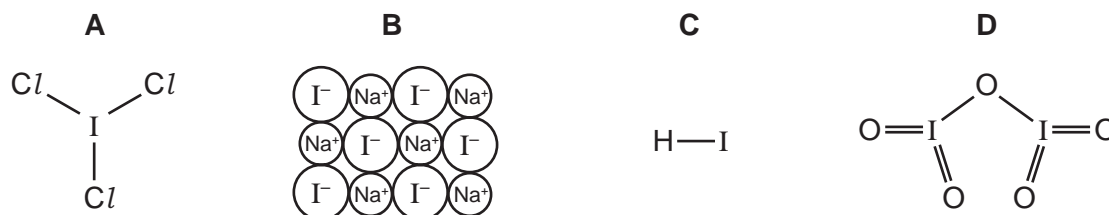
..... [1]

- (e) Which oxide is formed when calcium carbonate undergoes thermal decomposition?

..... [1]

[Total: 7]

- 2 The diagram shows the structure of some compounds containing iodine.



- (a) (i) What do you understand by the term *compound*?

.....
 [1]

- (ii) Which **one** of these compounds, **A**, **B**, **C** or **D**, has a high melting point?
 Explain your answer.

compound

explanation [2]

- (iii) Which **one** of these compounds is similar in structure to hydrogen chloride?

..... [1]

- (b) Compound **B** is sodium iodide.

- (i) Which statement about the electrical conductivity of sodium iodide is correct?
 Tick **one** box.

It conducts electricity when molten.

It conducts electricity when solid.

It does not conduct electricity when molten.

It does not conduct electricity in aqueous solution.

[1]

- (ii) Describe a test for iodide ions.

test

result [2]

- (c) Compound **D** is iodine(V) oxide. It is an acidic oxide.
 Suggest why iodine(V) oxide is an acidic oxide.

..... [1]

[Total: 8]

3 Some properties of the Group I elements are given in the table.

element	melting point / °C	boiling point / °C	density in g/cm ³
lithium	181	1342	0.53
sodium	98	883	0.97
potassium	63		0.86
rubidium	39	686	1.53
caesium	29	669	1.88

(a) (i) Predict the boiling point of potassium.

..... [1]

(ii) Which Group I elements are liquids at 50 °C?

..... [2]

(iii) How, in general, does the density of the Group I elements change down the group?

..... [1]

(b) Complete the following sentences about the Group I elements using words from the list below.

crystallising decreases hard increases
melting similarity soft

The Group I elements are relatively metals which show a trend in point and reaction with water.

The reactivity with water down the group. [3]

(c) The equation for the reaction of sodium with water is given below.

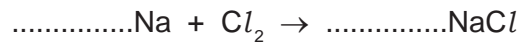


Write a word equation for this reaction.

[2]

(d) Chlorine reacts with sodium to form sodium chloride.

(i) Complete the equation for this reaction.



[2]

(ii) Chlorine is a diatomic gas.

What do you understand by the term *diatomic*?

..... [1]

(iii) Describe the arrangement and motion of the molecules in chlorine gas.

arrangement

motion [2]

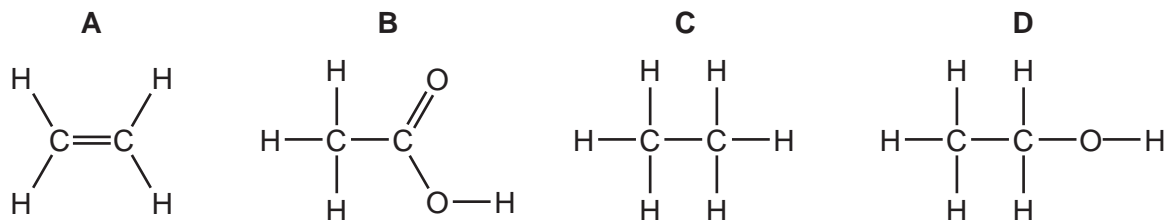
(iv) Draw a diagram to show the arrangement of the electrons in a molecule of chlorine.

Show only the outer electrons.

[2]

[Total: 16]

4 The formulae of four organic compounds are shown below.



(a) (i) State the name of the type of bonding between the atoms in these four compounds.

..... [1]

(ii) Which **one** of these compounds, **A**, **B**, **C** or **D**, is a saturated hydrocarbon?

..... [1]

(iii) Which **one** of these compounds is acidic?

..... [1]

(iv) State the name of compound **D**.

..... [1]

(v) Compound **A** contains a C=C double bond.
Describe a test for a C=C double bond.

test

result [2]

(b) Compound **C** is a member of the alkane homologous series.

(i) State **two** features of an homologous series.

1.

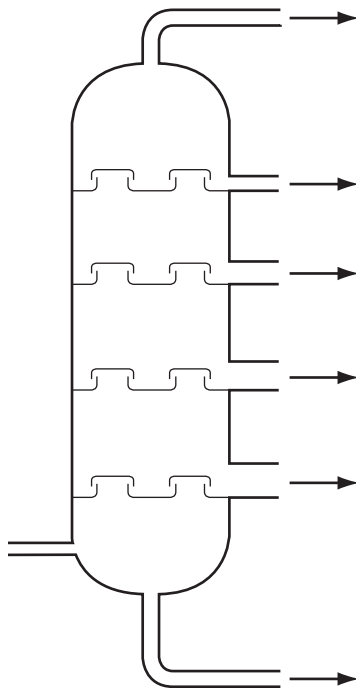
2. [2]

(ii) State the formula and name of another alkane in the same homologous series as compound **C**.

formula

name [2]

- (c) The alkanes present in petroleum can be separated by fractional distillation. The diagram below shows a fractional distillation column.

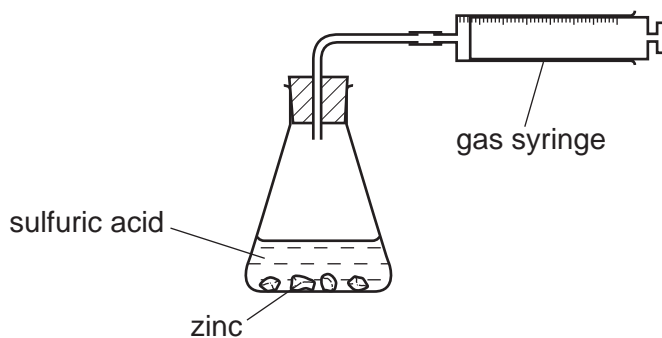


- (i) On the diagram, label where the temperature in the column is the lowest. Mark this with the letter **X**. [1]
- (ii) On the diagram, label where the bitumen fraction is collected. Mark this with the letter **Y**. [1]

[Total: 12]

- 5 A student used the apparatus shown below to investigate the speed of reaction when large lumps of zinc reacted with excess sulfuric acid.

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Use



- (a) As the reaction proceeds, describe what happens to

(i) the mass of the zinc lumps.

..... [1]

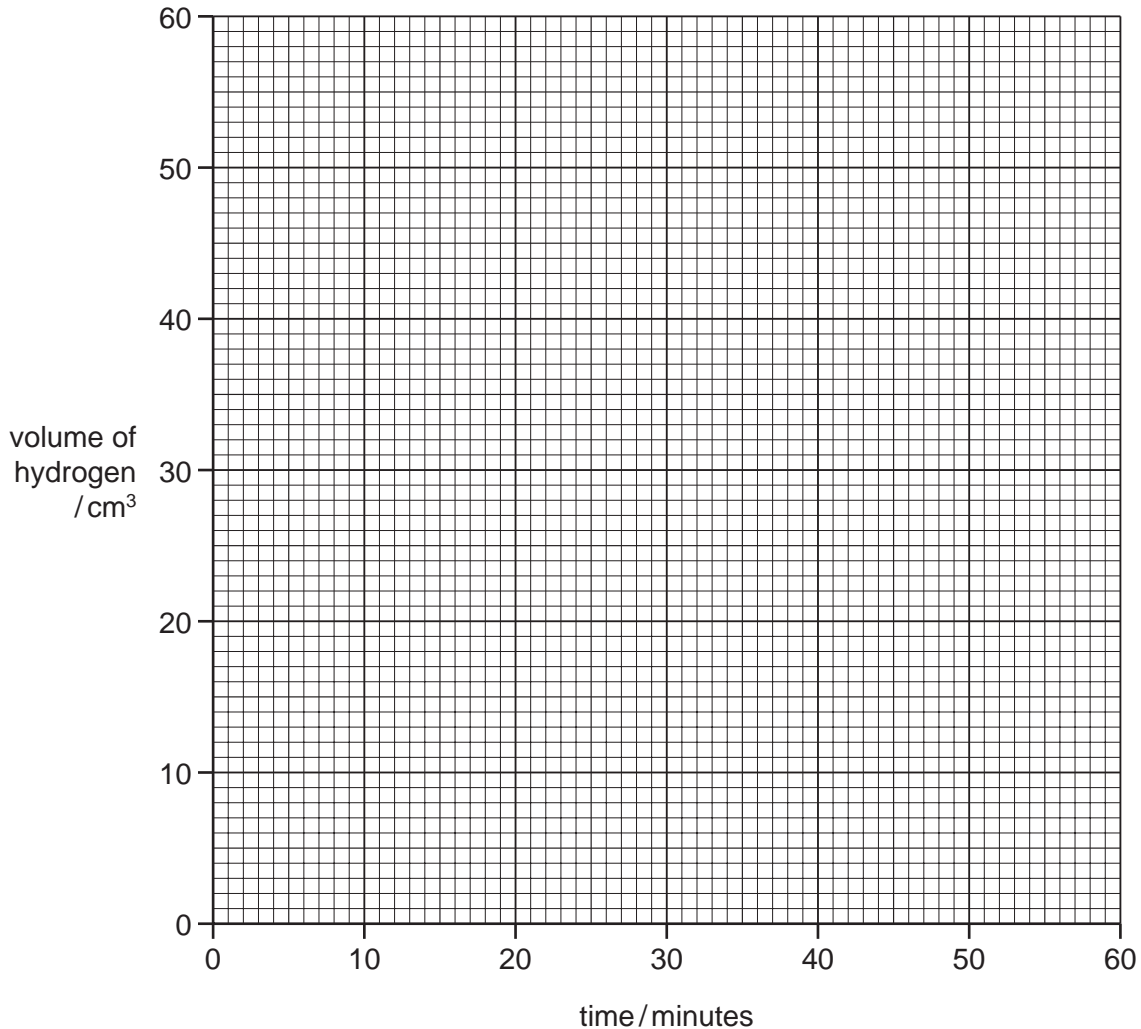
(ii) the concentration of zinc sulfate in the solution in the flask.

..... [1]

(b) The student's results are shown below.

time / minutes	0	10	20	30	40	50	60
volume of hydrogen / cm ³	0	24	39	48	53	55	55

(i) Plot a graph of volume of hydrogen against time. Use the axes below.



[3]

(ii) Use your graph to calculate the volume of hydrogen given off after 25 minutes.

volume of hydrogen [1]

(iii) Explain why no more hydrogen was given off after 50 minutes.

..... [1]

(iv) Describe a test for hydrogen.

test

result [2]

(c) What happens to the speed of the reaction when

(i) smaller pieces of zinc are used?

..... [1]

(ii) some water is added to the sulfuric acid?

..... [1]

(d) The reaction between zinc and sulfuric acid is catalysed by copper(II) sulfate solution.
What do you understand by the term *catalyst*?

..... [1]

[Total: 12]

6 Iron is a transition element.

(a) State **three** properties of transition elements which are not shown by the Group I elements.

1.

2.

3. [3]

(b) The symbols for two isotopes of iron are shown below.



(i) How do these two isotopes differ in their atomic structure?

..... [1]

(ii) State the number of nucleons present in one atom of the isotope ${}_{26}^{57}\text{Fe}$.

..... [1]

(iii) How many electrons are there in one atom of the isotope ${}_{26}^{54}\text{Fe}$?

..... [1]

(c) Pure iron rusts very easily.

(i) State the **two** conditions that are needed for rusting to take place.

1.

2. [2]

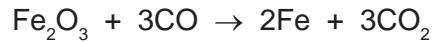
(ii) Describe and explain **one** method of preventing rusting.

method

explain why this method works

..... [2]

- (d) In the blast furnace, iron(III) oxide reacts with carbon monoxide.



Which substance gets reduced in this reaction?
Explain your answer.

substance

explanation

..... [2]

- (e) (i) Carbon monoxide is a pollutant gas produced in motor car engines.
Explain why carbon monoxide is formed.

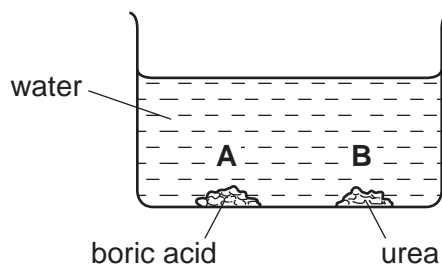
..... [1]

- (ii) State **one** harmful effect of carbon monoxide.

..... [1]

[Total: 14]

- 7 Boric acid is an acid. Urea is a base. Both compounds are crystalline. A student placed some crystals of boric acid and urea in a large beaker of water. The pH value of the water at the start of the experiment was pH 7.



- (a) After 15 minutes the pH at point **A** in the beaker was pH 6.2.

(i) Suggest why the pH at point **A** had decreased.

..... [1]

(ii) What was the most likely pH at point **B** in the beaker after 15 minutes? Put a ring around the correct answer.

pH 1 **pH 6** **pH 7** **pH 8** [1]

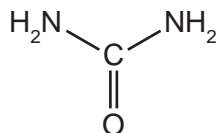
(iii) The particles of boric acid and urea diffuse throughout the solution. What do you understand by the term *diffusion*?

.....
..... [1]

(iv) After 24 hours the pH throughout the whole solution was pH 7. Use your knowledge of acids and alkalis to explain why the pH returned to pH 7.

.....
..... [1]

- (b) The structure of urea is shown below.



(i) Write the simplest formula for urea.

[1]

- (ii) Calculate the relative molecular mass of urea.
Use your Periodic Table to help you.

[1]

- (c) Urea is used as a fertiliser.

- (i) Which element present in urea is an essential part of most fertilisers?

..... [1]

- (ii) Explain why farmers put fertilisers on their fields.

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

- (d) Describe how you can obtain pure, dry crystals of urea from an aqueous solution of urea.

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

[Total: 11]

DATA SHEET
The Periodic Table of the Elements

Group		I	II	III	IV	V	VI	VII	0																									
		1 H Hydrogen 1							2 He Helium 2																									
7 Li Lithium 3	9 Be Beryllium 4				11 B Boron 5	12 C Carbon 6	13 Al Aluminium 13	14 Si Silicon 14	15 P Phosphorus 15	16 S Sulfur 16	17 Cl Chlorine 17	18 Ar Argon 18	19 F Fluorine 9	20 Ne Neon 10																				
23 Na Sodium 11	24 Mg Magnesium 12				27 Fe Iron 26	28 Ni Nickel 28	29 Cu Copper 29	30 Zn Zinc 30	31 Ga Gallium 31	32 Ge Germanium 32	33 As Arsenic 33	34 Se Selenium 34	35 Br Bromine 35	36 Kr Krypton 36																				
39 K Potassium 19	40 Ca Calcium 20				41 Nb Niobium 41	42 Mo Molybdenum 42	43 Tc Technetium 43	44 Ru Ruthenium 44	45 Rh Rhodium 45	46 Pd Palladium 46	47 Ag Silver 47	48 Cd Cadmium 48	49 In Indium 49	50 Sn Tin 50	51 Sb Antimony 51	52 Te Tellurium 52	53 I Iodine 53	54 Xe Xenon 54																
85 Rb Rubidium 37	86 Sr Strontium 38				87 Y Yttrium 39	88 Zr Zirconium 40	89 Hf Hafnium 72	90 Ta Tantalum 73	91 Nb Niobium 41	92 Mo Molybdenum 42	93 Tc Technetium 43	94 Ru Ruthenium 44	95 Rh Rhodium 45	96 Pd Palladium 46	97 Ag Silver 47	98 Cd Cadmium 48	99 In Indium 49	100 Sb Antimony 51	101 Te Tellurium 52	102 I Iodine 53	103 Xe Xenon 54													
133 Cs Caesium 55	137 Ba Barium 56				139 La Lanthanum 57	140 Ce Cerium 58	141 Pr Praseodymium 59	142 Nd Neodymium 60	143 Pm Promethium 61	144 Sm Samarium 62	145 Eu Europium 63	146 Gd Gadolinium 64	147 Tb Terbium 65	148 Dy Dysprosium 66	149 Ho Holmium 67	150 Er Erbium 68	151 Tm Thulium 69	152 Yb Ytterbium 70	153 Lu Lutetium 71	154 Hf Hafnium 72	155 Ta Tantalum 73	156 W Tungsten 74	157 Re Rhenium 75	158 Os Osmium 76	159 Ir Iridium 77	160 Pt Platinum 78	161 Au Gold 79	162 Hg Mercury 80	163 Tl Thallium 81	164 Pb Lead 82	165 Bi Bismuth 83	166 Po Polonium 84	167 At Astatine 85	168 Rn Radon 86
226 Ra Radium 88	227 Ac Actinium 89				228 Th Thorium 90	229 Pa Protactinium 91	230 U Uranium 92	231 Np Neptunium 93	232 Pu Plutonium 94	233 Am Americium 95	234 Cm Curium 96	235 Bk Berkelium 97	236 Cf Californium 98	237 Es Einsteinium 99	238 Fm Fermium 100	239 Md Mendelevium 101	240 No Nobelium 102	241 Lr Lawrencium 103	242 Rf Rutherfordium 104	243 Db Dubnium 105	244 Sg Seaborgium 106	245 Bh Bohrium 107	246 Hs Hassium 108	247 Mt Meitnerium 109	248 Ds Darmstadtium 110	249 Rg Roentgenium 111	250 Cn Copernicium 112	251 Nh Nihonium 113	252 Fl Flerovium 114	253 Mc Moscovium 115	254 Lv Livermorium 116	255 Ts Tennessine 117	256 Og Oganesson 118	

*58-71 Lanthanoid series
†90-103 Actinoid series

a	X
b	†

Key
a = relative atomic mass
X = atomic symbol
b = proton (atomic) number

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).

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