



Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE
NAME

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CHEMISTRY

0620/22

Paper 2

May/June 2014

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 use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, 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.

The syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 1/Level 2 Certificate.

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

1 The diagram shows part of the Periodic Table. Only some of the elements are shown.

H																		
Li																C	N	O
Na																Al		
K							Fe	Co	Ni	Cu	Zn							
Rb																		
Cs																Pb		

- (a) Answer the following questions using **only** the elements shown in the diagram. Each element may be used once, more than once or not at all.
- (i) Which element has a giant covalent structure? [1]
- (ii) Which element has the highest relative atomic mass? [1]
- (iii) Which **two** elements are formed when molten aluminium oxide is electrolysed?
..... and [1]
- (iv) Which element in Group I reacts most rapidly with water? [1]
- (v) Which element oxidises in the presence of water to form rust? [1]
- (vi) Which element burns in oxygen to form water? [1]

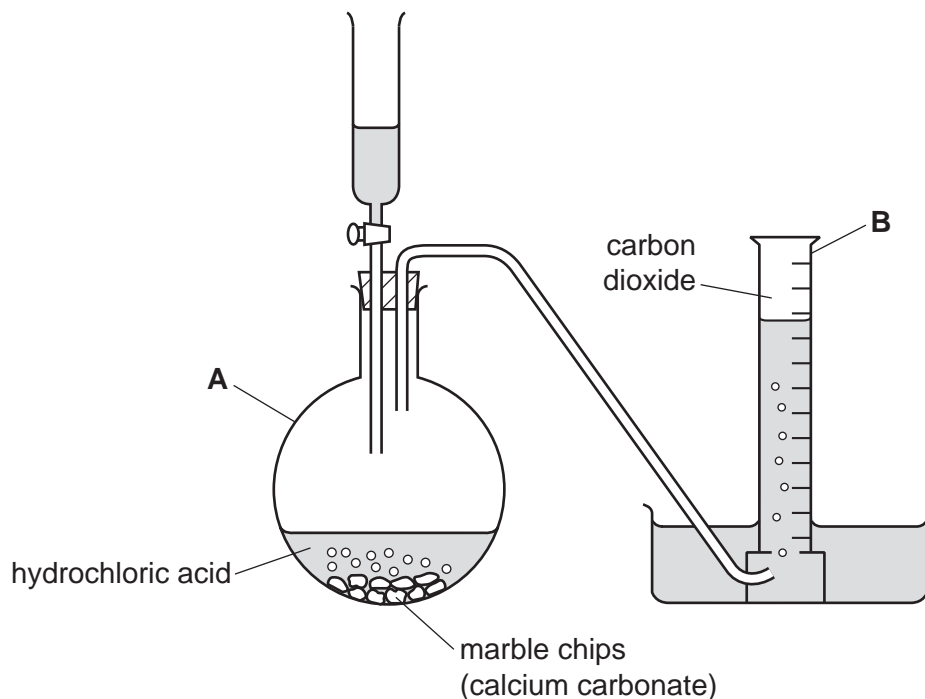
- (b) Rubidium reacts with oxygen to form rubidium oxide, Rb_2O . Complete the symbol equation for this reaction.



- (c) Lead compounds are atmospheric pollutants. State **one** adverse effect of lead compounds on health.
..... [1]

[Total: 9]

2 Carbon dioxide can be prepared in the laboratory using the apparatus shown below.



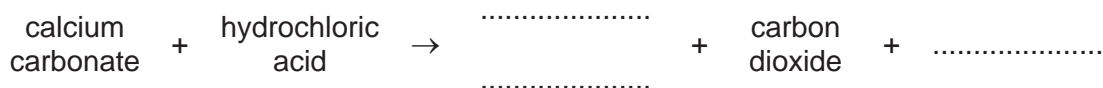
(a) State the names of the pieces of apparatus labelled **A** and **B**.

A

B

[2]

(b) Complete the word equation for this reaction.



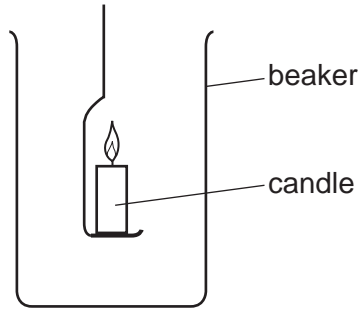
[2]

(c) Carbon dioxide is slightly soluble in water.
What effect will this have on the volume of carbon dioxide collected?
Tick **one** box.

- The volume is lower than expected.
- The volume is higher than expected.
- The volume is the same as expected.
- No carbon dioxide is collected.

[1]

(d) A burning candle is lowered into a beaker of carbon dioxide.



(i) The flame goes out.
Explain why the flame goes out.

..... [1]

(ii) After 20 seconds, the candle is removed and relit.
It is then lowered into the same beaker again.
The flame goes out again.
What does this tell you about the density of carbon dioxide compared to air?

..... [1]

(iii) After 40 minutes, the candle is removed and relit.
It is then lowered into the same beaker again.
The candle stays alight.
Explain why the candle stays alight.

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

[Total: 9]

3 River water contains a variety of ions and gases, and insoluble materials such as soil particles.

- (a) Describe how you could remove the insoluble materials from a sample of river water. Include a labelled diagram.

.....

.....

.....

..... [4]

- (b) The table shows the ions present in a sample of river water.

name of ion	formula of ion	concentration in mg/dm ³
calcium	Ca ²⁺	0.6
chloride	Cl ⁻	14.0
hydrogen carbonate	HCO ₃ ⁻	1.5
iron(III)	Fe ³⁺	0.5
magnesium	Mg ²⁺	1.0
potassium	K ⁺	3.0
sodium	Na ⁺	11.0
	SO ₄ ²⁻	0.4

- (i) Which ion with a charge of 2+ is present in the highest concentration?

..... [1]

- (ii) State the name of the ion with the formula SO₄²⁻.

..... [1]

(iii) Calculate the total mass of ions present in 1 dm³ of river water.

..... mg [1]

(iv) Use your answer to part (iii) to calculate the total mass of ions in 50 cm³ of river water.

..... mg [1]

(v) A student evaporated the sample of river water to leave a solid containing a number of different compounds.

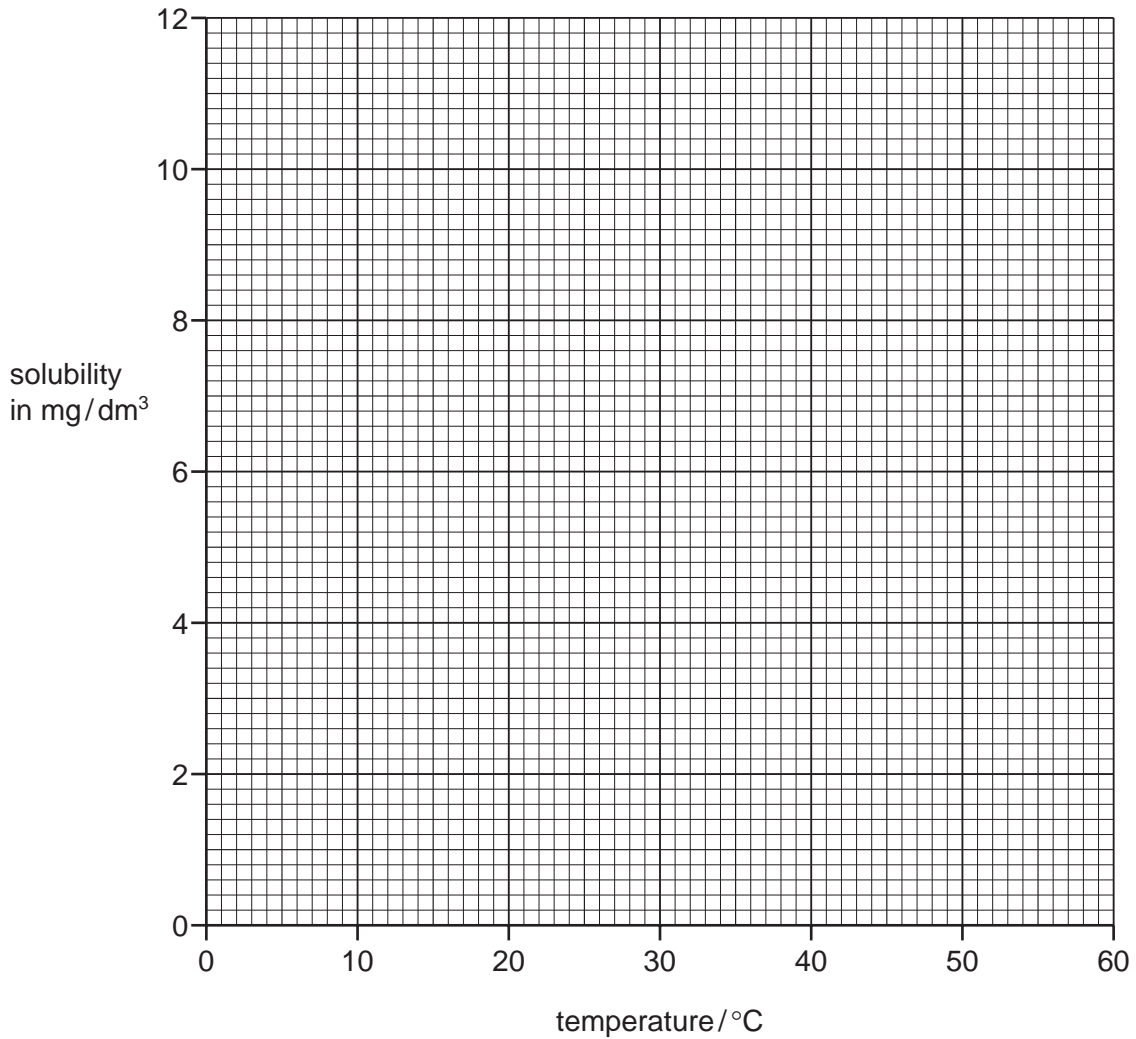
Use the information in the table to suggest the name of the compound present in the greatest amount.

..... [1]

(c) The table shows the solubility of oxygen in river water at different temperatures.

temperature / °C	0	10	20	30	40	50	60
solubility in mg/dm ³	11.0	8.8	7.2	6.0	4.9	4.2	3.6

(i) On the axes below, plot a graph to show how the solubility of oxygen changes with temperature. Draw a curve of best fit through the points.



[3]

(ii) Deduce the solubility of oxygen in river water at 25 °C.

..... [1]

(iii) State the approximate percentage of oxygen **in the air**.

..... [1]

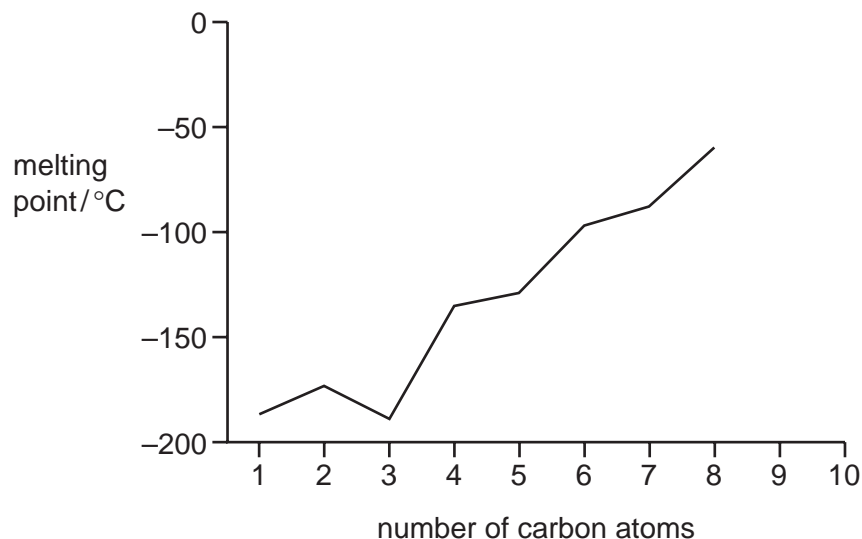
[Total: 14]

4 The alkanes are a homologous series of hydrocarbons.

(a) Name another homologous series of hydrocarbons.

..... [1]

(b) The graph below shows how the melting points of the first eight alkanes vary with the number of carbon atoms.



(i) Describe how the melting points of these alkanes vary with the number of carbon atoms.

.....

 [2]

(ii) **On the graph above**, continue the line to show the melting points of the hydrocarbons having 9 and 10 carbon atoms. [2]

(c) The first member of the alkane homologous series is methane.

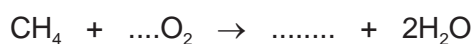
(i) State **one** source of the methane in the atmosphere.

..... [1]

(ii) State **one** adverse effect of methane in the atmosphere.

..... [1]

(d) Complete the symbol equation to show the complete combustion of methane.



[2]

[Total: 9]

5 Iron from a blast furnace contains carbon, sulfur, silicon and phosphorus as impurities.

(a) Iron is converted into steel in a basic oxygen converter.

The impurities undergo oxidation.

What is meant by the term *oxidation*?

..... [1]

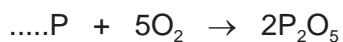
(b) Carbon is oxidised to carbon dioxide. Sulfur is oxidised to sulfur dioxide.

Explain why these oxides are easily removed from the molten iron.

..... [1]

(c) Phosphorus is converted to phosphorus(V) oxide.

(i) Complete the symbol equation for this reaction.



[1]

(ii) Is phosphorus(V) oxide an acidic or basic oxide?

Give a reason for your answer.

.....

..... [1]

(d) Phosphorus(V) oxide is a solid.

Explain how this oxide is removed from the molten iron.

.....

.....

..... [3]

(e) Steel is an alloy.

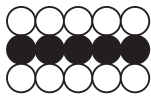
(i) State **one** use of:

mild steel,

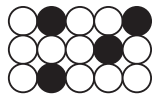
stainless steel.

[2]

- (ii) Which diagram, **A**, **B**, **C** or **D**, best represents an alloy?
Put a ring around the correct answer.



A



B



C



D

[1]

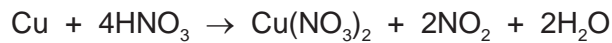
- (f) The table shows the composition of some different brasses.

composition of the brass		strength / 10 ⁸ Pa
% zinc	% copper	
10	90	2.6
20	80	3.0
30	70	3.3
40	60	3.6

How does the composition of brass affect its strength?

..... [1]

- (g) A student dissolved a sample of brass in concentrated nitric acid.
Nitrogen dioxide, NO₂, was released.



- (i) Write a word equation for this reaction.

[2]

- (ii) The student added aqueous ammonia to the solution formed until the ammonia was in excess.
Describe what the student would observe.

.....
.....
..... [3]

- (iii) State **one** source of the nitrogen dioxide in the atmosphere.

..... [1]

[Total: 17]

- 6 In the 1860s, John Newlands listed the elements in order of increasing atomic mass. Part of his table is shown.

H 1	Li 2	Be 3	B 4	C 5	N 6	O 7
F 8	Na 9	Mg 10	Al 11	Si 12	P 13	S 14
Cl 15	K 16	Ca 17	Cr 18	Ti 19	Mn 20	Fe 21

- (a) (i) Describe the differences between Newlands' table and the Periodic Table we use today.

.....

 [3]

- (ii) What evidence is there, from Newlands' table, that some elements with similar properties are grouped together?

.....
 [1]

- (b) The table below shows some properties of some of the halogens.

halogen	melting point /°C	boiling point /°C	colour
chlorine	-101	-7	yellow-green
bromine	-7		red-brown
iodine	+114	+184	grey-black
astatine	+302	+337	

Deduce:

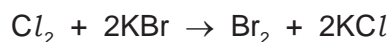
the colour of astatine,

the boiling point of bromine,

the state of iodine at 190°C.

[3]

(c) Aqueous chlorine reacts with aqueous potassium bromide.



(i) Describe the colour change you would observe in this reaction.

..... [1]

(ii) State the name of the salt formed in this reaction.

..... [1]

(iii) Explain why aqueous bromine does not react with aqueous potassium chloride.

.....

..... [1]

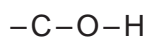
(iv) The halogens exist as diatomic molecules.
What is meant by the term *diatomic*?

..... [1]

[Total: 11]

7 Ethanol is an alcohol.

(a) Complete the structure of ethanol showing all atoms and bonds.



[1]

(b) State the name of the products formed when ethanol undergoes **incomplete** combustion.

..... and [2]

(c) Ethanol can be manufactured by fermentation or by the hydration of ethene.

(i) Complete the word equation for the manufacture of ethanol from ethene.



[1]

(ii) What conditions are needed for the manufacture of ethanol from ethene?
Tick **two** boxes.

temperature above 100 °C

room temperature

presence of inorganic catalyst

presence of yeast

presence of hydrogen

[2]

(iii) When ethanol is prepared by fermentation, the fermentation mixture produced contains ethanol and water.

The boiling point of ethanol is 78 °C.

Describe how fractional distillation can be used to separate ethanol from water.

In your answer, refer to:

- the apparatus used,
- changes in state,
- differences in boiling points.

You may use a diagram.

.....

.....

.....

.....

.....

.....

.....

..... [5]

[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		
3 Li Lithium 7	4 Be Beryllium 9											10 Ne Neon 20	
11 Na Sodium 23	12 Mg Magnesium 24	13 Al Aluminium 27	14 Si Silicon 28	15 P Phosphorus 31	16 S Sulfur 32	17 Cl Chlorine 35.5	18 Ar Argon 40						
19 K Potassium 39	20 Ca Calcium 40	21 Sc Scandium 45	22 Ti Titanium 48	23 V Vanadium 51	24 Cr Chromium 52	25 Mn Manganese 55	26 Fe Iron 56	27 Co Cobalt 59	28 Ni Nickel 59	29 Cu Copper 64	30 Zn Zinc 65	36 Kr Krypton 84	
37 Rb Rubidium 85	38 Sr Strontium 88	39 Y Yttrium 89	40 Zr Zirconium 91	41 Nb Niobium 93	42 Mo Molybdenum 96	43 Tc Technetium 98	44 Ru Ruthenium 101	45 Rh Rhodium 103	46 Pd Palladium 106	47 Ag Silver 108	48 Cd Cadmium 112	34 Se Selenium 79	
55 Cs Caesium 133	56 Ba Barium 137	57 La Lanthanum 139	72 Hf Hafnium 178	73 Ta Tantalum 181	74 W Tungsten 184	75 Re Rhenium 186	76 Os Osmium 190	77 Ir Iridium 192	78 Pt Platinum 195	79 Au Gold 197	80 Hg Mercury 201	84 Po Polonium 209	
87 Fr Francium 226	88 Ra Radium 227	89 Ac Actinium 227											86 Rn Radon 222
												85 At Astatine 210	86 Rn Radon 222
												83 Bi Bismuth 209	84 Po Polonium 209
												53 I Iodine 127	54 Xe Xenon 131
												35 Br Bromine 80	36 Kr Krypton 84
												17 Cl Chlorine 35.5	18 Ar Argon 40
												9 F Fluorine 19	10 Ne Neon 20

58-71 Lanthanoid series	59 Pr Praseodymium 141	60 Nd Neodymium 144	61 Pm Promethium 147	62 Sm Samarium 150	63 Eu Europium 152	64 Gd Gadolinium 157	65 Tb Terbium 159	66 Dy Dysprosium 162	67 Ho Holmium 165	68 Er Erbium 167	69 Tm Thulium 169	70 Yb Ytterbium 173	71 Lu Lutetium 175	
90-103 Actinoid series	90 Th Thorium 232	91 Pa Protactinium 231	92 U Uranium 238	93 Np Neptunium 237	94 Pu Plutonium 244	95 Am Americium 243	96 Cm Curium 247	97 Bk Berkelium 247	98 Cf Californium 251	99 Es Einsteinium 252	100 Fm Fermium 257	101 Md Mendelevium 288	102 No Nobelium 289	103 Lr Lawrencium 260

Key	a	X	b
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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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