Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

6572782506

CHEMISTRY **0620/32**

Paper 3 Theory (Core) **February/March 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 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 **16** printed pages.

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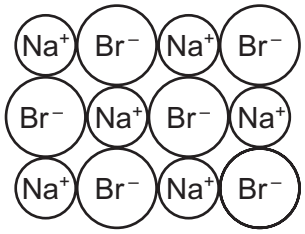
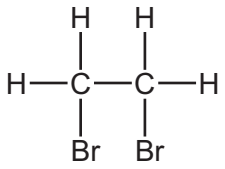
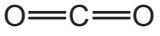
1 **(a)** The structures of five substances, **A**, **B**, **C**, **D** and **E**, are shown.



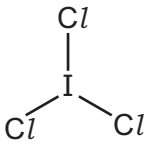
A



B



C



D

E

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

State which substance, **A**, **B**, **C**, **D** or **E**:

(i) is a diatomic molecule ..... [1]

(ii) contains bromide ions ..... [1]

(iii) is an element ..... [1]

(iv) is a gas which is a product of respiration ..... [1]

(v) gives a yellow colour in a flame test. ..... [1]

(b) An isotope of oxygen is represented by the symbol shown.

$^{17}_{8}O$

Deduce the number of protons, neutrons and electrons in this isotope of oxygen.

number of protons .....

number of neutrons .....

number of electrons .....

[3]

(c) Describe a test for oxygen.

test .....

result .....

[2]

[Total: 10]

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2 **(a)** The table shows the mass of each type of ion present in a 100 cm^3 sample of milk.

name of ion	formula of ion	mass of ion present in 100 cm^3 milk / mg
calcium	Ca^{2+}	125
chloride	Cl^-	120
	Mg^{2+}	12
phosphate	PO_4^{3-}	95
potassium	K^+	140
sodium	Na^+	58
	SO_4^{2-}	30
negative ions of organic acids		160

(i) Calculate the mass of calcium ions present in a 20 cm^3 sample of this milk.

mass of calcium ions = ... mg [1]

(ii) Which positive ion is present in the highest concentration in this sample of milk?

..... [1]

(iii) Name the compound formed from Mg^{2+} and SO_4^{2-} ions.

..... [1]

(iv) Describe a test for chloride ions.

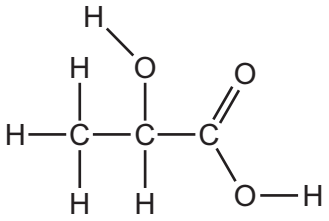
test .....

.....

result .....

[3]

(b) One of the organic acids present in milk is lactic acid.
The structure of lactic acid is shown.



(i) On the structure shown draw a circle around the carboxylic acid functional group. [1]

(ii) Deduce the molecular formula of lactic acid showing the number of carbon, hydrogen and oxygen atoms.

..... [1]

(c) Ethanoic acid is another organic acid.

(i) The reduction of ethanoic acid produces ethanol.

What is meant by the term *reduction*?

..... [1]

(ii) The molecular formula of ethanol is C_2H_6O.

Complete the table to calculate the relative molecular mass of ethanol.

	number of atoms	relative atomic mass	
carbon	2	12	2 × 12 = 24
hydrogen			
oxygen			

relative molecular mass = ... [2]

[Total: 11]

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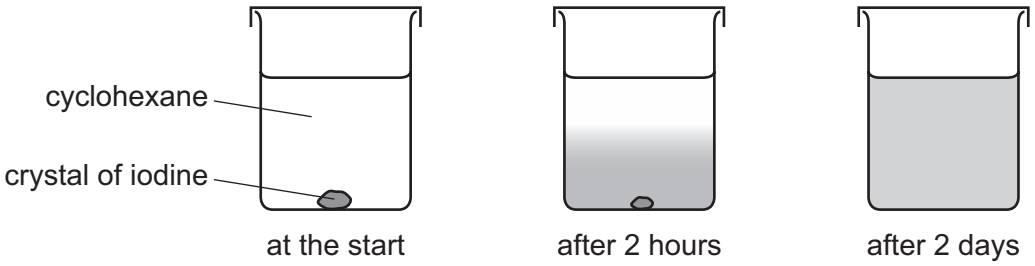
3 This question is about halogens.

(a) A crystal of iodine was placed at the bottom of a beaker containing the solvent cyclohexane. After 2 days, a purple colour had spread throughout the cyclohexane.



Explain these observations using the kinetic particle model.

.....

.....

.....

.....

..... [3]

Question 3 continues on the next page.

(b) The table shows the properties of some halogens.

halogen	melting point in °C	boiling point in °C	density when liquid in g / cm^3	colour
fluorine	–220	–188		
chlorine		–29	1.56	light green
bromine	–7	59	3.12	red-brown
iodine	114	184	3.96	grey-black

(i) Complete the table to estimate:
- the density of liquid fluorine
- the melting point of chlorine.

[2]

(ii) Is fluorine lighter or darker in colour than chlorine?
Explain your answer.

.....

..... [1]

(iii) What is the physical state of bromine at 40 °C?
Give a reason for your answer.

.....

..... [2]

(c) Complete the chemical equation for the reaction of aqueous bromine with aqueous potassium iodide.

..... + 2KI $\rightarrow$ I_2 + ...KBr [2]

[Total: 10]

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4 This question is about organic compounds.

(a) Which **two** statements about members of a homologous series are correct?
Tick **two** boxes.

They have similar chemical properties.	☐
They have similar physical properties.	☐
They have the same functional group.	☐
They have the same relative molecular mass.	☐
They have the same number of carbon atoms.	☐

[2]

(b) To which homologous series do methane and ethane belong?

..... [1]

(c) Methane and ethane are both hydrocarbons.

What is meant by the term *hydrocarbon*?

.....

..... [2]

(d) Draw the structure of ethane showing all of the atoms and all of the bonds.

[1]

(e) The hydrocarbon tetradecane, $C_{14}H_{30}$, can be cracked to form a mixture of alkanes and alkenes.

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

1 .....

2 .....
[2]

(ii) Complete the chemical equation for the cracking of tetradecane to form **two** different hydrocarbons.

$$C_{14}H_{30} \rightarrow C_3H_6 + ...$$ [1]

(f) Ethanol can be manufactured from ethene.

Complete the word equation for this reaction.

ethene + ... → ethanol [1]

(g) Ethene can be polymerised to form poly(ethene).

Complete the sentence about this reaction using words from the list.

addition condensation ions monomers oxidation polymers

Ethene ..... combine to form poly(ethene) by ..... polymerisation.
[2]

[Total: 12]

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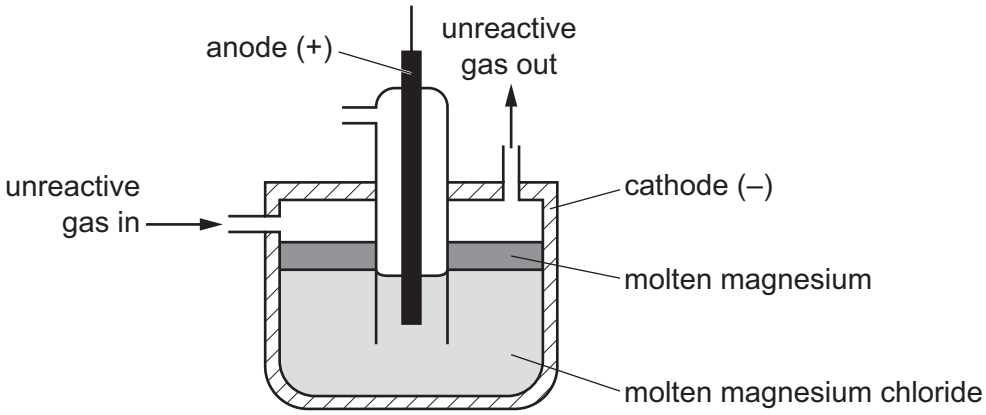
5 This question is about metals.

(a) Magnesium is manufactured by the electrolysis of molten magnesium chloride.



(i) What information in the diagram shows that molten magnesium is less dense than molten magnesium chloride?

..... [1]

(ii) One of the products of this electrolysis is magnesium.

State the name of the other product.

..... [1]

An unreactive gas is blown over the surface of the molten magnesium.

(iii) Suggest why an unreactive gas and **not** air is blown over the surface of the molten magnesium.

..... [1]

(iv) Suggest the name of an unreactive gas which could be used.

..... [1]

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[Turn over

(b) The table shows some properties of four metals.

metal	density in g / cm^3	melting point in °C	relative strength	relative electrical conductivity
aluminium	2.7	660	7	9
cobalt	8.9	1495	21	4
gallium	5.9	30	1	1
nickel	8.9	1455	20	3

Answer these questions using **only** the information shown in the table.

(i) Which metal is most suitable to make the body of an aircraft?
Give a reason for your answer.

.....

..... [2]

(ii) Which metal is most suitable to use for overhead power cables?
Give a reason for your answer.

.....

..... [2]

(iii) Which **two** metals in the table are transition elements?

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

(c) Give **two** properties of transition elements which are **not** shown by Group I elements.

1 .....

2 .....
[2]

(d) Cobalt is added to iron to make steel alloys.

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

.....

..... [1]

(ii) Give **one** reason why alloys are used instead of pure metals.

..... [1]

[Total: 13]

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6 This question is about sulfur and its compounds.

(a) Natural gas contains hydrocarbons and hydrogen sulfide.

(i) Give the name of the hydrocarbon which is present in the greatest concentration in natural gas.

..... [1]

(ii) Hydrogen sulfide is removed from natural gas by reaction with oxygen in the presence of a catalyst.

What is the purpose of a catalyst?

..... [1]

(b) (i) Name the acid manufactured from sulfur.

..... [1]

(ii) When fossil fuels containing sulfur are burned, sulfur dioxide is formed.
Sulfur dioxide contributes to acid rain.

Give **one** harmful effect of acid rain on buildings.

..... [1]

(iii) Sulfur dioxide is oxidised by nitrogen dioxide in the atmosphere to form sulfur trioxide.

$$SO_2 + NO_2 \rightarrow SO_3 + NO$$

How does this equation show that sulfur dioxide is oxidised?

.....

..... [1]

[Total: 5]

7 Acids have characteristic chemical properties.

(a) Describe the reactions of hydrochloric acid with:
- calcium oxide
- magnesium
- a named indicator of your choice.

.....

.....

.....

.....

.....

.....

..... [5]

(b) Acids react with alkalis such as sodium hydroxide.

(i) What type of chemical reaction is this?

..... [1]

(ii) Which **one** of the following pH values is the pH of an aqueous solution of sodium hydroxide? Draw a circle around the correct answer.

pH 2 pH 5 pH 7 pH 13

[1]

(iii) A mixture of sodium hydroxide and ammonium sulfate is warmed gently.

State the name of the gas produced.

..... [1]

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(iv) The melting point of sodium hydroxide is 319 °C.
The boiling point of sodium hydroxide is 1390 °C.

Which **one** of the following statements about sodium hydroxide is correct?
Tick **one** box.

Pure sodium hydroxide melts over a range of temperatures.	☐
Impure sodium hydroxide has a sharp melting point.	☐
Pure sodium hydroxide boils between 319 °C and 1390 °C.	☐
Pure sodium hydroxide has a sharp boiling point.	☐

[1]

(v) Sodium hydroxide is used in the manufacture of some medicines.

Why is it important that the ingredients used in medicines are pure?

..... [1]

[Total: 10]

8 This question is about iron and its compounds.

(a) A student investigates the rate of reaction of 1 g of iron powder with 25 cm^3 of hydrochloric acid of concentration 2.0 mol/dm^3. The temperature is 20 °C.

What effect do the following have on the initial rate of this reaction?

(i) Using hydrochloric acid of concentration 1.2 mol/dm^3.
All other conditions are kept the same.

..... [1]

(ii) Using a piece of iron of mass 1 g.
All other conditions are kept the same.

..... [1]

(iii) Carrying out the experiment at 25 °C.
All other conditions are kept the same.

..... [1]

(b) Siderite is an ore of iron.

(i) State the name of **one** other ore of iron.

..... [1]

(ii) Siderite contains mainly iron(II) carbonate.

Describe how to show that siderite contains a carbonate.

.....

.....

..... [3]

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(c) Iron can be extracted from its oxide by reduction with carbon.
The table shows how easy it is to reduce four metal oxides by heating with carbon.

metal oxide	ease of reduction with carbon
bismuth(III) oxide	only reduced above 250 °C
iron(III) oxide	only reduced above 650 °C
tin(II) oxide	only reduced above 500 °C
titanium(IV) oxide	**not** reduced at 700 °C

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

least reactive ⟶ most reactive

[2]

[Total: 9]

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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.).