Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

5201718844

CHEMISTRY **0620/43**

Paper 4 Theory (Extended) **May/June 2019**

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.

This syllabus is regulated for use in England, Wales and Northern Ireland as a Cambridge International Level 1/Level 2 Certificate.

This document consists of **14** printed pages and **2** blank pages.

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1 Atoms contain particles called electrons, neutrons and protons.

(a) Complete the table.

particle	where the particle is found in an atom	relative mass	relative charge
	orbiting the nucleus	$\frac{1}{1840}$	
			+1
	in the nucleus		

[3]

(b) How many electrons, neutrons and protons are there in the ion shown?

$$^{44}_{20}Ca^{2+}$$

number of electrons .....

number of neutrons .....

number of protons .....

[3]

[Total: 6]

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2 Magnesium exists as three isotopes, $^{24}_{12}Mg$, $^{25}_{12}Mg$ and $^{26}_{12}Mg$.

(a) State, in terms of the total numbers of electrons, neutrons and protons, **one** difference and **two** similarities between these magnesium isotopes.

difference .....

similarity 1 .....

similarity 2 .....

[3]

(b) All isotopes of magnesium react with dilute hydrochloric acid to make hydrogen and a salt.

(i) Why do all isotopes of magnesium react in the same way?

.....

.....

..... [2]

(ii) Write a chemical equation for the reaction between magnesium and dilute hydrochloric acid.

..... [2]

(iii) Describe a test for hydrogen.

test .....

result .....

[2]

(c) Magnesium is a metal.

Describe the structure and bonding of metals. Include a labelled diagram in your answer.

.....

.....

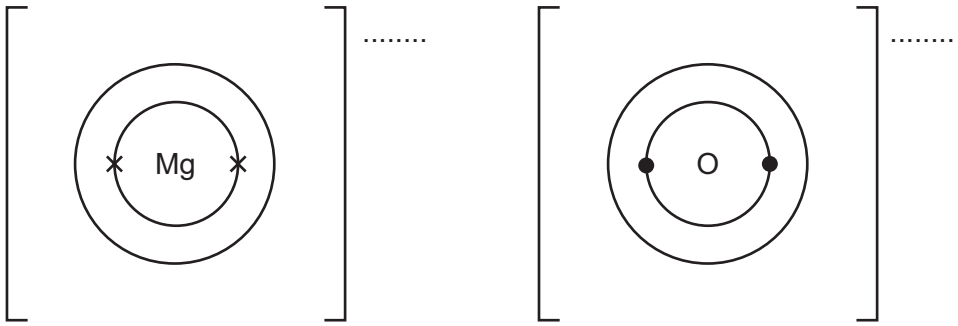
.....

.....

[3]

(d) Magnesium reacts with oxygen to form the ionic compound magnesium oxide.

(i) Complete the dot-and-cross diagrams to show the electronic structures of the ions in magnesium oxide. Show the charges on the ions.



[3]

(ii) Magnesium oxide melts at 2853 °C.

Why does magnesium oxide have a high melting point?

.....

..... [1]

(iii) Explain why molten magnesium oxide can conduct electricity.

.....

.....

..... [1]

[Total: 17]

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3 (a) (i) Sodium is in Group I of the Periodic Table.

Describe **two** physical properties of sodium which are different from the physical properties of transition elements such as copper.

1 .....

.....

2 .....

.....
[2]

(ii) Sodium reacts rapidly with water.

Give **one** observation made when sodium is added to water.

..... [1]

(b) Some car airbags contain sodium azide.
When a car airbag is used the sodium azide, NaN_3, decomposes.
The products are nitrogen and sodium.

The equation for the decomposition of sodium azide is shown.

$$2NaN_3(s) \rightarrow 2Na(l) + 3N_2(g)$$

Calculate the mass, in g, of sodium azide needed to produce 144 dm^3 of nitrogen using the following steps.

- Calculate the number of moles in 144 dm^3 of N_2 measured at room temperature and pressure.

moles of N_2 = ... mol

- Determine the number of moles of NaN_3 needed to produce this number of moles of N_2.

moles of NaN_3 = ... mol

- Calculate the relative formula mass, M_r, of NaN_3.

M_r = ...

- Calculate the mass of NaN_3 needed to produce 144 dm^3 of N_2.

..... g
[4]

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[Turn over

(c) Some airbags contain silicon(IV) oxide.
When the airbag is used sodium oxide is formed.

Oxides can be classified as acidic, amphoteric, basic or neutral.

Classify each of these oxides:

sodium oxide .....

silicon(IV) oxide. .....
[2]

(d) Lead(II) azide is insoluble in water. Solid lead(II) azide can be made in a precipitation reaction between aqueous lead(II) nitrate and aqueous sodium azide.
Lead(II) azide has the formula $Pb(N_3)_2$.

(i) Deduce the formula of the azide ion.

..... [1]

(ii) Complete the chemical equation for the reaction between aqueous lead(II) nitrate and aqueous sodium azide to form solid lead(II) azide and aqueous sodium nitrate. Include state symbols.

$Pb(NO_3)_2(aq)$ + ... $NaN_3(aq) \rightarrow Pb(N_3)_2$(.....) + ...(.....)
[2]

(iii) Describe how you could obtain a sample of lead(II) azide that is **not** contaminated with any soluble salts from the reaction mixture.

.....

.....

.....

..... [2]

(e) An organic compound made from sodium azide has the composition by mass: 49.5% carbon, 7.2% hydrogen and 43.3% nitrogen.

Calculate the empirical formula of the organic compound.

[3]

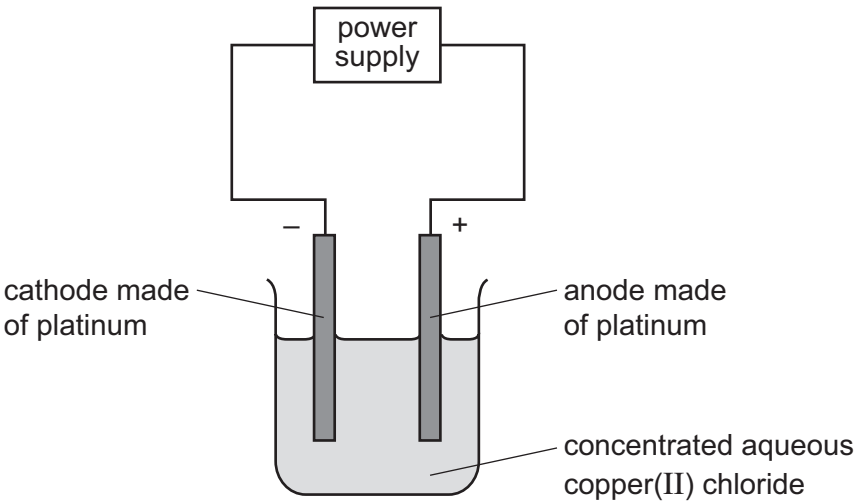
[Total: 17]

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Question 4 starts on the next page.

4 Solutions of ionic compounds can be broken down by electrolysis.

(a) Concentrated aqueous copper(II) chloride was electrolysed using the apparatus shown.



The ionic half-equations for the reactions at the electrodes are shown.

negative electrode: $Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$

positive electrode: $2Cl^-(aq) \rightarrow Cl_2(g) + 2e^-$

(i) Platinum is a solid which is a good conductor of electricity.

State **one** other property of platinum which makes it suitable for use as electrodes.

.....

..... [1]

(ii) State what would be **seen** at the positive electrode during this electrolysis.

.....

..... [1]

(iii) State and explain what would happen to the mass of the negative electrode during this electrolysis.

.....

.....

..... [2]

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(iv) The concentrated aqueous copper(II) chloride electrolyte is green.

Suggest what would happen to the colour of the electrolyte during this electrolysis.
Explain your answer.

.....

.....

..... [2]

(v) Identify the species that is oxidised during this electrolysis.
Explain your answer.

species that is oxidised .....

explanation .....

.....
[2]

(b) Metal objects can be electroplated with silver.

(i) Describe how a metal spoon can be electroplated with silver.
Include:

- what to use as the positive electrode and as the negative electrode
- what to use as the electrolyte
- an ionic half-equation to show the formation of silver.

You may include a diagram in your answer.

.....

.....

.....

ionic half-equation .....
[4]

(ii) Give **one** reason why metal spoons are electroplated with silver.

.....

..... [1]

[Total: 13]

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[Turn over

5 Carboxylic acids react with alcohols to form esters. The reaction is reversible.
The equation for the reaction between ethanoic acid and ethanol is shown.

$$CH_3COOH + CH_3CH_2OH \rightleftharpoons CH_3COOCH_2CH_3 + H_2O$$

(a) (i) What is the name of the ester formed in this reaction?

..... [1]

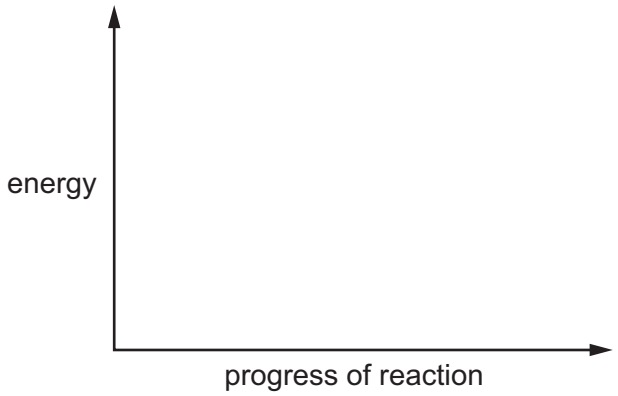
(ii) Draw the structure of the ester formed. Show all of the atoms and all of the bonds.

[1]

(b) The reaction between ethanoic acid and ethanol is exothermic.

Draw an energy level diagram for this reaction.

On your diagram label:
- the reactants and products
- the energy change of the reaction, ΔH.



[3]

(c) Concentrated sulfuric acid is a catalyst for this reaction.

What is meant by the term *catalyst*?

.....

..... [2]

(d) The rate of reaction can be increased by increasing the temperature.

Explain why increasing the temperature increases the rate of reaction.

.....

.....

.....

.....

.....

..... [4]

(e) The reaction between ethanoic acid and ethanol reaches equilibrium.

(i) The reaction between ethanoic acid and ethanol is exothermic.

State and explain the effect, if any, of increasing the temperature on the amount of ester at equilibrium.

.....

.....

..... [2]

(ii) State and explain the effect, if any, of removing water from the mixture on the amount of ester at equilibrium.

.....

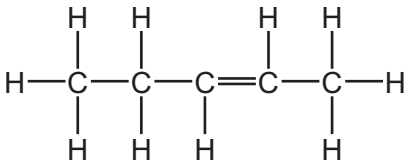
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..... [2]

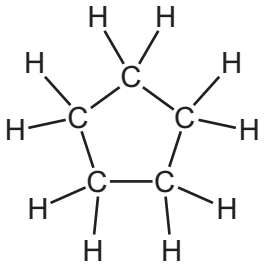
[Total: 15]

6 **(a)** Two hydrocarbons have the structures shown.

hydrocarbon **A**



hydrocarbon **B**



(i) Why are these **two** compounds *hydrocarbons*?

.....

..... [2]

(ii) Hydrocarbon **B** reacts in the same way as a typical alkane.

Describe a chemical test to tell the difference between hydrocarbon **A** and hydrocarbon **B**.

State the name of the reagent you would use and the result you would obtain with hydrocarbon **A** and hydrocarbon **B**.

reagent .....

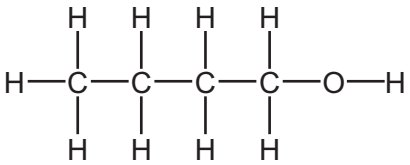
result with hydrocarbon **A** .....

result with hydrocarbon **B** .....

[3]

(b) Alkenes react with steam to form alcohols.
Compound **C** is an alcohol.

compound **C**



Draw the structure of the alkene which could be reacted with steam to make compound **C**. Show all of the atoms and all of the bonds.

[1]

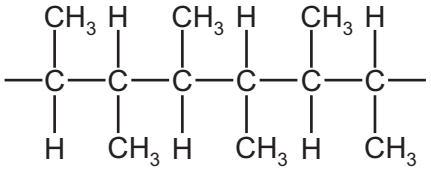
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(c) Alkenes can form polymers.

(i) What type of polymerisation occurs when alkenes form polymers?

..... [1]

(ii) Part of the structure of a polymer is shown.

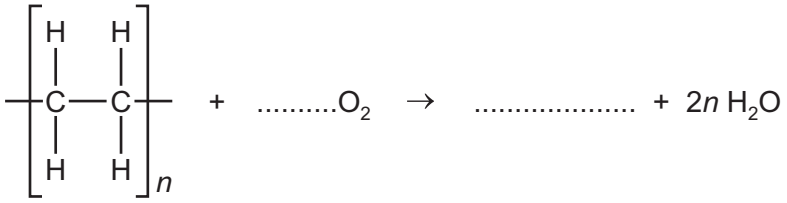


Draw the structure of the alkene from which this polymer can be made. Show all of the atoms and all of the bonds.

[1]

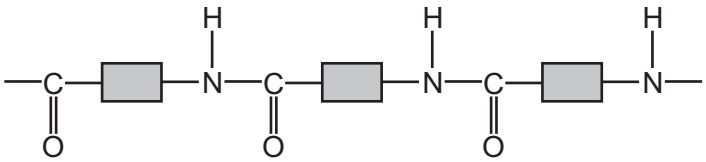
(iii) Polymers can undergo incomplete combustion to form carbon monoxide.

Complete the chemical equation for the incomplete combustion of poly(ethene). The only carbon-containing product is carbon monoxide.



[2]

(d) Part of the structure of a polyamide is shown.



This polyamide is formed from identical monomers. Complete the diagram to show the structure of **one** monomer. Show all of the atoms and all of the bonds.



[2]

[Total: 12]

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The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	VIII
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

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^3 at room temperature and pressure (r.t.p.).