



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
International General Certificate of Secondary Education

CANDIDATE  
NAME

CENTRE  
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]

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.

.....

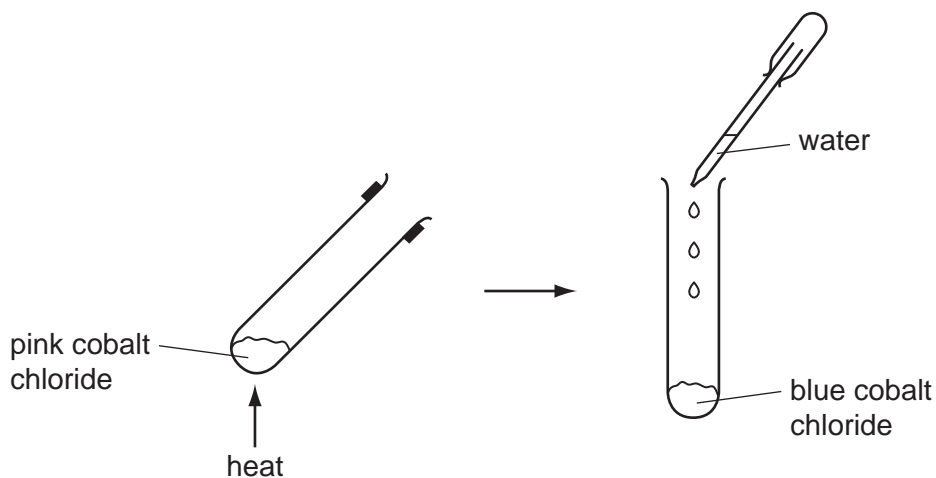
.....

..... [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.

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]

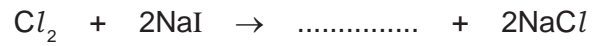
- (d) Describe a test for iodide ions.

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]

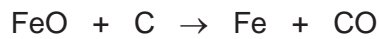
(b) Iron is extracted from its ore in a blast furnace.

(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

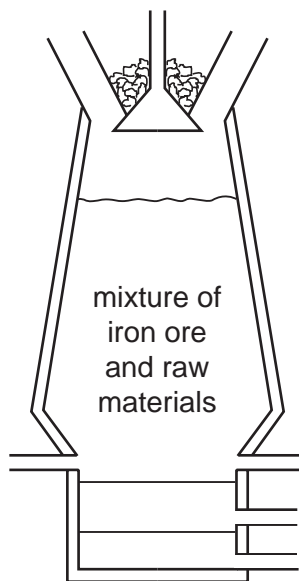


Write a word equation for this reaction.

..... [2]

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

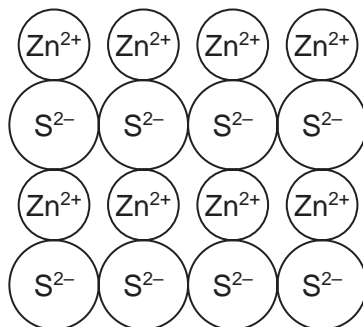
- the slag,
- where the molten iron collects,
- where air is blown into the furnace,
- where the iron ore is put into the furnace.



[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]

- 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.

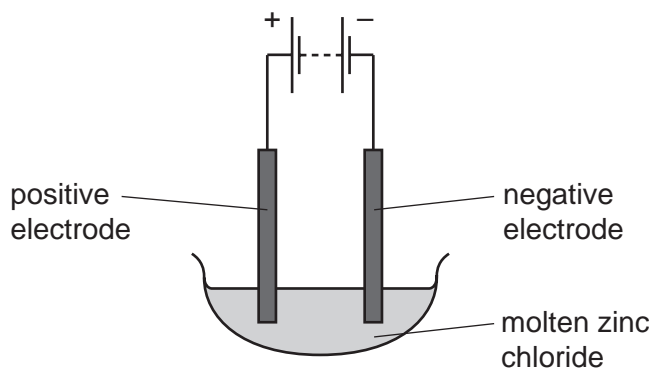
aqueous sodium chloride	<input type="checkbox"/>
ceramics	<input type="checkbox"/>
copper	<input type="checkbox"/>
graphite	<input type="checkbox"/>
sodium chloride crystals	<input type="checkbox"/>
sulfur	<input type="checkbox"/>

[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]

(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					4 <b>He</b> Helium 2									
7 <b>Li</b> Lithium 3	9 <b>Be</b> Beryllium 4		11 <b>B</b> Boron 5	12 <b>C</b> Carbon 6	14 <b>N</b> Nitrogen 7	16 <b>O</b> Oxygen 8	19 <b>F</b> Fluorine 9	20 <b>Ne</b> Neon 10								
23 <b>Na</b> Sodium 11	24 <b>Mg</b> Magnesium 12		27 <b>Al</b> Aluminium 13	28 <b>Si</b> Silicon 14	31 <b>P</b> Phosphorus 15	32 <b>S</b> Sulfur 16	35.5 <b>Cl</b> Chlorine 17	40 <b>Ar</b> Argon 18								
39 <b>K</b> Potassium 19	40 <b>Ca</b> Calcium 20		48 <b>Ti</b> Titanium 22	51 <b>V</b> Vanadium 23	55 <b>Mn</b> Manganese 25	59 <b>Co</b> Cobalt 27	59 <b>Ni</b> Nickel 28	64 <b>Cu</b> Copper 29	65 <b>Zn</b> Zinc 30	70 <b>Ga</b> Gallium 31	73 <b>Ge</b> Germanium 32	75 <b>As</b> Arsenic 33	79 <b>Se</b> Selenium 34	80 <b>Br</b> Bromine 35	84 <b>Kr</b> Krypton 36	
85 <b>Rb</b> Rubidium 37	88 <b>Sr</b> Strontium 38		91 <b>Zr</b> Zirconium 40	93 <b>Nb</b> Niobium 41	96 <b>Mo</b> Molybdenum 42	101 <b>Ru</b> Ruthenium 44	103 <b>Rh</b> Rhodium 45	106 <b>Pd</b> Palladium 46	108 <b>Ag</b> Silver 47	112 <b>Cd</b> Cadmium 48	115 <b>In</b> Indium 49	122 <b>Sb</b> Antimony 51	128 <b>Te</b> Tellurium 52	127 <b>I</b> Iodine 53	131 <b>Xe</b> Xenon 54	
133 <b>Cs</b> Caesium 55	137 <b>Ba</b> Barium 56		178 <b>Hf</b> Hafnium 72	181 <b>Ta</b> Tantalum 73	184 <b>W</b> Tungsten 74	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	209 <b>Pb</b> Lead 82	207 <b>Pb</b> Lead 82	209 <b>Pb</b> Lead 82	209 <b>Pb</b> Lead 82	209 <b>Pb</b> Lead 82
226 <b>Fr</b> Francium 87	226 <b>Ra</b> Radium 88		227 <b>Ac</b> Actinium 89													

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	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
232 <b>Th</b> Thorium 90	238 <b>U</b> Uranium 92	238 <b>U</b> Uranium 92	238 <b>U</b> Uranium 92	238 <b>U</b> Uranium 92	238 <b>U</b> Uranium 92	238 <b>U</b> Uranium 92	238 <b>U</b> Uranium 92	238 <b>U</b> Uranium 92	238 <b>U</b> Uranium 92	238 <b>U</b> Uranium 92	238 <b>U</b> Uranium 92

<b>a</b>	<b>X</b>	<b>b</b>
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**Key**

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

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

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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