

CANDIDATE  
NAME

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CENTRE  
NUMBER

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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
<b>A</b>	33	40	33
<b>B</b>	19	20	18
<b>C</b>	34	45	36
<b>D</b>	33	42	33
<b>E</b>	13	14	13
<b>F</b>	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]

- 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,

.....  
 .....  
 .....  
 .....  
 .....  
 .....  
 .....  
 ..... [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]



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.

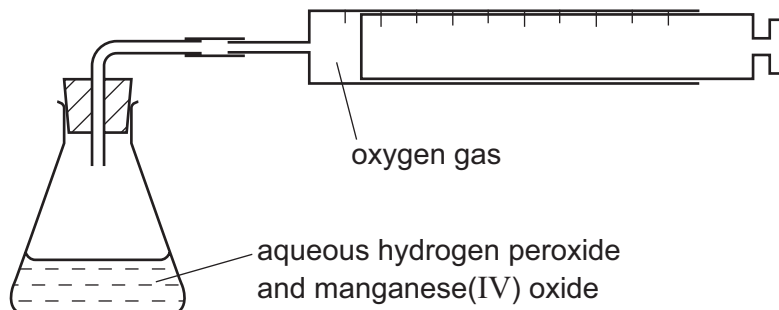
.....  
..... [2]

[Total: 7]

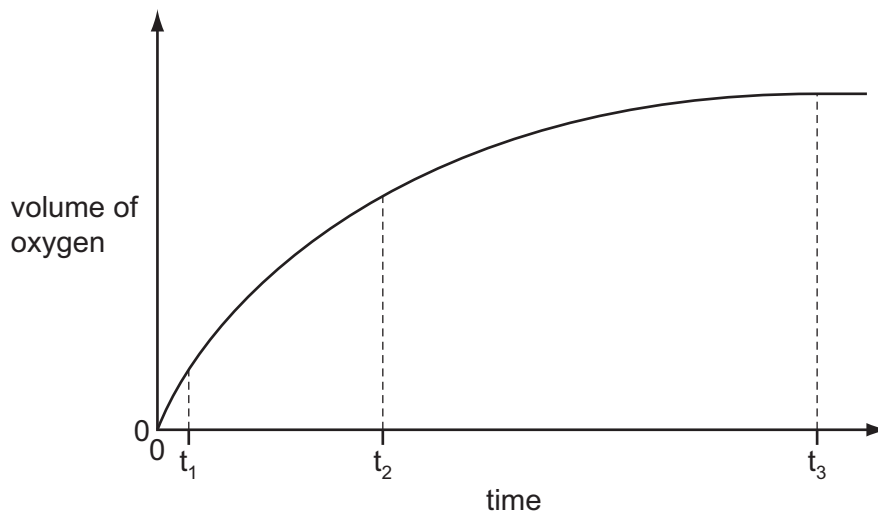
- 6 Hydrogen peroxide decomposes to form water and oxygen. This reaction is catalysed by manganese(IV) oxide.



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



40 cm<sup>3</sup> 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.

.....

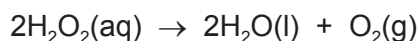
.....

.....

.....

..... [4]

(d) In the first experiment, the maximum volume of oxygen produced was 96 cm<sup>3</sup> measured at r.t.p. Calculate the concentration of the aqueous hydrogen peroxide in mol/dm<sup>3</sup>.



number of moles of O<sub>2</sub> formed = ..... [1]

number of moles of H<sub>2</sub>O<sub>2</sub> in 40 cm<sup>3</sup> of solution = ..... [1]

concentration of the aqueous hydrogen peroxide in mol/dm<sup>3</sup> = .....

..... [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.

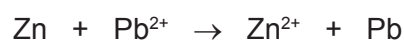
✓ = reacts

x = does not react

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



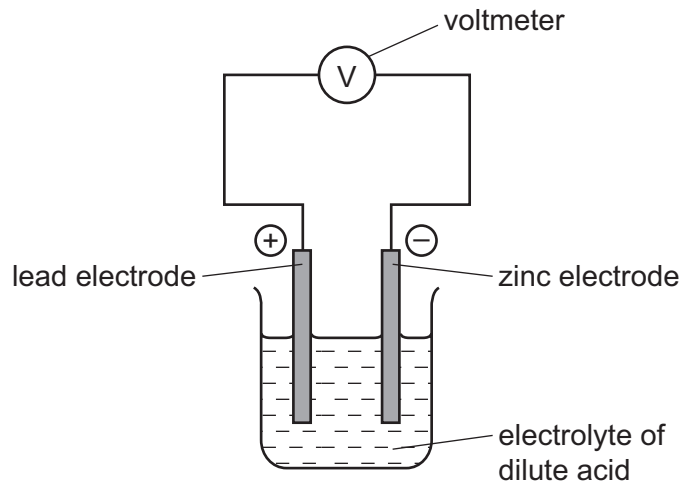
[2]

- (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]

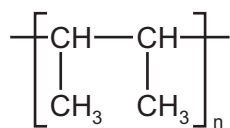
- (iv) What additional information is needed to establish the order of reactivity of these four metals using cells?

..... [1]

[Total: 12]

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

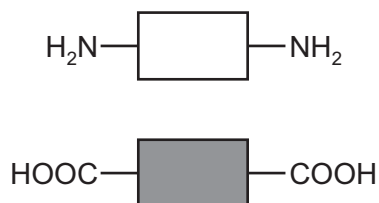
(a) (i) The structural formula of a polymer is given below.



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**

I		Group										VII	0	
		II	III	IV	V	VI	VII	0						
7 <b>Li</b> Lithium 3	9 <b>Be</b> Beryllium 4	1 <b>H</b> Hydrogen 1	11 <b>B</b> Boron 5	12 <b>C</b> Carbon 6	14 <b>N</b> Nitrogen 7	16 <b>O</b> Oxygen 8	19 <b>F</b> Fluorine 9	20 <b>Ne</b> Neon 10	27 <b>Al</b> Aluminium 13	28 <b>Si</b> Silicon 14	31 <b>P</b> Phosphorus 15	32 <b>S</b> Sulfur 16	35.5 <b>Cl</b> Chlorine 17	40 <b>Ar</b> Argon 18
39 <b>K</b> Potassium 19	40 <b>Ca</b> Calcium 20	55 <b>Mn</b> Manganese 25	56 <b>Fe</b> Iron 26	59 <b>Co</b> Cobalt 27	59 <b>Ni</b> Nickel 28	64 <b>Cu</b> Copper 29	65 <b>Zn</b> Zinc 30	70 <b>Ga</b> Gallium 31	73 <b>Ge</b> Germanium 32	75 <b>As</b> Arsenic 33	79 <b>Se</b> Selenium 34	80 <b>Br</b> Bromine 35	84 <b>Kr</b> Krypton 36	
85 <b>Rb</b> Rubidium 37	88 <b>Sr</b> Strontium 38	91 <b>Zr</b> Zirconium 40	101 <b>Ru</b> Ruthenium 44	103 <b>Rh</b> Rhodium 45	106 <b>Pd</b> Palladium 46	108 <b>Ag</b> Silver 47	112 <b>Cd</b> Cadmium 48	115 <b>In</b> Indium 49	119 <b>Sn</b> Tin 50	122 <b>Sb</b> Antimony 51	128 <b>Te</b> Tellurium 52	127 <b>I</b> Iodine 53	131 <b>Xe</b> Xenon 54	
133 <b>Cs</b> Caesium 55	137 <b>Ba</b> Barium 56	181 <b>Ta</b> Tantalum 73	186 <b>Re</b> Rhenium 75	192 <b>Ir</b> Iridium 77	195 <b>Pt</b> Platinum 78	197 <b>Au</b> Gold 79	201 <b>Hg</b> Mercury 80	204 <b>Tl</b> Thallium 81	207 <b>Pb</b> Lead 82	209 <b>Bi</b> Bismuth 83	210 <b>Po</b> Polonium 84	210 <b>At</b> Astatine 85	222 <b>Rn</b> Radon 86	
87 <b>Fr</b> Francium	226 <b>Ra</b> Radium	227 <b>Ac</b> Actinium												

140 <b>Ce</b> Cerium 58	141 <b>Pr</b> Praseodymium 59	144 <b>Nd</b> Neodymium 60	150 <b>Sm</b> Samarium 62	152 <b>Eu</b> Europium 63	157 <b>Gd</b> Gadolinium 64	162 <b>Dy</b> Dysprosium 66	165 <b>Ho</b> Holmium 67	167 <b>Er</b> Erbium 68	169 <b>Tm</b> Thulium 69	173 <b>Yb</b> Ytterbium 70	175 <b>Lu</b> Lutetium 71	
232 <b>Th</b> Thorium 90	232 <b>Pa</b> Protactinium 91	238 <b>U</b> Uranium 92	238 <b>Pu</b> Plutonium 94	238 <b>Am</b> Americium 95	238 <b>Cm</b> Curium 96	238 <b>Bk</b> Berkelium 97	238 <b>Cf</b> Californium 98	238 <b>Es</b> Einsteinium 99	238 <b>Fm</b> Fermium 100	238 <b>Md</b> Mendelevium 101	238 <b>No</b> Nobelium 102	238 <b>Lr</b> Lawrencium 103

<b>a</b>	<b>X</b>	<b>b</b>
<b>Key</b>		
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 dm<sup>3</sup> at room temperature and pressure (r.t.p.).

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