Cambridge Assessment International Education

MEM

Cambridge IGCSE™

CHEMISTRY **0620/21**

Paper 2 Multiple Choice (Extended) **October/November 2024**

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)

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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 Which row describes the arrangement and motion of the particles in a liquid?

	arrangement	motion
A	random and particles are touching	moving slowly
B	random with space between all particles	moving slowly
C	an ordered lattice with all particles touching	moving slowly
D	an ordered lattice with space between all particles	moving quickly

2 Which gas has the lowest rate of diffusion at room temperature and pressure?

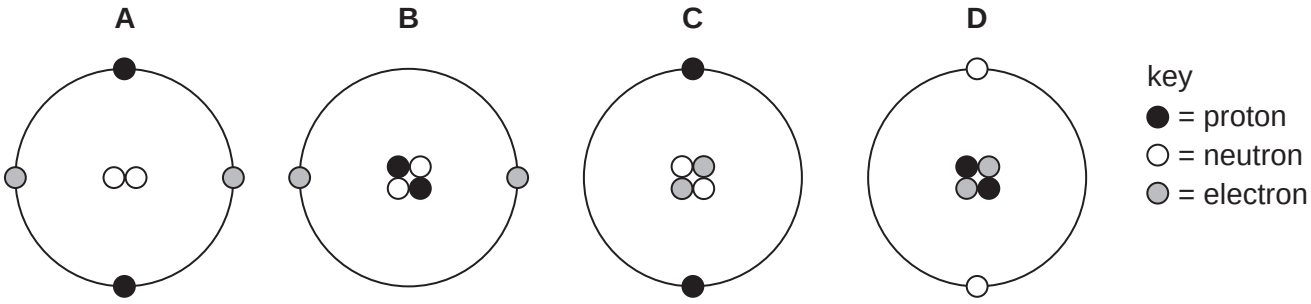
A the gas produced when ammonium chloride is heated with aqueous sodium hydroxide

B the gas which makes up approximately 78% of clean, dry air

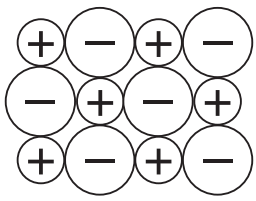
C the gas produced when sodium carbonate is added to dilute hydrochloric acid

D the gas produced when zinc is added to dilute sulfuric acid

3 Which diagram represents one helium atom?



4 The diagram shows part of an ionic lattice structure.



Which compound does the diagram represent?

A potassium bromide

B sodium oxide

C magnesium chloride

D carbon monoxide

5 Which statement about nitrogen molecules and ethene molecules is correct?

A A nitrogen molecule has 2 more shared electrons than an ethene molecule.

B An ethene molecule has 3 more shared electrons than a nitrogen molecule.

C A nitrogen molecule has 4 more shared electrons than an ethene molecule.

D An ethene molecule has 6 more shared electrons than a nitrogen molecule.

6 Sulfur is a simple molecule with the formula S_8.

Which row describes and explains the melting point of sulfur?

	melting point	explanation
A	high	the covalent bonds between sulfur atoms are strong
B	high	the covalent bonds between sulfur molecules are strong
C	low	the forces of attraction between sulfur atoms are weak
D	low	the forces of attraction between sulfur molecules are weak

7 Which row identifies a property and an explanation of the property for both diamond and silicon(IV) oxide?

	property	explanation of property
A	very hard	diamond has a giant covalent structure and silicon(IV) oxide has a giant ionic structure
B	high melting point	both have giant covalent structures with many strong bonds between the atoms
C	good lubricant	both have layers of atoms, which can slide over each other
D	poor conductor	both contain only non-metal elements and are simple molecules

8 Which statement about the structure of metals explains why metals are malleable?

A The electrons can move freely throughout the lattice.

B The layers of metal ions can slide over each other.

C The metal ions are positively charged.

D There is a strong force of attraction between the metal ions and the electrons.

[Turn over

9 What is the formula of iron(III) oxide?

A FeO **B** Fe_3O_4 **C** FeO_2 **D** Fe_2O_3

10 Calcium carbonate is heated. Calcium oxide and carbon dioxide gas are formed.

The equation for the reaction is shown.

$$CaCO_3 \rightarrow CaO + CO_2$$

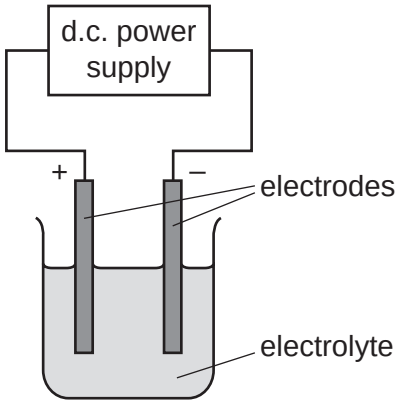
225 kg of calcium carbonate is heated until there is no further change in mass.

The yield of calcium oxide is 85 kg.

What is the percentage yield?

A 37.8% **B** 47.2% **C** 67.5% **D** 85.0%

11 The apparatus used for electrolysis is shown.



Which statement is correct?

A Copper forms at the anode in some electrolysis reactions.

B Hydrogen forms at the cathode in some electrolysis reactions.

C Oxygen forms at the cathode in some electrolysis reactions.

D Sodium forms at the anode in some electrolysis reactions.

12 Which statement about the electrolysis of aqueous copper(II) sulfate is correct?

A When copper electrodes are used, the solution turns from blue to colourless.

B When graphite electrodes are used, bubbles of gas are formed at the cathode.

C When copper electrodes are used, the anode gets smaller.

D When graphite electrodes are used, the colour of the solution does **not** change.

13 Which statement describes an advantage of using a hydrogen–oxygen fuel cell in a car compared to a gasoline engine?

A The hydrogen is difficult to store.

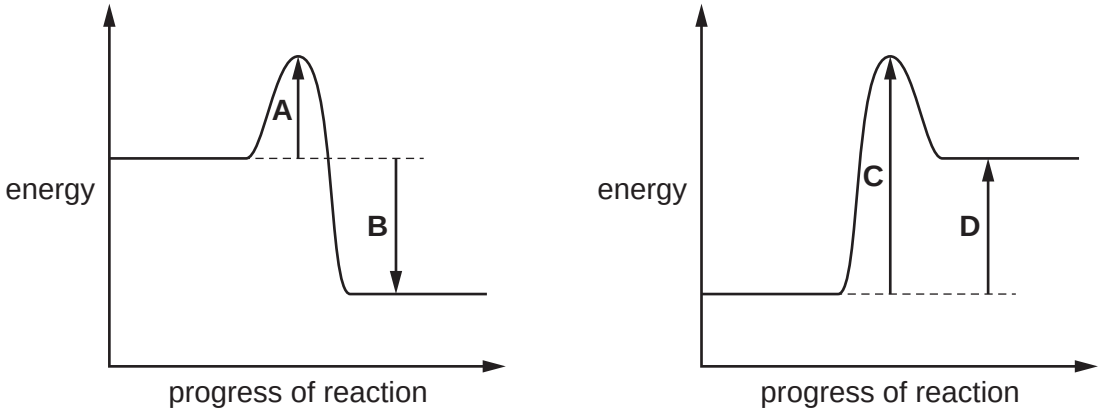
B The hydrogen is highly flammable.

C The hydrogen used is made from hydrocarbons.

D The only chemical product is water.

14 Two reaction pathway diagrams are shown.

Which arrow represents the activation energy for a reaction which releases thermal energy?



15 Which statements about the Haber process are correct?

1 A high temperature is used because the reaction is slow at room temperature.

2 A high pressure is used because there are more moles of gaseous reactants than moles of gaseous product.

3 A nickel catalyst is used to increase the rate of reaction.

4 An iron catalyst is used to increase the equilibrium yield of ammonia.

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

16 Which substance is a raw material used to manufacture sulfuric acid?

A vanadium(V) oxide

B sulfur

C sulfur dioxide

D sulfur trioxide

17 Which colours are seen when litmus and methyl orange are added to separate samples of aqueous sodium hydroxide?

	litmus	methyl orange
A	blue	orange
B	blue	yellow
C	purple	orange
D	purple	yellow

18 Information about the solubility in water of four oxides is shown.

Which oxide, when added to water, gives a solution with a pH less than pH 7?

	name of oxide	solubility in water
A	nitrogen dioxide	soluble
B	copper(II) oxide	insoluble
C	silicon(IV) oxide	insoluble
D	barium oxide	soluble

19 Copper(II) sulfate is made when copper(II) carbonate reacts with dilute sulfuric acid.

$$CuCO_3 + H_2SO_4 \rightarrow CuSO_4 + H_2O + CO_2$$

Pure copper(II) sulfate crystals are obtained.

Which reagent is in excess and how are the crystals obtained?

	reagent in excess	how the crystals are obtained
A	copper(II) carbonate	filter and evaporate the solution to dryness
B	copper(II) carbonate	filter, evaporate the solution to crystallising point and then cool
C	dilute sulfuric acid	evaporate the solution to dryness
D	dilute sulfuric acid	evaporate the solution to crystallising point and then cool

20 Which statement about elements in Group I or Group VII of the Periodic Table is correct?

A Bromine reacts with potassium chloride to produce chlorine.

B Iodine is a monatomic non-metal.

C Lithium has a higher melting point than potassium.

D Sodium is more reactive with water than potassium.

21 Some information about an element from Group VII of the Periodic Table is shown.

melting point / °C	–7
boiling point / °C	59

What is the element?

A fluorine

B chlorine

C bromine

D iodine

22 Manganese(IV) oxide, MnO_2, is a black solid.

The equation for the reaction between manganese(IV) oxide and dilute hydrochloric acid is shown.

$$MnO_2 + 4HCl \rightarrow MnCl_2 + 2H_2O + Cl_2$$

The reaction produces a pale pink solution.

Which properties of transition elements does this reaction show?

1 They can act as catalysts.

2 They form coloured compounds.

3 They have high melting points.

4 They have variable oxidation numbers.

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

23 Part of a steel ship is protected from rusting using a sacrificial metal.

What is a suitable sacrificial metal?

A copper

B zinc

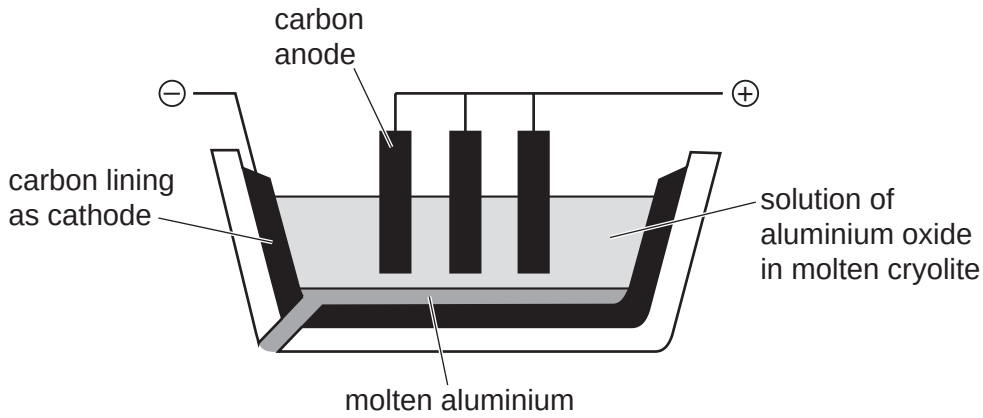
C silver

D potassium

24 Which row gives a use for the named metal and two properties which **both** explain this use?

	metal	use	property 1	property 2
A	aluminium	aircraft construction	high density	resistant to corrosion
B	copper	electrical wiring	good electrical conductivity	ductile
C	aluminium	food containers	resistant to corrosion	**not** malleable
D	copper	aircraft construction	malleable	low density

25 The apparatus used for the extraction of aluminium by electrolysis is shown.



Which equation represents the reaction at the anode?

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

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

C $Al^{3-} \rightarrow Al + 3e^-$

D $Al^{3+} + 3e^- \rightarrow Al$

26 Which gas is both an element and present in clean, dry air?

A argon

B carbon dioxide

C chlorine

D water vapour

27 Oxides of nitrogen formed in a car's engine are removed using a catalytic converter.

What happens to the oxides of nitrogen in the catalytic converter?

A They are hydrated.

B They are neutralised.

C They are oxidised.

D They are reduced.

28 What is the equation for photosynthesis?

A $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

B $2CO_2 + 2H_2O \rightarrow 2C_2H_5OH + 3O_2$

C $C_6H_{12}O_6 \rightarrow 2CO_2 + 2C_2H_5OH$

D $C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$

29 Four statements about members of the same homologous series are listed.

1 They have the same volatility.

2 They have the same molecular formula.

3 They have the same functional group.

4 They have the same general formula.

Which statements are correct?

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

30 Ethene reacts with steam to produce ethanol.

Which row describes each compound?

	ethene	ethanol
A	saturated	saturated
B	saturated	unsaturated
C	unsaturated	saturated
D	unsaturated	unsaturated

[Turn over

31 Which process is used to make an alkene from a long-chain alkane?

A combustion

B condensation

C cracking

D polymerisation

32 Which fraction obtained from petroleum has the lowest boiling point?

A diesel oil

B fuel oil

C kerosene

D naphtha

33 Alkanes undergo substitution reactions with chlorine in the presence of ultraviolet light.

Which equation shows a reaction of this type?

A $C_3H_6 + Cl_2 \rightarrow C_3H_6Cl_2$

B $C_3H_8 + Cl_2 \rightarrow C_3H_6Cl_2 + H_2$

C $C_3H_8 + Cl_2 \rightarrow C_3H_7Cl + HCl$

D $C_3H_6 + Cl_2 \rightarrow C_3H_5Cl + HCl$

34 Information about two reactions of ethene is listed.

- Reaction 1 requires a nickel catalyst.
- Reaction 2 requires an acid catalyst.

Which substance reacts with ethene in each reaction?

	reaction 1	reaction 2
A	bromine	steam
B	bromine	hydrogen
C	hydrogen	bromine
D	hydrogen	steam

35 Which process converts CH_3CH_2OH to CH_3COOH?

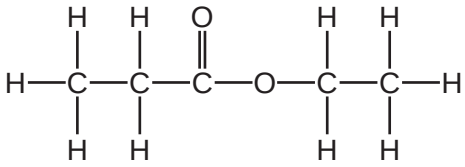
A bacterial oxidation

B fermentation

C catalytic addition of steam

D catalytic addition of hydrogen

36 The structure of an ester is shown.



Which row identifies the name of the ester and the two compounds from which it is made?

	name	compound 1	compound 2
A	ethyl propanoate	ethanol	propanoic acid
B	ethyl propanoate	propanol	ethanoic acid
C	propyl ethanoate	ethanol	propanoic acid
D	propyl ethanoate	propanol	ethanoic acid

37 Which statements about monomers or polymers are correct?

1 Monomers are **always** joined together by addition reactions.

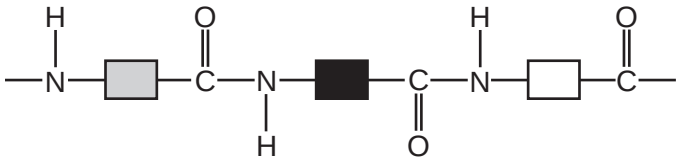
2 A polymer can be formed from a single type of monomer.

3 A polymer can be formed by joining two different types of monomer.

4 Water is **always** produced when monomer molecules join together.

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

38 The diagram shows the structure of a naturally occurring polymer, Q.



What is Q?

A an amino acid

B nylon

C a protein

D PET

39 Which row shows how the boiling point and the melting point of water change when a soluble impurity is added to the water?

	boiling point	melting point
A	increases	increases
B	decreases	decreases
C	increases	decreases
D	decreases	increases

40 X is a white powder. The following tests are done on X.

- When a few drops of aqueous sodium hydroxide are added to a solution of X, no precipitate is seen.
- When X is heated with aqueous sodium hydroxide, no gas is formed.
- X gives a lilac colour when put into a flame.
- When acidified aqueous silver nitrate is added to a solution of X, a yellow precipitate is seen.

What is X?

A ammonium bromide

B ammonium iodide

C potassium bromide

D potassium iodide

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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.).