Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME	
CENTER NUMBER	
CANDIDATE NUMBER	

2416425961

CHEMISTRY (US) **0439/33**

Paper 3 (Extended) **May/June 2015**

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 on all the work you hand in.
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 12.
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 **12** printed pages.

CAMBRIDGE International Examinations

1 Use your copy of the Periodic Table to help you answer these questions.

(a) Predict the formula of each of the following compounds.

(i) aluminum fluoride ..... [1]

(ii) arsenic oxide ..... [1]

(iii) silicon bromide ..... [1]

(b) Deduce the formula of each of the following ions.

(i) phosphide ..... [1]

(ii) barium ..... [1]

(iii) francium ..... [1]

(c) Draw a diagram showing the arrangement of the valency electrons in one molecule of the covalent compound carbon dioxide.

Use x to represent an electron from a carbon atom.
Use o to represent an electron from an oxygen atom.

[3]

[Total: 9]

2 This question is concerned with the following oxides.

aluminum oxide
carbon monoxide
copper(II) oxide
silicon(IV) oxide
sodium oxide
sulfur dioxide
zinc oxide

Choose **one** oxide from the above list to match each of the following descriptions. An oxide may be used once, more than once or not at all.

(a) This oxide does not react with acid or alkali. ..... [1]

(b) This oxide reacts with water to give a strong alkali solution. ..... [1]

(c) This oxide is used as a bleach. ..... [1]

(d) This oxide is amphoteric. ..... [1]

(e) This oxide has a giant covalent structure. ..... [1]

(f) This oxide is soluble in water and it is acidic. ..... [1]

[Total: 6]

[Turn over

3 Quicklime, which is calcium oxide, is made by heating limestone in a furnace.

$$CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$$

The reaction does not come to equilibrium.

(a) Suggest why the conversion to calcium oxide is complete.

..... [1]

(b) Calcium hydroxide, slaked lime, is made from calcium oxide.

Write an equation for this reaction.

..... [2]

(c) Calculate the maximum mass of calcium oxide which could be made from 12.5 tons of calcium carbonate. 1 ton = 1×10^6 g.

.....

.....

..... [2]

(d) Limestone is used in agriculture to reduce the acidity of soil and for the desulfurization of flue gases in power stations.

(i) Most crops thrive in soils whose pH is close to 7. Calcium carbonate, which is insoluble in water, and calcium oxide, which is slightly soluble in water, are both used to reduce the acidity of soils.

Suggest **two** advantages of using calcium carbonate for this purpose.

1. .....

2. ..... [2]

(ii) Explain the chemistry of desulfurization of flue gases.

.....

.....

.....

..... [3]

(iii) Give **one** other use of calcium carbonate.

..... [1]

[Total: 11]

4 **(a)** **(i)** Coal is a solid fossil fuel.

Name another fossil fuel.

..... [1]

(ii) Explain what is meant by the term *fossil fuel*.

.....

..... [2]

(b) The burning of fossil fuels is largely responsible for the formation of acid rain. Two of the acids in acid rain are sulfuric acid and nitric acid.

(i) Explain how the combustion of coal can form sulfuric acid.

.....

.....

..... [3]

(ii) High temperatures generated by the combustion of fossil fuels can lead to the formation of nitric acid. Explain.

.....

.....

..... [3]

(iii) Nitric acid contains nitrate ions.

Describe a test for nitrate ions.

.....

..... [2]

(iv) Explain how you could determine which one of two samples of acid rain had the higher concentration of hydrogen ions.

.....

..... [2]

[Total: 13]

[Turn over

5 The law of constant composition states that all pure samples of a compound contain the same elements in the same proportion by weight.

A typical experiment to test this law is to prepare the same compound by different methods and then show that the samples have the same composition.

Methods of making copper(II) oxide include:

- heating copper carbonate,
- heating copper hydroxide,
- heating copper nitrate,
- heating copper foil in air.

(a) Complete the following equations.

(i) $CuCO_3 \rightarrow$ ..... + ... [1]

(ii) $Cu(OH)_2 \rightarrow$ ..... + ... [1]

(iii) $2Cu(NO_3)_2 \rightarrow$ ..... + $4NO_2$ + ... [2]

(b) Copper oxide can be reduced to copper by heating in hydrogen.

(i) What color change would you observe during the reduction?

..... [1]

(ii) Explain why the copper must be allowed to cool in hydrogen before it is exposed to air.

..... [2]

(iii) Name another gas which can reduce copper(II) oxide to copper.

..... [1]

(iv) Name a solid which can reduce copper(II) oxide to copper.

..... [1]

(c) The table below shows the results obtained by reducing the copper(II) oxide produced by different methods to copper.

(i) Complete the table.

source of copper(II) oxide	mass of copper(II) oxide / g	mass of copper / g	percentage copper / %
$CuCO_3$	2.37	1.89	79.7
$Cu(OH)_2$	2.51	1.99	
$Cu(NO_3)_2$	2.11	1.68	
Cu and O_2	2.29	1.94	

[2]

(ii) One of the samples of copper(II) oxide is impure.

Identify this sample and suggest an explanation why the percentage of copper in this sample is bigger than in the other three samples.

.....

..... [2]

[Total: 13]

[Turn over

6 Chemical reactions are always accompanied by an energy change.

(a) Aluminum is extracted by the electrolysis of a molten mixture which contains aluminum oxide, Al_2O_3. This decomposes to form aluminum at the negative electrode and oxygen at the positive electrode.

(i) Write an ionic equation for the reaction at the negative electrode.

..... [2]

(ii) Complete the ionic equation for the reaction at the positive electrode.

$$2O^{2-} \rightarrow \text{.....} + \text{.....}$$

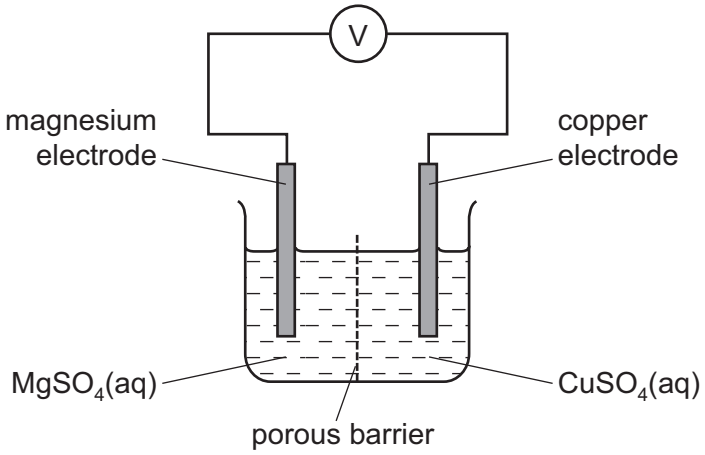
[2]

(iii) Is the reaction exothermic or endothermic? Explain your answer.

.....

..... [1]

(b) The cell shown below can be used to determine the order of reactivity of metals.



(i) Is the reaction in the cell exothermic or endothermic? Explain your answer.

.....

..... [1]

(ii) Explain why the mass of the magnesium electrode decreases and the mass of the copper electrode increases.

.....

..... [2]

(iii) How could you use this cell to determine which is the more reactive metal, magnesium or manganese?

.....

..... [2]

(c) The combustion of propane, C_3H_8, is exothermic.

Give an equation for the complete combustion of propane.

..... [2]

(d) Photosynthesis is an unusual endothermic reaction.

(i) Where does the energy for photosynthesis come from?

..... [1]

(ii) Give the word equation for photosynthesis.

..... [1]

[Total: 14]

7 **(a)** Alkanes and alkenes are both hydrocarbons.

(i) How does the structure of alkenes differ from the structure of alkanes?

..... [1]

(ii) Is the straight-chain hydrocarbon $C_{22}H_{44}$ an alkane or an alkene? Explain your choice.

.....

..... [2]

(iii) Describe how you could distinguish between pentane and pentene.

test .....

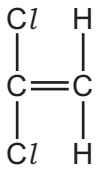
result with pentane .....

result with pentene .....

[3]

(b) Alkenes polymerize to form poly(alkenes).

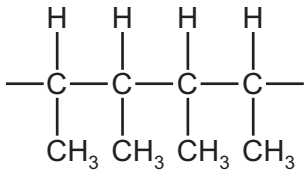
(i) The alkene 1,1-dichloroethene has the structural formula given below.



Draw the structural formula of the polymer formed by the polymerization of 1,1-dichloroethene.

[3]

(ii) The structural formula of a different polymer is given below.



Deduce the structural formula of the monomer used to form this polymer.

[2]

(iii) There are two types of polymerization - addition and condensation.

Explain the difference between them.

.....

.....

..... [2]

(iv) There are two types of condensation polymer.

Give the name of **one** type of condensation polymer.

.....

..... [1]

[Total: 14]

DATA SHEET
The Periodic Table of the Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 **H** Hydrogen 1										4 **He** Helium 2
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** 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	**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 †															

*58-71 Lanthanoid series
†90-103 Actinoid 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
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 **X** b		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.).