



Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE
NAME

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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.

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]

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



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.

.....

(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]

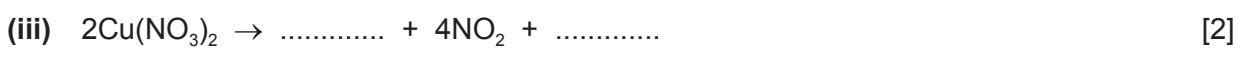
5 The law of constant composition states that all pure samples of a compound contain the same elements in the same proportion by weight.

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.



(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 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	
$\text{Cu(NO}_3)_2$	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]

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]

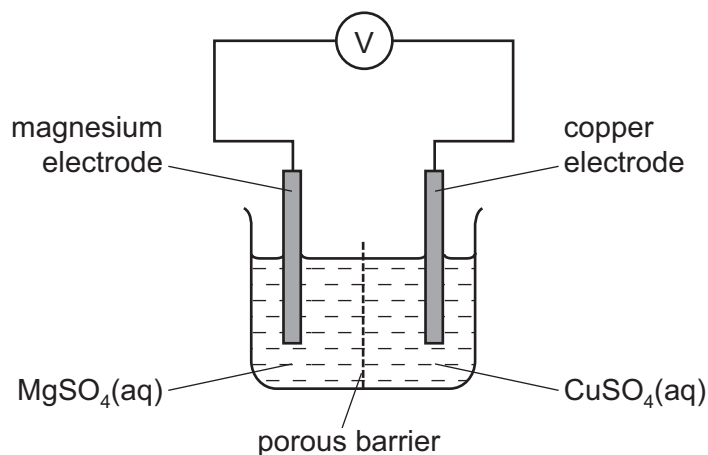
(ii) Complete the ionic equation for the reaction at the positive electrode.



(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, C₃H₈, 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?

.....

(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

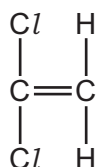
result with pentane

result with pentene

[3]

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

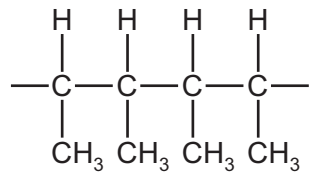
(i) The alkene 1,1-dichloroethene has the structural formula given below.



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																																																													
7 Li Lithium 3	9 Be Beryllium 4	1 H Hydrogen 1	11 B Boron 5	12 C Carbon 6	13 Al Aluminum 13	14 N Nitrogen 7	15 O Oxygen 8	16 F Fluorine 9	17 Ne Neon 10	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	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	238 U Uranium 92	91 Pa Protactinium 91	93 Np Neptunium 93	94 Pu Plutonium 94	95 Am Americium 95	96 Cm Curium 96	97 Bk Berkelium 97	98 Cf Californium 98	99 Es Einsteinium 99	100 Fm Fermium 100	101 Md Mendelevium 101	102 No Nobelium 102	103 Lr Lawrencium 103																														

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

a	X
b	†

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

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).