UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

7049085722

CHEMISTRY **0620/02**

Paper 2 **May/June 2009**

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	
Total	

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

For Examiner's Use

1 **(a)** Choose from the list of compounds to answer questions **(i)** to **(v)**.

calcium carbonate **carbon dioxide** **hydrogen chloride**

iron(III) oxide **lead(II) bromide** **methane** **sodium hydroxide**

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

Name the compound which

(i) is a transition metal compound,

..... [1]

(ii) produces brown fumes at the anode when electrolysed,

..... [1]

(iii) is used to manufacture lime,

..... [1]

(iv) dissolves in water to form an alkaline solution,

..... [1]

(v) is the main constituent of natural gas.

..... [1]

(b) At a high temperature iron(III) oxide is reduced by carbon.

$$Fe_2O_3 + 3C \longrightarrow 2Fe + 3CO$$

(i) Explain how the equation shows that iron(III) oxide is reduced by carbon.

..... [1]

(ii) Complete these sentences about the extraction of iron using words from the list.

bauxite **blast** **converter** **haematite** **lime**

limestone **sand** **slag**

Iron is extracted from ..... by mixing the ore with coke and ..... in a ..... furnace. The iron ore is reduced to iron and impurities in the ore react with calcium oxide to form ..... . [4]

[Total: 10]

2 The table shows some observations about the reactivity of various metals with dilute hydrochloric acid.

metal	observations
calcium	many bubbles produced rapidly with much spitting
copper	no bubbles formed
iron	a few bubbles produced very slowly
magnesium	many bubbles produced rapidly with no spitting

(a) Put these metals in order of their reactivity.

most reactive → least reactive

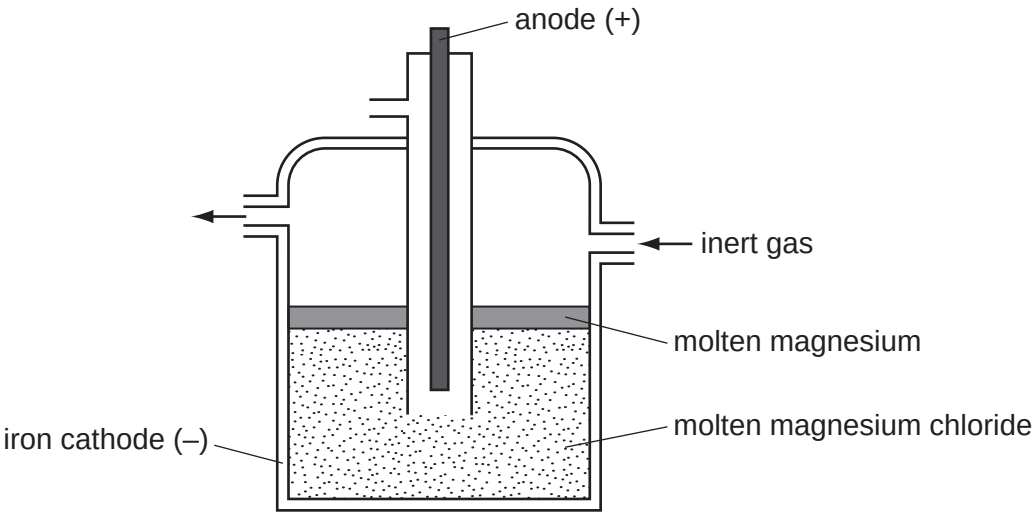
[1]

(b) Zinc is between iron and magnesium in its reactivity.
Suggest what observations are made about how fast the bubbles are produced when zinc reacts with dilute hydrochloric acid.

.....

[1]

(c) Magnesium is extracted by the electrolysis of molten magnesium chloride.



(i) What information in the diagram suggests that magnesium is less dense than molten magnesium chloride?

.....

[1]

For Examiner's Use

(ii) Suggest why magnesium has to be extracted by electrolysis rather than by heating its oxide with carbon.

..... [1]

(iii) Suggest why a stream of inert gas is blown over the surface of the molten magnesium.

..... [1]

(iv) State the name of a gaseous element which is inert.

..... [1]

(d) In some old magnesium manufacturing plants, coal gas is blown over the surface of the magnesium.
The list shows the main substances in coal gas.

carbon monoxide **ethene** **hydrogen**

hydrogen sulfide **methane**

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

[1]

(ii) Suggest **two** hazards of using coal gas by referring to **two** specific substances in the list.

substance .....

hazard .....

substance .....

hazard ..... [2]

For Examiner's Use

(e) Carbon monoxide can be removed from coal gas by mixing it with steam and passing the mixture over a catalyst of iron(III) oxide at 400 °C.

$$CO + H_2O \rightleftharpoons CO_2 + H_2$$

(i) Write a word equation for this reaction.

..... [1]

(ii) What does the symbol $\rightleftharpoons$ mean?

..... [1]

(iii) Iron(III) oxide reacts with acids to form a solution containing iron(III) ions.
Describe a test for aqueous iron(III) ions.

test .....

result .....

..... [2]

[Total: 13]

For Examiner's Use

3 Petroleum is a mixture of hydrocarbons which can be separated into fractions such as petrol, paraffin and diesel.

(a) State the name of the process used to separate these fractions.

..... [1]

(b) Name **two** other fractions which are obtained from petroleum .

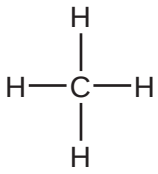
..... and ..... [2]

(c) Give **one** use for the paraffin fraction.

..... [1]

(d) Many of the compounds obtained from petroleum are alkanes.
Which **two** of the following structures are alkanes?

A



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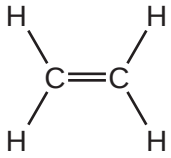
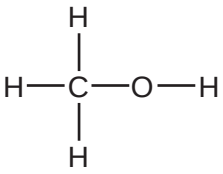
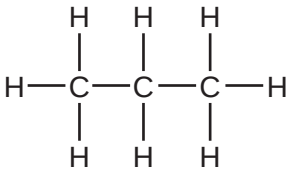


C



D



..... [1]

(e) Use words from the list below to complete the following sentence.

ethane **ethene** **hydrogen** **nitrogen** **oxygen**

reactive **unreactive** **water**

Alkanes such as ..... are generally ..... but they can be burnt in ..... to form carbon dioxide and ..... [4]

(f) Alkanes are saturated hydrocarbons.
What do you understand by the terms

(i) saturated, ...

.....

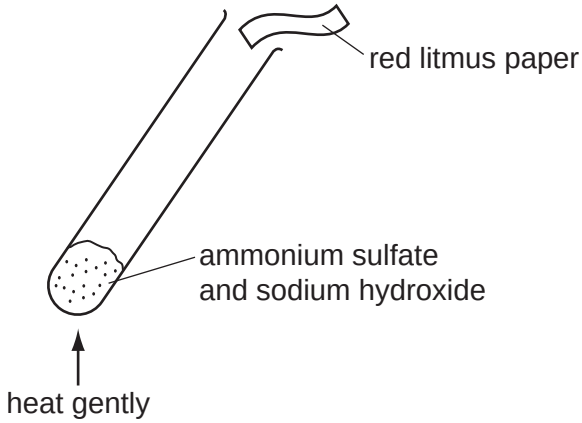
(ii) hydrocarbon? .....

..... [2]

[Total: 11]

4 This question is about some compounds of nitrogen.

A mixture of ammonium sulfate and sodium hydroxide was warmed in a test-tube. The gas was tested with moist red litmus paper.



(a) State the name of the gas released.

.....

[1]

(b) State the colour change of the litmus paper.

.....

[1]

(c) Complete the word equation for the reaction of ammonium carbonate with hydrochloric acid.

ammonium carbonate + hydrochloric acid ⟶ ……..... + ……..... + ……..... ……..... ……..... [3]

(d) Ammonium salts such as ammonium nitrate, NH_4NO_3 and ammonium chloride NH_4Cl are used as fertilisers.

(i) Explain why farmers need to use fertilisers.

.....

.....

[1]

(ii) Explain why ammonium nitrate is a better fertiliser than ammonium chloride.

.....

[1]

(iii) Calculate the relative formula mass of ammonium nitrate.

For Examiner's Use

[1]

(e) When ammonium nitrate is heated nitrogen(I) oxide is given off.
Nitrogen(I) oxide relights a glowing splint.
Name **one** other gas which relights a glowing splint.

..... [1]

(f) State **one** harmful effect of nitrogen oxides on the environment.

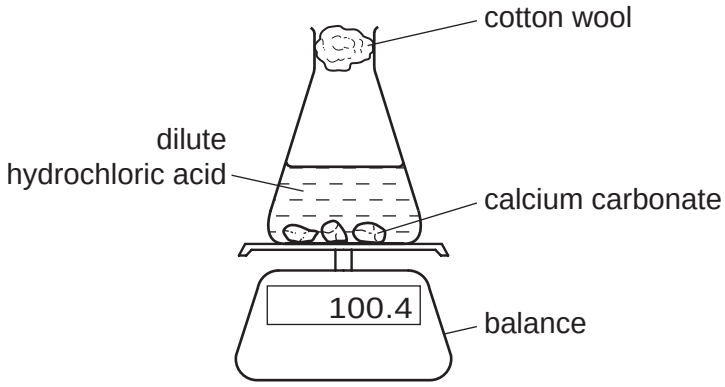
..... [1]

[Total: 10]

For Examiner's Use

5 A student used the apparatus shown below to investigate the rate of reaction of calcium carbonate with dilute hydrochloric acid.

$$CaCO_3 + 2HCl \longrightarrow CaCl_2 + CO_2 + H_2O$$

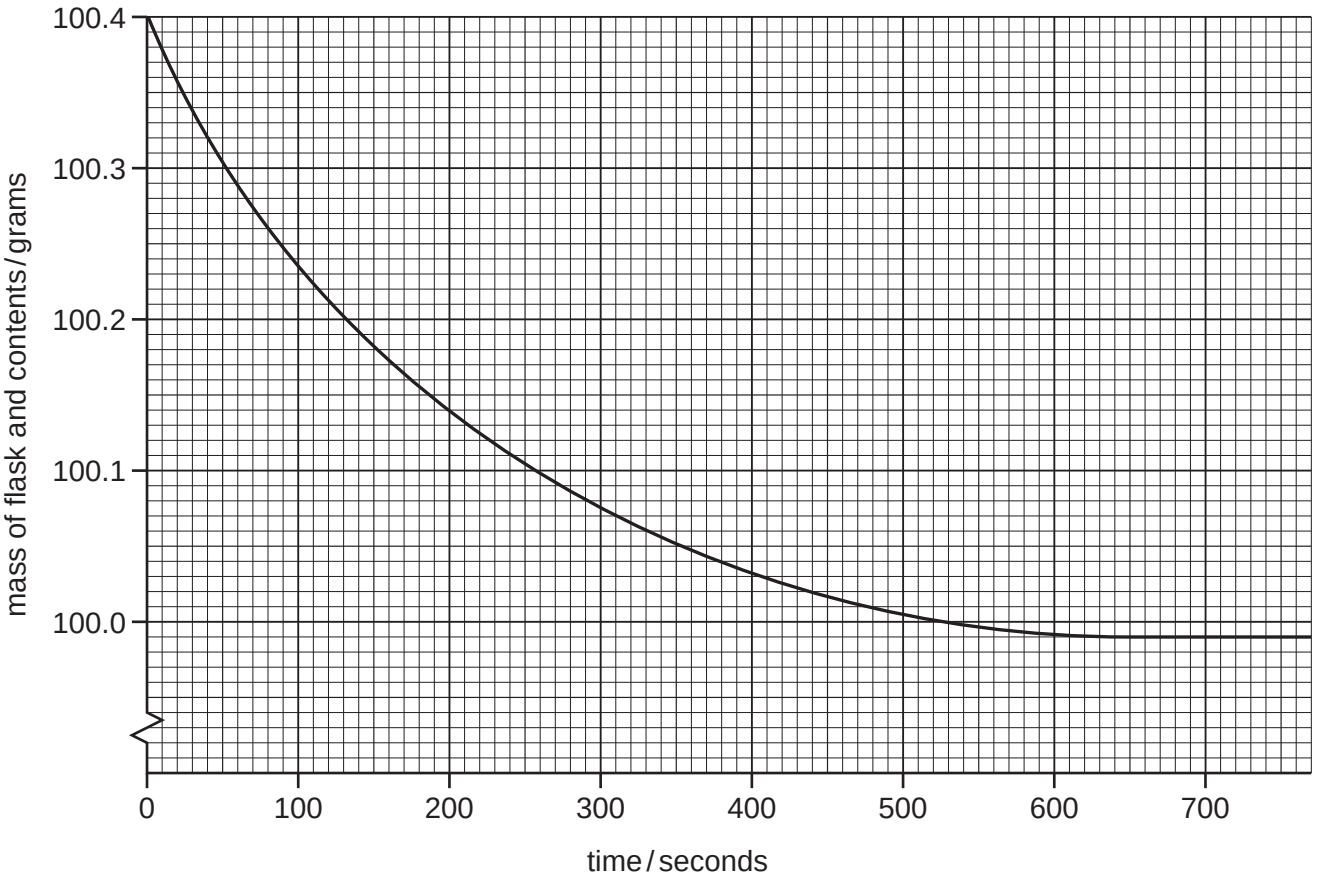


(a) Use the information in the equation to suggest why the mass of the flask and contents decreases with time.

.....

..... [1]

(b) The graph shows how the mass of the flask and its contents changes with time.



For Examiner's Use

(i) At what time was the reaction just complete?

..... [1]

(ii) On the graph, mark with an **X** the point where the speed (rate) of reaction was fastest. [1]

(iii) The student repeated the experiment but altered the concentration of the hydrochloric acid so that it was half the original value. In both experiments calcium carbonate was in excess and all other conditions were kept the same.

On the graph on page 10, draw a curve to show how the mass of the flask and contents changes with time when hydrochloric acid of half the concentration was used. [2]

(c) How does the speed (rate) of this reaction change when

(i) the temperature is increased, ... [1]

(ii) smaller pieces of calcium carbonate are used? ..... [1]

(d) Complete the following sentence using words from the list.

combustion **expansion** **large** **rapid** **slow** **small**

In flour mills there is often the risk of an explosion due to the rapid .....

of the very ..... particles which have a very

..... surface area to react. [3]

(e) Cells in plants and animals break down glucose to carbon dioxide and water.

glucose + oxygen ⟶ carbon dioxide + water

(i) State the name of this process.

..... [1]

(ii) In this process enzymes act as catalysts.
What do you understand by the term *catalyst*?

..... [1]

[Total: 12]

For Examiner's Use

6 Bromine is an element in Group VII of the Periodic Table.

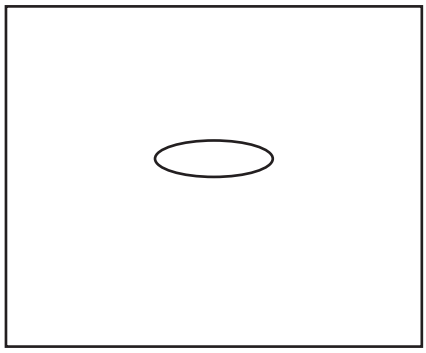
(a) Write the formula for a molecule of bromine.

.....

[1]

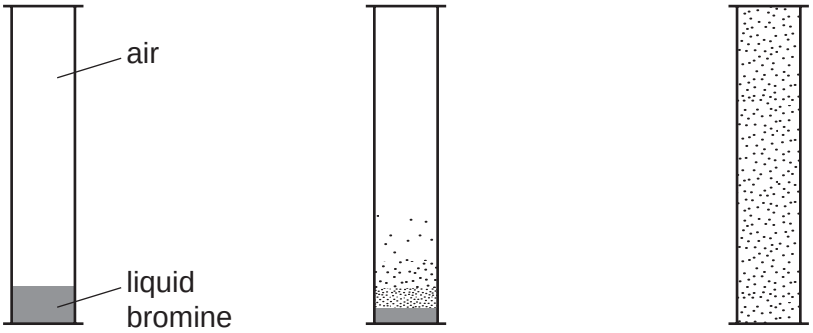
(b) Complete the diagram below to show the arrangement of the molecules in liquid bromine.


represents a bromine molecule



[2]

(c) A teacher placed a small amount of liquid bromine in the bottom of a sealed gas jar of air. After two minutes brown fumes were seen just above the liquid surface. After one hour the brown colour had spread completely throughout the gas jar.



Use the kinetic particle theory to explain these observations.

.....

.....

.....

[3]

For Examiner's Use

(d) Magnesium salts are colourless but Group VII elements are coloured.
An aqueous solution of magnesium bromide reacts with an aqueous solution of chlorine.

magnesium bromide + chlorine ⟶ magnesium chloride + bromine

State the colour change in this reaction.

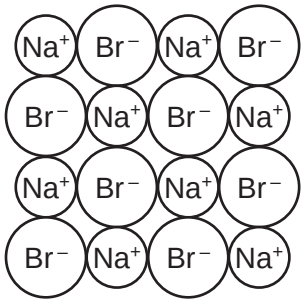
..... [2]

(e) A solution of magnesium bromide will not react with iodine.
Explain why there is no reaction.

..... [1]

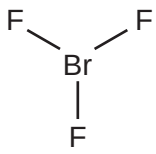
(f) The structures of some compounds containing bromine are shown below.

A

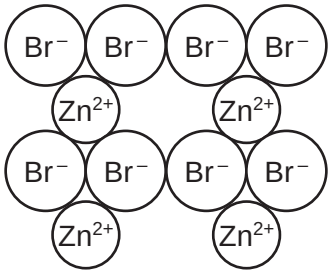


B

C



D



(i) Write the simplest formula for the substance with structure **A**.

..... [1]

(ii) State the name of the substance with structure **D**.

..... [1]

(iii) State the type of bonding within a molecule of structure **C**.

..... [1]

(iv) Which **two** structures are giant structures?

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

(v) Why does structure **A** conduct electricity when it is molten?

..... [1]

[Total: 14]

For Examiner's Use

7 Hydrogen chloride can be made by burning hydrogen in chlorine.

(a) Complete the equation for this reaction.

$$H_2 + \text{……...} \longrightarrow \text{…….....} \quad HCl$$

[2]

(b) Draw a dot and cross diagram for a molecule of hydrogen chloride.
Show all the electrons.

use **o** for an electron from a hydrogen atom
use **x** for an electron from a chlorine atom

[2]

(c) Hydrochloric acid is formed when hydrogen chloride gas dissolves in water.
Suggest the pH of hydrochloric acid.
Put a ring around the correct answer.

pH 1 **pH7** **pH9** **pH 13**

[1]

(d) Complete the equation for the reaction of hydrochloric acid with zinc.

zinc + hydrochloric acid ⟶ zinc chloride + …… [1]

(e) Describe how dry crystals of zinc chloride can be obtained from a solution of zinc chloride.

.....

.....

..... [2]

(f) A student electrolysed molten zinc chloride.
State the name of the product formed at

(i) the anode, ... [1]

(ii) the cathode. ..... [1]

[Total: 10]

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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 above X above b

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.).