Cambridge Assessment International Education

Cambridge IGCSE™

CHEMISTRY **0620/23**

Paper 2 Multiple Choice (Extended) **May/June 2023**

45 minutes

You must answer on the multiple choice answer sheet.

You will need: Multiple choice answer sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)

INSTRUCTIONS

- There are **forty** questions on this paper. Answer **all** questions.
- For each question there are four possible answers **A**, **B**, **C** and **D**. Choose the **one** you consider correct and record your choice in soft pencil on the multiple choice answer sheet.
- Follow the instructions on the multiple choice answer sheet.
- Write in soft pencil.
- Write your name, centre number and candidate number on the multiple choice answer sheet in the spaces provided unless this has been done for you.
- Do **not** use correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.

INFORMATION

- The total mark for this paper is 40.
- Each correct answer will score one mark.
- Any rough working should be done on this question paper.
- The Periodic Table is printed in the question paper.

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1 Nitrogen is heated in a balloon, which expands slightly.

Which statements about the molecules of nitrogen are correct?

1 They move further apart.

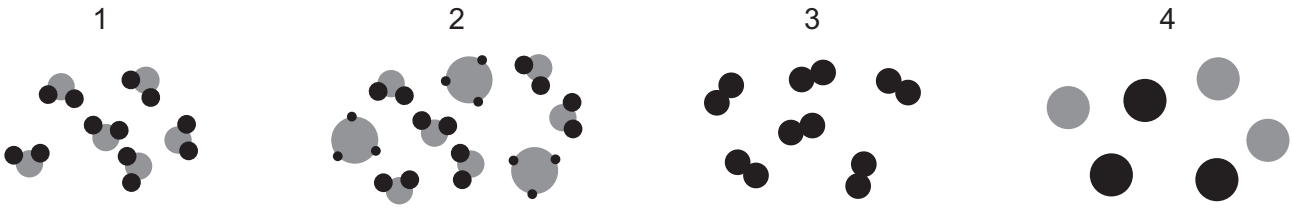
2 They move more quickly.

3 They remain the same distance apart.

4 Their speed remains unchanged.

A 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

2 The diagrams represent some elements, compounds and mixtures.



Which row describes the numbered substances?

	1	2	3	4
A	element	mixture of compounds	compound	mixture of elements
B	compound	mixture of compounds	element	mixture of elements
C	element	mixture of elements	compound	mixture of compounds
D	compound	mixture of elements	element	mixture of compounds

3 Two atoms, X and Y, have the same mass number but different atomic numbers.

Which statement about X and Y is correct?

A They have the same number of protons.

B They have the same number of electrons.

C They are in the same group of the Periodic Table.

D They have different numbers of neutrons.

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4 A sample of pure iron contains three isotopes only.

percentage abundance of isotope / %	isotope
2	^{n}Fe
6	^{54}Fe
92	^{56}Fe

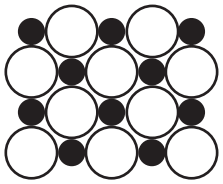
The iron in the sample has a relative atomic mass of 55.9.

What is the value of *n*?

A 53 **B** 55 **C** 57 **D** 58

5 Magnesium oxide is a white solid at room temperature and pressure.

Part of the structure of solid magnesium oxide is shown.



key

● = Mg^{2+} magnesium ion

○ = O^{2-} oxide ion

Three statements are listed.

1 Magnesium ions are smaller than oxide ions because they contain fewer electrons.

2 Magnesium oxide has good electrical conductivity when molten because the ions are mobile.

3 Magnesium oxide has a high melting point because of the strong electrostatic attraction between the ions and delocalised electrons in the giant lattice.

Which statements are correct?

A 1 and 2 **B** 1 and 3 **C** 2 and 3 **D** 2 only

6 In which molecule are all the outer-shell electrons involved in covalent bonding?

A Cl_2 **B** CH_4 **C** HCl **D** NH_3

7 Which row describes the properties of silicon(IV) oxide?

	giant covalent structure	melting point
A	no	high
B	no	low
C	yes	high
D	yes	low

8 Which row describes the structure of a solid metal and explains the property?

	structure of solid metal	property of solid metal
A	lattice of negative ions in a sea of electrons	conducts electricity because the electrons are free to move
B	lattice of negative ions in a sea of electrons	is malleable because the layers of ions can slide over each other
C	lattice of positive ions in a sea of electrons	conducts electricity because the ions are free to move
D	lattice of positive ions in a sea of electrons	is malleable because the layers of ions can slide over each other

9 What is the formula of potassium oxide?

A P_2O **B** PO_2 **C** KO **D** K_2O

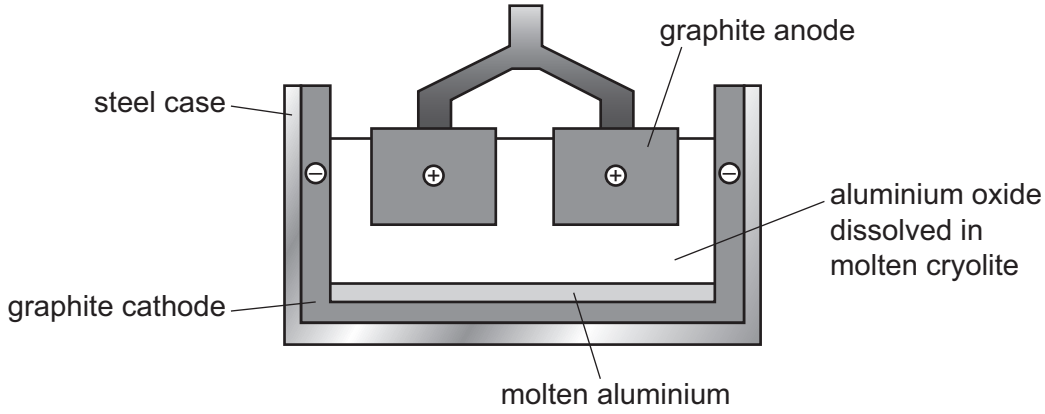
10 A dilute aqueous solution of sodium bromide is electrolysed using inert electrodes.

Which row identifies the product at the cathode and at the anode?

	cathode	anode
A	bromine	hydrogen
B	hydrogen	bromine
C	hydrogen	oxygen
D	oxygen	hydrogen

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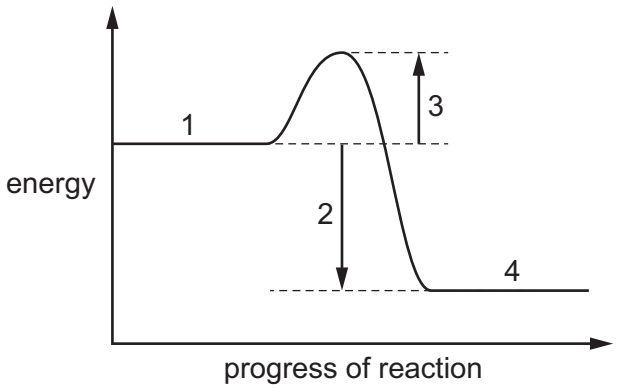
11 Aluminium is extracted by electrolysis, as shown.



Which row shows the ionic half-equations at the cathode and the anode?

	cathode	anode
A	$Al^{3+} \rightarrow Al + 3e^-$	$2O^{2-} \rightarrow O_2 + 4e^-$
B	$Al^{3+} \rightarrow Al + 3e^-$	$2O^{2-} + 4e^- \rightarrow O_2$
C	$Al^{3+} + 3e^- \rightarrow Al$	$2O^{2-} \rightarrow O_2 + 4e^-$
D	$Al^{3+} + 3e^- \rightarrow Al$	$2O^{2-} + 4e^- \rightarrow O_2$

12 The reaction pathway diagram for an exothermic reaction is shown.



Which row identifies labels 1, 2, 3 and 4?

	1	2	3	4
A	reactants	ΔH	E_a	products
B	products	ΔH	E_a	reactants
C	reactants	E_a	ΔH	products
D	products	E_a	ΔH	reactants

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[Turn over

13 The equation for the complete combustion of ethene is shown.

$$C_2H_4(g) + 3O_2(g) \rightarrow 2CO_2(g) + 2H_2O(g)$$

Some bond energies are listed.

bond	bond energy in kJ / mol
C–H	412
C–C	348
C=C	612
C–O	360
C=O	743
O–O	146
O=O	496
O–H	463

What is the overall energy change when one mole of ethene is completely burned?

A –456 **B** –1076 **C** –1340 **D** –2126

14 Magnesium reacts with hydrochloric acid to form magnesium chloride and hydrogen.

Why does magnesium powder react faster than magnesium ribbon?

A The magnesium atoms in the powder have a lower activation energy.

B The powder has a smaller surface area.

C The magnesium atoms in the powder have more frequent collisions with acid particles.

D The magnesium atoms in the powder have greater kinetic energy.

15 Which row shows the conditions used in the Contact process?

	catalyst	pressure / atm	temperature / °C
A	iron	2	100
B	iron	200	450
C	vanadium(V) oxide	2	450
D	vanadium(V) oxide	200	100

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16 A student heats hydrated copper(II) sulfate. The blue crystals change to a white powder.

How can the student reverse this reaction?

A Add anhydrous copper(II) sulfate to the white powder.

B Add water to the white powder.

C Cool the white powder.

D Reheat the white powder.

17 Which reaction of hydrochloric acid is a redox reaction?

A $MgCO_3 + 2HCl \rightarrow MgCl_2 + H_2O + CO_2$

B $Mg(OH)_2 + 2HCl \rightarrow MgCl_2 + 2H_2O$

C $MgO + 2HCl \rightarrow MgCl_2 + H_2O$

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

18 Which oxide is amphoteric?

A Al_2O_3 **B** CaO **C** Na_2O **D** SO_2

19 Four statements about strong acids are listed.

1 They react with carbonates to form carbon dioxide.

2 They completely dissociate in aqueous solution.

3 They react with ammonium salts to form ammonia.

4 They are proton acceptors.

Which statements are correct?

A 1 and 2 **B** 1 and 3 **C** 2 and 4 **D** 3 and 4

20 Which reaction mixture will produce a precipitate?

A aqueous Na_2CO_3 and aqueous $CuSO_4$

B dilute H_2SO_4 and aqueous NaOH

C dilute HNO_3 and solid MgO

D solid CuO and dilute H_2SO_4

21 Which set of elements shows the change from metallic to non-metallic character across a period of the Periodic Table?

A beryllium → magnesium → calcium

B fluorine → bromine → iodine

C oxygen → boron → lithium

D sodium → silicon → chlorine

22 A sample of ethanoic acid and a sample of hydrochloric acid have the same concentration.

How do the hydrogen ion concentration and pH of ethanoic acid compare to those of hydrochloric acid?

	ethanoic acid compared to hydrochloric acid	
	hydrogen ion concentration	pH
A	higher	higher
B	higher	lower
C	lower	higher
D	lower	lower

23 What is a typical property of transition elements?

A can act as catalysts

B poor electrical conductivity

C low melting point

D low density

24 Which statement about copper or aluminium is correct?

A Aluminium is more dense than copper.

B Aluminium is less reactive than copper.

C Copper has high ductility.

D Copper has poor electrical conductivity.

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25 Water from a reservoir flows to the water works where purification process 1 takes place followed by process 2.

What are processes 1 and 2?

	process 1	process 2
A	chlorination	filtration
B	filtration	chlorination
C	fractional distillation	filtration
D	filtration	fractional distillation

26 Calcium reacts with cold water to produce hydrogen.

Lead reacts slowly when heated in air to form an oxide but has almost no reaction with steam.

Silver does not react with either air or water.

Zinc reacts when heated with steam to produce hydrogen.

What is the order of reactivity starting with the least reactive?

	least reactive ⟶ most reactive			
A	calcium	lead	zinc	silver
B	calcium	zinc	lead	silver
C	silver	lead	zinc	calcium
D	silver	zinc	lead	calcium

27 Blocks of magnesium are attached to the bottom of a steel boat to prevent rusting.

Which equation describes a change that prevents the steel from rusting?

A $Fe \rightarrow Fe^{3+} + 3e^-$

B $Fe_2O_3 + 3Mg \rightarrow 2Fe + 3MgO$

C $3Mg^{2+} + 2Fe \rightarrow 2Fe^{3+} + 3Mg$

D $Mg \rightarrow Mg^{2+} + 2e^-$

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28 Which statements about the extraction of iron in a blast furnace are correct?

1 The temperature inside the blast furnace is increased by burning carbon.

2 Iron(III) oxide is reduced to iron by carbon monoxide.

3 The thermal decomposition of calcium carbonate forms slag.

4 Slag reacts with acidic impurities.

A 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

29 Which statements about water are correct?

1 Tap water has fewer impurities than distilled water.

2 Tap water will turn anhydrous cobalt(II) chloride pink.

3 The domestic water supply is treated with carbon to kill microbes.

4 Phosphates from fertilisers can cause deoxygenation of water.

A 1 and 2 **B** 1 and 3 **C** 2 and 4 **D** 3 and 4

30 Oxides of nitrogen form in car engines and are removed by catalytic converters.

Which equation represents a reaction that occurs in a catalytic converter?

A $CO + NO_2 \rightarrow NO + CO_2$

B $2CO + 2NO \rightarrow N_2 + 2CO_2$

C $CO_2 + NO \rightarrow NO_2 + CO$

D $CO_2 + 2NO_2 \rightarrow N_2 + 3O_2 + C$

31 An alkene is represented by the formula $CH_3CH{=}CH_2$.

Which name is given to this type of formula?

A displayed

B empirical

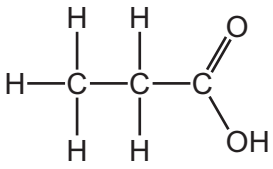
C general

D structural

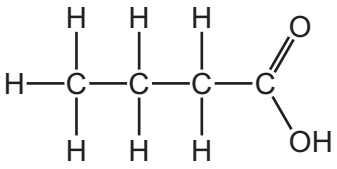
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32 What is the structure of propanoic acid?

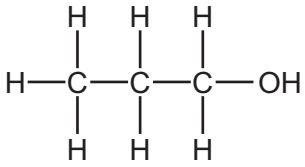
A



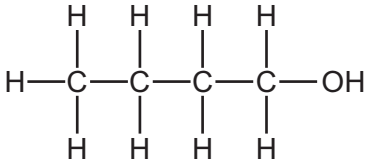
B



C



D



33 Butane reacts with chlorine in the presence of ultraviolet radiation.

What is the equation for this reaction?

A $C_4H_{10} + Cl_2 \rightarrow C_4H_8Cl_2 + H_2$

B $C_4H_{10} + Cl_2 \rightarrow C_4H_9Cl + HCl$

C $C_4H_{10} + Cl_2 \rightarrow 2C_2H_5Cl + H_2$

D $C_4H_{10} + Cl_2 \rightarrow C_2H_4 + C_2H_5Cl + HCl$

34 A hydrocarbon P is cracked to make compound Q and hydrogen.

Compound R is formed by the addition polymerisation of compound Q.

To which homologous series do P, Q and R belong?

	alkene	alkane
A	P only	Q and R
B	Q only	P and R
C	P and Q	R only
D	P and R	Q only

35 Which substances are structural isomers?

A but-2-ene and propene

B ethyl ethanoate and butanoic acid

C methyl methanoate and ethanol

D propan-1-ol and butan-1-ol

36 Ethanol is produced by:

1 the catalytic addition of steam to ethene

2 fermentation.

Which statement is correct?

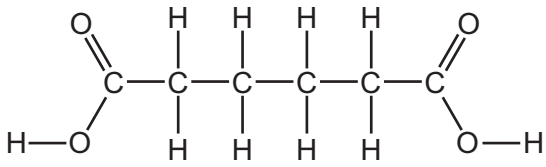
A Both processes use similar amounts of energy.

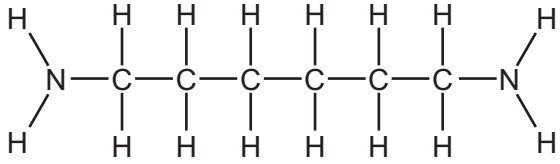
B Both processes use a catalyst.

C Process 1 uses a temperature of 25–35 °C.

D Process 2 uses a pressure of 60 atm.

37 The two monomers shown can be used to form a condensation polymer.





Which small molecule is released during this reaction?

A H_2O **B** NH_3 **C** CO_2 **D** $CONH_2$

38 Dilute hydrochloric acid is titrated into a conical flask containing sodium hydroxide solution and a few drops of methyl orange indicator.

Which piece of apparatus is used to add the hydrochloric acid?

A beaker

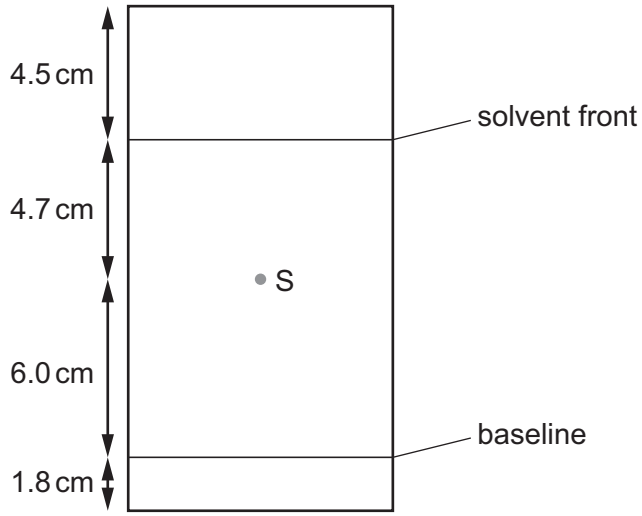
B burette

C measuring cylinder

D pipette

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39 The chromatogram obtained from a chromatography experiment on substance S is shown.



What is the R_f value of S?

A 0.39 **B** 0.46 **C** 0.56 **D** 0.62

40 Element X burns in air to form an acidic gas that decolourises potassium manganate(VII).

What is X?

A carbon

B nitrogen

C magnesium

D sulfur

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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 –	113 Nh nihonium –	114 Fl flerovium –	115 Mc moscovium –	116 Lv livermorium –	117 Ts tennessine –	118 Og oganesson –

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.).