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CHEMISTRY (US)

0439/23

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 Center 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.

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.

aluminum 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 electrolyzed, gives a red-brown vapor 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

acid

base

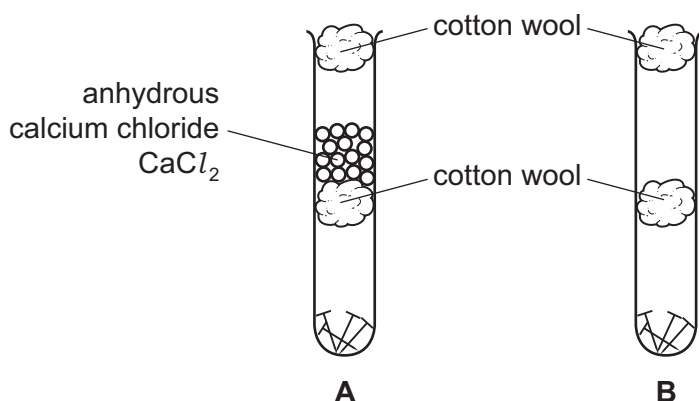
[2]

- (b) Calcium chloride absorbs water vapor.
When calcium chloride is heated, it loses its water of crystallization.
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

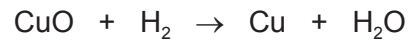
lead oxide	moderate heating to about 200 °C needed
iron oxide	high temperature furnace at 750 °C needed
magnesium oxide	temperatures above 1000 °C needed
zinc oxide	very high temperature furnace at 900 °C needed

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.

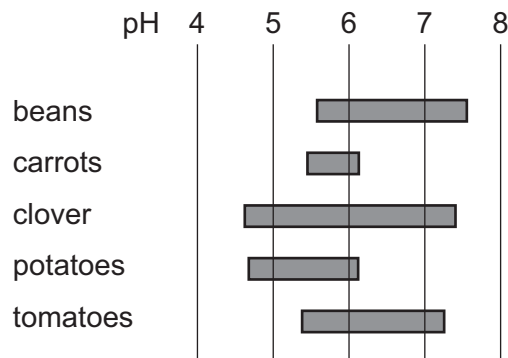


Explain how this equation shows that copper oxide is being reduced.

..... [1]

[Total: 10]

- 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.

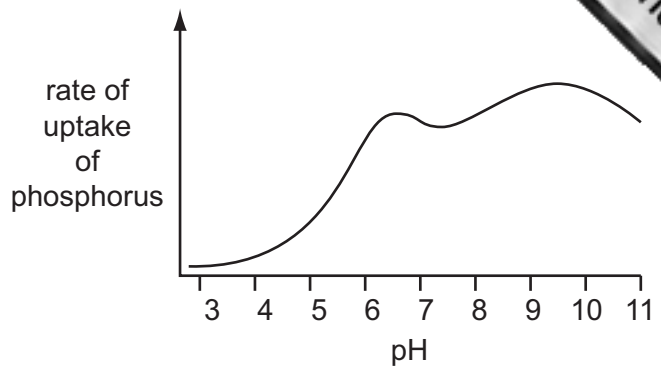
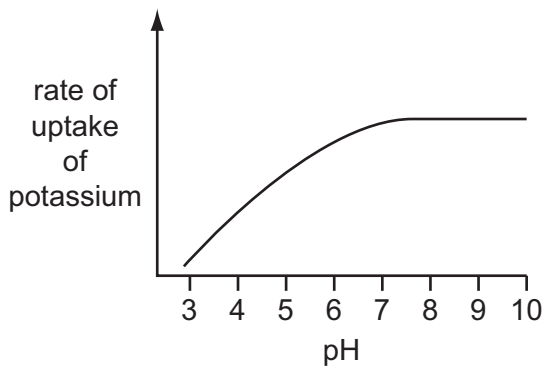
.....
 [2]

- (ii) Farmers fertilize soil by adding compounds containing ammonium salts.
 Explain why adding lime to fertilized 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]

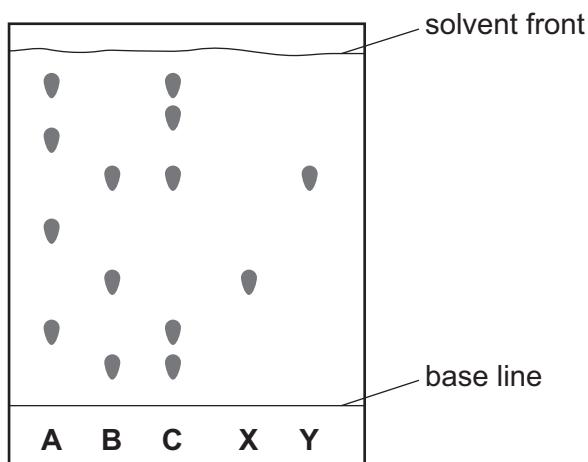
(ii) At which pH value is the rate of uptake of phosphorus by plant roots the highest?

..... [1]

[Total: 10]

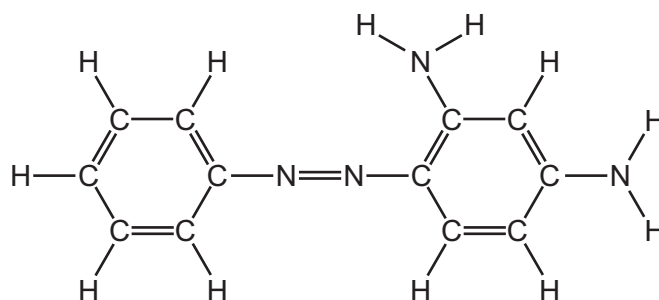
4 Chromatography is used to separate a mixture of colored dyes.

- (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 fibers 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

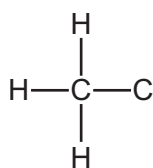
the density of butanoic acid. g/cm³
[2]

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

Use the data in the table to explain your answer.

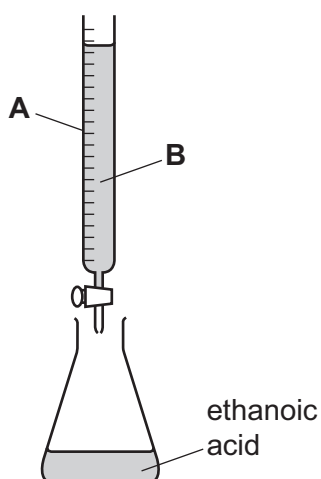
.....
..... [1]

(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 labeled **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]

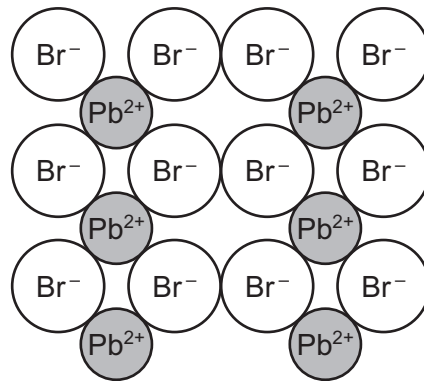
- (iii) Describe how you would carry out this titration.

.....

[2]

[Total: 9]

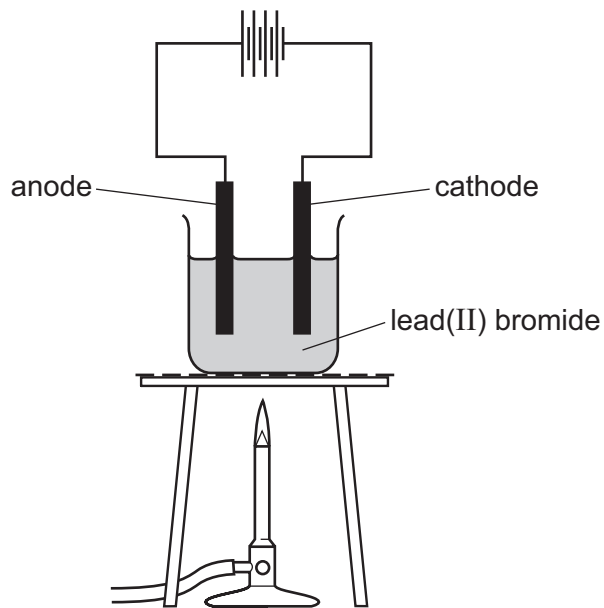
- 6 Lead(II) bromide is a white solid.
Part of the structure of lead(II) bromide is shown below.



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

..... [1]

- (b) A student electrolyzed 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.

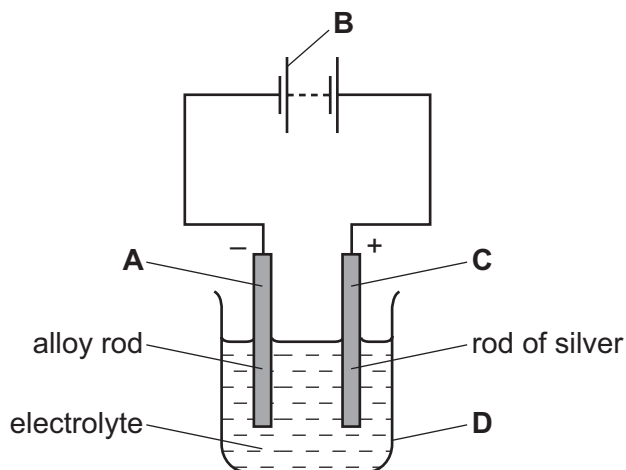
..... [1]

- (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]

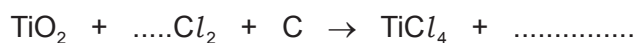
- (b) Titanium is a transition element. Sodium is a metal in Group I of the Periodic Table. State **three** differences in the physical properties of titanium and sodium.

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.



[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.

.....

.....

.....

.....

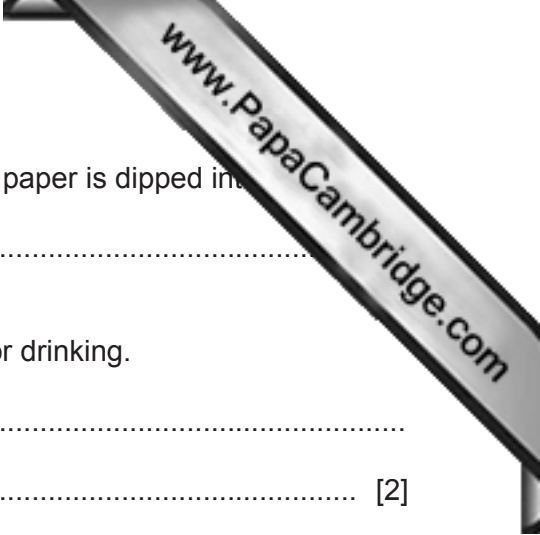
.....

.....

.....

.....

[5]



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

.....

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

.....

..... [2]

[Total: 11]

DATA SHEET
The Periodic Table of the Elements

		Group																		
I	II	III	IV	V	VI	VII	0													
7 Li Lithium 3	9 Be Beryllium 4	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												
23 Na Sodium 11	24 Mg Magnesium 12	27 Al Aluminum 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 Ru Ruthenium 44	101 Rh Rhodium 45	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	212 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86			
87 Fr Francium	88 Ra Radium	226 Ra Radium	227 Ac Actinium	†																

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 U Uranium 92	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
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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.).

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