



Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--



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]

3

- 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

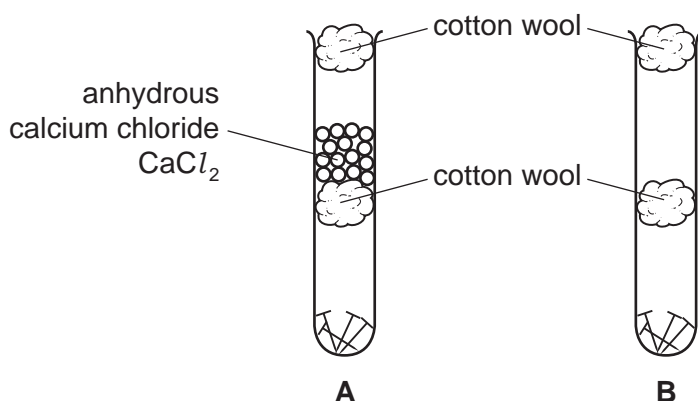
[2]

- (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.



[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

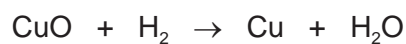
Put these metals in order of their reactivity with carbon monoxide.

least reactive $\xrightarrow{\hspace{15em}}$ most reactive

--	--	--	--

[2]

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



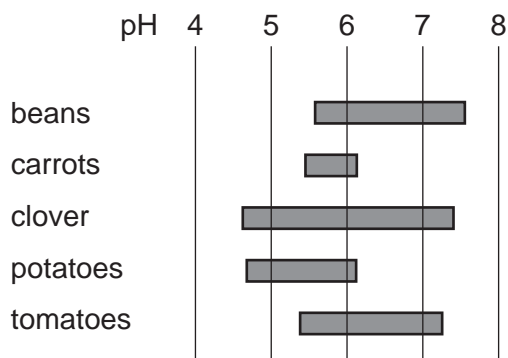
Explain how this equation shows that copper oxide is being reduced.

..... [1]

[Total: 10]

5

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.

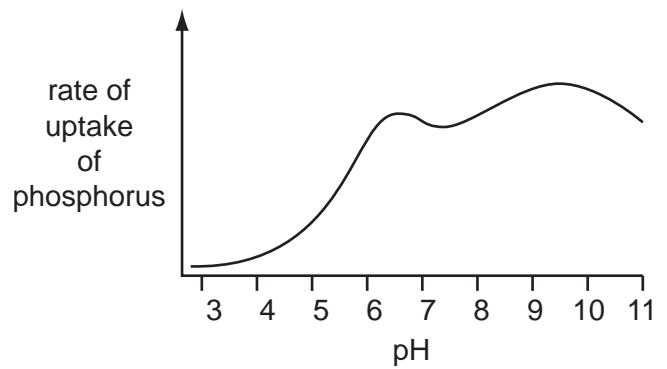
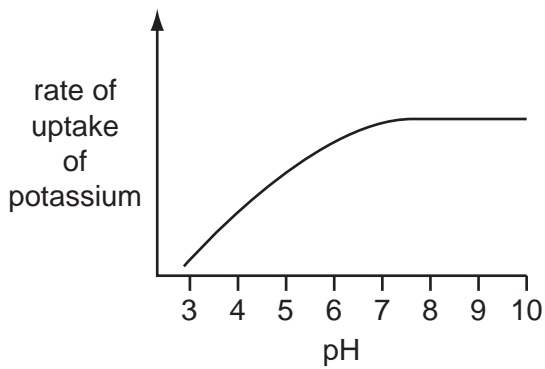
.....
 [2]

(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]

(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]

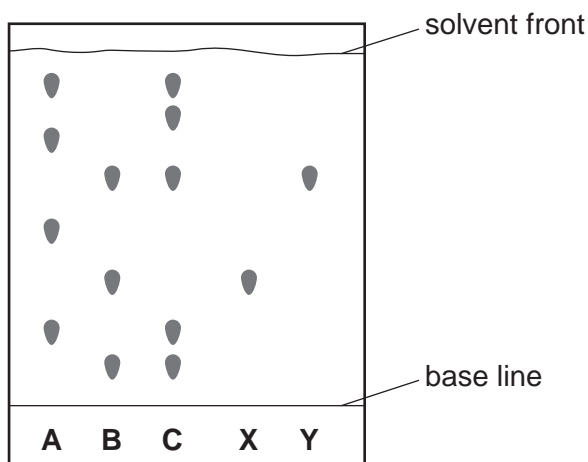
(ii) At which pH value is the rate of uptake of phosphorus by plant roots the highest?

..... [1]

[Total: 10]

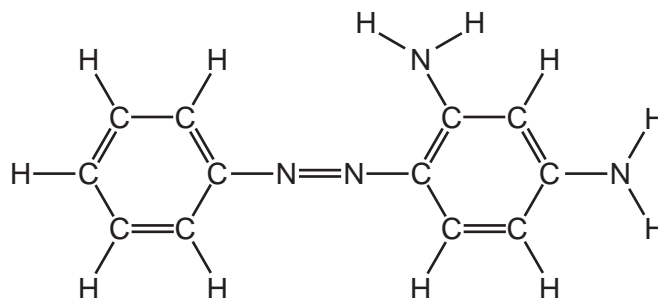
4 Chromatography is used to separate a mixture of coloured dyes.

- (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]

(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	$12 \times 12 = 144$
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 ₂ O ₂	+10	+101	1.22
ethanoic acid	C ₂ H ₄ O ₂	+17	+118	1.05
propanoic acid	C ₃ H ₆ O ₂	-21		0.99
butanoic acid	C ₄ H ₈ O 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

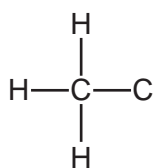
the density of butanoic acid. g/cm³
[2]

(iii) Is butanoic acid a solid, liquid or gas at room temperature?

Use the data in the table to explain your answer.

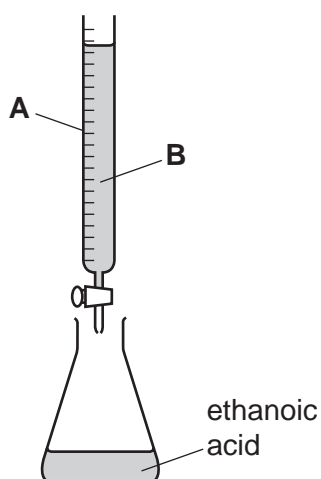
.....
..... [1]

(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

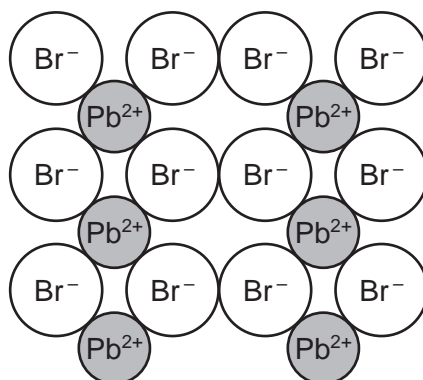
[1]

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

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

[Total: 9]

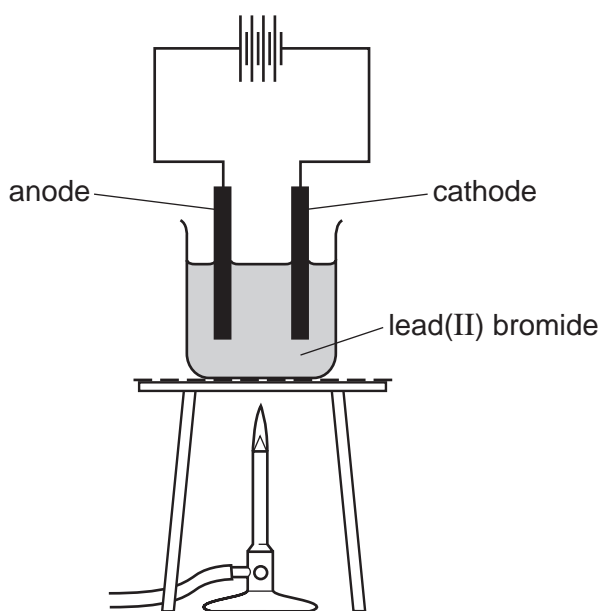
- 6 Lead(II) bromide is a white solid.
Part of the structure of lead(II) bromide is shown below.



- (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.

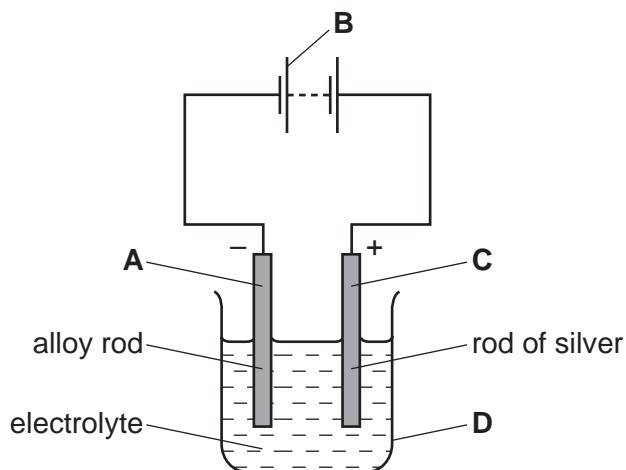
..... [1]

- (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	Al = 27.4	?
	C = 12	Si = 28	?
	N = 14	P = 31	As = 75
	O = 16	S = 32	Se = 79.4
	F = 19	Cl = 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]

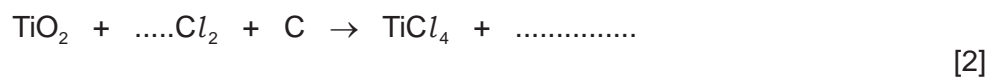
- (ii) State the names of any **two** elements in the table above which exist as diatomic molecules.

..... 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]

- (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.



- (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]

16

(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]

BLANK PAGE

DATA SHEET
The Periodic Table of the Elements

		Group															
I	II	III	IV	V	VI	VII	0										
1 H Hydrogen 1											2 He Helium 2						
3 Li Lithium 3	4 Be Beryllium 4	5 B Boron 5	6 C Carbon 6	7 N Nitrogen 7	8 O Oxygen 8	9 F Fluorine 9	10 Ne Neon 10	11 B Boron 11	12 C Carbon 12	13 Al Aluminium 13	14 N Nitrogen 14	15 P Phosphorus 15	16 S Sulfur 16	17 Cl Chlorine 17	18 Ar Argon 18		
19 K Potassium 19	20 Ca Calcium 20	21 Sc Scandium 21	22 Ti Titanium 22	23 V Vanadium 23	24 Cr Chromium 24	25 Mn Manganese 25	26 Fe Iron 26	27 Co Cobalt 27	28 Ni Nickel 28	29 Cu Copper 29	30 Zn Zinc 30	31 Ga Gallium 31	32 Ge Germanium 32	33 As Arsenic 33	34 Se Selenium 34	35 Br Bromine 35	36 Kr Krypton 36
37 Rb Rubidium 37	38 Sr Strontium 38	39 Y Yttrium 39	40 Zr Zirconium 40	41 Nb Niobium 41	42 Mo Molybdenum 42	43 Tc Technetium 43	44 Ru Ruthenium 44	45 Rh Rhodium 45	46 Pd Palladium 46	47 Ag Silver 47	48 Cd Cadmium 48	49 In Indium 49	50 Sn Tin 50	51 Sb Antimony 51	52 Te Tellurium 52	53 I Iodine 53	54 Xe Xenon 54
55 Cs Caesium 55	56 Ba Barium 56	57 La Lanthanum 57	72 Hf Hafnium 72	73 Ta Tantalum 73	74 W Tungsten 74	75 Re Rhenium 75	76 Os Osmium 76	77 Ir Iridium 77	78 Pt Platinum 78	79 Au Gold 79	80 Hg Mercury 80	81 Tl Thallium 81	82 Pb Lead 82	83 Bi Bismuth 83	84 Po Polonium 84	85 At Astatine 85	86 Rn Radon 86
87 Fr Francium 87	88 Ra Radium 88	89 Ac Actinium 89															

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	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	238 U Uranium 92	238 Pa Protactinium 91	94 Pu Plutonium 94	95 Am Americium 95	96 Cm Curium 96	98 Cf Californium 98	99 Es Einsteinium 99	100 Fm Fermium 100	101 Md Mendelevium 101	102 No Nobelium 102	103 Lr Lawrencium 103

a	X
b	

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

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

The volume of one mole of any gas is 24 dm³ 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.