



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	
Total	

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.

.....

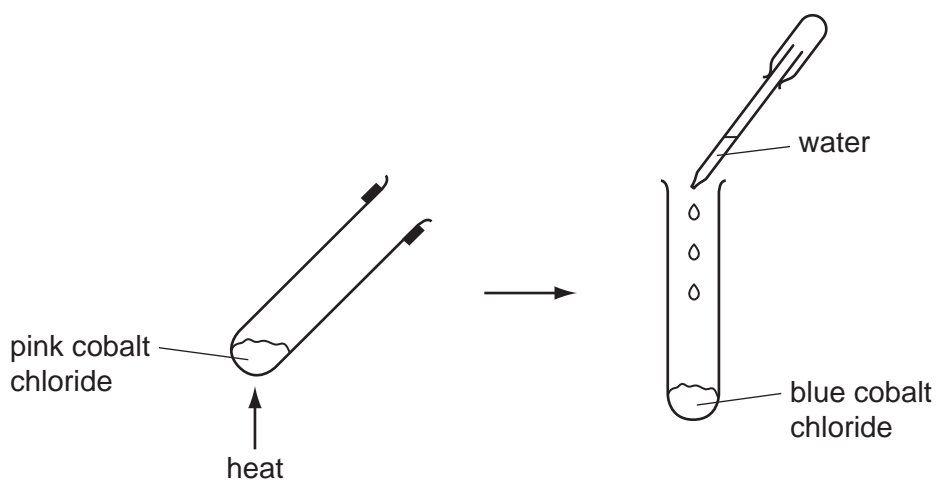
.....

..... [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 cm³ of seawater was evaporated.

compound	ions present	mass of compound / g
sodium chloride	Na ⁺ and Cl ⁻	14.0
magnesium chloride	Mg ²⁺ and Cl ⁻	3.0
magnesium sulfate	Mg ²⁺ and SO ₄ ²⁻	2.0
calcium sulfate	Ca ²⁺ and SO ₄ ²⁻	0.5
potassium chloride	K ⁺ and Cl ⁻	0.5
potassium bromide		
calcium carbonate	Ca ²⁺ and CO ₃ ²⁻	
sodium iodide	Na ⁺ and I ⁻	
		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]

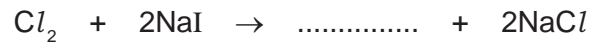
- (d) Describe a test for iodide ions.

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, 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]

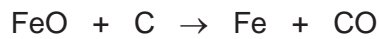
(b) Iron is extracted from its ore in a blast furnace.

(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

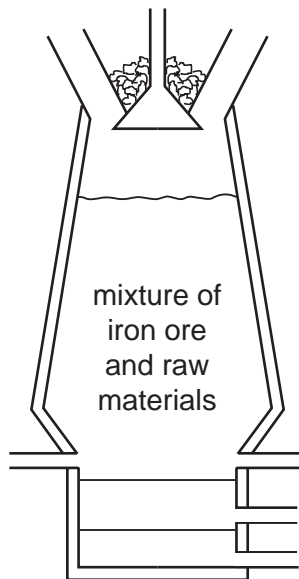


Write a word equation for this reaction.

..... [2]

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

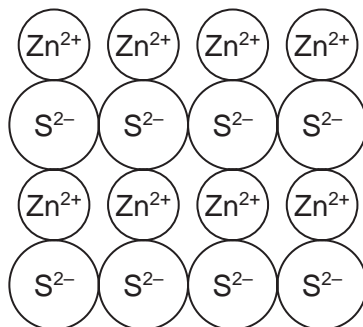
- the slag,
- where the molten iron collects,
- where air is blown into the furnace,
- where the iron ore is put into the furnace.



[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
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.

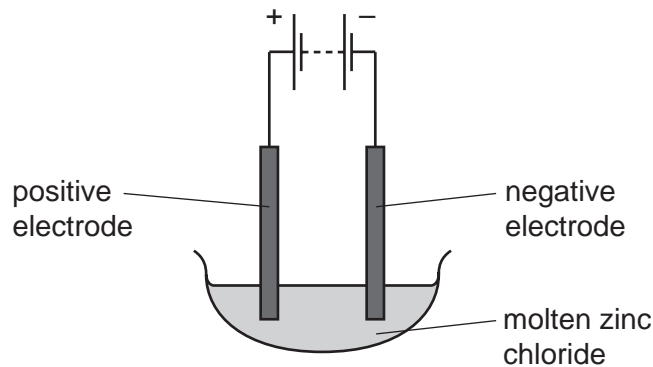
aqueous sodium chloride	<input type="checkbox"/>
ceramics	<input type="checkbox"/>
copper	<input type="checkbox"/>
graphite	<input type="checkbox"/>
sodium chloride crystals	<input type="checkbox"/>
sulfur	<input type="checkbox"/>

[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 H Hydrogen 1					4 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 Al Aluminium 13	28 Si Silicon 14	29 Co Cobalt 27	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		48 Ti Titanium 22	51 V Vanadium 23	55 Mn Manganese 25	56 Fe Iron 26	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	84 Kr Krypton 36												
85 Rb Rubidium 37	88 Sr Strontium 38		91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	122 Sb Antimony 51	128 Te Tellurium 52	131 Xe Xenon 54												
133 Cs Caesium 55	137 Ba Barium 56		178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	209 Pb Lead 82	210 Po Polonium 84	210 Rn Radon 86												
87 Fr Francium	88 Ra Radium	89 Ac Actinium																								
													140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	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	238 Pa Protactinium 91	238 U Uranium 92	238 Pu Plutonium 94	238 Np Neptunium 93	238 Am Americium 95	238 Cm Curium 96	238 Bk Berkelium 97	238 Cf Californium 98	238 Es Einsteinium 99	238 Fm Fermium 100	238 Md Mendelevium 101	238 No Nobelium 102	238 Lr Lawrencium 103

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

Key

a	X
b	
†	

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.).