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Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME	

CENTRE NUMBER						CANDIDATE NUMBER					

* 1 7 2 6 3 1 0 7 5 1 *

CHEMISTRY **0620/32**

Paper 3 Theory (Core) **February/March 2017**

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 **14** printed pages and **2** blank pages.

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CAMBRIDGE International Examinations

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1 **(a)** Choose from the list of elements to answer the following questions.

aluminium
argon
carbon
lithium
magnesium
nickel
nitrogen
oxygen
sulfur

Each element can be used once, more than once or not at all.

Which element

(i) forms 21% of dry air,

..... [1]

(ii) reacts rapidly with cold water to produce hydrogen,

..... [1]

(iii) is in Group III of the Periodic Table,

..... [1]

(iv) has atoms which have a complete outer shell of electrons,

..... [1]

(v) is a transition element,

..... [1]

(vi) forms stable ions with a single positive charge?

..... [1]

(b) Complete the table to show the number of electrons, neutrons and protons in the nickel atom and oxide ion shown.

	number of electrons	number of neutrons	number of protons
$^{62}_{28}Ni$			28
$^{18}_{8}O^{2-}$			

[4]

[Total: 10]

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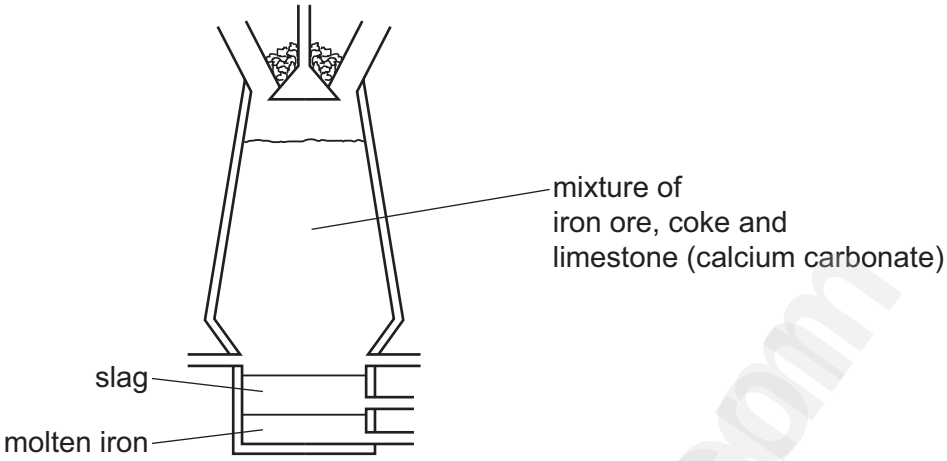
2 The diagram shows a blast furnace for extracting iron.



(a) **(i)** On the diagram write

- the letter **A** to show where air is blown into the furnace,
- the letter **W** to show where waste gases exit the furnace.

[2]

(ii) How do you know from the information in the diagram that slag is less dense than molten iron?

..... [1]

(b) Limestone (calcium carbonate) is one of the raw materials added to the blast furnace. Calcium carbonate undergoes thermal decomposition in the blast furnace.

(i) What is meant by the term *thermal decomposition*?

.....

..... [2]

(ii) Complete the chemical equation for this reaction.

$$CaCO_3 \rightarrow CaO + \text{.....}$$ [1]

(iii) A further reaction in the blast furnace involves calcium oxide, CaO.

Describe this reaction and explain its importance.

.....

..... [2]

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(c) Pure iron can be prepared by electrolysis of an aqueous solution of a suitable iron(II) salt.

Draw a labelled diagram of an electrolysis cell that could be used to carry out this reaction. In your diagram include

- the electrodes,
- the electrolyte,
- the power supply.

[3]

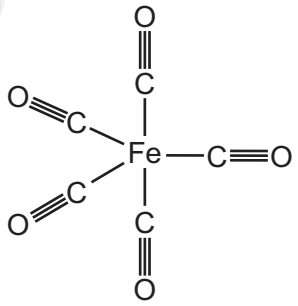
(d) **(i)** State the name of an element that could be used for the electrodes.

..... [1]

(ii) State **one** property that an electrode should have.

..... [1]

(e) Pure iron can also be prepared by the thermal decomposition of iron pentacarbonyl. The structure of iron pentacarbonyl is shown.



(i) Write the formula for iron pentacarbonyl.

..... [1]

(ii) The word equation for the reaction is shown.

iron pentacarbonyl → iron + carbon monoxide

Explain why the gaseous product is hazardous.

..... [1]

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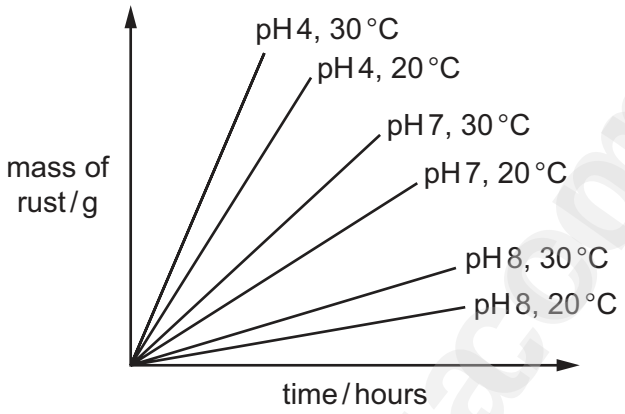
(f) The rate of rusting of iron varies with pH and temperature.

(i) What **two** substances must be in contact with iron for it to rust?

..... [2]

(ii) The graph shows the rate of rusting at different pH values and temperatures.



How do pH and temperature affect the rate of rusting?

pH .....

temperature .....
[2]

[Total: 19]

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3 The hydrocarbons burnt in car engines react with air to form a mixture of gases.
The table shows the composition of the mixture of all the gases coming from a car exhaust.

gas	% of gas in the exhaust gases
carbon dioxide	15
carbon monoxide	3
hydrocarbons	2
hydrogen	1
nitrogen oxides	1
oxygen	1
water vapour	18
gas **X**	59

(a) Identify gas **X**.

..... [1]

(b) Carbon dioxide is formed when hydrocarbons such as octane are burnt in car engines.

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

.....

..... [2]

(ii) Complete the word equation for this reaction.

octane + ... → carbon dioxide + ... [2]

(iii) The concentration of carbon dioxide in the atmosphere is increasing.

Explain why this is a global concern.

.....

.....

..... [2]

(iv) Explain why carbon monoxide is present in the exhaust gases.

..... [1]

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(v) Complete the table to calculate the relative molecular mass of octane, C_8H_{18}.

	number of atoms	relative atomic mass	relative mass in octane
hydrogen	18	1	18 × 1 = 18
carbon			

relative molecular mass = ... [2]

(c) Octane is an alkane.
The table shows some properties of different alkanes.

alkane	formula	melting point / °C	boiling point / °C
methane	CH_4	–182	–164
ethane	C_2H_6	–183	–88
propane	C_3H_8	–190	–42
butane	C_4H_{10}	–138	0
pentane	C_5H_{12}	–130	36

(i) How does the boiling point of the alkanes change with the number of carbon atoms?

..... [1]

(ii) Which alkane in the table is liquid at room temperature (20 °C)?
Explain your answer.

.....

..... [2]

(iii) Draw the structure of methane showing all of the atoms and all of the bonds.

[1]

[Total: 14]

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4 Ammonia is manufactured by combining nitrogen and hydrogen at high temperature and pressure.

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

(a) What does the symbol $\rightleftharpoons$ mean?

..... [1]

(b) Ammonia is used to make fertilisers.

Explain why farmers spread fertilisers on the soil where they are going to grow crops.

.....

..... [1]

(c) Some fertilisers are salts made by adding acids to ammonia.

Give the name of the compound formed when ammonia reacts with nitric acid.

..... [1]

(d) Farmers use calcium oxide to treat acidic soils.

(i) Explain how calcium oxide helps treat acidic soils.

.....

..... [1]

(ii) Suggest why farmers need to treat soils which are too acidic.

.....

..... [1]

[Total: 5]

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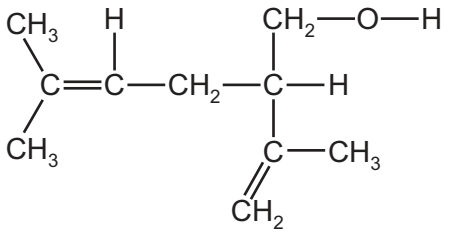
5 Lavandulol is a compound found in lavender flowers.
The structure of lavandulol is shown.



(a) On the diagram, draw a circle around the alcohol functional group. [1]

(b) How many carbon atoms are there in **one** molecule of lavandulol?

..... [1]

(c) **(i)** What feature of the lavandulol structure shows that it is unsaturated?

..... [1]

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

test .....

result .....
[2]

(d) Lavandulol can be extracted from lavender flowers.
The following statements are about the procedure for extracting lavandulol.

A Stir the mixture and leave it for a few hours.
B Filter off the solid from the solution.
C Distil the solution.
D Add solvent to the ground up lavender flowers.
E Grind up the lavender flowers.

Put the statements **A**, **B**, **C**, **D** and **E** in the correct order.
The first one has been done for you.

E				

[2]

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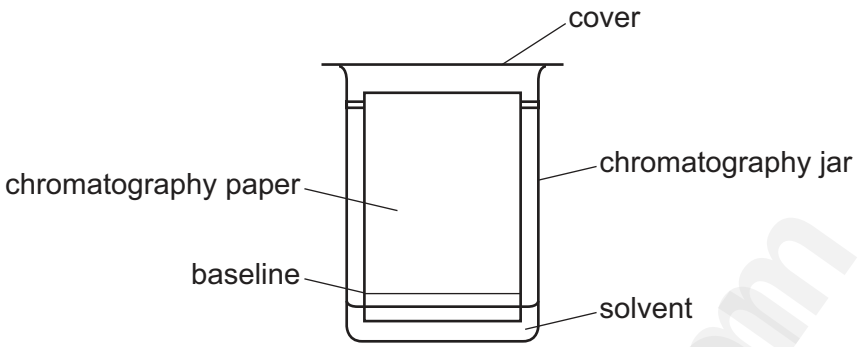
(e) Chromatography can be used to separate the coloured pigments extracted from lavender flowers. The apparatus used is shown.



After a few minutes the solvent vapour fills the whole chromatography jar.

Use the kinetic particle model to explain this.

.....

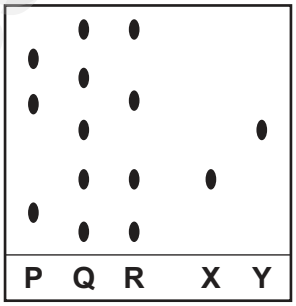
.....

.....

.....

..... [3]

(f) Three different dye mixtures, **P**, **Q** and **R**, were placed on a sheet of chromatography paper. Two pure dyes, **X** and **Y**, were also placed on the same piece of chromatography paper. The experiment was carried out and the results are shown.



(i) Where were the dyes placed on the chromatography paper at the start of the experiment?

..... [1]

(ii) Which dye mixture contained the greatest number of dyes?

..... [1]

(iii) Which dye mixture contained both dye **X** and dye **Y**?

..... [1]

[Total: 13]

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6 Chlorine and sodium hydroxide are manufactured by the electrolysis of concentrated aqueous sodium chloride.

(a) Chlorine is produced at the positive electrode (anode).

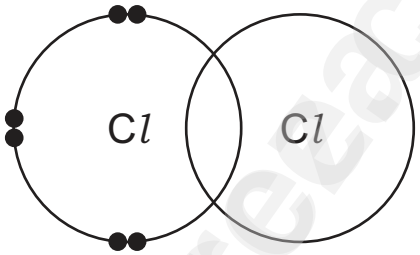
Name the substance produced at the negative electrode (cathode) during the electrolysis.

..... [1]

(b) State the name of the particle that is removed from a chloride ion to make a chlorine atom.

..... [1]

(c) Complete the electronic structure of a chlorine molecule.



[2]

(d) Describe a test for chlorine.

test .....

result .....

[2]

(e) If chlorine reacts with sodium hydroxide, sodium chlorate(I), NaOC*l*, is formed. Another compound of sodium is also produced. This forms a white precipitate on addition of aqueous silver nitrate.

Complete the chemical equation for this reaction.

$$Cl_2 + \text{.....}NaOH \rightarrow NaOCl + \text{.....} + H_2O$$

[2]

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(f) 1000 g of a solution produced by the electrolysis of concentrated aqueous sodium chloride contains the following masses of compounds.

compound	mass of substance present / g
sodium chlorate(I)	300
sodium chloride	6
sodium hydroxide	9
water	685
total	1000

(i) Calculate the mass of sodium hydroxide present in 200 g of this solution.

[1]

(ii) All the water from the 1000 g of solution is evaporated.

Deduce the mass of the remaining mixture.

[1]

[Total: 10]

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7 Metals have characteristic properties.

(a) Write about the properties of metals.
In your answer

- refer to the physical properties which are characteristic of metals,
- refer to the chemical properties which are characteristic of metals,
- include a word equation to show a chemical reaction of a metal.

.....

.....

.....

.....

.....

.....

..... [5]

(b) The table shows how easy it is to reduce four metal oxides.

metal oxide	ease of reduction
calcium oxide	not reduced by carbon at 1600 °C
magnesium oxide	reduced by carbon at 1600 °C
nickel(II) oxide	reduced by carbon at 350 °C
zinc oxide	reduced by carbon at 850 °C

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

least reactive → most reactive

[2]

(c) Uranium is a radioactive metal which has several isotopes.

(i) What is the meaning of the term *isotopes*?

.....

..... [1]

(ii) Give the main use of the isotope ^{235}U.

..... [1]

[Total: 9]

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The Periodic Table of Elements

Key

atomic number
atomic symbol
name
relative atomic mass

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 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 –		

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.).

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