



Cambridge IGCSE™

CANDIDATE NAME



CENTRE NUMBER

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CHEMISTRY

0620/32

Paper 3 Theory (Core)

October/November 2024

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [].
- The Periodic Table is printed in the question paper.

This document has **20** pages. Any blank pages are indicated.





(b) Helium is a monatomic gas.

(i) State the meaning of the term monatomic.

..... [1]

(ii) Explain in terms of electronic configuration why helium is unreactive.

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

[Total: 8]

DO NOT WRITE IN THIS MARGIN





2 (a) Hydrogen chloride has a simple molecular structure.

(i) State **two** physical properties of a compound with a simple molecular structure.

- 1
- 2 [2]

(ii) Hydrogen chloride is a molecule with a covalent bond.

Complete this sentence about a covalent bond.

A covalent bond is formed when two atoms share a pair of [1]

(iii) Complete Fig. 2.1 to show the dot-and-cross diagram for a molecule of hydrogen chloride. Show outer shell electrons only.

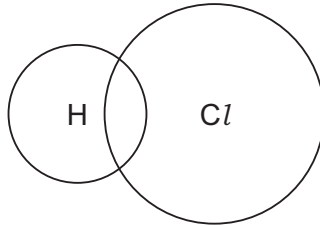


Fig. 2.1

[2]

(b) Zinc chloride has a giant ionic structure of positive and negative ions.

State the general name given to any negative ion.

..... [1]

(c) Diamond is used for jewellery.

(i) State one **other** use of diamond.

..... [1]





(ii) Choose the correct statement that describes the structure and bonding in diamond.

Tick (✓) **one** box.

simple covalent molecule

giant covalent

simple ionic

giant ionic

[1]

[Total: 8]

DO NOT WRITE IN THIS MARGIN





- 3 (a) The list shows some substances present in water from natural sources.

dissolved oxygen
calcium compounds
plastics
harmful microbes

State which **one** of these substances provides essential minerals for aquatic life.

..... [1]

- (b) Explain why phosphates present in polluted water are harmful to aquatic life.

.....
 [1]

- (c) Table 3.1 shows the masses of ions, in mg, present in a 1000 cm³ sample of polluted water.

Table 3.1

name of ion	formula of ion	mass of ion in 1000 cm ³ of polluted water / mg
bromide	Br ⁻	0.3
calcium	Ca ²⁺	2.5
chloride	Cl ⁻	3.5
hydrogencarbonate	HCO ₃ ⁻	10.0
magnesium	Mg ²⁺	0.8
mercury	Hg ²⁺	0.1
	NO ₃ ⁻	0.4
phosphate	PO ₄ ³⁻	2.0
potassium	K ⁺	5.9
silicate	SiO ₃ ²⁻	4.0
sodium	Na ⁺	12.2
sulfate	SO ₄ ²⁻	0.5

Answer these questions using the information from Table 3.1.

- (i) Name the negative ion present in the highest concentration.

..... [1]

- (ii) State the name of the NO₃⁻ ion.

..... [1]





(iii) Calculate the mass of phosphate ions present in 200 cm³ of polluted water.

mass = mg [1]

(d) Fig. 3.1 shows some of the stages in the purification of drinking water.



Fig. 3.1

(i) State the purpose of sedimentation.

..... [1]

(ii) State why chlorine is added to drinking water.

..... [1]

(e) Describe how to test for the purity of water using boiling point.

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

(f) Complete the symbol equation for the reaction of disulfur dichloride, S₂Cl₂, with water.



[Total: 11]

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4 (a) Fig. 4.1 shows the displayed formula of compound A.

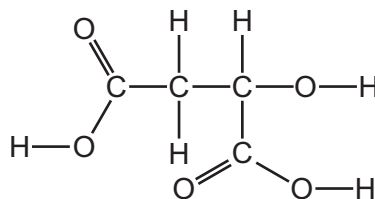


Fig. 4.1

(i) On Fig 4.1 draw a circle around the alcohol functional group. [1]

(ii) Deduce the molecular formula of compound A.

..... [1]

(b) Compound A reacts with ethanol to produce a compound with the molecular formula $C_8H_{14}O_5$.

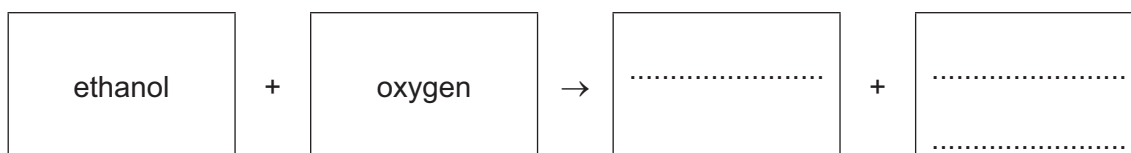
Complete Table 4.1 to calculate the relative molecular mass of $C_8H_{14}O_5$.

Table 4.1

type of atom	number of atoms	relative atomic mass	
carbon	8	12	$8 \times 12 = 96$
hydrogen		1	
oxygen		16	

relative molecular mass = [2]

(c) Complete the word equation for the complete combustion of ethanol.



[2]





(d) Table 4.2 shows the names, formulae and boiling points of ethene, propene, butene and pentene.

Table 4.2

name	formula	boiling point /°C
ethene	C ₂ H ₄	-104
propene	C ₃ H ₆	-47
butene	C ₄ H ₈	-6
pentene	C ₅ H ₁₀	+30

Use the information in Table 4.2 to answer these questions.

(i) Name the homologous series that includes ethene, propene, butene and pentene.

..... [1]

(ii) Deduce the general formula of this homologous series.

..... [1]

(iii) State the trend in the boiling point of this homologous series as the number of carbon atoms increases.

..... [1]

(e) Ethene is manufactured by cracking.

(i) Describe the manufacture of ethene by cracking.

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

(ii) Give a reason for cracking hydrocarbons.

..... [1]

[Total: 13]

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5 (a) Table 5.1 shows some properties of five halogens.

Table 5.1

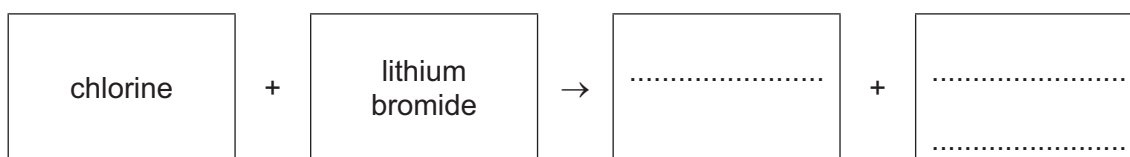
halogen	melting point in °C	boiling point in °C	density in liquid state in g/cm ³
fluorine	-220	-188	
chlorine	-101	-35	1.56
bromine	-7	+59	3.12
iodine	+114		3.96
astatine	+302	+337	6.40

Use the information in Table 5.1 to predict:

- (i) the boiling point of iodine [1]
- (ii) the density of liquid fluorine [1]
- (iii) the physical state of chlorine at -20 °C. Give a reason for your answer.
- physical state
- reason
- [2]

(b) Aqueous chlorine reacts with aqueous lithium bromide.

(i) Complete the word equation for this reaction.



[2]

(ii) Explain why aqueous iodine does **not** react with aqueous lithium bromide.

..... [1]

(iii) Describe a test for chlorine.

test

observations

[2]





(c) Fluorine reacts with ammonia to produce hydrogen fluoride and nitrogen.

Complete the symbol equation for this reaction.



[Total: 11]

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6 This question is about metals.

(a) Many metals have high melting points and boiling points.

State three **other** typical physical properties of metals.

- 1
- 2
- 3

[3]

(b) (i) Complete Table 6.1 to show the number of electrons, neutrons and protons in the sodium atom and silver ion shown.

Table 6.1

	number of electrons	number of neutrons	number of protons
$^{23}_{11}\text{Na}$	11		
$^{109}_{47}\text{Ag}^+$		62	

[3]

(ii) Write the electronic configuration of the sodium atom.

..... [1]

(c) Silver is a transition element. Sodium is in Group I of the Periodic Table.

State **one** difference in the physical properties of silver and sodium.

..... [1]

DO NOT WRITE IN THIS MARGIN





(d) Table 6.2 shows the observations when four different metals are heated in oxygen.

Table 6.2

metal	observations when heated in oxygen
cerium	burns rapidly and forms an oxide
copper	forms an oxide layer very slowly and does not burn
lanthanum	forms an oxide layer rapidly and does not burn
silver	does not form an oxide layer and does not burn

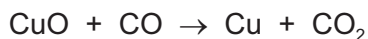
Put the four metals in order of their reactivity.
Put the least reactive metal first.

least reactive \longrightarrow most reactive

--	--	--	--

[2]

(e) Copper(II) oxide is reduced by carbon monoxide.



Explain how this equation shows that copper(II) oxide is reduced.

..... [1]

[Total: 11]

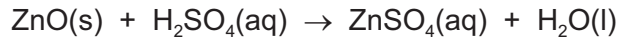
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7 This question is about acids, bases and salts.

(a) Crystals of zinc sulfate are made by warming excess solid zinc oxide with dilute sulfuric acid.



(i) State the meaning of the state symbol (aq).

..... [1]

(ii) State the method used to separate the excess solid zinc oxide from the reaction mixture.

..... [1]

(b) Crystals of sodium nitrate can be made by neutralising an acid with an alkali.

(i) Name the acid and the alkali used.

acid

alkali

[2]

(ii) Complete the equation for all neutralisation reactions.



[2]

(iii) Neutralisation reactions are exothermic.

Define the term exothermic.

..... [1]

(iv) Fig. 7.1 shows the reaction pathway diagram for an exothermic reaction.

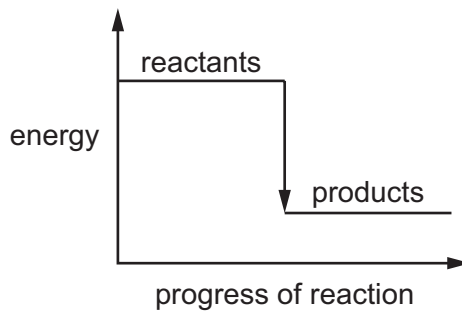


Fig. 7.1

Explain how Fig. 7.1 shows that the reaction is exothermic.

..... [1]





(c) Methyl orange is an acid–base indicator.

State the colour of methyl orange at pH2 and at pH 12.

colour at pH2

colour at pH 12

[2]

[Total: 10]

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8 (a) A student investigates the reaction of small pieces of calcium carbonate with excess dilute hydrochloric acid of three different concentrations. The time taken for each reaction to finish is recorded.

The three concentrations of acid are:

- 0.5 mol/dm³
- 1.0 mol/dm³
- 2.0 mol/dm³.

All other conditions stay the same.

Table 8.1 shows the time taken for each reaction to finish.

Table 8.1

concentration of dilute hydrochloric acid in mol/dm ³	time taken for the reaction to finish in s
	32
	64
	16

(i) Complete Table 8.1 by writing the concentrations in the first column. [1]

(ii) Describe the effect on the time taken for the reaction to finish when the reaction is carried out at a lower temperature.

All other conditions stay the same.

..... [1]

(iii) Describe the effect on the time taken for the reaction to finish when powdered calcium carbonate is used instead of small pieces of calcium carbonate.

All other conditions stay the same.

..... [1]

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(b) Molten calcium chloride is electrolysed using inert electrodes.

(i) Name the products at the positive and negative electrodes.

product at the positive electrode

product at the negative electrode

[2]

(ii) Choose from the list the substance that is used as an inert electrode.

Draw a circle around your chosen answer.

graphite

iodine

magnesium

phosphorus

[1]

(c) Carbon dioxide is a gas at room temperature.

Describe the motion and separation of the particles in carbon dioxide gas.

motion

.....

separation

.....

[2]

[Total: 8]

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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	N nitrogen 14	O oxygen 16	F fluorine 19	Ne neon 20	Na sodium 23	Mg magnesium 24	Al aluminium 27	Si silicon 28	P phosphorus 31	S sulfur 32	Cl chlorine 35.5	Ar argon 40	K potassium 39	Ca calcium 40	Sc scandium 45	Ti titanium 48	V vanadium 51	Cr chromium 52	Mn manganese 55	Fe iron 56	Co cobalt 59	Ni nickel 59	Cu copper 64	Zn zinc 65	Ga gallium 70	Ge germanium 73	As arsenic 75	Se selenium 79	Br bromine 80	Kr krypton 84	Rb rubidium 85	Sr strontium 88	Y yttrium 89	Zr zirconium 91	Nb niobium 93	Mo molybdenum 96	Tc technetium —	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 —	At astatine —	Rn radon —	Fr francium —	Ra radium —	Ac actinium —	Rf rutherfordium —	Rf rutherfordium —	Db dubnium —	Sg seaborgium —	Bh bohrium —	Hs hassium —	Mt meitnerium —	Ds darmstadtium —	Rg roentgenium —	Cn copernicium —	Nh nihonium —	Fl flerovium —	Mc moscovium —	Lv livermorium —	Ts tennessine —	Og oganesson —

Key

atomic number

atomic symbol

name

relative atomic mass

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

lanthanoids

actinoids

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).

