



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**

**0620/21**

Paper 2

**May/June 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	
8	
<b>Total</b>	

This document consists of **16** printed pages.



1 Choose from the following list of gases to answer the questions.

ammonia    carbon monoxide    chlorine    ethene    methane

nitrogen    nitrogen dioxide    oxygen    propane

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

Which gas

(a) is a greenhouse gas produced by the decomposition of vegetation,

..... [1]

(b) is an alkane,

..... [1]

(c) reacts with sulfuric acid to form a salt,

..... [1]

(d) makes up about 20% of the air,

..... [1]

(e) is a halogen,

..... [1]

(f) is a hydrocarbon which decolourizes aqueous bromine?

..... [1]

[Total: 6]

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2 This question is about hydrogen and some compounds containing hydrogen.

(a) Hydrogen is a gas at room temperature.

Describe the arrangement and motion of the molecules in hydrogen gas.

arrangement .....

motion ..... [2]

(b) Draw the electronic structure of a hydrogen molecule.

[1]

(c) The symbols for two isotopes of hydrogen are shown below.



(i) What do you understand by the term *isotope*?

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

(ii) Complete the table to show the number of subatomic particles in these two isotopes of hydrogen.

isotope	${}^1_1\text{H}$	${}^3_1\text{H}$
number of electrons		
number of neutrons		
number of protons		

[4]

(d) When hydrogen burns, energy is given out.

State the name given to a reaction which gives out energy.

..... [1]

(e) Hydrochloric acid reacts both with metals and with metal carbonates.

- (i) A student observed the reaction of hydrochloric acid with four different metals. The student used the same concentration of hydrochloric acid and the same mass of metal in each experiment.

metal	observations
cobalt	dissolves very slowly and very few bubbles produced
iron	dissolves slowly and a few bubbles produced slowly
magnesium	dissolves very quickly and many bubbles produced very rapidly
zinc	dissolves quickly and many bubbles produced rapidly

Use the information in the table to suggest the order of reactivity of these metals.

most reactive  $\longrightarrow$  least reactive

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[2]

- (ii) State the names of the **three** products formed when hydrochloric acid reacts with calcium carbonate.

.....

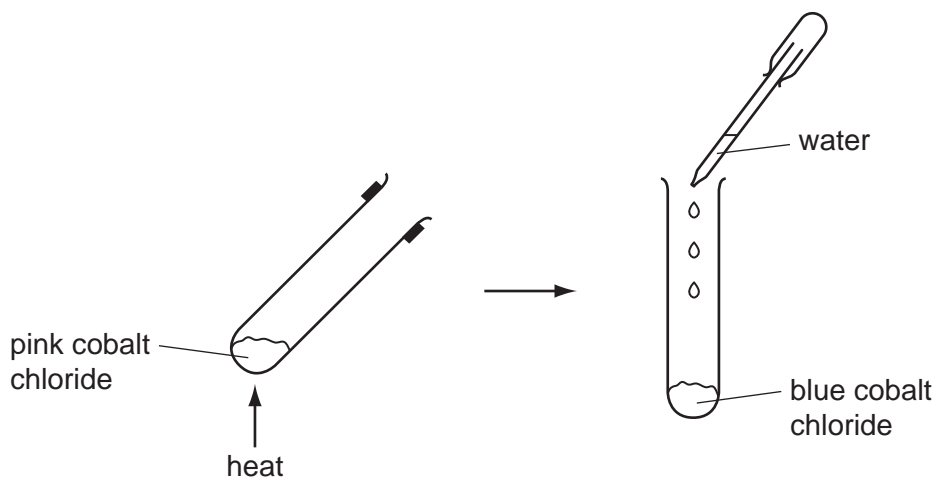
.....

..... [3]

[Total: 14]

- 3 Some pink cobalt chloride was heated gently in a test-tube.  
The cobalt chloride turned blue.

A few drops of water were then added to the blue cobalt chloride.  
The cobalt chloride turned pink.



- (a) (i) State the name of this type of reaction.

..... [1]

- (ii) Complete the following sentence. Use words from the list below.

**alkaline chloride dehydrated hydrated water**

When ..... cobalt chloride is heated, it loses  
its ..... of crystallisation and changes colour. [2]

- (b) Cobalt is a metal.

- (i) State **two** physical properties which are characteristic of metals.

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

- (ii) From its position in the Periodic Table predict **two** physical properties of cobalt in addition to its general metallic properties.

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

- (c) Cobalt(II) oxide is a basic oxide.  
Predict **one** chemical property of cobalt(II) oxide.

..... [1]

[Total: 8]

- 4 The table shows the mass of various compounds obtained when 500 cm<sup>3</sup> of seawater is evaporated.

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compound	ions present	mass of compound/g
sodium chloride	Na <sup>+</sup> and Cl <sup>-</sup>	14.0
magnesium chloride	Mg <sup>2+</sup> and Cl <sup>-</sup>	3.0
magnesium sulfate	Mg <sup>2+</sup> and SO <sub>4</sub> <sup>2-</sup>	2.0
calcium sulfate	Ca <sup>2+</sup> and SO <sub>4</sub> <sup>2-</sup>	0.5
potassium chloride	K <sup>+</sup> and Cl <sup>-</sup>	0.5
potassium bromide		
calcium carbonate	Ca <sup>2+</sup> and CO <sub>3</sub> <sup>2-</sup>	
sodium iodide	Na <sup>+</sup> and I <sup>-</sup>	
		total mass = 20.0

- (a) Which negative ion is present in seawater in the highest concentration?

..... [1]

- (b) Write the symbols for the **two** ions present in potassium bromide.

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

- (c) Calculate the mass of sodium chloride present in 5 g of the solid left by evaporating the seawater.

[1]

- (d) Describe a test for iodide ions.

test .....

result ..... [2]

(e) Aqueous chlorine reacts with aqueous sodium iodide.

(i) Complete the equation for this reaction.



[1]

(ii) What colour is the solution when the reaction is complete?

..... [1]

(iii) An aqueous solution of iodine does not react with aqueous potassium bromide.  
Explain why there is no reaction.

..... [1]

(f) Calculate the relative formula mass of magnesium chloride,  $\text{MgCl}_2$ .

..... [1]

[Total: 9]

5 Ammonium sulfate is used in fertilisers.

(a) State the names of the three elements found in most fertilisers.

1. ....

2. ....

3. ....

[3]

(b) Suggest why farmers use fertilisers.

.....

..... [2]

(c) Ammonium sulfate is a salt which is soluble in water.

(i) What do you understand by the term *soluble*?

..... [1]

(ii) Which of the following methods is used to make this salt in the laboratory?  
Tick **one** box.

adding an acid to a metal

adding an acid to a metal oxide

by a precipitation reaction

by the titration of an acid with an alkali

[1]

(d) A mixture of ammonium sulfate and sodium hydroxide was warmed in a test-tube.  
A gas was given off which turned red litmus paper blue.

State the name of this gas.

..... [1]



(e) Fertilisers containing ammonium salts are often slightly acidic.

(i) State the name of a compound which farmers add to the soil to make it less acidic.

..... [1]

(ii) Explain why it is important for farmers to control the acidity of the soil.

.....

..... [2]

(f) The formula of ammonium sulfate is  $(\text{NH}_4)_2\text{SO}_4$ .

In this formula state:

(i) the number of different types of atoms present, ..... [1]

(ii) the total number of atoms present. .... [1]

[Total: 13]

6 Many metals are extracted from their ores by reduction with carbon.

(a) Name the main ore of iron.

..... [1]

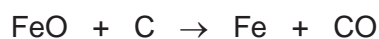
(b) Iron is extracted from its ore in a blast furnace.

(i) Other than iron ore, state the names of two other raw materials used in the extraction of iron.

1. ....

2. .... [2]

(ii) One of the reactions taking place in the blast furnace is

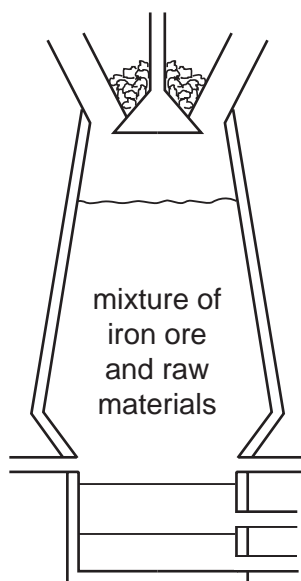


Write a word equation for this reaction.

..... [2]

(iii) The diagram shows a blast furnace.  
Label the diagram to show each of the following:

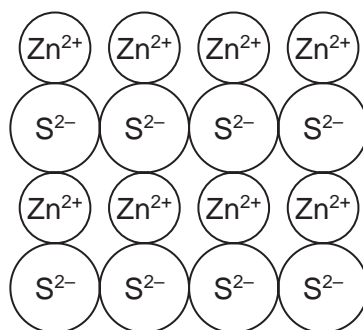
- the slag,
- where the molten iron collects,
- where air is blown into the furnace,
- where the iron ore is put into the furnace.



[4]

(c) Zinc is extracted from an ore containing zinc sulfide.

Part of a zinc sulfide structure is shown below.



Suggest the simplest formula for zinc sulfide.

..... [1]

[Total: 10]

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- 7 Petroleum is a mixture of hydrocarbons.  
Two of the processes carried out in an oil refinery are fractional distillation of petroleum and cracking of hydrocarbon fractions.

(a) Which property of hydrocarbons is used to separate petroleum into fractions?  
Tick **one** box.

boiling point	<input type="checkbox"/>
chemical reactivity	<input type="checkbox"/>
electrical conductivity	<input type="checkbox"/>
melting point	<input type="checkbox"/>

[1]

(b) Match the fractions on the left with their uses on the right.  
The first one has been done for you.

bitumen	fuel for home heating
fuel oil	making roads
kerosene	waxes and polishes
lubricating fraction	making chemicals
naphtha	jet fuel

[4]

(c) Cracking is used to break down long chained alkanes into shorter chained alkanes and alkenes.

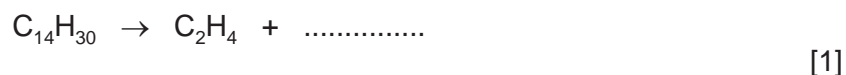
(i) State two conditions needed for cracking.

1. ....

2. .... [2]

(ii) The hydrocarbon,  $C_{14}H_{30}$ , can be cracked to make ethene and one other hydrocarbon.

Complete the equation for this reaction.



(iii) Draw the full structure of ethene showing all atoms and bonds.

[1]

(d) State the name of the polymer formed from ethene.

..... [1]

(e) Ethene is used to make ethanol.

(i) Which substance is needed for this reaction?  
Put a ring around the correct answer.

**ammonia**

**hydrogen**

**oxygen**

**steam**

[1]

(ii) Phosphoric acid is a catalyst in this reaction.  
What do you understand by the term *catalyst*?

.....

..... [1]

[Total: 12]

8 Some substances conduct electricity, others do not.

(a) Which three of the following conduct electricity?  
Tick **three** boxes.

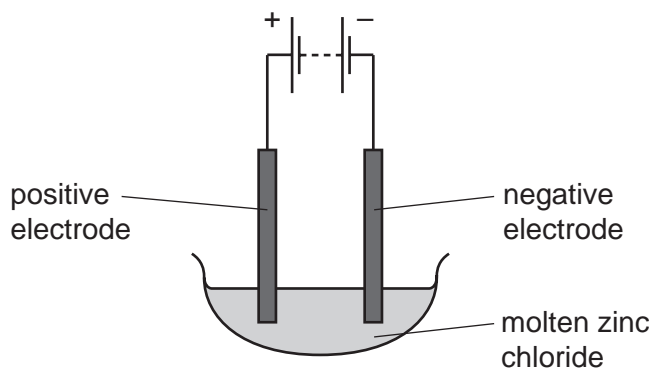
aqueous sodium chloride	<input type="checkbox"/>
ceramics	<input type="checkbox"/>
copper	<input type="checkbox"/>
graphite	<input type="checkbox"/>
sodium chloride crystals	<input type="checkbox"/>
sulfur	<input type="checkbox"/>

[3]

(b) State the name given to a substance, such as plastic, which does not conduct electricity.

..... [1]

(c) Molten zinc chloride was electrolysed using the apparatus shown below.



(i) Choose a word from the list below which describes the positive electrode.  
Put a ring around the correct answer.

**anion**      **anode**      **cathode**      **cation**

[1]

15

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Use*

(ii) State the name of the product formed during this electrolysis at  
the negative electrode, .....

the positive electrode. .... [2]

(iii) Suggest the name of a non-metal which can be used for the electrodes in this  
electrolysis.

..... [1]

[Total: 8]

**DATA SHEET**  
**The Periodic Table of the Elements**

		Group																																																																																																																																						
I	II	III	IV	V	VI	VII	0																																																																																																																																	
1 <b>H</b> Hydrogen 1											2 <b>He</b> Helium 2																																																																																																																													
3 <b>Li</b> Lithium 3	4 <b>Be</b> Beryllium 4	5 <b>B</b> Boron 5	6 <b>C</b> Carbon 6	7 <b>N</b> Nitrogen 7	8 <b>O</b> Oxygen 8	9 <b>F</b> Fluorine 9	10 <b>Ne</b> Neon 10	11 <b>Na</b> Sodium 11	12 <b>Mg</b> Magnesium 12	13 <b>Al</b> Aluminium 13	14 <b>Si</b> Silicon 14	15 <b>P</b> Phosphorus 15	16 <b>S</b> Sulfur 16	17 <b>Cl</b> Chlorine 17	18 <b>Ar</b> Argon 18	19 <b>K</b> Potassium 19	20 <b>Ca</b> Calcium 20	21 <b>Sc</b> Scandium 21	22 <b>Ti</b> Titanium 22	23 <b>V</b> Vanadium 23	24 <b>Cr</b> Chromium 24	25 <b>Mn</b> Manganese 25	26 <b>Fe</b> Iron 26	27 <b>Co</b> Cobalt 27	28 <b>Ni</b> Nickel 28	29 <b>Cu</b> Copper 29	30 <b>Zn</b> Zinc 30	31 <b>Ga</b> Gallium 31	32 <b>Ge</b> Germanium 32	33 <b>As</b> Arsenic 33	34 <b>Se</b> Selenium 34	35 <b>Br</b> Bromine 35	36 <b>Kr</b> Krypton 36	37 <b>Rb</b> Rubidium 37	38 <b>Sr</b> Strontium 38	39 <b>Y</b> Yttrium 39	40 <b>Zr</b> Zirconium 40	41 <b>Nb</b> Niobium 41	42 <b>Mo</b> Molybdenum 42	43 <b>Tc</b> Technetium 43	44 <b>Ru</b> Ruthenium 44	45 <b>Rh</b> Rhodium 45	46 <b>Pd</b> Palladium 46	47 <b>Ag</b> Silver 47	48 <b>Cd</b> Cadmium 48	49 <b>In</b> Indium 49	50 <b>Sn</b> Tin 50	51 <b>Sb</b> Antimony 51	52 <b>Te</b> Tellurium 52	53 <b>I</b> Iodine 53	54 <b>Xe</b> Xenon 54	55 <b>Cs</b> Caesium 55	56 <b>Ba</b> Barium 56	57 <b>La</b> Lanthanum 57	72 <b>Hf</b> Hafnium 72	73 <b>Ta</b> Tantalum 73	74 <b>W</b> Tungsten 74	75 <b>Re</b> Rhenium 75	76 <b>Os</b> Osmium 76	77 <b>Ir</b> Iridium 77	78 <b>Pt</b> Platinum 78	79 <b>Au</b> Gold 79	80 <b>Hg</b> Mercury 80	81 <b>Tl</b> Thallium 81	82 <b>Pb</b> Lead 82	83 <b>Bi</b> Bismuth 83	84 <b>Po</b> Polonium 84	85 <b>At</b> Astatine 85	86 <b>Rn</b> Radon 86	87 <b>Fr</b> Francium 87	88 <b>Ra</b> Radium 88	89 <b>Ac</b> Actinium 89	†	90 <b>Th</b> Thorium 90	91 <b>Pa</b> Protactinium 91	92 <b>U</b> Uranium 92	93 <b>Np</b> Neptunium 93	94 <b>Pu</b> Plutonium 94	95 <b>Am</b> Americium 95	96 <b>Cm</b> Curium 96	97 <b>Bk</b> Berkelium 97	98 <b>Cf</b> Californium 98	99 <b>Es</b> Einsteinium 99	100 <b>Fm</b> Fermium 100	101 <b>Md</b> Mendelevium 101	102 <b>No</b> Nobelium 102	103 <b>Lr</b> Lawrencium 103	133 <b>Cs</b> Caesium 55	137 <b>Ba</b> Barium 56	139 <b>La</b> Lanthanum 57	178 <b>Hf</b> Hafnium 72	181 <b>Ta</b> Tantalum 73	184 <b>W</b> Tungsten 74	186 <b>Re</b> Rhenium 75	190 <b>Os</b> Osmium 76	192 <b>Ir</b> Iridium 77	195 <b>Pt</b> Platinum 78	197 <b>Au</b> Gold 79	201 <b>Hg</b> Mercury 80	204 <b>Tl</b> Thallium 81	207 <b>Pb</b> Lead 82	209 <b>Bi</b> Bismuth 83	212 <b>Po</b> Polonium 84	214 <b>At</b> Astatine 85	218 <b>Rn</b> Radon 86	226 <b>Fr</b> Francium 87	227 <b>Ra</b> Radium 88	227 <b>Ac</b> Actinium 89	†	232 <b>Th</b> Thorium 90	232 <b>Pa</b> Protactinium 91	238 <b>U</b> Uranium 92	238 <b>Np</b> Neptunium 93	238 <b>Pu</b> Plutonium 94	238 <b>Am</b> Americium 95	238 <b>Cm</b> Curium 96	238 <b>Bk</b> Berkelium 97	238 <b>Cf</b> Californium 98	238 <b>Es</b> Einsteinium 99	238 <b>Fm</b> Fermium 100	238 <b>Md</b> Mendelevium 101	238 <b>No</b> Nobelium 102	238 <b>Lr</b> Lawrencium 103	140 <b>Ce</b> Cerium 58	141 <b>Pr</b> Praseodymium 59	144 <b>Nd</b> Neodymium 60	150 <b>Sm</b> Samarium 62	152 <b>Eu</b> Europium 63	157 <b>Gd</b> Gadolinium 64	159 <b>Tb</b> Terbium 65	162 <b>Dy</b> Dysprosium 66	165 <b>Ho</b> Holmium 67	167 <b>Er</b> Erbium 68	169 <b>Tm</b> Thulium 69	173 <b>Yb</b> Ytterbium 70	175 <b>Lu</b> Lutetium 71

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

**Key**  

a	<b>X</b>
b	

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

The volume of one mole of any gas is 24 dm<sup>3</sup> at room temperature and pressure (r.t.p.).

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