Cambridge IGCSE

Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

9200369506

CHEMISTRY **0620/32**

Paper 3 Theory (Core) **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 20.
You may lose marks if you do not show your working or if you do not use appropriate units.

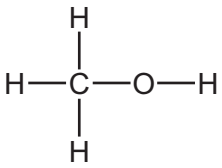
At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

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

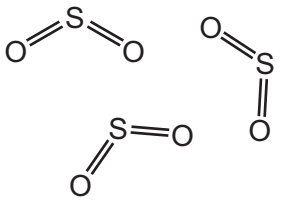
This document consists of **18** printed pages and **2** blank pages.

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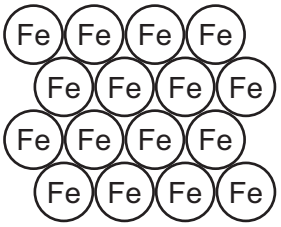
1 The diagrams show part of the structures of five substances, **A**, **B**, **C**, **D** and **E**.



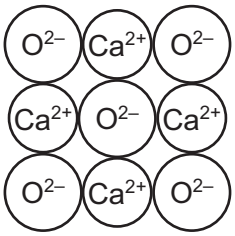
A



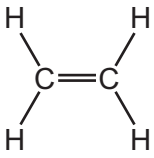
B



C



D



E

(a) Answer the following questions about these structures.
Each structure may be used once, more than once or not at all.

State which **one** of these structures, **A**, **B**, **C**, **D** or **E**:

(i) is an alcohol

..... [1]

(ii) is an ionic compound

..... [1]

(iii) conducts electricity when solid

..... [1]

(iv) contributes to acid rain

..... [1]

(v) reacts with an acid to form a salt and water.

..... [1]

(b) Substance **E** is a compound.

What is meant by the term *compound*?

.....

..... [1]

[Total: 6]

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2 This question is about iron and compounds of iron.

(a) Iron can be converted into steel in a basic oxygen converter.
Oxygen is blown into the impure molten iron to remove some of the impurities.

(i) Oxygen reacts with the carbon in the impure iron to form carbon dioxide.

Write a chemical equation for this reaction.

..... [2]

(ii) Basic oxides in the lining of the converter react with impurities such as sulfur dioxide to form slag.

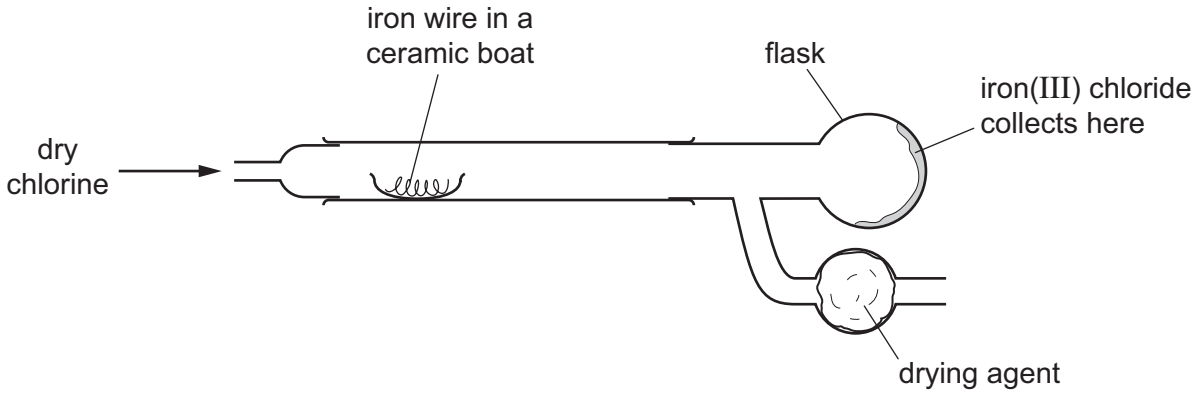
What type of oxide is sulfur dioxide?
Give a reason for your answer.

.....

..... [2]

(b) Iron(III) chloride, Fe_2Cl_6, is produced when iron is heated with chlorine.
The diagram shows the apparatus used.

(i) Draw an arrow on the diagram to show where the apparatus is heated.



[1]

(ii) Iron(III) chloride undergoes sublimation.

What is meant by the term *sublimation*?

.....

..... [1]

(iii) Suggest why the iron(III) chloride is collected in the flask and **not** in the ceramic boat.

.....

..... [2]

(iv) At higher temperatures, iron(III) chloride decomposes.

$$Fe_2Cl_6 \xrightarrow{\text{heat}} 2FeCl_2 + Cl_2$$

Explain why this is a decomposition reaction.

.....

..... [1]

(c) Iron reacts with chlorine and other halogens.

Name **two** other substances which react with iron.

1 .....

2 .....
[2]

(d) Describe a test for iron(II) ions.

test .....

observations .....
[2]

[Total: 13]

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3 **(a)** The table shows the percentage by mass of the elements in the Earth's crust and in the oceans.

element	percentage by mass in the Earth's crust	percentage by mass in the oceans
aluminium	8.20	0.00
calcium	3.60	0.05
chlorine	0.05	1.80
hydrogen	0.22	11.00
iron	5.00	0.00
oxygen	46.60	85.80
silicon	29.50	0.00
sodium	2.80	1.15
other elements	4.03	
total	100.00	100.00

Answer these questions using only the information in the table.

(i) Deduce the percentage by mass of other elements present in the oceans.

..... % [1]

(ii) Which element is present in the Earth's crust in the greatest percentage by mass?

..... [1]

(iii) Give **two** major differences in the percentage by mass of the elements in the Earth's crust and in the oceans.

1 .....

.....

2 .....

.....

[2]

(b) Aluminium oxide is a compound present in aluminium ore.

(i) Name an ore which contains aluminium oxide.

..... [1]

(ii) Predict the products of the electrolysis of molten aluminium oxide at:

the positive electrode .....

the negative electrode. .....
[2]

(iii) Suggest why aluminium is extracted by electrolysis and **not** by reduction with carbon.

..... [1]

[Total: 8]

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4 This question is about bromine and compounds of bromine.

(a) Use the kinetic particle model to describe the arrangement **and** type of motion of the molecules in:

- liquid bromine .....

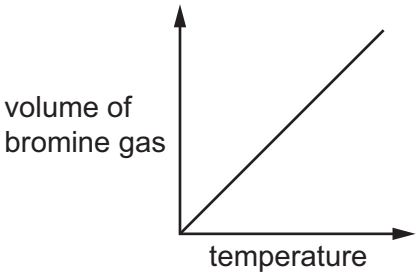
  .....

- bromine gas. .....

  .....

[4]

(b) The graph shows how the volume of bromine gas changes with temperature. The pressure is kept constant.



Describe how the volume of the bromine gas changes with temperature.

.....

..... [1]

(c) **(i)** Complete the word equation to show the halogen and halide compound which react to form the products bromine and potassium chloride.

.....	+	....	→	bromine	+	potassium chloride

[2]

(ii) Explain, in terms of the reactivity of the halogens, why aqueous bromine will **not** react with aqueous potassium chloride.

.....

..... [1]

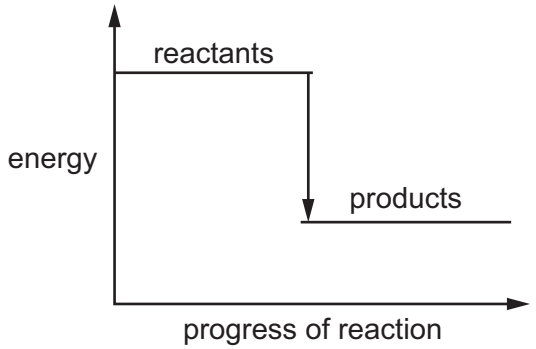
(d) Bromine reacts with hydrogen sulfide, H_2S.

(i) Complete the chemical equation for this reaction.

$$\text{.....} + H_2S \rightarrow \text{.....HBr} + S$$

[2]

(ii) The energy level diagram for this reaction is shown.



Explain how this diagram shows that the reaction is exothermic.

.....

..... [1]

(e) Describe a test for bromide ions.

test .....

observations .....

[2]

[Total: 13]

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5 Methane, ethane and ethene are hydrocarbons.

(a) Draw the structure of a molecule of ethane. Show all of the atoms and all of the bonds.

[1]

(b) Which **one** of these compounds belongs to the same homologous series as methane?
Draw a circle around the correct answer.

butane **methanoic acid** **methanol** **propene**

[1]

(c) Ethene can be manufactured by cracking.

(i) Complete the sentence about cracking using words from the list.

atoms **ions** **larger** **molecules** **reactive** **smaller**

Cracking is the process of breaking down ……. alkane …….. into …….. alkanes and alkenes.

[2]

(ii) State **two** conditions needed for cracking.

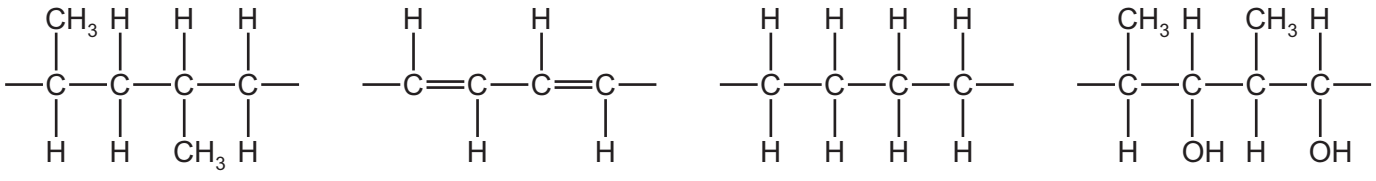
1 .....

2 .....

[2]

(d) Poly(ethene) is made by the polymerisation of ethene.

Which **one** of the structures represents part of a poly(ethene) molecule?
Tick **one** box.



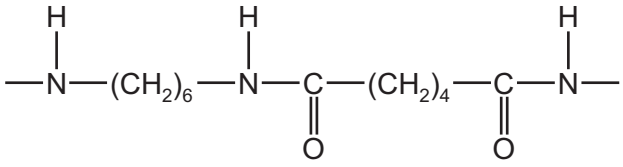
[1]

(e) Nylon is also a polymer.

(i) Give **one** common use of nylon.

..... [1]

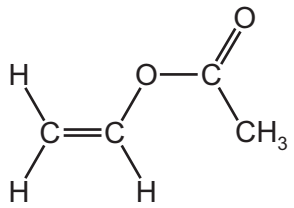
(ii) Part of the structure of nylon is shown.



How many different **types** of atom are shown in this structure?

..... [1]

(f) The structure of a monomer used to make a polymer is shown.



(i) What structural feature of this molecule shows that it is unsaturated?

..... [1]

(ii) Describe a test to show that this compound is unsaturated.

test .....

observations .....
[2]

[Total: 12]

6 This question is about cobalt and compounds of cobalt.

(a) Describe how you could prepare a pure sample of crystals of hydrated cobalt(II) sulfate using dilute sulfuric acid and an excess of cobalt(II) carbonate.

.....

.....

.....

.....

..... [3]

(b) Complete the table to calculate the relative formula mass of anhydrous cobalt(II) sulfate, $CoSO_4$.
Use your Periodic Table to help you.

type of atom	number of atoms	relative atomic mass	
cobalt			
sulfur	1	32	1 × 32 = 32
oxygen			

relative formula mass = ...
[2]

(c) Complete the table to show the number of electrons, protons and neutrons in the oxygen atom and cobalt ion shown.

	number of electrons	number of neutrons	number of protons
$^{17}_{8}O$			
$^{59}_{27}Co^{2+}$			27

[4]

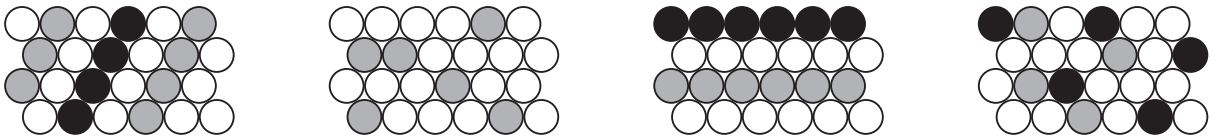
(d) Anhydrous cobalt(II) chloride is used to test for water.

State the colour change when water is added to anhydrous cobalt(II) chloride.

from ..... to .....
[2]

(e) An alloy of cobalt, chromium and molybdenum is used to make cutlery.

(i) Which **one** of the following diagrams best represents the structure of the alloy?
Draw a circle around the correct answer.



A **B** **C** **D**

[1]

(ii) Which **one** of these substances is also used to make cutlery?
Tick **one** box.

mercury	☐
sodium	☐
stainless steel	☐
graphite	☐

[1]

[Total: 13]

Question 7 starts on the next page.

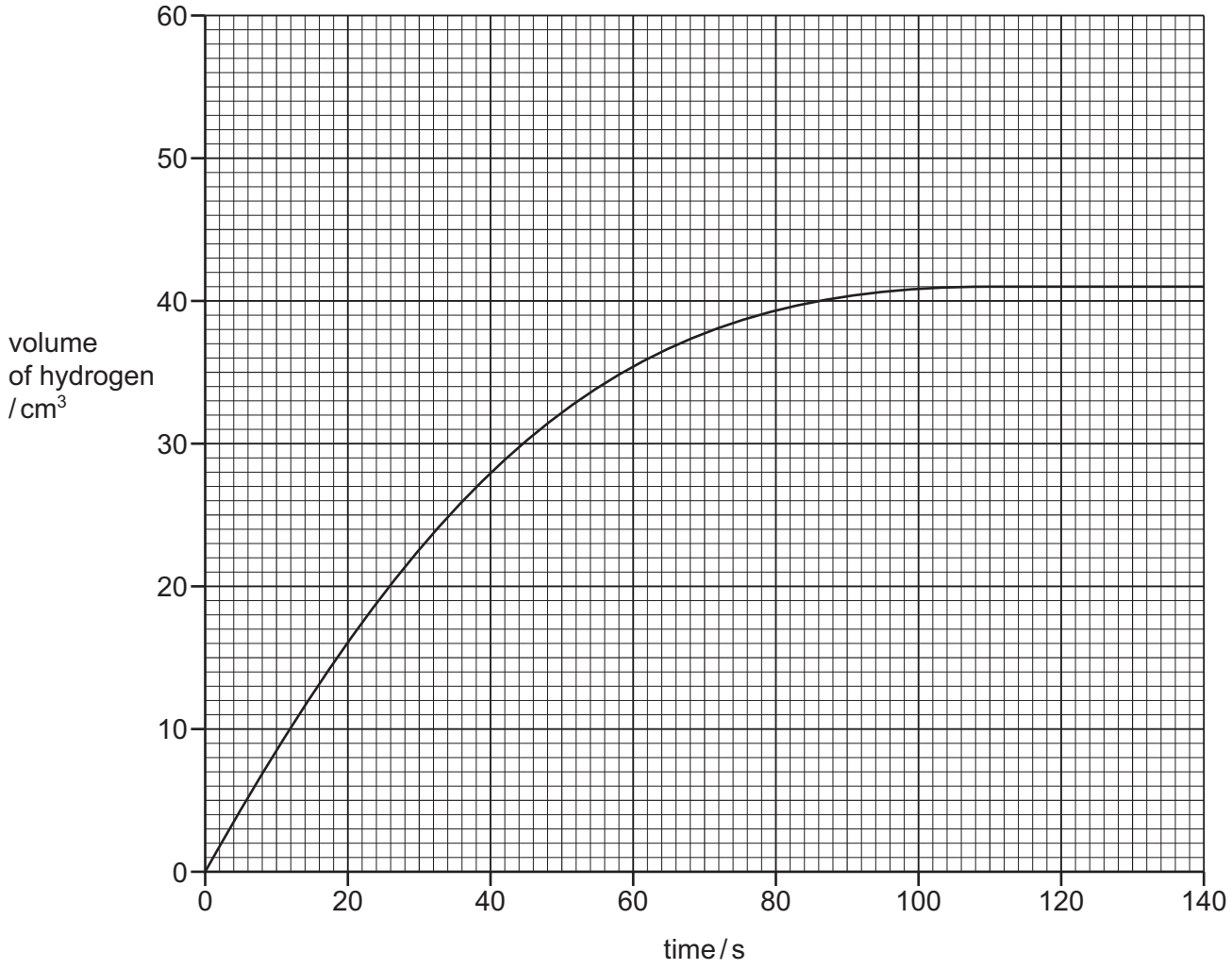
7 A student investigates the rate of reaction of magnesium ribbon with an excess of dilute hydrochloric acid.

$$Mg + 2HCl \rightarrow MgCl_2 + H_2$$

(a) Name the salt formed when magnesium reacts with dilute hydrochloric acid.

..... [1]

(b) The graph shows how the volume of hydrogen produced changes with time.



(i) Describe how the rate of reaction changes with time.
Use the graph to explain your answer.

.....

.....

..... [2]

(ii) How many seconds did it take to collect the first 25 cm^3 of hydrogen?

..... s [1]

(iii) The experiment is repeated at a higher temperature.
All other conditions are kept the same.

Draw a line **on the grid** for the experiment using a higher temperature. [2]

(iv) If 2.4 g of magnesium is used, 0.2 g of hydrogen is produced.

Calculate the mass of magnesium needed to produce 0.8 g of hydrogen using an excess of dilute hydrochloric acid.

mass of magnesium = ... g [1]

[Total: 7]

8 **(a)** Oxides of nitrogen are pollutants in the air.

(i) One source of oxides of nitrogen in the air is from the manufacture of nitric acid.

State **one** other source of oxides of nitrogen in the air.

..... [1]

(ii) State **one** adverse effect of oxides of nitrogen on health.

..... [1]

(iii) Oxides of nitrogen act as catalysts.

What is meant by the term *catalyst*?

.....

..... [1]

(iv) Oxides of nitrogen are formed during the manufacture of nitric acid.

Which **one** of the pH values could be the pH of nitric acid?
Draw a circle around the correct answer.

pH 1 pH 7 pH 10 pH 14

[1]

(b) Nitrogen is present in fertilisers.

Why are fertilisers added to the soil where crops are grown?

.....

..... [1]

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(c) The table shows some observations about the reactivity of four metals with dilute hydrochloric acid.

metal	reaction with hydrochloric acid
calcium	a rapid stream of bubbles is seen
lead	no bubbles are seen
manganese	a slow stream of bubbles is seen
tin	a few bubbles slowly form

Use the information in the table to put the **four** metals in order of their reactivity.
Put the least reactive metal first.

least reactive ⟶ most reactive

[2]

(d) Calcium melts at 839 °C and boils at 1484 °C.

What is the physical state of calcium at 1600 °C?

..... [1]

[Total: 8]

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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.).