



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

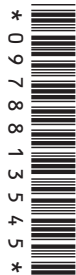
CANDIDATE
NAME

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--



CHEMISTRY

0620/31

Paper 3 (Extended)

May/June 2012

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 on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams, graphs or rough working.

Do not use staples, paper clips, highlighters, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Answer **all** questions.

A copy of the Periodic Table is printed on page 12.

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.

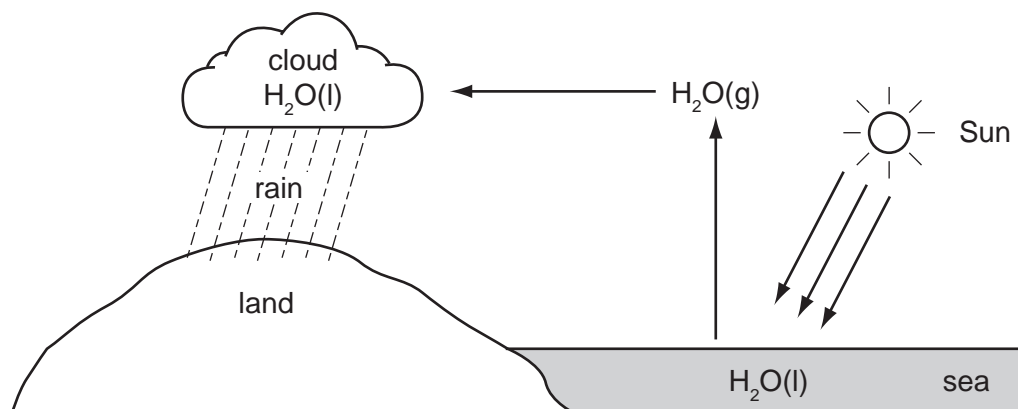
For Examiner's Use

1	
2	
3	
4	
5	
6	
7	
8	
Total	

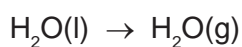
This document consists of **11** printed pages and **1** blank page.



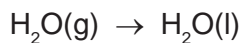
- 1 The diagram below shows part of the Water Cycle.



- (a) (i) State the name of each of the following changes of state.



name



name

[2]

- (ii) Which **one** of the above changes of state is exothermic? Explain your choice.

.....

..... [1]

- (b) The rain drains into rivers and then into reservoirs. Describe how water is treated before it enters the water supply.

.....

..... [2]

- (c) (i) Explain how acid rain is formed.

.....

.....

.....

..... [4]

- (ii) Fish live in water which is neutral (neither acidic nor alkaline). Acid rain decreases the pH of water in lakes and rivers. Both of the bases, calcium oxide and calcium carbonate, can neutralise this acid and increase the pH. Explain why calcium carbonate is a better choice.

.....
 [2]

[Total: 11]

2 Three ways of making salts are

- titration using a soluble base or carbonate
- neutralisation using an insoluble base or carbonate
- precipitation.

(a) Complete the following table of salt preparations.

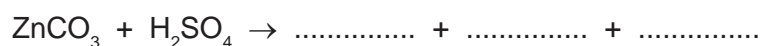
method	reagent 1	reagent 2	salt
titration	sodium nitrate
neutralisation	nitric acid	copper(II) nitrate
precipitation	silver(I) chloride
neutralisation	sulfuric acid	zinc(II) carbonate

[6]

(b) (i) Write an ionic equation with state symbols for the preparation of silver(I) chloride.

..... [2]

(ii) Complete the following equation.



[2]

[Total: 10]

3 The Group I metals show trends in both their physical and chemical properties.

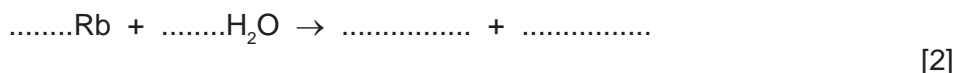
(a) (i) How do their melting points vary down the Group?

..... [1]

(ii) Which element in the Group has the highest density?

..... [1]

(iii) All Group I metals react with cold water. Complete the following equation.



(b) Lithium reacts with nitrogen to form the ionic compound, lithium nitride.

(i) State the formula of the lithium ion. [1]

(ii) Deduce the formula of the nitride ion. [1]

(iii) In all solid ionic compounds, the ions are held together in a lattice.
Explain the term *lattice*.

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

(iv) What is the ratio of lithium ions to nitride ions in the lattice of lithium nitride?
Give a reason for your answer.

..... lithium ions : nitride ions
.....
..... [2]

[Total: 9]

4 Vanadium is a transition element. It has more than one oxidation state.
The element and its compounds are often used as catalysts.

(a) Complete the electron distribution of vanadium by inserting one number.



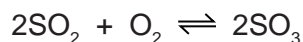
(b) Predict **three** physical properties of vanadium which are typical of transition elements.

1.

2.

3. [2]

- (c) Vanadium(V) oxide is used to catalyse the exothermic reaction between sulfur dioxide and oxygen in the Contact Process.



The rate of this reaction can be increased either by using a catalyst or by increasing the temperature. Explain why a catalyst is used and not a higher temperature.

.....

 [2]

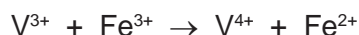
- (d) The oxidation states of vanadium in its compounds are V(+5), V(+4), V(+3) and V(+2). The vanadium(III) ion can behave as a reductant or an oxidant.

- (i) Indicate on the following equation which reactant is the oxidant.



[1]

- (ii) Which change in the following equation is oxidation?
Explain your choice.



.....
 [2]

[Total: 8]

- 5 Reactive metals tend to have unreactive compounds. The following is part of the reactivity series.

sodium	most reactive
calcium	↓
zinc	↓
copper	↓
silver	least reactive

- (a) Sodium hydroxide and sodium carbonate do not decompose when heated. The corresponding calcium compounds do decompose when heated. Complete the following equations.

calcium carbonate → +

$\text{Ca}(\text{OH})_2 \rightarrow \dots + \dots$ [2]

(b) All nitrates decompose when heated.

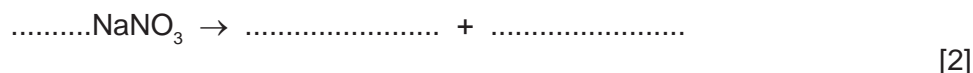
(i) The equation for the thermal decomposition of silver(I) nitrate is given below.



What are the products formed when copper(II) nitrate is heated?

..... [1]

(ii) Complete the equation for the action of heat on sodium nitrate.



(c) Which of the metals in the list on page 5 have oxides which are not reduced by carbon?

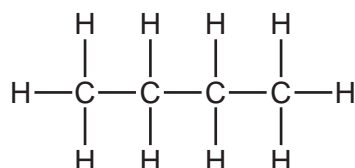
..... [1]

(d) Choose from the list on page 5, metals whose ions would react with zinc.

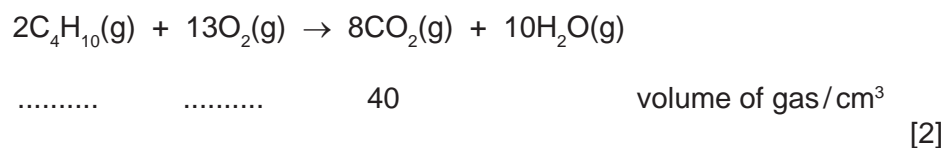
..... [2]

[Total: 8]

6 Butane is an alkane. It has the following structural formula.



(a) The equation for the complete combustion of butane is given below. Insert the two missing volumes.



(b) Butane reacts with chlorine to form two isomers of chlorobutane.

(i) What type of reaction is this?

..... [1]

(ii) Explain the term *isomer*.

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

(iii) Draw the structural formulae of these two chlorobutanes.

[2]

(c) One of the chlorobutanes reacts with sodium hydroxide to form butan-1-ol. Butan-1-ol can be oxidised to a carboxylic acid.

(i) State a reagent, other than oxygen, which will oxidise butan-1-ol to a carboxylic acid.

..... [1]

(ii) Name the carboxylic acid formed.

..... [1]

(iii) Butan-1-ol reacts with ethanoic acid to form an ester. Name this ester and give its structural formula showing all the individual bonds.

name [1]

structural formula

[2]

[Total: 12]

7 Plastics are polymers. They are formed from their monomers by polymerisation.

(a) Two methods for the disposal of waste plastics are

- burning
- recycling.

Describe one advantage **and** one disadvantage of each method.

burning

.....

.....

recycling

.....

..... [4]

(b) (i) There are two types of polymerisation reaction. Give their names and explain the differences between them.

.....

.....

.....

..... [4]

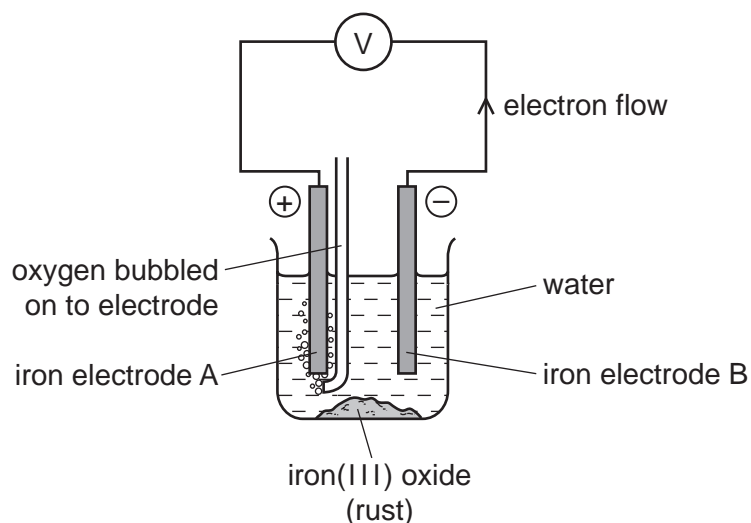
(ii) Give the structural formula of a polymer which is formed from two different monomers.

[2]

[Total: 10]

8 Iron and steel rust when exposed to water and oxygen. Rust is hydrated iron(III) oxide.

(a) The following cell can be used to investigate rusting.



(i) What is a cell?

.....
 [2]

(ii) Which electrode will be oxidised and become smaller? Explain your choice.

.....

 [3]

(iii) What measurements would you need make to find the rate of rusting of the electrode you have chosen in (ii)?

.....
 [2]

(iv) Suggest an explanation why the addition of salt to the water increases the rate of rusting.

..... [1]

(b) A sample of rust had the following composition:

51.85 g of iron 22.22 g of oxygen 16.67 g of water.

Calculate the following and then write the formula for this sample of rust.

number of moles of iron atoms, Fe = [1]

number of moles of oxygen atoms, O = [1]

number of moles of water molecules, H₂O = [1]

simplest mole ratio Fe:O:H₂O is : :

formula for this sample of rust is [1]

[Total: 12]

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	4	7 Li Lithium	9 Be Beryllium		11 B Boron	12 C Carbon	13 Al Aluminium	14 Si Silicon	15 P Phosphorus	16 S Sulfur	17 Cl Chlorine	18 Ar Argon					
11	12	23 Na Sodium	24 Mg Magnesium		27 Fe Iron	28 Ni Nickel	29 Cu Copper	30 Zn Zinc	31 Ga Gallium	32 Ge Germanium	33 As Arsenic	34 Se Selenium	35 Br Bromine	36 Kr Krypton			
19	20	39 K Potassium	40 Ca Calcium		44 Ru Ruthenium	45 Rh Rhodium	46 Pd Palladium	47 Ag Silver	48 Cd Cadmium	49 In Indium	50 Sn Tin	51 Sb Antimony	52 Te Tellurium	53 I Iodine	54 Xe Xenon		
37	38	85 Rb Rubidium	88 Sr Strontium		101 Ru Ruthenium	102 Rh Rhodium	103 Pd Palladium	104 Ag Silver	105 Cd Cadmium	106 In Indium	107 Sn Tin	108 Sb Antimony	109 Te Tellurium	110 I Iodine	111 Xe Xenon		
55	56	133 Cs Caesium	137 Ba Barium		186 Re Rhenium	187 Rh Rhodium	188 Pt Platinum	189 Au Gold	190 Hg Mercury	191 Tl Thallium	192 Pb Lead	193 Bi Bismuth	194 Po Polonium	195 At Astatine	196 Rn Radon		
87	88	226 Fr Francium	226 Ra Radium		227 Ac Actinium	227 Ac Actinium	227 Ac Actinium	227 Ac Actinium	227 Ac Actinium	227 Ac Actinium	227 Ac Actinium	227 Ac Actinium	227 Ac Actinium	227 Ac Actinium	227 Ac Actinium	227 Ac Actinium	
										*58-71 Lanthanoid series		†90-103 Actinoid series					
		a	X	b											a = relative atomic mass	X = atomic symbol	b = proton (atomic) number
		Key															

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.

University of 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.