

Cambridge International Examinations

Cambridge International General Certificate of Secondary Education (9–1)

CHEMISTRY

0971/02

Paper 2 Multiple Choice (Extended)

For Examination from 2018

SPECIMEN PAPER

45 minutes

Additional Materials: Multiple Choice Answer Sheet

Soft clean eraser

Soft pencil (type B or HB is recommended)

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

Write your name, Centre number and candidate number on the Answer Sheet in the spaces provided unless this has been done for you.

DO **NOT** WRITE IN ANY BARCODES.

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 separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

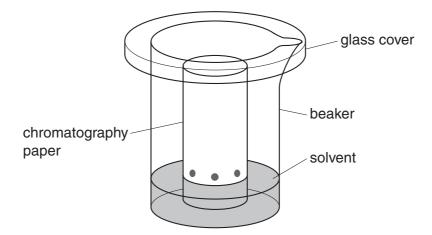
Any rough working should be done in this booklet.

A copy of the Periodic Table is printed on page 18.

Electronic calculators may be used.



1 Amino acids are colourless and can be separated and identified by chromatography.



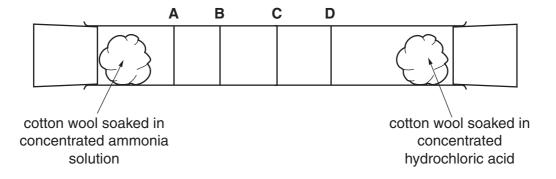
What additional apparatus is required to identify the amino acids present in a mixture?

- A a locating agent
- **B** a ruler
- **C** a ruler and a locating agent
- **D** neither a ruler or a locating agent
- 2 The diagram shows the diffusion of hydrogen chloride and ammonia in a glass tube.

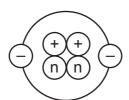
The gases are given off by the solutions at each end of the tube.

When hydrogen chloride and ammonia mix they produce a white solid, ammonium chloride.

Which line shows where the white solid is formed?



3 The diagram shows the structure of an atom.



key

+ = proton

n = neutron

= electron

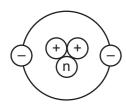
Which diagram shows the structure of an isotope of this atom?

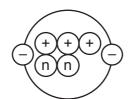


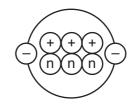


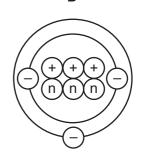
C

D









4 The table shows the structure of different atoms and ions.

particle	proton number	nucleon number	number of protons	number of neutrons	number of electrons
Mg	12	24	12	W	12
Mg ²⁺	X	24	12	12	10
F	9	19	9	Υ	9
F ⁻	9	19	9	10	Z

What are the values of W, X, Y and Z?

	W	Х	Y	Z
Α	10	10	9	9
В	10	12	10	9
С	12	10	9	10
D	12	12	10	10

5 Iron is a metal. The structure of iron is described as a lattice of positive ions in a sea of electrons.

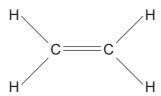
Which of the following statements about iron are correct?

- 1 iron conducts electricity because the electrons are free to move
- 2 iron has a high melting point due to the strong covalent bonds
- 3 iron is an alloy
- 4 iron is malleable because the layers of atoms can slide over one another
- A 1 only
- **B** 1 and 3
- **C** 1 and 4
- **D** 2, 3 and 4
- **6** Which two elements react together to form an ionic compound?

element	electronic structure
R	2,4
T	2,8
X	2,8,1
Z	2,8,7

- A R and T
- **B** T and X
- C X and Z
- **D** Z and R

7 Ethene is an unsaturated hydrocarbon.



Which description of the bonding in ethene is correct?

- **A** All atoms in the molecule have a share of eight electrons.
- **B** Each carbon atom shares two of its electrons with hydrogen atoms and two of its electrons with a carbon atom.
- **C** Each carbon atom shares two of its electrons with hydrogen atoms and one of its electrons with a carbon atom.
- **D** The two carbon atoms share a total of six electrons with other atoms.
- 8 What is the relative molecular mass, M_r , of butanol?
 - **A** 15
- **B** 37
- **C** 74
- **D** 148

© UCLES 2016

- **9** The chemical formulae of two substances, W and X, are given.
 - W NaAlSi₃O₈
 - X CaAl₂Si₂O₈

Which statements are correct?

- 1 W and X contain the same amount of oxygen.
- 2 W contains three times as much silicon as X.
- 3 X contains twice as much aluminium as W.
- **A** 1 and 2
- **B** 1 and 3
- **C** 2 and 3
- **D** 1, 2 and 3
- **10** What is the concentration of a solution containing 1.0g of sodium hydroxide in 250 cm³ of solution?
 - \mathbf{A} 0.025 mol/dm³
 - **B** 0.10 mol/dm³
 - **C** 0.25 mol/dm³
 - \mathbf{D} 1.0 mol/dm³
- **11** Four students prepared hydrated copper(II) sulfate by adding an excess of dilute sulfuric acid to copper(II) oxide.

Each student used a different mass of copper(II) oxide.

CuO
$$\longrightarrow$$
 CuSO₄.5H₂O \longrightarrow $M_r = 80$ $M_r = 250$

After the copper(II) sulfate had crystallised the students dried and weighed the crystals.

Which student produced the highest percentage yield of hydrated copper(II) sulfate?

	mass of copper(II) oxide used / g	mass of crystals produced / g
Α	4.0	11.5
В	8.0	23.5
С	12.0	35.0
D	16.0	46.5

12 20 cm³ of ethyne, C₂H₂, are reacted with 500 cm³ of oxygen.

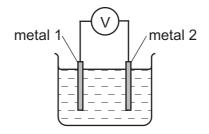
The equation for the reaction is

$$2C_2H_2(g) + 5O_2(g) \rightarrow 4CO_2(g) + 2H_2O(I)$$

What is the total volume of gas remaining at the end of the reaction?

(all volumes are measured at room temperature and pressure)

- **A** 400 cm³
- **B** 450 cm³
- **C** 490 cm³
- **D** 520 cm³
- **13** Different metals were tested using the apparatus shown.



Which pair of metals would produce the largest voltage?

- A copper and silver
- **B** magnesium and silver
- C magnesium and zinc
- D zinc and copper
- **14** Three electrolysis cells are set up. Each cell has inert electrodes.

The electrolytes are listed below.

cell 1 aqueous sodium chloride

cell 2 dilute sulfuric acid

cell 3 molten lead(II) bromide

In which of these cells is a gas formed at **both** electrodes?

- **A** 1 and 2 **B** 1 and 3 **C** 2 only **D** 3 only
- © UCLES 2016 0971/02/SP/18

- **15** The statements refer to the electrolysis of concentrated copper(II) chloride solution.
 - 1 Electrons are transferred from the cathode to the copper(II) ions.
 - 2 Electrons move around the circuit from the cathode to the anode.
 - 3 Chloride ions are attracted to the anode.
 - 4 Hydroxide ions transfer electrons to the cathode.

Which statements about the electrolysis of concentrated copper(II) chloride are correct?

- **A** 1 and 3
- **B** 1 and 4
- **C** 2 and 3
- **D** 2 and 4
- 16 Water can be used to produce hydrogen gas.

$$2H_2O \rightarrow 2H_2 + O_2$$

Which row describes bond breaking in the reactant?

Α	endothermic	heat absorbed	
В	endothermic	heat released	
С	exothermic	heat absorbed	
D	exothermic	heat released	

17 Dinitrogen tetroxide, N₂O₄, breaks down into nitrogen dioxide, NO₂.

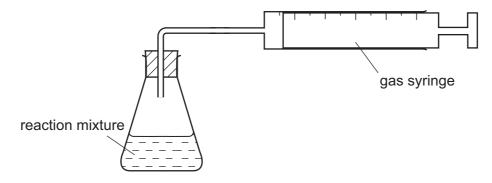
$$N_2O_4(g) \rightleftharpoons 2NO_2(g)$$

The reaction is reversible and endothermic.

Which conditions will give the largest yield of nitrogen dioxide, NO₂?

	temperature	pressure
Α	high	high
В	high	low
С	low	high
D	low	low

18 The apparatus shown can be used to measure the rate of some chemical reactions.



For which two reactions would this apparatus be suitable?

reaction 1 AgNO₃(aq) + HCl(aq) \rightarrow AgCl(s) + HNO₃(aq)

reaction 2 $2H_2O_2(aq) \rightarrow 2H_2O(1) + O_2(g)$

reaction 3 $MgO(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2O(I)$

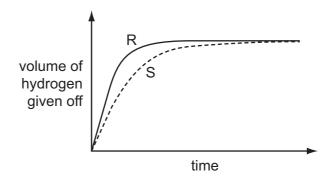
reaction 4 $ZnCO_3(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + CO_2(g) + H_2O(l)$

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

19 A student investigates the rate of reaction between magnesium and excess sulfuric acid.

The volume of hydrogen given off in the reaction is measured over time.

The graph shows the results of two experiments, R and S.



Which change in conditions would cause the difference between R and S?

- A A catalyst is added in S.
- **B** The acid is more concentrated in R than in S.
- **C** The magnesium is less finely powdered in R than in S.
- **D** The temperature in R is lower than in S.

20 Which of these reactions shows only reduction?

A
$$Cu^{2+} + 2e^{-} \rightarrow Cu$$

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

C
$$HCl + NaOH \rightarrow NaCl + H_2O$$

D Mg + ZnSO₄
$$\rightarrow$$
 Zn + MgSO₄

21 The red colour in some pottery glazes may be formed as a result of the reactions shown.

$$CuCO_3 \xrightarrow{\text{heat}} CuO + CO_2$$

$$CuO + SnO \longrightarrow Cu + SnO_2$$

These equations show that1..... is oxidised and2..... is reduced.

Which substances correctly complete gaps 1 and 2 in the above sentence?

	1	2
Α	CO_2	SnO_2
В	CuCO ₃	CuO
С	CuO	SnO
D	SnO	CuO

22 Acids are compounds which donate protons (hydrogen ions).

$$NH_3(aq) + H_2O(I) \rightarrow NH_4^+(aq) + OH^-(aq)$$

Which compound in this equation is behaving as an acid?

- A ammonia
- B ammonium hydroxide
- **C** none of them
- **D** water

23 The reactions of four different oxides W, X, Y and Z are shown.

W reacts with hydrochloric acid but not sodium hydroxide.

X reacts with both hydrochloric acid and sodium hydroxide.

Y does not react with either hydrochloric acid or sodium hydroxide.

Z reacts with sodium hydroxide but not hydrochloric acid.

Which row shows the correct types of oxide?

	acidic	basic	amphoteric	neutral
Α	W	Z	Х	Υ
В	×	Υ	W	Z
С	Z	Х	Υ	W
D	Z	W	X	Υ

24 A solution contains barium ions and silver ions and one type of anion.

What could the anion be?

- A chloride only
- **B** nitrate only
- **C** sulfate only
- **D** chloride or nitrate or sulfate
- **25** A mixture containing two anions was tested and the results are shown below.

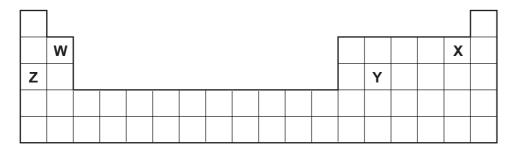
test	result
dilute nitric acid added	effervescence of a gas which turned limewater milky
dilute nitric acid added, followed by aqueous silver nitrate	yellow precipitate formed

Which anions were present?

- A carbonate and chloride
- B carbonate and iodide
- C sulfate and chloride
- **D** sulfate and iodide

26 Part of the Periodic Table is shown.

The letters are not the chemical symbols of the elements.



Which statement about the elements is **not** correct.

- **A** W has two electrons in the outermost shell.
- **B** Y is in Group IV of the Periodic Table.
- C X and Y bond covalently to form a molecule XY₄.
- **D** Z has more metallic character than Y.
- 27 Astatine is an element in Group VII of the Periodic Table. It has only ever been produced in very small amounts.

What are the likely properties of astatine?

	colour	state	reaction with aqueous potassium iodide
Α	black	solid	no reaction
В	dark brown	gas	brown colour
С	green	solid	no reaction
D	yellow	liquid	brown colour

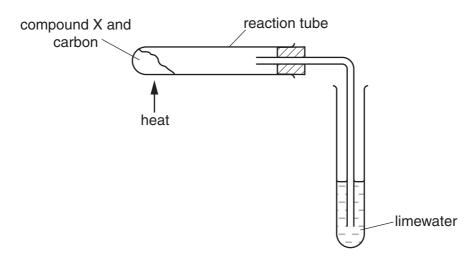
28 The table shows the results of adding three metals, P, Q and R, to dilute hydrochloric acid and to water.

metal	dilute hydrochloric acid	water
Р	hydrogen produced	hydrogen produced
Q	no reaction	no reaction
R	hydrogen produced	no reaction

What is the order of reactivity of the metals?

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

29 Compound X is heated with carbon using the apparatus shown.



A brown solid is formed in the reaction tube and the limewater turns cloudy.

What is compound X?

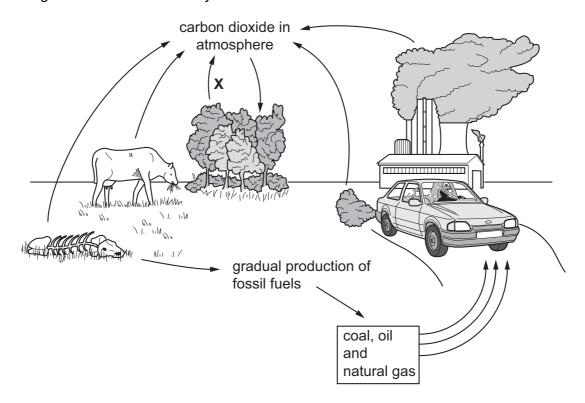
- A calcium oxide
- B copper(II) oxide
- **C** magnesium oxide
- **D** sodium oxide

30 Zinc is extracted from zinc blende. Zinc blende is an ore of zinc and consists mainly of zinc sulfide.

One of the steps in the process involves zinc sulfide reacting with oxygen from the air.

What is the equation for this reaction?

- A $2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$
- **B** $2ZnS + O_2 \rightarrow 2Zn + SO_2$
- **C** $2ZnS + O_2 \rightarrow 2ZnO + S$
- **D** $ZnS + 2O_2 \rightarrow ZnSO_4$
- 31 The diagram shows the carbon cycle.



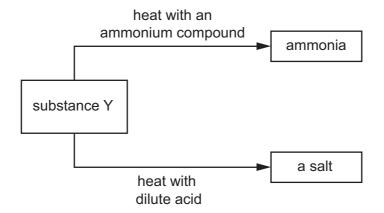
Which process is shown by the arrow marked X?

- A combustion
- **B** photosynthesis
- **C** respiration
- **D** transpiration

32 A catalytic converter removes harmful gases from motor car exhausts.

Which reaction does **not** take place in a catalytic converter?

- A $2CO + O_2 \rightarrow 2CO_2$
- $\textbf{B} \quad N_2 + 2CO_2 \rightarrow 2NO + 2CO$
- $\mathbf{C} \quad 2\mathsf{NO}_2 \to \mathsf{N}_2 + 2\mathsf{O}_2$
- $\textbf{D} \quad 2NO_2 + 4CO \rightarrow N_2 + 4CO_2$
- **33** The diagram shows some reactions of substance Y.



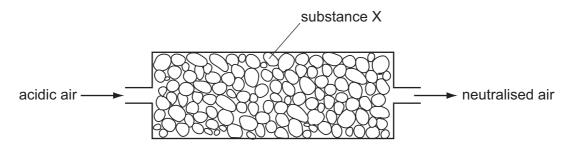
Which type of substance is Y?

- A an alcohol
- **B** a base
- C a catalyst
- **D** a metal

34 Which row shows the conditions for the manufacture of sulfuric acid?

	pressure/atm	temperature/°C	catalyst
Α	2	450	vanadium(V) oxide
В	2	250	iron
С	200	450	iron
D	200	250	vanadium(V) oxide

35 Air containing an acidic impurity was neutralised by passing it through a column containing substance X.

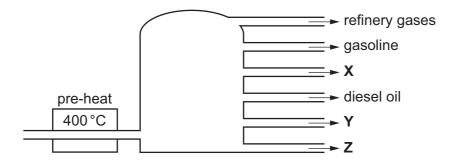


What is substance X?

- A calcium oxide
- **B** sand
- C sodium chloride
- D concentrated sulfuric acid

36 In an oil refinery, petroleum is separated into useful fractions.

The diagram shows some of these fractions.



What are fractions X, Y and Z?

	Х	Υ	Z
Α	fuel oil	bitumen	paraffin (kerosene)
В	fuel oil	paraffin (kerosene)	bitumen
С	paraffin (kerosene)	bitumen	fuel oil
D	paraffin (kerosene)	fuel oil	bitumen

37 Which reaction does not take place in the dark?

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

B
$$CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$$

$$\textbf{C} \quad C_2H_4 + H_2O \rightarrow C_2H_5OH$$

$$\mathbf{D} \quad C_2H_4 + H_2 \rightarrow C_2H_6$$

38 Ethane and ethene are both hydrocarbons.

Ethane reacts with chlorine and ethene reacts with bromine.

Which row describes the type of reaction that ethane and ethene undergo?

	ethane	ethene
Α	addition	addition
В	addition	substitution
С	substitution	substitution
D	substitution	addition

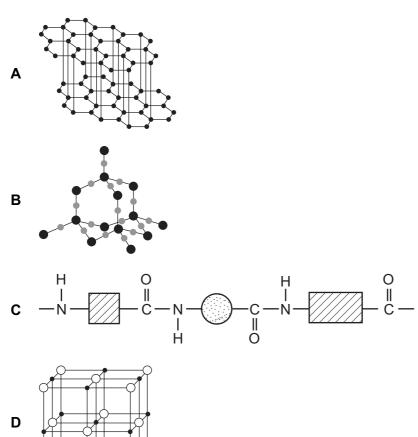
39 Esters are made by reacting an alcohol with a carboxylic acid.

Which acid and alcohol react together to form the following ester?

0971/02/SP/18

- A propanoic acid and ethanol
- B propanoic acid and methanol
- C ethanoic acid and ethanol
- **D** ethanoic acid and methanol

40 Which structure represents a polymer?



© UCLES 2016

	=	2	e H	ullium	4	10	ş	200	20	18	Ā	argan 40	36	호	uepdik	\$	35	Xe	aron	131	96	ş	adon	j												
			_	ı	+		_	_	_	H	_	atlotte at	⊢	_	_	+		_	_	-	_	_	_	1					7.	3	Modum	175	103	ے	BATODGUM	
	5					60	0	unddan	16	16	S	32 32	¥	Se	selectum	20	22	Тe	Solbutum	128	84	Po	polonium	1	116	^	wemorum		70	χ.	yterbirm	173	102	°	_	1
	>					7	z	nitrogen	14	16	۵	phosphorus 31	33	As	amenic	75	50	g	artimony	122	83	B	biamuth	509					69	Ę	trebun	169	101	ΡM	тегоемит	1
	2					9	O	carbon	12	14	Ö	28	32	Ge	permanam	73	20	S	Æ	119	82	Ь	load	202	114	FI	Serovium	(89	ш	entium	167	100	E	Semicin	
	=					9	В	borrer	11	13	ΑZ	ahminium 27	31	Ga	gallum	22	49	Ę	mojou	116	81	21	frallum	504					29	운	holmáun	165	66	S	oinsteirium	1
													98	Zu	Sinc	98	49	8	cadmium	112	90	Ē	mesony	201	112	ნ	openisim		99	2	dysprosium	163	86	Ö	calfornium	1
													59	2	saddro	8	47	Ag	ahur	108	79	Αn	Stole	197	111	Rg	roentgenium	1	65	2	terbian	159	26	ă	perfolium	
dni													28	ž	rickel	28	46	Б	pollodium	106	78	ă	platinum	195	110	S	comstactum		64	В	gadolinium	157	96	Š	outum	
Group													27	ပိ	cobst	20	45	둔	фофия	103	77	'n	mose	192	109	¥	megnerium		63	Ш	europium	152	98	Am	americkum	1
		1	I	нуфорун.	÷								8	Рe	inon	8	4	R	nuthanium	101	92	so	mreumo	190	108	Ë	hassium	1	62	Sm	samanum	150	ä	P	phronium	
													25	M	esourbusu	55	43	J _C	nchrotem	1	75	Se Se	monim	186	107	B	pohrlum	1		Pm			93			
						er.	poq		nass				75	ပ်	gromism	25	42	Wo	тоффонти	96	74	>	progspen	184	106	Sg	sesborgam	1	09	PZ	neotymium	144	35	⊃	uranium 238	200
				2	Key	atomic number	atomic symbol	rames	relative atomic mass				23	>	wanadum	5	4-1	g	riobium	93	73	Тa	tartahm	181	106	9	dubnum	1	20	ď	pranocimina	141	26	Pa	protectinium 234	200
						arto	ato		relati				22	F	Stankum	48	40	Z	zhorkm	91	7.2	Ξ	hafrium	178	104	峜	ntherfordum	1	58	8	mruso	140	06	£	morkum 232	606
													21	Sc	seandam	45	33	>	ytrum	8	57-71	lanthanoids			89-103	activoide			57	0	lanthanum	139	88	Ac	actrium	
	=					4	Be	burylium	6	12	Σ	magnessen 24	50	S	calclum	40	38	ഗ്	stronbum	88	99	Ba	berium	137	88	Ra	radkun	ī		\$2						_
	_					60	=	HHirm	7	11	Na	andum 23	19	¥	potassium	39	37	8	ndbidum	85	99	S	cansium	133	87	芷	frandum	1		lanthanoids				actinoids		

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

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.