

CANDIDATE  
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**CHEMISTRY**

**0620/43**

Paper 4 Theory (Extended)

**October/November 2018**

**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 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.

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 **11** printed pages and **1** blank page.

- 1 Answer the following questions using only the substances in the list. Each substance may be used once, more than once or not at all.

<b>ammonia</b>	<b>bauxite</b>	<b>carbon dioxide</b>	<b>carbon monoxide</b>
<b>hematite</b>	<b>oxygen</b>	<b>sodium chloride</b>	<b>sulfur dioxide</b>

State which substance is:

- (a) an element ..... [1]
- (b) an ore of iron ..... [1]
- (c) used to bleach wood pulp ..... [1]
- (d) used to manufacture fertilisers ..... [1]
- (e) a toxic gas produced during the incomplete combustion of hydrocarbons  
..... [1]
- (f) an ionic compound ..... [1]
- (g) a reactant in photosynthesis ..... [1]
- (h) a product of photosynthesis. .... [1]

[Total: 8]

2 This question is about electrolysis.

(a) (i) What is meant by the term *electrolysis*?

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

(ii) Name the type of particle responsible for the conduction of electricity during electrolysis in:

the metal wires .....

the electrolyte ..... [2]

(b) The table gives information about the products of the electrolysis of two electrolytes. Platinum electrodes are used in each case.

(i) Give **two** reasons why platinum is suitable to use as an electrode.

1 .....

2 ..... [2]

(ii) Complete the table.

electrolyte	observation at the anode (+)	name of product at the anode (+)	observation at the cathode (-)	name of product at the cathode (-)
concentrated aqueous potassium chloride			bubbles of colourless gas	
aqueous copper(II) sulfate	bubbles of colourless gas			

[6]

[Total: 12]

- 3 Tin is a metallic element in Group IV. Its main ore is cassiterite which is an impure form of tin(IV) oxide,  $\text{SnO}_2$ .  
Tin also occurs in stannite,  $\text{Cu}_2\text{FeSnS}_4$ .

(a) Calculate the relative formula mass,  $M_r$ , of  $\text{Cu}_2\text{FeSnS}_4$ .

$$M_r \text{ of } \text{Cu}_2\text{FeSnS}_4 = \dots\dots\dots [1]$$

(b) The  $M_r$  of  $\text{SnO}_2$  is 151.

Calculate the percentage of tin by mass in  $\text{SnO}_2$ .

$$\text{percentage of tin by mass in } \text{SnO}_2 = \dots\dots\dots [1]$$

(c) The percentage of tin by mass in  $\text{Cu}_2\text{FeSnS}_4$  is 27.6%.

Use this information and your answer to (b) to suggest whether it would be better to extract tin from  $\text{SnO}_2$  or  $\text{Cu}_2\text{FeSnS}_4$ .  
Explain your answer.

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

(d) Tin can be extracted by heating tin(IV) oxide with carbon. Carbon monoxide is the other product.

Write a chemical equation for this reaction.

..... [2]

(e) The position of tin in the reactivity series is shown.

iron	most reactive
tin	↑
copper	least reactive

A student added iron to a solution containing  $\text{Sn}^{2+}$  ions.

The student then separately added tin to a solution containing  $\text{Cu}^{2+}$  ions.

Complete the ionic equations. If there is no reaction write 'no reaction'.



[2]

(f) Copper(II) nitrate,  $\text{Cu}(\text{NO}_3)_2$ , decomposes when it is heated. The only solid product is copper(II) oxide,  $\text{CuO}$ . There are two gaseous products. One of the gaseous products is oxygen.

(i) Describe a test for oxygen.

test .....

result .....

[2]

(ii) Name the other gaseous product. Describe its appearance.

name .....

appearance .....

[2]

(iii) Write a chemical equation for the thermal decomposition of copper(II) nitrate.

..... [1]

(g) Iron does not rust when it is completely coated with zinc. When the zinc is scratched, the iron still does not rust.

(i) Explain why the iron does **not** rust when it is completely coated with zinc.

..... [1]

(ii) Explain why the iron still does **not** rust when the zinc is scratched.

.....

.....

.....

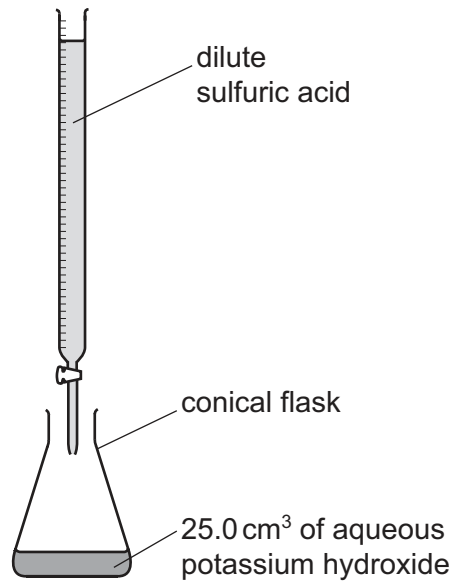
.....

.....

..... [3]

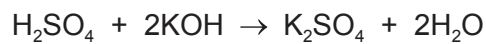
[Total: 16]

- 4 (a) Dilute sulfuric acid and aqueous potassium hydroxide can be used to make potassium sulfate crystals using a method that includes titration.



A student titrated 25.0 cm<sup>3</sup> of 0.0500 mol/dm<sup>3</sup> aqueous potassium hydroxide with dilute sulfuric acid in the presence of an indicator. The volume of dilute sulfuric acid needed to neutralise the aqueous potassium hydroxide was 20.0 cm<sup>3</sup>.

The equation for the reaction is shown.



Determine the concentration of the dilute sulfuric acid.

- Calculate the number of moles of aqueous potassium hydroxide used.

..... mol

- Calculate the number of moles of dilute sulfuric acid needed to neutralise the aqueous potassium hydroxide.

..... mol

- Calculate the concentration of the dilute sulfuric acid.

..... mol/dm<sup>3</sup>  
[3]

- (b) After the titration has been completed, the conical flask contains an aqueous solution of potassium sulfate and some of the dissolved indicator.

Describe how to prepare a **pure**, dry sample of potassium sulfate crystals from new solutions of dilute sulfuric acid and aqueous potassium hydroxide of the same concentrations as used in the titration. Include a series of key steps in your answer.

.....

.....

.....

.....

.....

.....

.....

..... [5]

- (c) Potassium hydrogensulfate,  $\text{KHSO}_4$ , is an acid salt. It dissolves in water to produce an aqueous solution, **X**, containing  $\text{K}^+$ ,  $\text{H}^+$  and  $\text{SO}_4^{2-}$  ions.

Describe what you would see when the following experiments are done.

- (i) Magnesium ribbon is added to an excess of solution **X**.

.....

..... [2]

- (ii) A flame test is done on solution **X**.

..... [1]

- (iii) An aqueous solution containing barium ions is added to solution **X**.

..... [1]

- (d) Dilute sulfuric acid reacts with bases, metals and carbonates.

Write chemical equations for the reaction of dilute sulfuric acid with each of the following:

- (i) magnesium hydroxide

..... [2]

- (ii) zinc

..... [2]

- (iii) sodium carbonate

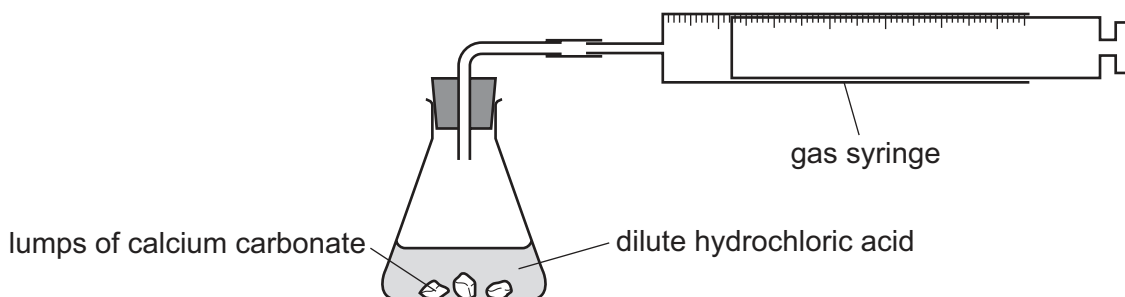
..... [2]

[Total: 18]

- 5 A student investigates the rate of reaction between lumps of calcium carbonate and dilute hydrochloric acid using the apparatus shown.



The calcium carbonate was in excess.



- (a) Which measurements should the student make during the reaction to determine the rate of reaction?

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

- (b) What happens to the rate of reaction as the reaction proceeds? Explain your answer.

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

- (c) The student repeated the experiment at a higher temperature. All other conditions were kept the same. The student found that the rate of reaction increased.

Explain, in terms of collisions, why the rate of reaction increased.

.....  
 .....  
 .....  
 ..... [4]

- (d) Apart from using a higher temperature, suggest **two** other methods of increasing the rate of this reaction.

1 .....

2 .....

[2]

[Total: 11]



6 (a) Ethanol can be manufactured by fermentation and by hydration.

(i) Describe these **two** processes of ethanol manufacture.

In each case you should:

- identify the reactants
- give the reaction conditions
- write a chemical equation for the reaction which produces ethanol.

fermentation .....

.....

.....

.....

.....

hydration .....

.....

.....

.....

.....

[6]

(ii) Give **two** advantages of ethanol manufacture by fermentation compared to by hydration.

1 .....

2 .....

[2]

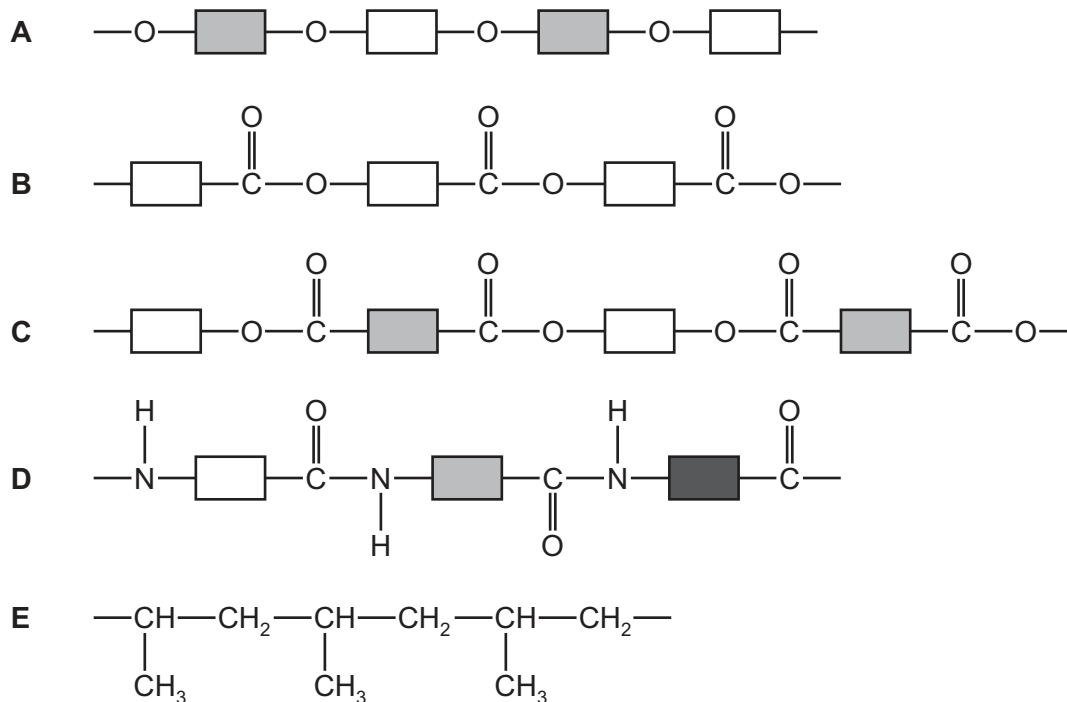
(iii) State **two** major uses of ethanol.

1 .....

2 .....

[2]

(b) The structures of some polymers are shown.



Answer the following questions about these polymers.  
Each polymer may be used once, more than once or not at all.

State which polymer, **A**, **B**, **C**, **D** or **E**, represents:

- (i) an addition polymer ..... [1]
- (ii) a protein ..... [1]
- (iii) a polyester made from only **one** monomer ..... [1]
- (iv) *Terylene* ..... [1]
- (v) a complex carbohydrate. .... [1]

[Total: 15]

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## The Periodic Table of Elements

		Group																																		
I	II	III	IV	V	VI	VII	VIII																													
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18																			
Li lithium 7	Be beryllium 9	B boron 11	C carbon 12	Al aluminium 13	Si silicon 14	P phosphorus 15	S sulfur 16	Cl chlorine 17	Ar argon 18	K potassium 19	Ca calcium 20	Sc scandium 21	Ti titanium 22	V vanadium 23	Cr chromium 24	Mn manganese 25	Fe iron 26	Co cobalt 27	Ni nickel 28	Cu copper 29	Zn zinc 30	Ga gallium 31	Ge germanium 32	As arsenic 33	Se selenium 34	Br bromine 35	Kr krypton 36									
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57-71 lanthanoids	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	
Rb rubidium 85	Sr strontium 88	Y yttrium 89	Zr zirconium 90	Nb niobium 91	Mo molybdenum 92	Tc technetium 93	Ru ruthenium 101	Rh rhodium 103	Pd palladium 106	Ag silver 108	Cd cadmium 112	In indium 115	Sn tin 119	Sb antimony 122	Te tellurium 128	I iodine 127	Xe xenon 131	Cs caesium 133	Ba barium 137	La lanthanum 139	Hf hafnium 178	Ta tantalum 181	W tungsten 184	Re rhenium 186	Os osmium 190	Ir iridium 192	Pt platinum 195	Au gold 197	Hg mercury 201	Tl thallium 204	Pb lead 207	Bi bismuth 209	Po polonium 210	At astatine 210	Rn radon 222	
87	88	89-103 actinoids	Rf rutherfordium 104	Db dubnium 105	Sg seaborgium 106	Bh bohrium 107	Hs hassium 108	Mt meitnerium 109	Ds darmstadtium 110	Rg roentgenium 111	Cn copernicium 112	Nh nihonium 113	Fl flerovium 114	Lv livermorium 116	Uu ununoctium 118	Ug unquagium 119	Uu ununoctium 120	Uu ununoctium 121	Uu ununoctium 122	Uu ununoctium 123	Uu ununoctium 124	Uu ununoctium 125	Uu ununoctium 126	Uu ununoctium 127	Uu ununoctium 128	Uu ununoctium 129	Uu ununoctium 130	Uu ununoctium 131	Uu ununoctium 132	Uu ununoctium 133	Uu ununoctium 134	Uu ununoctium 135	Uu ununoctium 136	Uu ununoctium 137	Uu ununoctium 138	Uu ununoctium 139

1  
H  
hydrogen  
1

**Key**  
atomic number  
atomic symbol  
name  
relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium —	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium —	94 Pu plutonium —	95 Am americium —	96 Cm curium —	97 Bk berkelium —	98 Cf californium —	99 Es einsteinium —	100 Fm fermium —	101 Md mendelevium —	102 No nobelium —	103 Lr lawrencium —

The volume of one mole of any gas is 24 dm<sup>3</sup> at room temperature and pressure (r.t.p.).