



Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE
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CHEMISTRY

0620/31

Paper 3 (Extended)

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 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 16.

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 **13** printed pages and **3** blank pages.



1 The table below gives the composition of six particles which are either atoms or ions.

particle	number of protons	number of neutrons	number of electrons
A	33	40	33
B	19	20	18
C	34	45	36
D	33	42	33
E	13	14	13
F	24	28	21

(a) Which particles are atoms? Explain your choice.

.....
 [2]

(b) Which particle is a negative ion and why has this particle got a negative charge?

.....
 [2]

(c) Which particles are positive ions?

..... [1]

(d) Explain why particle **A** and particle **D** are isotopes.

.....
 [2]

[Total: 7]

2 (a) Water is needed for industry and in the home.

(i) Rain water is collected in reservoirs. How is it treated before entering the water supply?

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

(ii) State **two** industrial uses of water.

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

(iii) State **two** uses of water in the home.

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

(b) In many regions, drinking water is obtained by the distillation of sea-water. Explain how distillation separates the water from sea-water.

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

[Total: 7]

3 (a) Different gases diffuse at different speeds.

(i) What is meant by the term *diffusion*?

.....
 [1]

(ii) What property of a gas molecule affects the speed at which it diffuses?

..... [1]

(b) Helium is a gas used to fill balloons. It is present in the air in very small quantities. Diffusion can be used to separate it from the air.

Air at 1000 °C is on one side of a porous barrier. The air which passes through the barrier has a larger amount of helium in it.

(i) Why does the air on the other side of the barrier contain more helium?

..... [1]

(ii) Why is it an advantage to have the air at a high temperature?

.....
 [1]

(c) Most helium is obtained from natural gas found in the USA. Natural gas contains methane and 7% helium. One possible way to obtain the helium would be to burn the methane.

(i) Write an equation for the complete combustion of methane.

..... [1]

(ii) Suggest why this would **not** be a suitable method to obtain the helium.

.....
 [1]

(iii) Suggest another method, other than diffusion, by which helium could be separated from the mixture of gases in natural gas.

..... [1]

[Total: 7]

5

- 4 In the Periodic Table, the elements are arranged in columns called Groups and in rows called Periods.

(a) (i) Complete the table for some of the elements in Period 3.

group number	I	II	III	IV	V	VI	VII
symbol	Na	Mg	Al	Si	P	S	Cl
number of valency electrons							
valency							

[2]

(ii) What is the relationship between the group number and the number of valency electrons?

.....
 [1]

(iii) Explain the relationship between the number of valency electrons and the valency for the elements Na to Al,

.....

for the elements P to Cl.

.....

[4]

(b) Across a period, the elements change from metallic to non-metallic.

(i) Describe how the type of oxide changes across this period.

.....
 [2]

(ii) Describe how the type of bonding in the chlorides formed by these elements changes across this period.

.....
 [2]

[Total: 11]

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7

5 Zinc is obtained from the ore, zinc blende, ZnS.

(a) Describe the extraction of zinc from its ore, zinc blende. Include at least one balanced equation in your description.

.....

.....

.....

.....

..... [5]

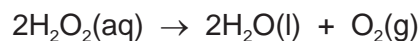
(b) State **two** major uses of zinc.

.....

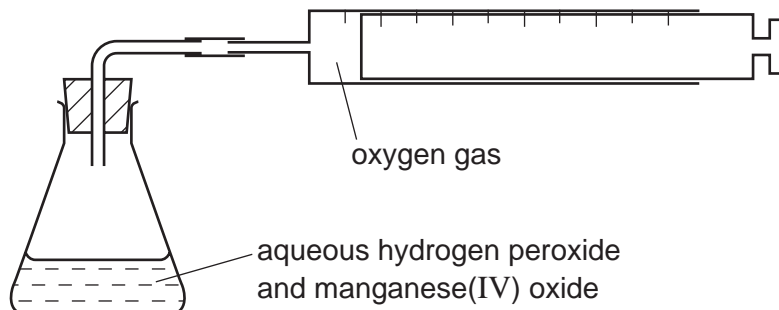
..... [2]

[Total: 7]

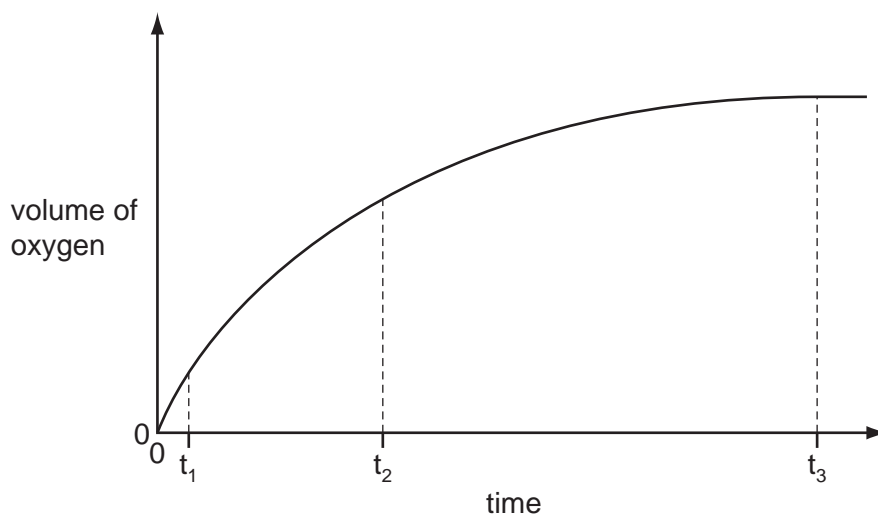
- 6 Hydrogen peroxide decomposes to form water and oxygen. This reaction is catalysed by manganese(IV) oxide.



The rate of this reaction can be investigated using the following apparatus.



40 cm³ of aqueous hydrogen peroxide was put in the flask and 0.1 g of small lumps of manganese(IV) oxide was added. The volume of oxygen collected was measured every 30 seconds. The results were plotted to give the graph shown below.



- (a) (i) How do the rates at times t_1 , t_2 and t_3 differ?

.....
 [2]

- (ii) Explain the trend in reaction rate that you described in (a)(i).

.....

 [2]

(b) The experiment was repeated using 0.1 g of finely powdered manganese(IV) oxide. All the other variables were kept the same.

(i) On the axes opposite, sketch the graph that would be expected. [2]

(ii) Explain the shape of this graph.

.....

 [2]

(c) Describe how you could show that the catalyst, manganese(IV) oxide, was not used up in the reaction. Manganese(IV) oxide is insoluble in water.

.....

 [4]

(d) In the first experiment, the maximum volume of oxygen produced was 96 cm³ measured at r.t.p. Calculate the concentration of the aqueous hydrogen peroxide in mol/dm³.



number of moles of O₂ formed = [1]

number of moles of H₂O₂ in 40 cm³ of solution = [1]

concentration of the aqueous hydrogen peroxide in mol/dm³ =
 [1]

[Total: 15]

7 One way of establishing a reactivity series is by displacement reactions.

- (a) A series of experiments was carried out using the metals lead, magnesium, zinc and silver. Each metal was added in turn to aqueous solutions of the metal nitrates.

The order of reactivity was found to be:

magnesium	most reactive
zinc	↓
lead	
silver	least reactive

- (i) Complete the table.

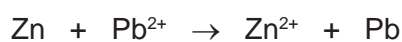
✓ = reacts

✗ = does not react

aqueous solution	metal			
	lead Pb	magnesium Mg	zinc Zn	silver Ag
lead(II) nitrate		✓	✓	✗
magnesium nitrate				
zinc nitrate				
silver nitrate				

[3]

- (ii) Displacement reactions are redox reactions. On the following equation, draw a **ring** around the reducing agent and an **arrow** to show the change which is oxidation.



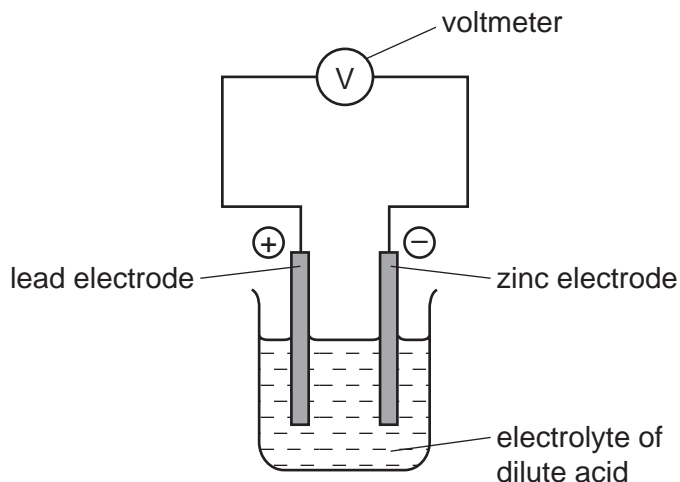
[2]

- (iii) Complete the following ionic equation.



[1]

- (b) Another way of determining the order of reactivity of metals is by measuring the voltage and polarity of simple cells. The polarity of a cell is shown by which metal is the positive electrode and which metal is the negative electrode. An example of a simple cell is shown below.



- (i) Mark on the above diagram the direction of the electron flow. [1]
- (ii) Explain, in terms of electron transfer, why the more reactive metal is always the negative electrode.

.....

.....

..... [2]

- (iii) The following table gives the polarity of cells using the metals zinc, lead, copper and manganese.

cell	electrode 1	polarity	electrode 2	polarity
A	zinc	-	lead	+
B	manganese	-	lead	+
C	copper	+	lead	-

What information about the order of reactivity of these four metals can be deduced from the table?

.....

.....

..... [2]

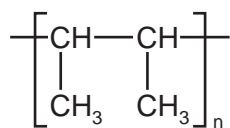
- (iv) What additional information is needed to establish the order of reactivity of these four metals using cells?

..... [1]

[Total: 12]

8 Polymers are made by the polymerisation of simple molecules called monomers.

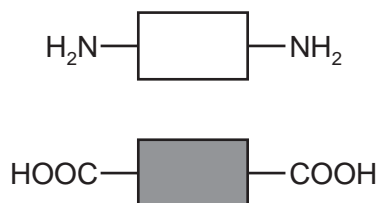
(a) (i) The structural formula of a polymer is given below.



This polymer is made by addition polymerisation. Draw the structural formula of its monomer.

[1]

(ii) The two monomers shown below form a nylon which is a condensation polymer.



Draw its structural formula showing one repeat unit of the polymer.

[3]

(iii) Name the natural macromolecule which contains the same linkage as nylon.

..... [1]

(iv) Explain the difference between addition polymerisation and condensation polymerisation.

.....

 [2]

(b) Many polymers are non-biodegradable.

(i) Explain the term *non-biodegradable*.

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

(ii) State **three** problems caused by the disposal of non-biodegradable polymers.

.....
.....
..... [3]

(c) Storage tanks for cold water are now made from polymers because they are cheaper than metal tanks. Suggest **two** other advantages of making cold water tanks from polymers.

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

[Total: 14]

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	7 Li Lithium 3								9 Be Beryllium 4	20 Ne Neon 10
11	23 Na Sodium 11								12 C Carbon 6	16 O Oxygen 8
19	39 K Potassium 19								14 N Nitrogen 7	18 Ar Argon 18
37	85 Rb Rubidium 37								15 P Phosphorus 15	36 Kr Krypton 36
55	133 Cs Caesium 55								16 S Sulfur 16	54 Xe Xenon 54
87	226 Fr Francium 87								17 Cl Chlorine 17	86 Rn Radon 86
									29 Cu Copper 29	80 Po Polonium 84
									30 Zn Zinc 30	85 At Astatine 85
									31 Ga Gallium 31	86 Lr Lawrencium 103
									32 Ge Germanium 32	
									33 As Arsenic 33	
									34 Se Selenium 34	
									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 Pd Palladium 46	
									53 Te Tellurium 52	
									54 I Iodine 53	
									55 Mn Manganese 25	
									56 Fe Iron 26	
									57 Tl Thallium 81	
									58 Ce Cerium 58	
									59 Pr Praseodymium 59	
									60 Nd Neodymium 60	
									61 Pm Promethium 61	
									62 Sm Samarium 62	
									63 Eu Europium 63	
									64 Gd Gadolinium 64	
									65 Tb Terbium 65	
									66 Dy Dysprosium 66	
									67 Ho Holmium 67	
									68 Er Erbium 68	
									69 Tm Thulium 69	
									70 Yb Ytterbium 70	
									71 Lu Lutetium 71	
									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 Lr Lawrencium 103	
									87 Fr Francium 87	
									88 Ra Radium 88	
									89 Ac Actinium 89	
									90 Th Thorium 90	
									91 Pa Protactinium 91	
									92 U Uranium 92	
									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	
									104 Rf Rutherfordium 104	
									105 Db Dubnium 105	
									106 Sg Seaborgium 106	
									107 Bh Bohrium 107	
									108 Hs Hassium 108	
									109 Mt Meitnerium 109	
									110 Ds Darmstadtium 110	
									111 Rg Roentgenium 111	
									112 Cn Copernicium 112	
									113 Nh Nihonium 113	
									114 Fl Flerovium 114	
									115 Mc Moscovium 115	
									116 Lv Livermorium 116	
									117 Ts Tennessine 117	
									118 Og Oganesson 118	
									119 Uu Ununennium 119	
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