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.

© UCLES 2014

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]

© UCLES 2014

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.

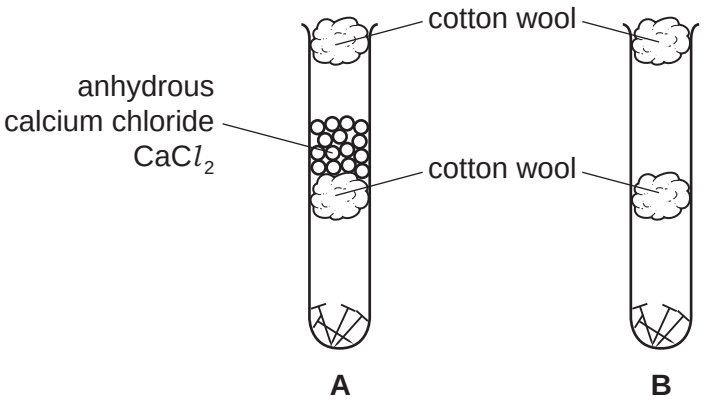
acid .....

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]

© UCLES 2014

(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.

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

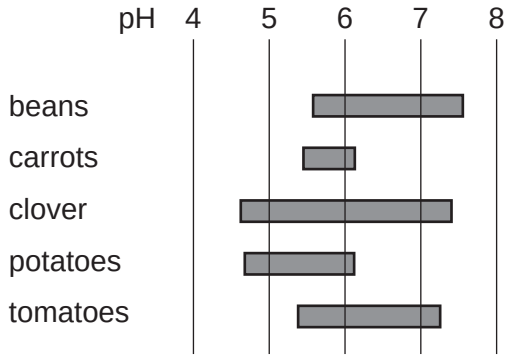
Explain how this equation shows that copper oxide is being reduced.

..... [1]

[Total: 10]

© UCLES 2014

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.

.....

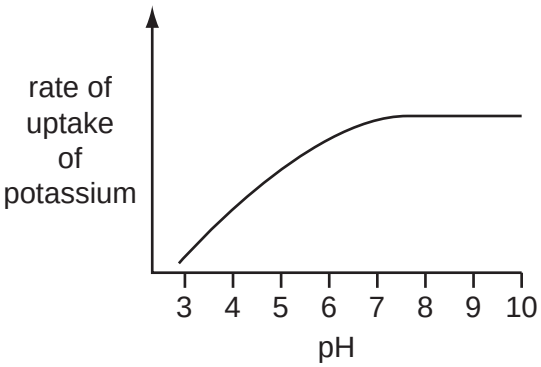
.....

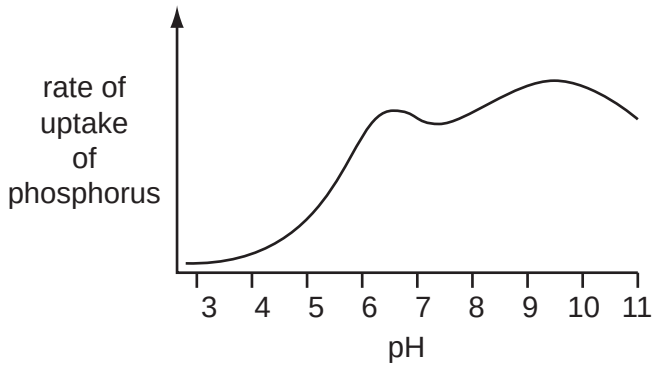
..... [3]

© UCLES 2014

[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?

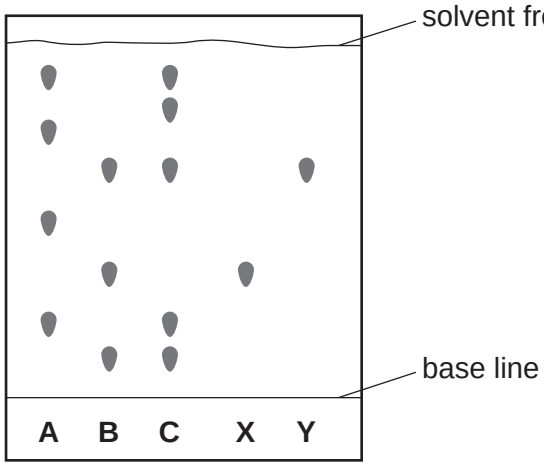
..... [1]

[Total: 10]

© UCLES 2014

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]

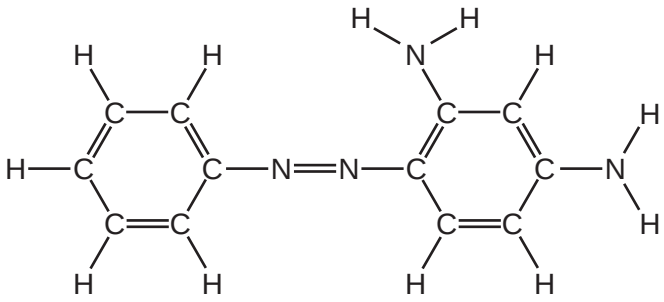
(v) In which mixture, **A**, **B** or **C**, has the greatest number of dyes been separated?

..... [1]

© UCLES 2014

[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]

© UCLES 2014

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

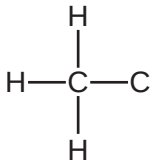
the density of butanoic acid. ..... g / cm^3
[2]

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

.....

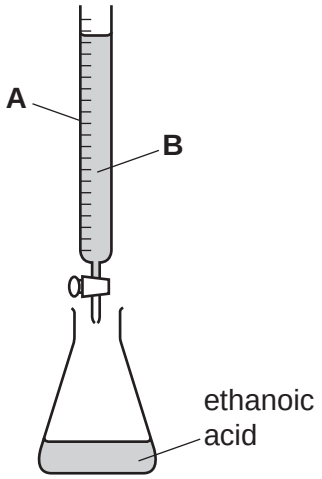
..... [1]

(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.

.....

.....

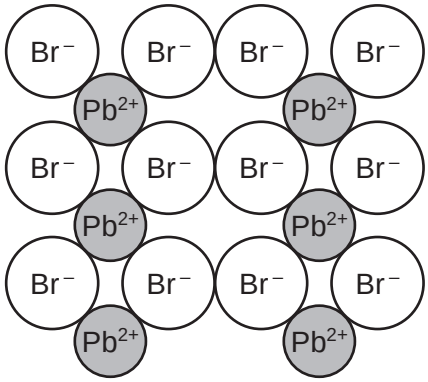
.....

..... [2]

[Total: 9]

© UCLES 2014

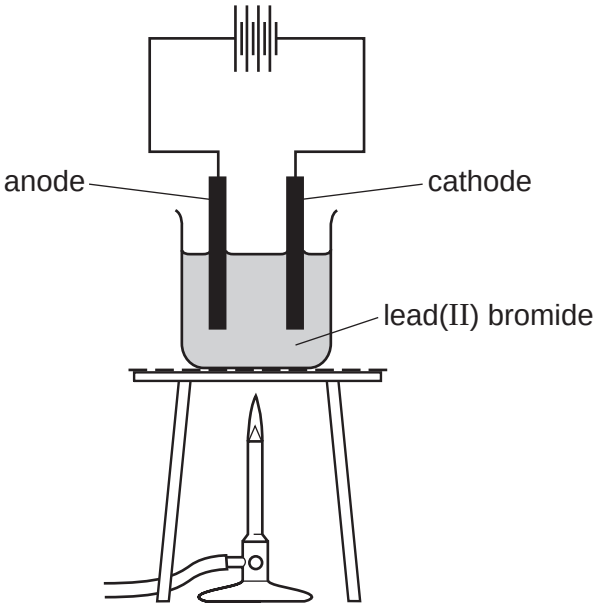
6 Lead(II) bromide is a white solid.
Part of the structure of lead(II) bromide is shown below.



(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.

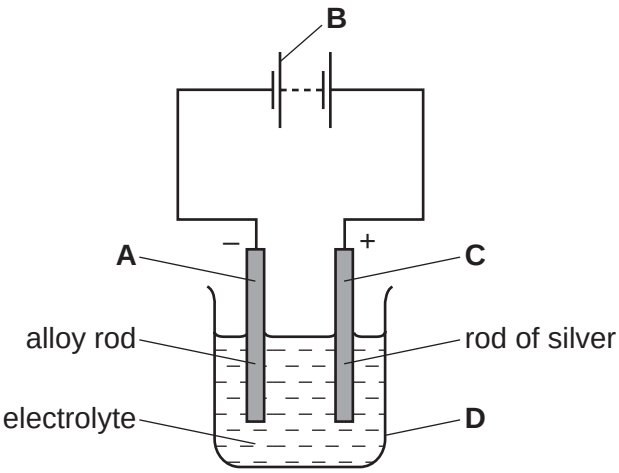
..... [1]

(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]

© UCLES 2014

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]

© UCLES 2014

[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]

© UCLES 2014

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]

© UCLES 2014

BLANK PAGE

© UCLES 2014

BLANK PAGE

© UCLES 2014

BLANK PAGE

© UCLES 2014

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	115 **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	119 **Sn** Tin 50	207 **Pb** Lead 82	209 **Bi** Bismuth 83	**Po** Polonium 84	**At** Astatine 85	**Rn** Radon 86
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				
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	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.).

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included the publisher will be pleased to make amends at the earliest possible opportunity.

Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.

© UCLES 2014