Cambridge Assessment International Education

Cambridge IGCSE™ (9–1)

CHEMISTRY **0971/22**

Paper 2 Multiple Choice (Extended) **October/November 2021**

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

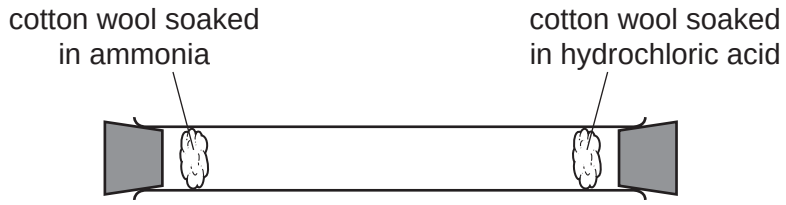
- There are **forty** questions on this paper. Answer **all** questions.
- For each question there are four possible answers **A**, **B**, **C** and **D**. Choose the **one** you consider correct and record your choice in soft pencil on the multiple choice answer sheet.
- Follow the instructions on the 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

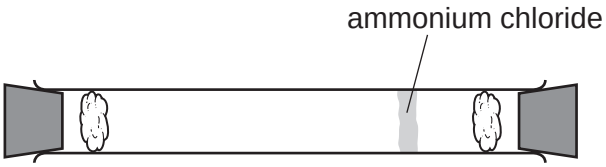
- The total mark for this paper is 40.
- Each correct answer will score one mark.
- Any rough working should be done on this question paper.
- The Periodic Table is printed in the question paper.

This document has **16** pages. Any blank pages are indicated.

1 An experiment is set up as shown.



After several minutes, a white ring of ammonium chloride appears as shown.



Which statement explains the observation after several minutes?

A Ammonia gas diffuses faster than hydrogen chloride gas because its molecules have a lower molecular mass.

B Ammonia gas diffuses faster than hydrogen chloride gas because its molecules have a higher molecular mass.

C Ammonia gas diffuses slower than hydrogen chloride gas because its molecules have a lower molecular mass.

D Ammonia gas diffuses slower than hydrogen chloride gas because its molecules have a higher molecular mass.

2 A student put exactly 25.00 cm^3 of dilute hydrochloric acid into a conical flask.

The student added 2.5 g of solid sodium carbonate and measured the change in temperature of the mixture.

Which apparatus does the student need to use?

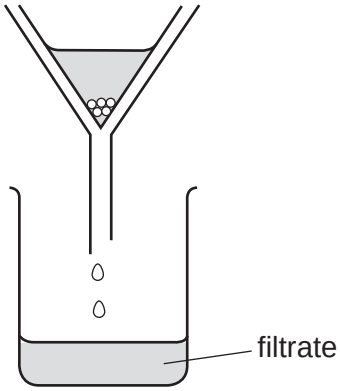
A balance, measuring cylinder, thermometer

B balance, pipette, stopwatch

C balance, pipette, thermometer

D burette, pipette, thermometer

3 A student separates sugar from pieces of broken glass by dissolving the sugar in water and filtering off the broken glass.



What is the filtrate?

A broken glass only

B broken glass and sugar solution

C pure water

D sugar solution

4 How many protons, neutrons and electrons are there in one atom of the isotope $^{27}_{13}Al$?

	protons	neutrons	electrons
A	13	13	13
B	13	14	13
C	14	13	13
D	14	14	13

5 Which description of brass is correct?

A alloy

B compound

C element

D non-metal

6 Some properties of diamond are shown.

1 It is very hard.

2 Every atom forms four bonds.

3 It does not conduct electricity.

Which properties are also shown by silicon(IV) oxide?

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

7 Which statement describes the attractive forces between molecules?

A They are strong covalent bonds which hold molecules together.

B They are strong ionic bonds which hold molecules together.

C They are weak forces formed between covalently-bonded molecules.

D They are weak forces which hold ions together in a lattice.

8 Which substance is described as a macromolecule?

A ammonia

B graphite

C iron

D sodium chloride

9 The equation for the reaction of sodium with water is shown.

$$2Na + 2H_2O \rightarrow 2NaOH + H_2$$

What is the volume of hydrogen gas, measured at r.t.p., produced when 18.4 g of sodium reacts with excess water?

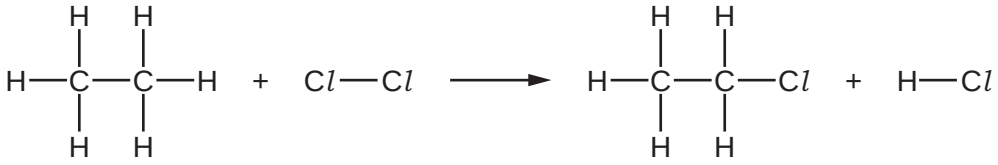
A 9.6 dm^3 **B** 15.0 dm^3 **C** 19.2 dm^3 **D** 30.0 dm^3

10 Iron can be electroplated with zinc to make it resistant to corrosion.

Which row about electroplating iron with zinc is correct?

	positive electrode (anode)	negative electrode (cathode)	electrolyte
A	iron	zinc	iron nitrate
B	iron	zinc	zinc nitrate
C	zinc	iron	iron nitrate
D	zinc	iron	zinc nitrate

11 Chlorine reacts with ethane to produce chloroethane and hydrogen chloride.



The reaction is exothermic.

The bond energies are shown in the table.

bond	bond energy in kJ / mol
C–C*l*	+340
C–C	+350
C–H	+410
C*l*–C*l*	+240
H–C*l*	+430

What is the energy change for the reaction?

A –1420 kJ / mol

B –120 kJ / mol

C +120 kJ / mol

D +1420 kJ / mol

12 Chlorine gas is bubbled into aqueous potassium iodide.

What is the ionic equation for the reaction that takes place?

A $Cl + I^- \rightarrow Cl^- + I$

B $Cl_2 + 2I^- \rightarrow Cl_2^- + I_2$

C $Cl_2 + 2I^- \rightarrow 2Cl^- + I_2$

D $Cl_2 + 2I^- \rightarrow 2Cl^- + 2I$

13 Concentrated aqueous sodium chloride is electrolysed.

Which equation represents the reaction at the cathode?

A $Na^+ + e^- \rightarrow Na$

B $2O^{2-} \rightarrow O_2 + 4e^-$

C $2H^+ + 2e^- \rightarrow H_2$

D $2Cl^- \rightarrow Cl_2 + 2e^-$

14 Which statements about hydrogen are correct?

1 When hydrogen is burned, heat energy is released.

2 When hydrogen is used in a fuel cell, electrical energy is generated.

3 When hydrogen is used as a fuel, water is the only product.

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

15 Solid X is heated strongly.

The colour of the solid changes from blue to white.

What is solid X?

A anhydrous cobalt(II) chloride

B calcium carbonate

C hydrated copper(II) sulfate

D lead(II) bromide

16 Iron(II) chloride solution reacts with chlorine gas.

The equation is shown.

$$2FeCl_2(aq) + Cl_2(g) \rightarrow 2FeCl_3(aq)$$

Which statements about this reaction are correct?

1 Fe^{2+} ions are reduced to Fe^{3+} ions.

2 Chlorine acts as a reducing agent.

3 Fe^{2+} ions each lose an electron.

4 Cl_2 molecules are reduced to Cl^- ions.

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

17 Which statements about acids and bases are correct?

1 An acid reacts with a metal to give off hydrogen.

2 A base reacts with an ammonium salt to give off ammonia.

3 An acid reacts with a carbonate to give off carbon dioxide.

4 Alkaline solutions are orange in methyl orange.

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

18 Oxide 1 is a solid that reacts with dilute hydrochloric acid.

Oxide 2 is a gas that reacts with sodium hydroxide solution.

What are the formulae of the oxides?

	oxide 1	oxide 2
A	CaO	MgO
B	MgO	NO_2
C	NO_2	SO_2
D	SO_2	CaO

19 Which reaction is a photochemical reaction?

A addition of bromine to propene

B esterification of ethanol and ethanoic acid

C oxidation of ethanol

D substitution of methane with chlorine

20 The equation shown represents a reaction at equilibrium.

m and n represent the balancing numbers for the reactant and product respectively.

$$mP(g) \rightleftharpoons nQ(g)$$

A high temperature increases the concentration of Q.

A high pressure increases the concentration of Q.

Which statement about the reaction is correct?

A The forward reaction is exothermic and m is greater than n.

B The forward reaction is exothermic and m is less than n.

C The forward reaction is endothermic and m is greater than n.

D The forward reaction is endothermic and m is less than n.

21 A period of the Periodic Table is shown.

group	I	II	III	IV	V	VI	VII	VIII
element	R	S	T	V	W	X	Y	Z

The letters are not their chemical symbols.

Which statement is correct?

A Element R does not conduct electricity.

B Elements R and Y react together to form an ionic compound.

C Element Z exists as a diatomic molecule.

D Element Z reacts with element T.

22 All metal nitrates are soluble in water.

All metal chlorides are soluble except silver and lead.

All metal carbonates are insoluble except sodium and potassium.

Which aqueous solutions produce a precipitate when mixed together?

1 silver nitrate + sodium carbonate

2 silver nitrate + sodium chloride

3 barium nitrate + potassium chloride

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

23 Which row describes properties of transition elements?

	property 1	property 2	property 3
A	coloured compounds	high density	variable oxidation states
B	high density	high melting point	one oxidation state
C	high melting point	coloured compounds	one oxidation state
D	low melting point	high density	variable oxidation states

24 The noble gases are in Group VIII of the Periodic Table.

Which statement explains why noble gases are unreactive?

A They all have eight electrons in their outer shells.

B They all have full outer shells.

C They are all gases.

D They are all monoatomic.

25 Which statement is correct for **all** metals?

A They conduct electricity when molten.

B They gain electrons when they form ions.

C They have a low density.

D They have a low melting point.

26 Carbon dioxide is produced during the extraction of aluminium from bauxite.

Which statement describes how this carbon dioxide is made?

A Carbon monoxide reduces aluminium oxide forming carbon dioxide and aluminium.

B Carbon is burned in the blast furnace to release heat energy.

C Oxygen made in the process reacts with the carbon electrode.

D The ore of aluminium undergoes thermal decomposition.

27 Aluminium objects do not need protection from corrosion.

Iron objects must be protected from corrosion.

Which statement explains why aluminium resists corrosion?

A Aluminium does not form ions easily.

B Aluminium does not react with water or air.

C Aluminium has a protective oxide layer.

D Aluminium is below iron in the reactivity series.

28 Which statements explain why zinc is used to protect iron from rusting?

1 Zinc is more reactive than iron.

2 Zinc is less reactive than iron.

3 Zinc can form alloys with iron.

4 Zinc acts as a sacrificial metal.

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

29 Which conditions are used in the Haber process?

	temperature / °C	pressure / atmospheres
A	100	10
B	450	10
C	450	200
D	1000	500

30 Which process does **not** produce a greenhouse gas?

A acid rain on limestone buildings

B combustion of wood

C digestion in cows

D zinc reacting with sulfuric acid

31 Which reaction involving sulfur dioxide is correct?

A It is produced during the extraction of zinc from zinc blende.

B It reacts with concentrated sulfuric acid to form oleum.

C It reacts with sulfur to form sulfur trioxide.

D It turns an acidified solution of potassium manganate(VII) purple.

32 Lime (calcium oxide) is used to treat waste water from a factory.

Which substance is removed by the lime?

A ammonia

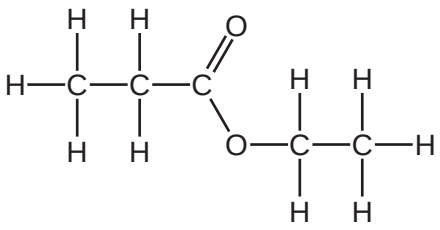
B sodium chloride

C sodium hydroxide

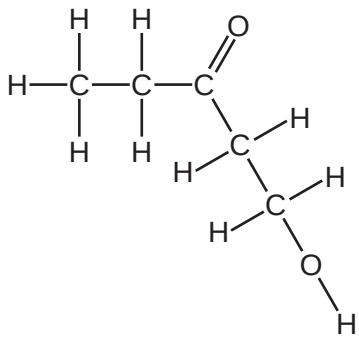
D sulfuric acid

33 What is the structure of the ester formed from ethanoic acid and propanol?

A



B



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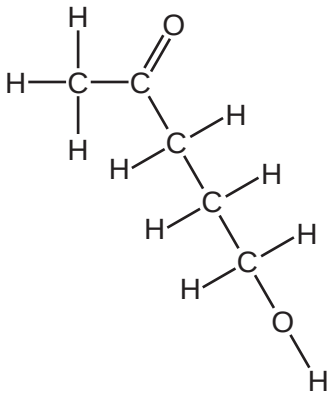

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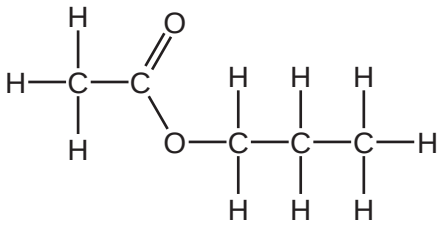
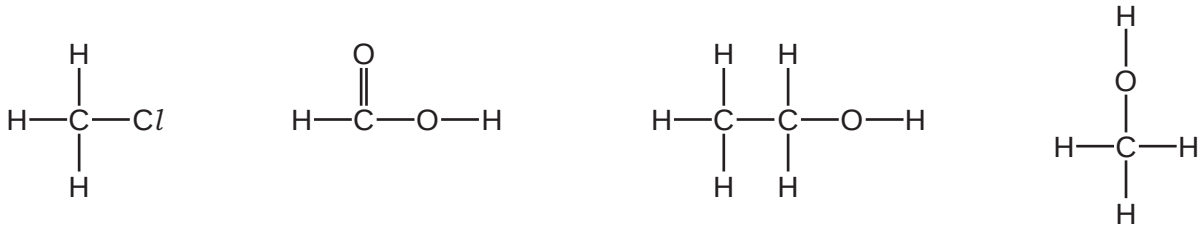


34 Fuel X produces carbon dioxide and water when it is burned in air. So does fuel Y.

What could X and Y be?

	X	Y
A	C	H_2
B	C	C_8H_{18}
C	CH_4	H_2
D	CH_4	C_8H_{18}

35 The structures of four organic molecules are shown.



How many different homologous series are represented by these molecules?

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

36 Which statement about ethene is correct?

A It has the chemical formula C_2H_6.

B It burns in excess oxygen producing carbon dioxide and water.

C It reacts with Br_2 to produce an orange solution.

D It reacts with oxygen to form ethanol.

37 Ethanol is manufactured by fermentation of sugars or by catalytic hydration of ethene.

Which row states an advantage of each method?

	fermentation	hydration
A	produces purer ethanol	is a batch process
B	produces purer ethanol	is a continuous process
C	uses a renewable resource	is a batch process
D	uses a renewable resource	is a continuous process

38 Which statements about unsaturated hydrocarbons are correct?

1 They contain both single and double bonds.

2 They turn aqueous bromine from colourless to brown.

3 They can be manufactured by cracking.

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

39 Which polymers have the same linkage between monomer units?

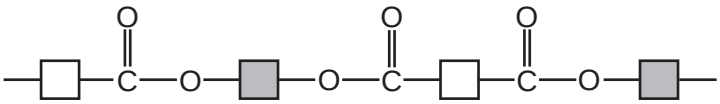
A carbohydrate and polyamide

B carbohydrate and polyester

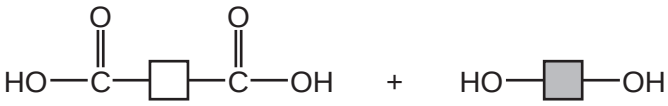
C protein and polyamide

D protein and polyester

40 The diagram shows the partial structure of *Terylene*.



From which pair of compounds is it made?

A 

B 

C 

D 

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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.).