Cambridge IGCSE[™](9–1)

CHEMISTRY 0971/12

Paper 1 Multiple Choice (Core)

May/June 2022

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.

1 Substances change state when their temperature is changed.

Which changes of state take place when the temperature of a substance is lowered?

- 1 boiling
- 2 condensation
- 3 freezing
- 4 melting
- **A** 1 and 4
- **B** 2, 3 and 4
- C 2 and 3 only
- **3** only

2 A student measures the time taken for 2.0 g of magnesium to dissolve in 50 cm³ of dilute sulfuric acid.

Which apparatus is essential to complete the experiment?

- 1 stop-clock
- 2 measuring cylinder
- 3 thermometer
- 4 balance
- **A** 1. 2 and 4
- **B** 1 and 2 only
- C 1 and 4 only
- **D** 2, 3 and 4

3 Which method is used to separate a mixture of the following liquids?

liquid	boiling point/°C
methanol	64.5
ethanol	78.5
propan-1-ol	97.2
butan-1-ol	117.0

- **A** crystallisation
- **B** evaporation
- **C** filtration
- **D** fractional distillation

4 X and Y are two different elements.

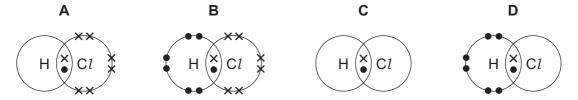
X and Y have the same number of nucleons.

Which statement about X and Y is correct?

- **A** They have the same physical properties.
- **B** Their atoms have the same number of electrons.
- **C** They are in different groups of the Periodic Table.
- **D** They have different relative masses.
- 5 Which row identifies an alloy, a pure metal and a non-metal?

	alloy	pure metal	non-metal
Α	brass	carbon	copper
В	brass	copper	carbon
С	copper	brass	carbon
D	copper	carbon	brass

- **6** Which statement about ions and ionic bonding is correct?
 - A Caesium atoms gain electrons to form negatively charged caesium ions.
 - **B** lonic bonding involves sharing of pairs of electrons.
 - **C** Potassium ions and chloride ions have the same number of outer-shell electrons.
 - **D** Sodium ions have an equal number of protons and electrons.
- **7** Which dot-and-cross diagram shows the arrangement of outer shell electrons in a molecule of hydrogen chloride?

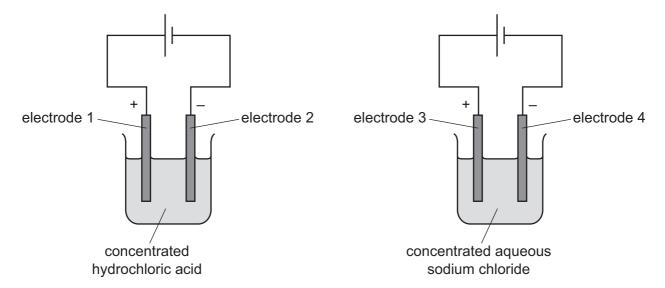


- 8 Which statement explains why graphite can be used as a lubricant?
 - **A** All of the atoms in graphite are carbon.
 - **B** Each carbon atom forms three bonds.
 - **C** Graphite has a macromolecular structure.
 - **D** The layers in graphite can slide over each other.

9 A compound of element X has the formula X_2O and a relative formula mass of 144.

What is element X?

- A copper, Cu
- B gadolinium, Gd
- C sulfur, S
- D tellurium, Te
- **10** The diagram shows the electrolysis of concentrated hydrochloric acid and concentrated aqueous sodium chloride using carbon electrodes.



At which electrodes is hydrogen produced?

- A electrode 1 only
- B electrodes 1 and 3
- C electrode 2 only
- D electrodes 2 and 4
- **11** Which type of reaction occurs when calcium carbonate is heated at a high temperature to produce calcium oxide and carbon dioxide?
 - A combustion
 - **B** endothermic
 - **C** oxidation
 - **D** reduction

12 Which row identifies a chemical change and a physical change?

	chemical change	physical change
Α	boiling ethanol	burning ethanol
В	burning ethanol	evaporating ethanol
С	dissolving ethanol in water	burning ethanol
D	evaporating ethanol	dissolving ethanol in water

- **13** Which statement about rate of reaction is correct?
 - A Catalysts increase the time for the reaction to be completed.
 - **B** Decreasing particle size increases the rate of reaction.
 - **C** Decreasing temperature increases the rate of reaction.
 - **D** Rate of reaction decreases as the concentration increases.
- **14** Some common household substances are tested with litmus and methyl orange.

household substance	colour of litmus	colour of methyl orange
bicarbonate of soda	blue	yellow
lemonade	red	red
milk	red	red
milk of magnesia	blue	yellow
washing powder	blue	yellow
vinegar	red	red

Which statement is correct?

- A Lemonade, milk and bicarbonate of soda are all acidic.
- **B** Milk of magnesia can neutralise washing powder.
- **C** Milk of magnesia, washing powder and vinegar are all bases.
- **D** Vinegar can neutralise bicarbonate of soda.

15 Water is added to anhydrous copper(II) sulfate.

What happens during the reaction?

- **A** The copper(II) sulfate turns blue and the solution formed gets colder.
- **B** The copper(II) sulfate turns blue and the solution formed gets hotter.
- **C** The copper(II) sulfate turns white and the solution formed gets colder.
- **D** The copper(II) sulfate turns white and the solution formed gets hotter.
- 16 In which equation is carbon both oxidised and reduced?

A C +
$$O_2 \rightarrow CO_2$$

$$\mathbf{B}\quad \mathsf{CO_2}\,+\,\mathsf{C}\,\rightarrow\,2\mathsf{CO}$$

$$\textbf{C} \quad 3\text{CO + Fe}_2\text{O}_3 \,\rightarrow\, 3\text{CO}_2 \,+\, 2\text{Fe}$$

$$\textbf{D} \quad 2\text{CO} \, + \, \text{O}_2 \, \rightarrow \, 2\text{CO}_2$$

17 Aqueous solutions containing copper(II) ions can be identified using flame tests and by adding aqueous sodium hydroxide.

Which row describes what is observed in these tests?

	flame test	aqueous sodium hydroxide
Α	blue-green flame	light blue precipitate
В	blue-green flame	green precipitate
С	lilac flame	light blue precipitate
D	lilac flame	green precipitate

18 The oxides of two elements, X and Y, are separately dissolved in water and the pH of each solution tested.

oxide tested	pH of solution
X	1
Y	13

Which information about X and Y is correct?

	oxide is acidic	oxide is basic	metal	non-metal
Α	Х	Υ	Х	Υ
В	X	Υ	Y	Х
С	Y	X	X	Y
D	Υ	Х	Υ	Х

19 An acid is neutralised by adding an excess of an insoluble solid base.

A soluble salt is formed.

How is the pure salt obtained from the reaction mixture?

- **A** crystallisation \rightarrow evaporation \rightarrow filtration
- **B** evaporation \rightarrow crystallisation \rightarrow filtration
- **C** filtration \rightarrow crystallisation \rightarrow evaporation
- **D** filtration \rightarrow evaporation \rightarrow crystallisation
- 20 Some statements about gas G are listed.

G is monoatomic.

G is found in clean, dry air.

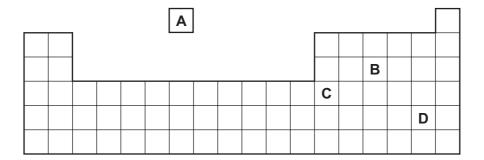
G is used in lamps.

Which element is G?

- **A** argon
- **B** helium
- C nitrogen
- **D** oxygen

21 Part of the Periodic Table is shown.

Which element is a metal?



22 The elements sodium to argon form Period 3 of the Periodic Table.

Which row describes the trend across Period 3 from left to right?

	number of outer-shell electrons	metallic character	group number
Α	decreases	decreases	decreases
В	decreases	increases	decreases
С	increases	decreases	increases
D	increases	increases	increases

23 Some properties of element E are listed.

It has a high density.

It has a high melting point.

What is E?

- **A** aluminium
- **B** bromine
- **C** iron
- **D** lithium

24 Lithium, sodium and potassium are elements in Group I of the Periodic Table.

Chlorine, bromine and iodine are elements in Group VII of the Periodic Table.

Which row identifies the least dense of these elements in each group?

	Group I	Group VII
Α	lithium	chlorine
В	lithium	iodine
С	potassium	chlorine
D	potassium	iodine

25 The reactions of metals P, Q, R and S are shown.

metal	reaction with water	reaction with hydrochloric acid	reduction of the metal oxide with carbon
Р	no reaction	no reaction	reduced
Q	slow	vigorous	no reaction
R	vigorous	vigorous	no reaction
S	very slow	vigorous	reduced

What is the order of reactivity of the metals?

	least reactive			most reactive
Α	Р	S	Q	R
В	Р	Q	S	R
С	R	S	Q	Р
D	R	Q	S	Р

26 Iron is extracted from hematite in the blast furnace at a temperature of about 1550 °C.

Which equation shows the main reaction that increases the temperature in the furnace?

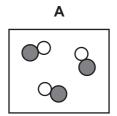
A
$$CaCO_3 \rightarrow CaO + CO_2$$

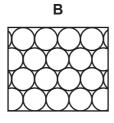
$$\textbf{B} \quad \textbf{C} \, + \, \textbf{O}_2 \, \rightarrow \, \textbf{CO}_2$$

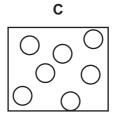
$$\mathbf{C}$$
 $CO_2 + C \rightarrow 2CO$

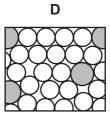
D Fe₂O₃ + 3CO
$$\rightarrow$$
 2Fe + 3CO₂

27 Which diagram represents the arrangement of atoms in an alloy?









28 Which uses of the metals shown are correct?

	aluminium	stainless steel
Α	aircraft bodies	car bodies
В	car bodies	aircraft bodies
С	chemical plant	food containers
D	food containers	cutlery

29 Which row identifies a substance present in clean air and a substance that is a pollutant in air?

	present in clean air	pollutant in air
Α	oxides of nitrogen	nitrogen
В	carbon dioxide	sulfur dioxide
С	carbon monoxide	lead compounds
D	nitrogen	argon

- 30 Which property of sulfur dioxide explains why it is used as a food preservative?
 - A acidic oxide
 - **B** bleach
 - C kills bacteria
 - **D** pungent smell

31 Fertilisers are used to provide three of the elements needed for plant growth.

Which two compounds would give a fertiliser containing all three of these elements?

- A $Ca(NO_3)_2$ and $(NH_4)_2SO_4$
- **B** $Ca(NO_3)_2$ and $(NH_4)_3PO_4$
- C KNO₃ and (NH₄)₂SO₄
- **D** KNO₃ and (NH₄)₃PO₄
- **32** Compound J is an unsaturated carboxylic acid.

Which bonds are present in a molecule of J?

	C=C	C=O	O–H	
Α	✓	✓	✓	key
В	X	✓	✓	✓= yes
С	✓	X	X	x = no
D	X	✓	X	

33 Petroleum is separated into useful fractions by fractional distillation.

Which fraction is used as a fuel for jet aeroplanes?

- A fuel oil
- **B** gasoline
- C naphtha
- **D** kerosene/paraffin
- 34 What are the products when limestone (calcium carbonate) is heated strongly?
 - A calcium hydroxide and carbon dioxide
 - **B** calcium hydroxide and carbon monoxide
 - C calcium oxide and carbon dioxide
 - D calcium oxide and carbon monoxide

35 Ethene reacts with substance X to form ethanol.

What is X?

- A ethanoic acid
- **B** glucose
- C hydrogen
- **D** steam
- 36 What is the equation for the complete combustion of methane?

$$A \quad CH_4 + 4O_2 \rightarrow CO_2 + 2H_2O$$

$$\textbf{B} \quad 2\text{CH}_4 \,+\, 3\text{O}_2 \,\rightarrow\, 2\text{CO} \,+\, 4\text{H}_2\text{O}$$

$$\textbf{C} \quad \text{CH}_4 \, + \, 2\text{O}_2 \, \rightarrow \, \text{CO}_2 \, + \, 2\text{H}_2\text{O}$$

- **D** $C_2H_6 + 3O_2 \rightarrow 2CO_2 + 3H_2O$
- **37** Alkenes can be produced by cracking large hydrocarbon molecules to form smaller hydrocarbon molecules.

Which equations represent possible reactions when tetradecane, C₁₄H₃₀, is cracked?

$$1 \quad C_{14}H_{30} \, \to \, C_2H_6 \, + \, C_3H_6 \, + \, C_4H_8 \, + \, C_5H_{10}$$

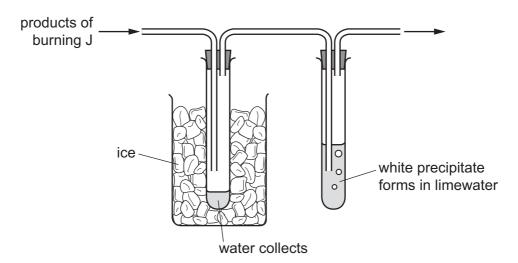
$$2 \quad C_{14}H_{30} \rightarrow H_2 + C_2H_4 + C_3H_6 + C_4H_8 + C_5H_{10}$$

$$3 \quad C_{14}H_{30} \rightarrow C_2H_6 + 4C_3H_6$$

$$4 \quad C_{14}H_{30} \, \rightarrow \, C_2H_6 \, + \, C_3H_8 \, + \, C_9H_{18}$$

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

38 The products formed by burning substance J are passed through the apparatus shown.



What is substance J?

- A carbon monoxide
- **B** ethanol
- C hydrogen
- **D** sulfur
- 39 Which statements about ethanoic acid are correct?
 - 1 Aqueous ethanoic acid reacts with magnesium to form magnesium ethanoate.
 - 2 Carbon dioxide is formed when aqueous ethanoic acid reacts with sodium carbonate.
 - 3 Hydrogen is formed when aqueous ethanoic acid reacts with sodium hydroxide.
 - 4 Ethanoic acid turns red litmus paper blue.
 - **A** 1 and 2 **B** 1 and 3 **C** 2 and 3 **D** 2 and 4
- 40 Which statement about polymerisation is correct?
 - **A** Large monomer molecules join to form small polymer molecules.
 - **B** Large polymer molecules join to form small monomer molecules.
 - **C** Small monomer molecules join to form large polymer molecules.
 - **D** Small polymer molecules join to form large monomer molecules.

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The Periodic Table of Elements

	\	2	He	helium 4	10	Ne	neon 20	18	Ā	argon 40	36	궃	kryptoi 84	54	×e	xenon 131	86	R	radon			
	\				6	щ	fluorine 19	17	Cl	chlorine 35.5	35	ğ	bromine 80	53	П	iodine 127	85	Αŧ	astatine -			
	I				8	0	oxygen 16	16	ഗ	sulfur 32	34	Se	selenium 79	52	<u>e</u>	tellurium 128	84	Ъ	molod	116	^	livermorium -
	^				7	Z	nitrogen 14	15	凸	phosphorus 31	33	As	arsenic 75	51	Sb	antimony 122	83	<u>B</u>	bismuth 209			
	\ <u>\</u>				9	ပ	carbon 12	14	Si	silicon 28	32	Ge	germanium 73	50	Sn	tin 119	82	Pb	lead 207	114	Εl	flerovium -
	≡				2	В	boron 11	13	Ρl	aluminium 27	31	Ga	gallium 70	49	In	indium 115	81	<i>1</i> L	thallium 204			
											30	Zu	zinc 65	48	g	cadmium 112	80	Нg	mercury 201	112	S	copernicium
											29	Cn	copper 64	47	Ag	silver 108	62	Au	pold 197	111	Rg	roentgenium
dn											28	Z	nickel 59	46	Pd	palladium 106	78	础	platinum 195	110	Ds	darmstadtium -
Group											27	ပိ	cobalt 59	45	格	rhodium 103	77	٦	iridium 192	109	Ĭ	meitnerium -
		-	I	hydrogen 1							26	Fe	iron 56	44	Ru	ruthenium 101	9/	SO	osmium 190	108	Hs	hassium
											25	Mn	manganese 55	43	ည	technetium -	75	Re	rhenium 186	107	Bh	bohrium
						loc	SS				24	ပ်	chromium 52	42	Mo	molybdenum 96	74	>	tungsten 184	106	Sg	seaborgium -
				Key	atomic number	atomic symbo	name relative atomic mass				23	>	vanadium 51	14	g	niobium 93	73	<u>a</u>	tantalum 181	105	op O	dubnium -
					B	atol	relat				22	j	titanium 48	40	Zr	zirconium 91	72	Ξ	hafnium 178	104	꿆	rutherfordium -
								_			21	Sc	scandium 45	39	>	yttrium 89	57–71	lanthanoids		89–103	actinoids	
	=				4	Be	beryllium 9	12	Mg	magnesium 24	20	Ca	calcium 40	38	Š	strontium 88	56	Ba	barium 137	88	Ra	radium
	_				3	:=	lithium 7	1	Na	sodium 23	19	¥	potassium 39	37	8	rubidium 85	55	Cs	caesium 133	87	ᇁ	francium

Ce Pr necedom		22	28	29	09	61	62	63	64	65	99	29	89	69		71
cerum praseodymium promethium samarium samarium europium gadolinium terbium dysprosium 140 141 144 - 150 157 159 163 150 91 92 93 94 95 96 97 98 150 Np Np Pu Am Cm Bk Cf 150 234 238 - - - - -	spic	Га	Ce	P	PZ	Pm	Sm	Ш	рg	Д	D	웃	ш	Tm		Γn
90 91 92 93 94 95 96 97 98 Th Pa U Np Pu Am Cm BK Cf thorum protectinium urranium neptunium pultronium americium berkelium californium e		lanthanum 139	cerium 140	praseodymium 141	neodymium 144	promethium -	samarium 150	europium 152	gadolinium 157	terbium 159	dysprosium 163	holmium 165	erbium 167	thulium 169	ytterbium 173	lutetium 175
Th Pa U Np Pu Am Cm Bk Cf throrium thorium protection uranium neptunium plutonium americum curium berkelium califonium e		88	06	91	92	93	94	98	96	26	86	66	100	101		103
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		ı	232	231	238	I	I	I	I	I	I	ı	I	I	I	I

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