UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

8135440613

CHEMISTRY **0620/23**

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 **15** printed pages and **1** blank page.

UNIVERSITY of CAMBRIDGE International Examinations

1 The diagram shows part of the Periodic Table.
Only some of the elements are shown.

Li				
Na	Mg			
K	Ca		Ti	V
			Zr	Nb

(a) Answer the following questions by choosing only from the elements shown in the diagram.
You can use each element once, more than once or not at all.

(i) State the names of **two** transition elements shown in the diagram.

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

(ii) State the name of an element which is in Period 3 of the Periodic Table.

..... [1]

(iii) Which element has the electronic structure 2,8,1?

..... [1]

(iv) Which element has the fastest reaction with water?

..... [1]

(v) Which element has 23 protons in its nucleus?

..... [1]

(b) Sodium reacts with oxygen to form sodium peroxide, Na_2O_2.
Complete the symbol equation for this reaction.

..... Na + ... $\rightarrow$ Na_2O_2

[2]

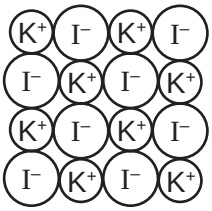
[Total: 8]

2 The list describes five types of chemical structures.

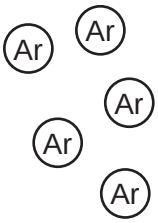
giant covalent
giant ionic
metallic
simple atomic
simple molecular

(a) The diagrams below show four types of chemical structures.

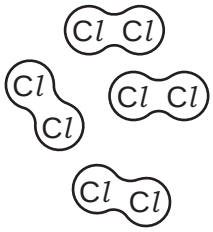
A



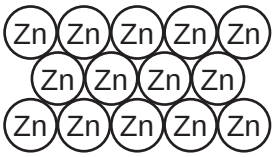
B



C



D



(i) Use the list to match these structures with the diagrams.

structure **A** is ..... [1]

structure **B** is ..... [1]

structure **C** is ..... [1]

structure **D** is ..... [1]

(ii) Which **two** of the structures **A**, **B**, **C** or **D** have low melting points?

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

(b) Sodium chloride is an ionic solid.
Complete the following sentences using words from the list.

electrons **ionic** **molecular** **molten** **solid**

Sodium chloride does not conduct electricity when it is a ..... because the ions cannot move. When it is ..... sodium chloride does conduct electricity because the ions are free to move. [2]

[Total: 7]

3 Water is an important raw material in industry.

(a) State **one** use of water in industry.

..... [1]

(b) Describe a chemical test for water.

test .....

result ..... [2]

(c) A small piece of potassium was placed in a beaker of water.
The equation for the reaction is

$$2K(s) + 2H_2O(l) \rightarrow 2KOH(aq) + H_2(g)$$

(i) Describe a test for the gas given off in this reaction.

test .....

result ..... [2]

(ii) What is the most likely pH of the solution in the beaker when the reaction is complete?
Put a ring around the correct answer.

pH2 pH6 pH7 pH8 pH12

[1]

(d) Water is formed when propane burns.

(i) Complete the equation for this reaction.

$$C_3H_8 + 5O_2 \rightarrow .....CO_2 + ... H_2O$$

[2]

(ii) Which of the following best describes this reaction?
Put a ring around the correct answer.

carbonisation **combustion** **dehydration** **hydrogenation**

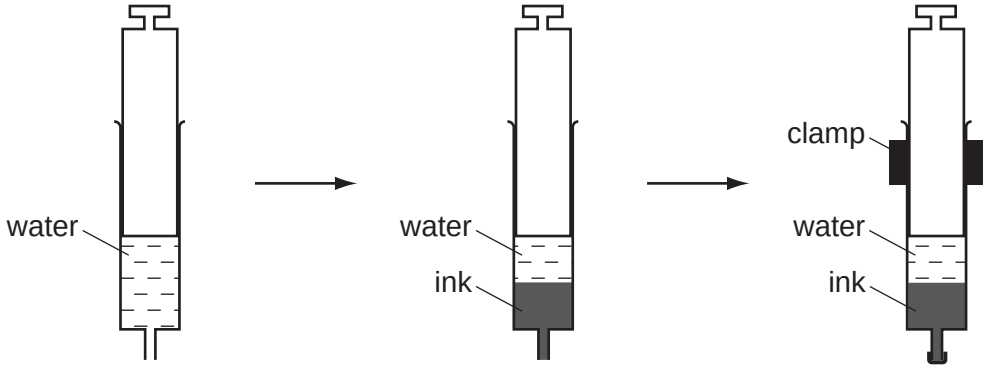
[1]

(iii) When 4.4 g of propane are burnt in excess oxygen, 7.2 g of water are formed.
Calculate the mass of water formed when 22 g of propane are burnt.

[1]

[Total: 10]

4 A student half-filled a syringe with water.
She then carefully drew up some blue ink into the syringe so that it formed a separate l
below the water.
She then left the syringe in a clamp for twenty hours.



After twenty hours the blue colour of the ink had spread throughout the water.

(a) Use the kinetic particle theory to explain these observations.

.....

.....

..... [2]

(b) Ink is a mixture of many chemicals.
What do you understand by the term *mixture*?

.....

..... [1]

(c) The list shows some of the substances present in ink.

carboxylic acids
cobalt(II) ions
ethanol
iron(II) ions
nickel(II) ions
tannins
water

(i) Water is a good solvent.
From the list choose **one** other substance that is a good solvent.

..... [1]

(ii) What is the meaning of the symbol (II) in iron(II)?
Tick **one** box.

the number of outer shell electrons	☐
the difference between the neutron and proton number	☐
the oxidation state	☐
the type of isotope	☐

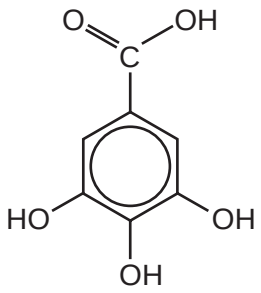
[1]

(iii) Tannins are polymers.
What do you understand by the term *polymer*?

.....

..... [2]

(d) One of the carboxylic acids present in ink is gallic acid.
The structure of gallic acid is shown below.



(i) On the structure above, put a ring around the carboxylic acid functional group. [1]

(ii) Gallic acid is a good reducing agent.
What do you understand by the term *reduction*?

..... [1]

[Total: 9]

5 A student wants to separate the coloured pigments in a plant leaf by chromatography. He grinds the plant leaf and separates the solids from the green solution.

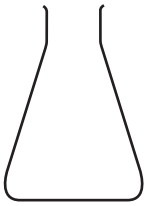
(a) What method can he use to separate the solids from the solution?

..... [1]

(b) The student takes a drop of the green solution and puts a spot of it onto a piece of chromatography paper.
From the diagrams below choose the letter for the most suitable piece of apparatus for this task.

A

B



C

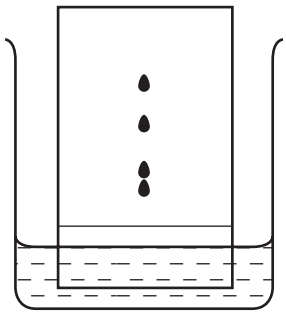
D

letter ..... [1]

(c) The student sets up the chromatography apparatus as shown.

(i) Label the diagram to show:

- the solvent,
- the original position of the spot of green solution,
- the chromatography paper.



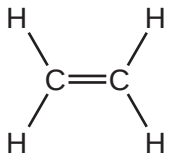
[3]

(ii) How many different pigments were present in the plant leaf?

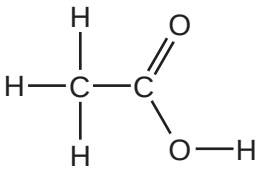
..... [1]

(d) The structure of some organic compounds found in plant leaves are shown belo

A



B



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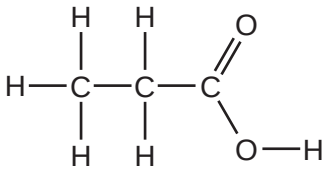
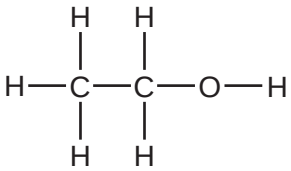


D



(i) Which one of these compounds is an unsaturated hydrocarbon?

..... [1]

(ii) Describe a chemical test for an unsaturated hydrocarbon.

test .....

result ..... [2]

(iii) What do you understand by the term *hydrocarbon*?

..... [1]

(iv) State the name of compound **B**.

..... [1]

(v) To which homologous series does compound **D** belong?

..... [1]

[Total: 12]

6 Lead is a grey metal.

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

.....

..... [2]

(b) To which Group in the Periodic Table does lead belong?

..... [1]

(c) An isotope of lead has the mass number 208.
Complete the table to show the number of subatomic particles in an atom of this isotope of lead.
Use the Periodic Table to help you.

type of particle	number of particles
electrons	
protons	
neutrons	

[3]

(d) When lead is heated in oxygen, lead(II) oxide is formed.
Write a word equation for this reation.

..... [1]

(e) When lead(II) oxide is heated with carbon, lead and carbon monoxide are formed.

$$PbO + C \rightarrow Pb + CO$$

(i) Which substance becomes oxidised during this reaction?

..... [1]

(ii) Carbon monoxide is a covalent compound.
Which one of these statements about carbon monoxide is correct?
Tick **one** box.

It is a solid with a high melting point. ☐

It conducts electricity when it is a liquid. ☐

It is a gas at room temperature. ☐

It forms about 1% of the atmosphere. ☐

[1]

[Total: 9]

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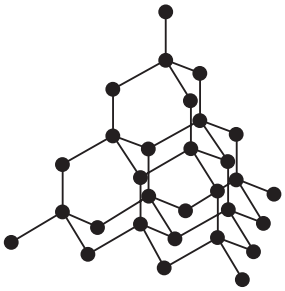
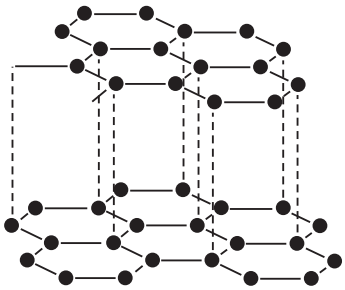
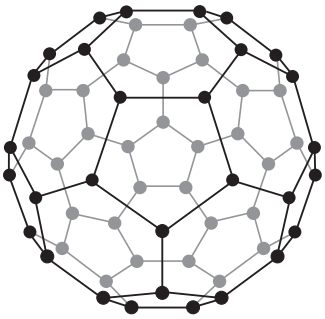
7 Three forms of carbon are diamond, graphite and Buckminsterfullerene.



diamond



graphite



Buckminsterfullerene

● carbon atom

(a) (i) State **one** difference in structure between Buckminsterfullerene and diamond.

.....

..... [1]

(ii) State **two** differences in structure between graphite and diamond.

.....

.....

..... [2]

(b) State the type of bonding between the carbon atoms in diamond.

..... [1]

(c) Suggest why graphite is used as a lubricant.
Refer to the layers in your answer.

.....

..... [1]

(d) State **one** use for diamond.

..... [1]

(e) Coal is a fuel containing carbon.
When coal is burnt, carbon dioxide is produced.
Explain how the increase in carbon dioxide concentration in the atmopshere affects th
world's climate.

.....

.....

..... [2]

(f) Coal also contains small amounts of sulfur.
Explain how burning coal leads to acid rain.

.....

.....

..... [2]

(g) Methane is a fuel.

(i) Which one of the following is a natural source of methane?
Tick **one** box.

waste gases from respiration in plants	☐
waste gases from digestion in animals	☐
gases from photosynthesis in plants	☐
gases from forest fires	☐

[1]

(ii) Draw a diagram to show the arrangement of the electrons in a molecule of m
CH_4.

Use
● for an electron from a carbon atom
× for an electron from a hydrogen atom

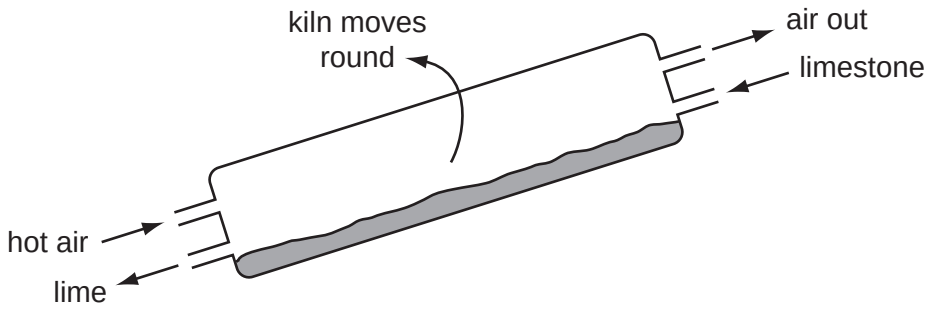
[1]

(iii) Methane belongs to the alkane homologous series.
Name **one** other alkane.

..... [1]

[Total: 13]

8 The diagram shows a rotary kiln used to make lime from limestone.
Limestone is fed in at the top of the kiln and lime comes out at the bottom.



(a) What is the chemical name for lime?

..... [1]

(b) State the name of the type of chemical reaction that takes place in the rotary lime kiln.

..... [1]

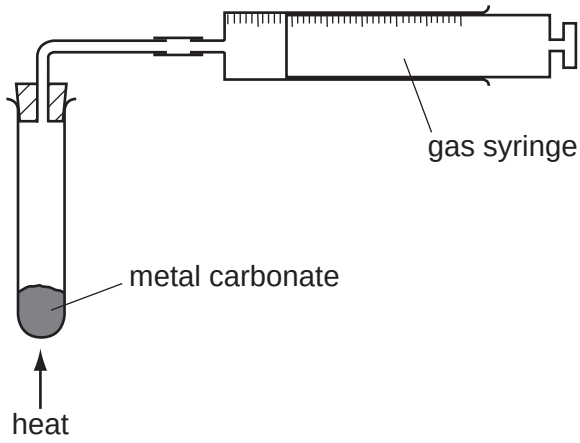
(c) Suggest why the air coming out of the rotary kiln has a greater percentage of carbon dioxide than the air entering the kiln.

..... [1]

(d) State **one** use for lime.

..... [1]

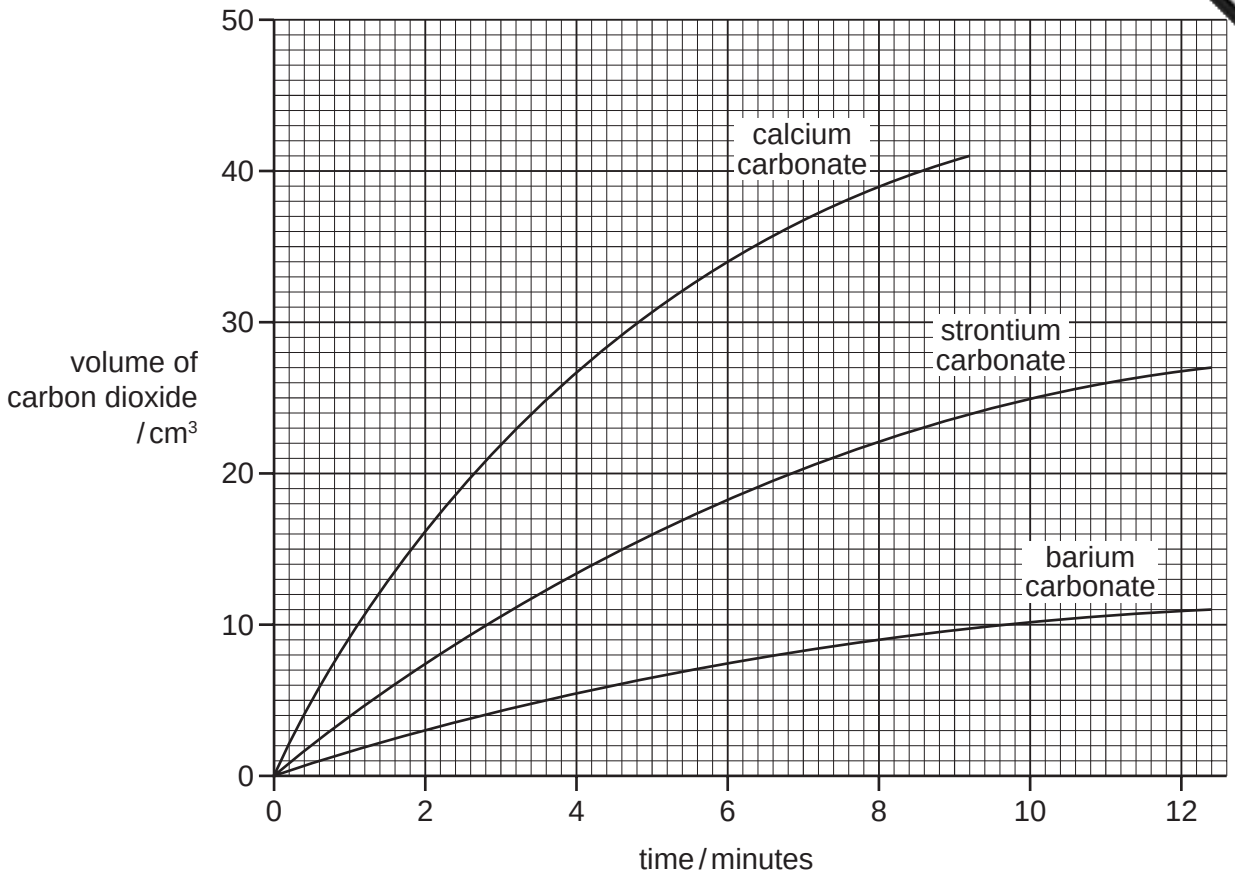
(e) A student compared the speed of reaction of three metal carbonates.
She measured the volume of gas released using the apparatus shown.



State **one** thing that must be kept constant if the speeds of these reactions are to be compared in a fair way.

..... [1]

(f) The graph shows the volume of carbon dioxide released when the three metal carb
are heated.



(i) Which carbonate produced carbon dioxide the fastest?

..... [1]

(ii) What volume of carbon dioxide was produced by strontium carbonate in ten minutes?

..... [1]

(iii) How does the speed of the reaction of these three metal carbonates relate to the position of calcium, strontium and barium in the Periodic Table?

.....

..... [2]

(g) Describe how hydrochloric acid and limewater can be used to show that carbonate ions are present in calcium carbonate.

.....

.....

..... [3]

[Total: 12]

DATA SHEET
The Periodic Table of the Elements

	Group																	
	I	II									III	IV	V	VI	VII	0
																4 **He** Helium 2
					1 **H** Hydrogen 1						11 **B** Boron 5	12 **C** Carbon 6	14 **N** Nitrogen 7	16 **O** Oxygen 8	19 **F** Fluorine 9	20 **Ne** Neon 10
	7 **Li** Lithium 3	9 **Be** Beryllium 4									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
	23 **Na** Sodium 11	24 **Mg** Magnesium 12									70 **Ga** Gallium 31	73 **Ge** Germanium 32	75 **As** Arsenic 33	79 **Se** Selenium 34	80 **Br** Bromine 35	84 **Kr** Krypton 36
	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	112 **Cd** Cadmium 48	119 **In** Indium 49	122 **Sb** Antimony 51	128 **Te** Tellurium 52	127 **I** Iodine 53	131 **Xe** Xenon 54
	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.).