UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

6848373417

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.

For Examiner's Use

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.

$^{1}_{1}H$ $^{3}_{1}H$

(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	$^{1}_{1}H$	$^{3}_{1}H$
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]

[Turn over

(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 ⟶ least reactive

[2]

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

.....

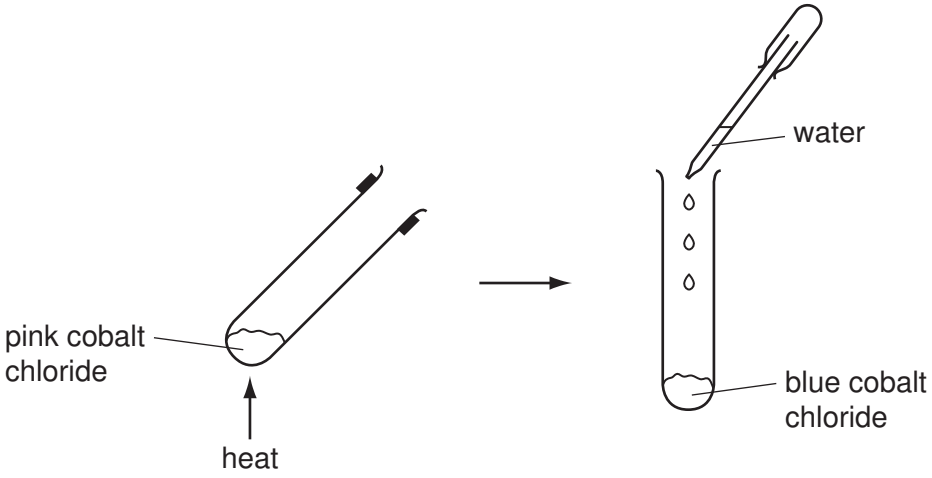
.....

..... [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]

For Examiner's Use

4 The table shows the mass of various compounds obtained when 500 cm^3 of seawater is 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]

For Examiner's Use

(e) Aqueous chlorine reacts with aqueous sodium iodide.

(i) Complete the equation for this reaction.

$$Cl_2 + 2NaI \rightarrow \text{.....} + 2NaCl$$

[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]

For Examiner's Use

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]

For Examiner's Use

(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 $(NH_4)_2SO_4$.

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

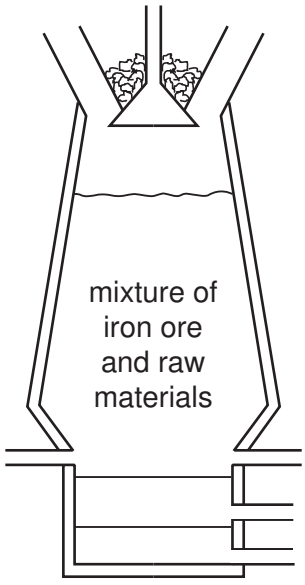
$$FeO + C \rightarrow Fe + CO$$

Write a word equation for this reaction.

..... [2]

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

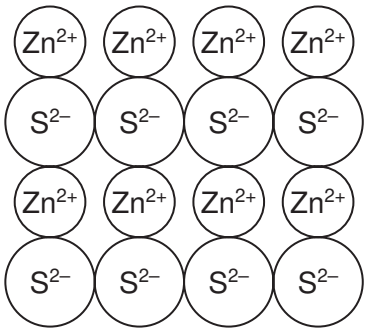
- the slag,
- where the molten iron collects,
- where air is blown into the furnace,
- where the iron ore is put into the furnace.



[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]

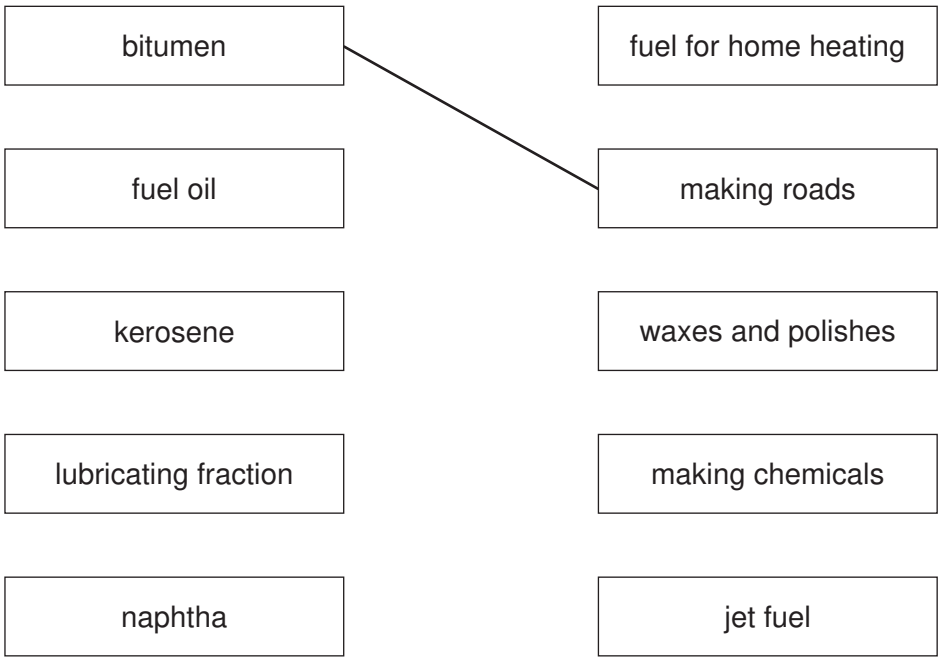
7 Petroleum is a mixture of hydrocarbons.
Two of the processes carried out in an oil refinery are fractional distillation of petroleum and cracking of hydrocarbon fractions.

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

boiling point	☐
chemical reactivity	☐
electrical conductivity	☐
melting point	☐

[1]

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



[4]

For Examiner's Use

(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.

$$C_{14}H_{30} \rightarrow C_2H_4 + ...$$

[1]

(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]

[Turn over

For Examiner's Use

8 Some substances conduct electricity, others do not.

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

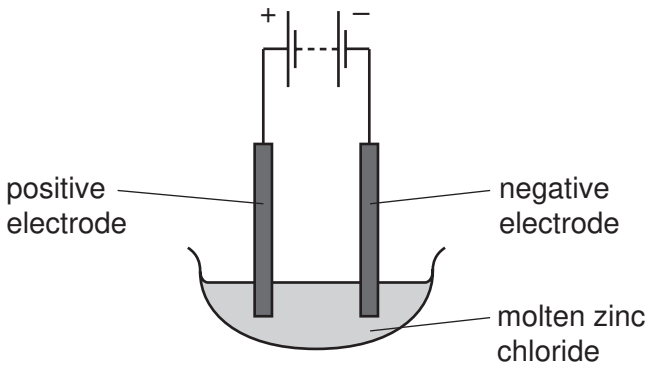
aqueous sodium chloride	☐
ceramics	☐
copper	☐
graphite	☐
sodium chloride crystals	☐
sulfur	☐

[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	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12										27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	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	80 Br Bromine 35	84 Kr Krypton 36
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57 *	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	Po Polonium 84	At Astatine 85	Rn Radon 86
Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89 †															

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	Pm Promethium 61	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	Pa Protactinium 91	238 U Uranium 92	Np Neptunium 93	Pu Plutonium 94	Am Americium 95	Cm Curium 96	Bk Berkelium 97	Cf Californium 98	Es Einsteinium 99	Fm Fermium 100	Md Mendelevium 101	No Nobelium 102	Lr Lawrencium 103

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

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

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