Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

1126807358

CHEMISTRY **0620/23**

Paper 2 **May/June 2014**

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 use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Electronic calculators may be used.
A copy of the Periodic Table is printed on page 20.
You may lose marks if you do not show your working or if you do not use appropriate units.

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.

The syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 1/Level 2 Certificate.

This document consists of **17** printed pages and **3** blank pages.

1 **(a)** Choose from the list of compounds below to answer the following questions.

aluminium oxide
calcium carbonate
calcium oxide
copper(II) sulfate
hydrogen chloride
potassium bromide
sodium chloride
sodium hydroxide

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

Which compound:

(i) reacts with aqueous ammonia to form a light blue precipitate,

..... [1]

(ii) is formed by the decomposition of limestone,

..... [1]

(iii) forms an acidic solution when dissolved in water,

..... [1]

(iv) when electrolysed, gives a red-brown vapour at the anode,

..... [1]

(v) is an oxide of a metal in Group III of the Periodic Table,

..... [1]

(vi) is a transition element compound?

..... [1]

(b) Complete the following sentences about compounds using words from the list below.

chemically **different** **fixed**

mixed **physically** **similar**

A compound is a substance which consists of two or more different elements ..... combined together.

The properties of a compound are ..... from those of the elements from which it is formed.

In a compound, the elements are combined in ..... proportions. [3]

[Total: 9]

2 **(a)** Calcium chloride, $CaCl_2$, is a salt.
Suggest the name of an acid and a base that would react together to make calcium chloride.

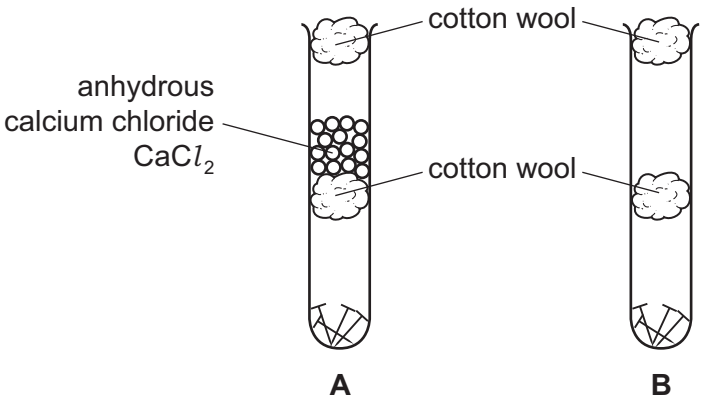
acid .....

base .....
[2]

(b) Calcium chloride absorbs water vapour.
When calcium chloride is heated, it loses its water of crystallisation.
Complete the symbol equation for this reaction. Include the sign for a reversible reaction.

$CaCl_2.6H_2O$ $CaCl_2$ + ...
[2]

(c) A student put some clean iron nails in two test-tubes, as shown in the diagram. She then left the test-tubes for several weeks.



Explain why the nails in tube **A** did not rust but the nails in tube **B** rusted.

.....

.....

..... [2]

(d) Rust is hydrated iron(III) oxide.
What does the (III) in iron(III) oxide refer to?
Tick **one** box.

the oxidation state of the oxygen	☐
the oxidation state of the iron	☐
the number of atoms of oxygen in a formula unit of iron(III) oxide	☐
the number of water molecules in the hydrated iron oxide	☐

[1]

(e) (i) The table describes the ease of reduction of some metal oxides with carbon monoxide.

lead oxide	moderate heating to about 200 °C needed
iron oxide	high temperature furnace at 750 °C needed
magnesium oxide	temperatures above 1000 °C needed
zinc oxide	very high temperature furnace at 900 °C needed

Put these metals in order of their reactivity with carbon monoxide.

least reactive ⟶ most reactive

[2]

(ii) Some metal oxides can be reduced by heating with hydrogen gas.

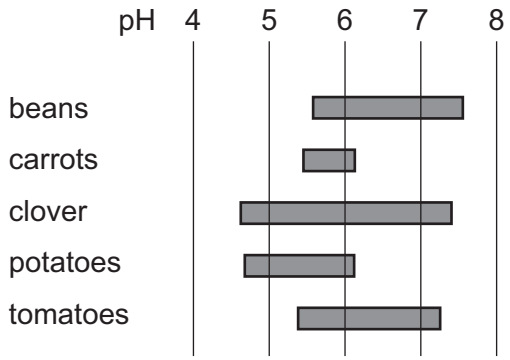
$$CuO + H_2 \rightarrow Cu + H_2O$$

Explain how this equation shows that copper oxide is being reduced.

..... [1]

[Total: 10]

3 The diagram shows the best pH ranges for growing different plants.



(a) (i) Which **two** plants grow best in acidic conditions **only**?

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

(ii) Which pH shown in the diagram above represents a neutral pH?

..... [1]

(b) (i) Explain why lime is added to acidic soils.

.....

..... [2]

(ii) Farmers fertilise soil by adding compounds containing ammonium salts.
Explain why adding lime to fertilised soil may cause a loss of nitrogen from the soil.

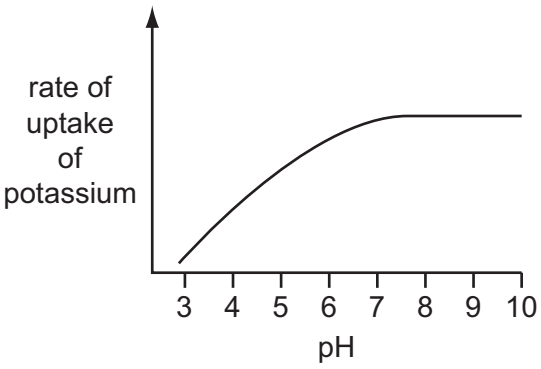
.....

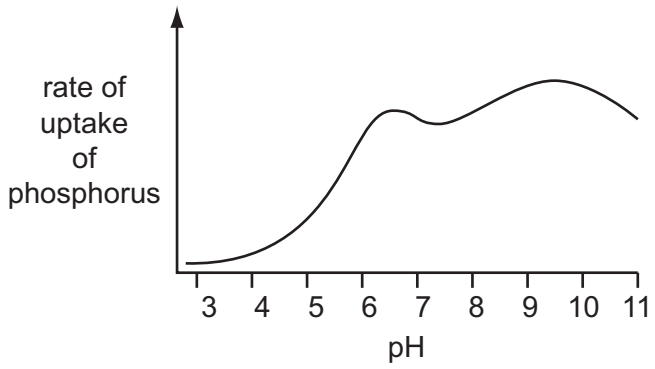
.....

..... [3]

[Turn over

(c) The graphs below show the rate of uptake of potassium and phosphate ions by plant roots at different pH values.





(i) Describe the effect of pH on the rate of uptake of potassium by plant roots.

.....

..... [2]

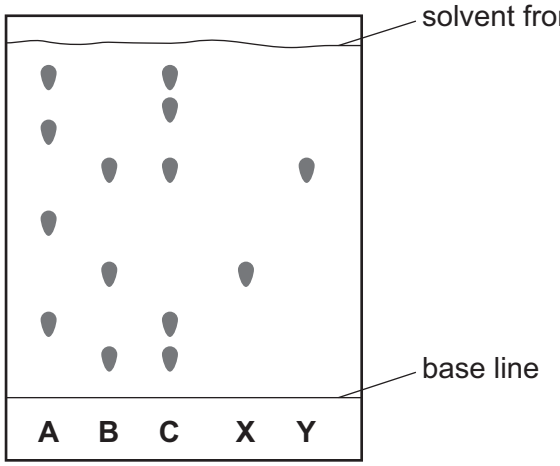
(ii) At which pH value is the rate of uptake of phosphorus by plant roots the highest?

..... [1]

[Total: 10]

4 Chromatography is used to separate a mixture of coloured dyes.

(a) Three different dye mixtures, **A**, **B** and **C**, were spotted onto a piece of chromatography paper. Two pure dyes, **X** and **Y**, were also spotted onto the same piece of paper. The diagram below shows the results of the chromatography.



(i) State the name of a piece of apparatus that could be used to spot the dyes onto the paper.

..... [1]

(ii) Suggest why the base line was drawn in pencil and not in ink.

..... [1]

(iii) Which dye mixture contains **both** dye **X** and dye **Y**?

..... [1]

(iv) Which dye mixture does **not** contain dye **X** or dye **Y**?

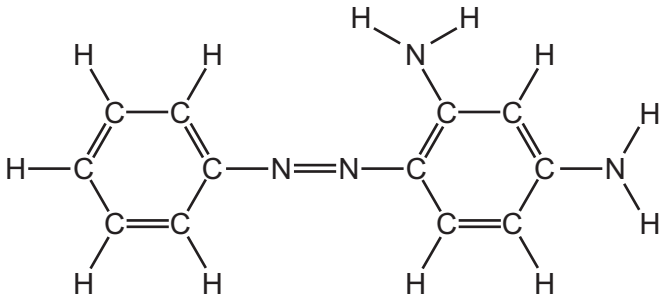
..... [1]

(v) In which mixture, **A**, **B** or **C**, has the greatest number of dyes been separated?

..... [1]

[Turn over

(b) The structure of the dye chrysoidine G is shown below.



(i) How many nitrogen atoms are there in a molecule of chrysoidine G?

..... [1]

(ii) Complete the table below to calculate the relative molecular mass of chrysoidine G.

type of atom	number of atoms	atomic mass	
carbon	12	12	12 × 12 = 144
hydrogen			
nitrogen			

relative molecular mass = ...
[2]

(c) The fibres in the chromatography paper are polymers.

(i) What is meant by the term *polymer*?

.....

..... [1]

(ii) State the chemical name of the polymer formed from ethene.

..... [1]

[Total: 10]

5 The table shows some properties of the first four carboxylic acids.

acid	molecular formula	melting point / °C	boiling point / °C	density in g / cm^3
methanoic acid	CH_2O_2	+10	+101	1.22
ethanoic acid	$C_2H_4O_2$	+17	+118	1.05
propanoic acid	$C_3H_6O_2$	–21		0.99
butanoic acid	$C_4H_8O_2$	–4	+166	

(a) (i) How does the boiling point of these carboxylic acids vary with the number of carbon atoms?

..... [1]

(ii) Suggest a value for:

the boiling point of propanoic acid, ... °C

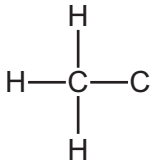
the density of butanoic acid. ..... g / cm^3
[2]

(iii) Is butanoic acid a solid, liquid or gas at room temperature?
Use the data in the table to explain your answer.

.....

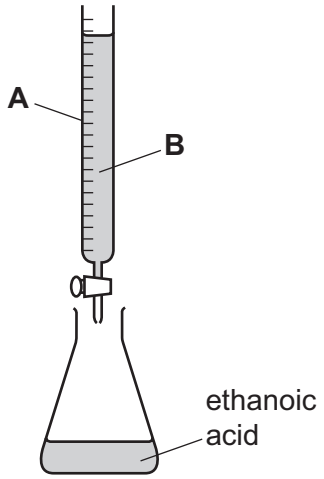
..... [1]

(b) Complete the diagram below to show the structure of ethanoic acid.
Show all atoms and bonds.



[1]

(c) The concentration of ethanoic acid can be determined by titration using the apparatus shown below.



(i) State the name of the piece of glassware labelled **A**.

..... [1]

(ii) Liquid **B** is an alkali.
Which **one** of the following compounds is also an alkali?
Put a ring around the correct answer.

calcium carbonate

calcium sulfate

sodium chloride

sodium hydroxide

[1]

(iii) Describe how you would carry out this titration.

.....

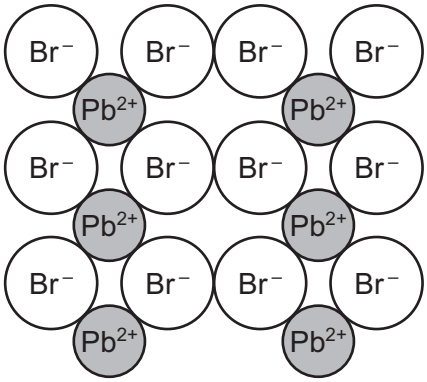
.....

.....

..... [2]

[Total: 9]

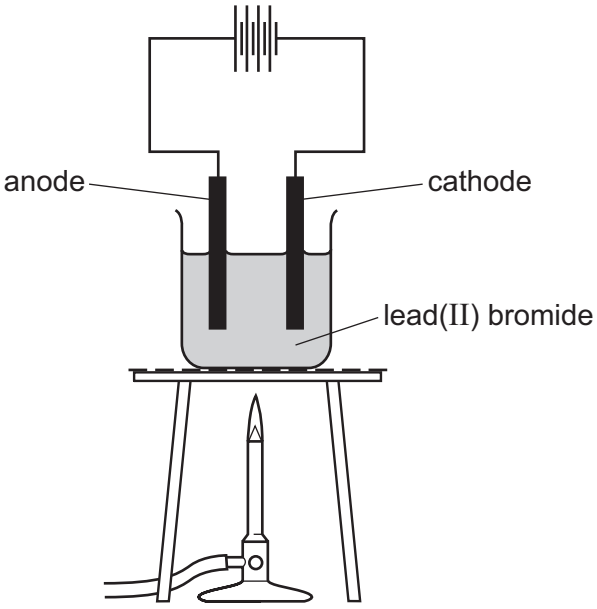
6 Lead(II) bromide is a white solid.
Part of the structure of lead(II) bromide is shown below.



(a) Deduce the simplest formula for lead(II) bromide.

..... [1]

(b) A student electrolysed lead(II) bromide in a fume cupboard using the apparatus shown below.



(i) Why is heat needed for this electrolysis?

..... [1]

(ii) Suggest the name of a substance that could be used for the electrodes.

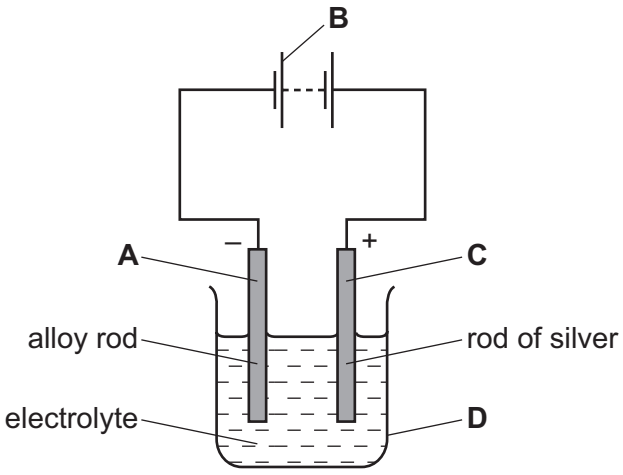
..... [1]

(iii) State the name of the products of electrolysis at:

the anode, ...

the cathode. ..... [1]

(c) Items can be electroplated with silver using the apparatus shown below.



(i) On the diagram, which letter, **A**, **B**, **C** or **D**, is the cathode?

..... [1]

(ii) What would you observe during the experiment at the:

positive electrode,

.....

negative electrode?

.....

[2]

(iii) The electrolyte used is aqueous silver cyanide, AgCN.
Calculate the relative formula mass of silver cyanide.
You must show all your working.

[2]

[Total: 9]

7 Dmitri Mendeleev published his first Periodic Table in 1869.
Part of this table is shown below.

			Ti = 50
			V = 51
			Cr = 52
			Mn = 55
			Fe = 56
			Co = 59
H = 1			**Cu = 63.4**
	Be = 9.4	**Mg = 24**	**Zn = 65.2**
	B = 11	**A*l* = 27.4**	**?**
	C = 12	**Si = 28**	**?**
	N = 14	**P = 31**	**As = 75**
	O = 16	**S = 32**	**Se = 79.4**
	F = 19	**C*l* = 35.5**	**Br = 80**
Li = 7	**Na = 23**	**K = 39**	**Rb = 85.4**

(a) (i) What differences are there between Mendeleev's table and the Periodic Table we use today?

.....

.....

.....

.....

..... [4]

(ii) State the names of any **two** elements in the table above which exist as diatomic molecules.

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

(b) Titanium is a transition element. Sodium is a metal in Group I of the Periodic Table.
State **three** differences in the physical properties of titanium and sodium.

1 .....

2 .....

3 .....

[3]

[Turn over

(c) Titanium(IV) oxide reacts with a mixture of chlorine and carbon.
The products are titanium(IV) chloride, $TiCl_4$, and a gas which turns limewater milky.
Complete the symbol equation for this reaction.

$$TiO_2 + ...Cl_2 + C \rightarrow TiCl_4 + ...$$

[2]

(d) Titanium is extracted from titanium(IV) chloride by reduction with molten sodium in the presence of argon.
Suggest why this reaction is carried out in the presence of argon.

.....

..... [2]

[Total: 12]

8 Sodium sulfate is a solid with a high melting point.
Sodium sulfate conducts electricity when molten but not when solid.

(a) What type of structure is sodium sulfate?
Tick **one** box.

structure of separated atoms	☐
simple molecular structure	☐
giant ionic structure	☐
giant covalent structure	☐

[1]

(b) Describe a test for sulfate ions.

test .....

result .....
[2]

(c) Describe how simple distillation is used to separate water from an aqueous solution of sodium sulfate.
In your answer, refer to:

- the apparatus used,
- changes in state,
- differences in boiling points.

You may use a diagram.

.....

.....

.....

.....

.....

.....

..... [5]

(d) What would you observe when a piece of blue cobalt chloride paper is dipped into water?

..... [1]

(e) Describe how impure water is treated so that it can be used for drinking.

.....

..... [2]

[Total: 11]

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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											
	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	101 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	209 Po Polonium 84	At Astatine 85	Rn Radon 86
	Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89 †															

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

Key

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

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