Cambridge Assessment International Education

Cambridge IGCSE™

CHEMISTRY **0620/23**

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)

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.

[Turn over

1 A sample of ethanol is left in an open beaker at room temperature.

After 24 hours, no ethanol remains in the beaker.

What has happened to the ethanol?

A It has boiled.

B It has condensed.

C It has evaporated.

D It has frozen.

2 A gas is in a sealed container with a fixed volume.

Which statements describe what happens to the molecules in the gas when the temperature is increased?

1 They move more slowly.

2 They collide with the walls of the container more frequently.

3 They collide with the walls of the container with less force.

4 They have greater kinetic energy.

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

3 What happens when sodium atoms combine with chlorine atoms to form sodium chloride?

A Sodium atoms each gain one electron, and chlorine atoms each lose one electron.

B Sodium atoms each lose one electron, and chlorine atoms each gain one electron.

C Sodium atoms and chlorine atoms share one electron with each other.

D Sodium atoms and chlorine atoms share two electrons with each other.

4 The table shows some properties of four substances.

substance	melting point	electrical conductivity when solid	electrical conductivity when molten
1	high	poor	poor
2	high	poor	good
3	low	poor	poor
4	high	good	good

Which substances are ionic?

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

5 Which statement about methane is correct?

A In methane, positive hydrogen ions are attracted to negative carbon ions.

B In methane, electrons are shared between carbon atoms and hydrogen atoms.

C Methane has a high boiling point.

D Methane is a good conductor of electricity.

6 A sample of iridium has a relative atomic mass of 192.29.

The sample contains two isotopes only.

64.50% of the sample is ^{193}Ir.

What is the other isotope in the sample?

A ^{189}Ir **B** ^{190}Ir **C** ^{191}Ir **D** ^{192}Ir

7 Ammonium iron(III) citrate contains in its formula:

- more than one ammonium ion
- one iron ion
- two $C_6H_4O_7^{4-}$ ions.

What is the formula of ammonium iron(III) citrate?

A $(NH_4)_4Fe(C_6H_4O_7)_2$

B $(NH_4)_5Fe(C_6H_4O_7)_2$

C $(NH_4)_6Fe(C_6H_4O_7)_2$

D $(NH_4)_7Fe(C_6H_4O_7)_2$

8 Silicon(IV) oxide reacts with chlorine and carbon to form liquid silicon(IV) chloride, $SiCl_4$, and carbon dioxide gas.

If the reaction is carried out at r.t.p., which symbol equation represents this reaction?

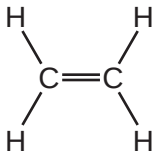
A $SiO_2(l) + 2Cl_2(g) + C(s) \rightarrow SiCl_4(l) + CO_2(g)$

B $SiO_2(l) + 2Cl_2(g) + C(g) \rightarrow SiCl_4(l) + CO_2(g)$

C $SiO_2(s) + 2Cl_2(g) + C(s) \rightarrow SiCl_4(g) + CO_2(g)$

D $SiO_2(s) + 2Cl_2(g) + C(s) \rightarrow SiCl_4(l) + CO_2(g)$

9 The structure of ethene is shown.



How many hydrogen atoms and how many carbon atoms are in one mole of ethene?

	hydrogen atoms	carbon atoms
A	2.4×10^{24}	1.2×10^{24}
B	2.4×10^{24}	6.0×10^{23}
C	6.0×10^{23}	1.2×10^{22}
D	6.0×10^{23}	6.0×10^{23}

10 A known volume and concentration of aqueous sodium hydroxide is titrated against dilute hydrochloric acid.

The volume of dilute hydrochloric acid needed to exactly neutralise the sodium hydroxide is measured.

Five calculation steps are shown.

1 Calculate the amount of hydrochloric acid in moles.

2 Calculate the relative formula mass of hydrochloric acid.

3 Calculate the concentration of hydrochloric acid in g/dm^3.

4 Calculate the amount of sodium hydroxide in moles.

5 Calculate the concentration of hydrochloric acid in mol/dm^3.

What is the order of these steps to calculate the concentration of the hydrochloric acid in g/dm^3?

A $1 \rightarrow 4 \rightarrow 3 \rightarrow 5 \rightarrow 2$

B $1 \rightarrow 2 \rightarrow 4 \rightarrow 5 \rightarrow 3$

C $4 \rightarrow 1 \rightarrow 5 \rightarrow 2 \rightarrow 3$

D $4 \rightarrow 2 \rightarrow 1 \rightarrow 3 \rightarrow 5$

11 Two different substances are electrolysed using inert electrodes in two separate experiments.

Hydrogen is produced in both experiments.

Which row identifies the two substances and the electrode at which hydrogen is produced?

	substance 1	substance 2	electrode
A	molten sodium chloride	aqueous sodium chloride	anode
B	molten sodium chloride	aqueous sodium chloride	cathode
C	dilute sulfuric acid	concentrated hydrochloric acid	anode
D	dilute sulfuric acid	concentrated hydrochloric acid	cathode

12 Aqueous copper(II) sulfate can be electrolysed using either carbon electrodes or copper electrodes.

Which statement describes what happens at the positive electrode?

A Copper is deposited if the electrode is made from carbon.

B Copper is deposited if the electrode is made from copper.

C Oxygen gas is produced if the electrode is made from carbon.

D Oxygen gas is produced if the electrode is made from copper.

13 Which statement about a hydrogen–oxygen fuel cell is **not** correct?

A Chemical energy is converted into electrical energy.

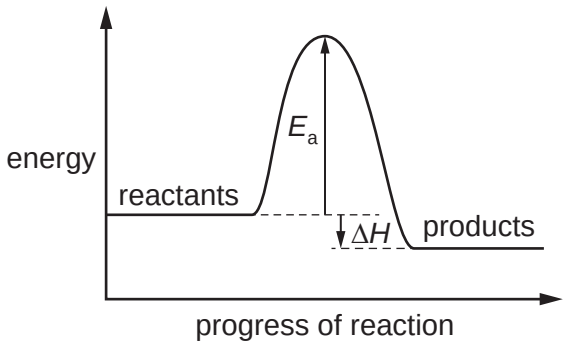
B Hydrogen is oxidised.

C The reaction that takes place is endothermic.

D Water is the only chemical product.

14 Which reaction pathway diagram is correctly labelled?

A



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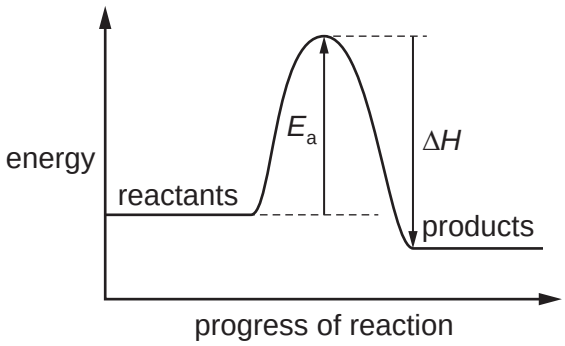

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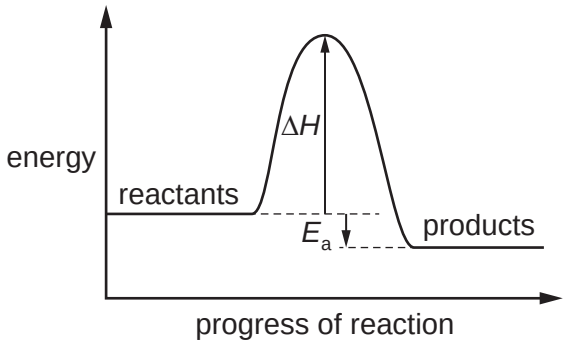

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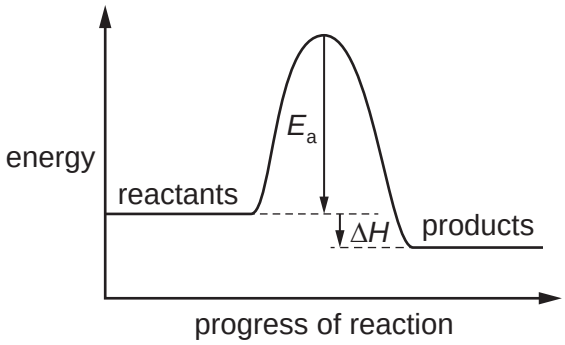


15 Which row describes a reaction where the overall energy change is exothermic?

	energy needed for breaking bonds / kJ	energy released by forming bonds / kJ	temperature of the surroundings
A	600	300	decreases
B	600	1200	decreases
C	900	300	increases
D	900	1200	increases

16 Which process involves a physical change only?

A heating calcium carbonate strongly

B burning wood

C melting an ice cube

D mixing an acid and a base

17 In the Haber process, an equilibrium is established.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

The forward reaction is exothermic.

Which change to the reaction conditions will move the position of equilibrium to the left?

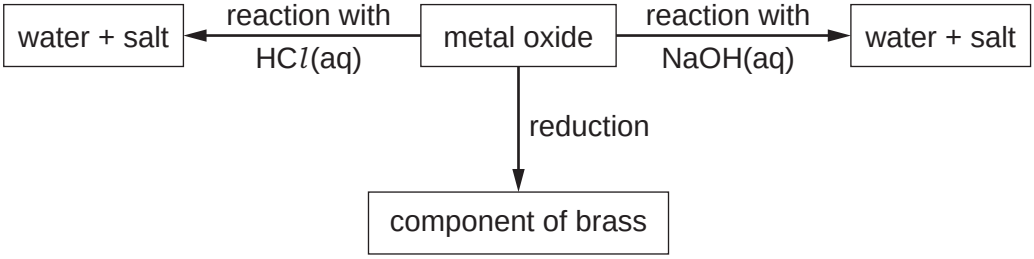
A decreasing the pressure by 100 atm

B decreasing the temperature by 100 °C

C adding more nitrogen gas to the mixture

D removing the iron catalyst

18 The flow chart shows some properties of a metal oxide.



What is the metal oxide?

A aluminium oxide

B copper(II) oxide

C iron(III) oxide

D zinc oxide

19 Which statement about reactants in redox reactions is correct?

A An oxidising agent donates electrons, and a reducing agent accepts electrons.

B When one element gains electrons, the oxidation number of a different element increases.

C When the oxidation number of one element increases, a different element gains oxygen.

D When the oxidation number of one element increases, a different element loses electrons.

20 Aluminium is extracted from aluminium oxide by electrolysis. The ionic half-equation for the reaction at one of the electrodes is shown.

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

Which row describes the change in oxidation number of the aluminium and the type of reaction at this electrode?

	change in oxidation number of aluminium	type of reaction
A	decrease	reduction
B	decrease	oxidation
C	increase	reduction
D	increase	oxidation

21 Which statement about dilute hydrochloric acid is correct?

A It is a strong acid as it fully dissociates.

B It is a strong acid as it partially dissociates.

C It is a weak acid as it fully dissociates.

D It is a weak acid as it partially dissociates.

22 Which row describes and gives the formula of hydrated copper(II) sulfate?

	description of hydrated copper(II) sulfate	formula of hydrated copper(II) sulfate
A	aqueous copper(II) sulfate	$CuSO_4 \cdot 5H_2O$
B	aqueous copper(II) sulfate	$CuSO_4(aq)$
C	copper(II) sulfate chemically combined with water molecules	$CuSO_4(aq)$
D	copper(II) sulfate chemically combined with water molecules	$CuSO_4 \cdot 5H_2O$

23 The equations for three reactions are shown.

1 $Pb(NO_3)_2(aq) + 2KI(aq) \rightarrow PbI_2(s) + 2KNO_3(aq)$

2 $2AgNO_3(aq) + CuI_2(aq) \rightarrow Cu(NO_3)_2(aq) + 2AgI(s)$

3 $CuO(s) + H_2SO_4(aq) \rightarrow CuSO_4(aq) + H_2O(l)$

Which reactions are suitable for making a salt by precipitation?

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

24 Acidified potassium dichromate(VI), $K_2Cr_2O_7$, is used to oxidise ethanol, C_2H_5OH.

The ionic equation for the reaction is shown.

$$3C_2H_5OH + 2Cr_2O_7^{2-} + 16H^+ \rightarrow 3CH_3COOH + 4Cr^{3+} + 11H_2O$$

Which properties of transition elements are shown by chromium in this reaction?

	acts as a catalyst	variable oxidation number
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

25 Which statements describe the Periodic Table?

1 The elements are arranged in order of their nucleon number.

2 The elements are arranged in order of their proton number.

3 It is used to predict the properties of elements.

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

26 Which row shows the correct order of reactivity of the four named metals?

	most reactive →			least reactive
A	magnesium	copper	zinc	silver
B	magnesium	zinc	copper	silver
C	silver	copper	zinc	magnesium
D	silver	zinc	copper	magnesium

27 Four iron nails are added to four different metal sulfate solutions.

In which solution does a displacement reaction occur?

A copper(II) sulfate

B magnesium sulfate

C sodium sulfate

D zinc sulfate

28 A fertiliser contains ammonium nitrate and potassium phosphate.

Why is the fertiliser described as an NPK fertiliser?

A It provides nitrogen, which is an essential element for improved plant growth.

B It contains the element oxygen, which neutralises acidic soil.

C It contains the elements nitrogen and phosphorus.

D It provides the three main elements needed for improved plant growth.

29 What are the approximate percentages of oxygen and nitrogen in clean, dry air?

	percentage of oxygen	percentage of nitrogen
A	19	80
B	21	78
C	80	19
D	78	21

30 Which compounds have similar chemical properties?

A butanol and butanoic acid

B ethane and ethene

C methane and butane

D propene and propanol

31 Four statements about organic compounds P, Q, R and S are listed.

P is a saturated hydrocarbon.

The formula of Q is CH_3CH_3.

A molecule of R contains only one oxygen atom.

Compound S is a carboxylic acid.

Which statement about these compounds is correct?

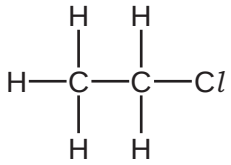
A P and Q are members of different homologous series.

B P and S are members of the same homologous series.

C Q and S are members of the same homologous series.

D Q, R and S are all members of different homologous series.

32 The structure of an organic compound is shown.



What is the name of the compound?

A chloroethane

B chloroethene

C chloroethanol

D chloroethanoic acid

33 Which statement about the manufacture of ethene from larger alkane molecules is correct?

A A low temperature is required.

B The process is called cracking.

C The process requires an excess of oxygen.

D Water is also a product.

34 Which processes are used to make ethanoic acid?

1 heating ethanol with acidified aqueous potassium manganate(VII)

2 bacterial oxidation of ethanol

3 distilling ethanol using a fractionating column

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

35 Which statement about propene, C_3H_6, is correct?

A Propene reacts with bromine in the dark in a substitution reaction.

B Propene reacts with steam in the presence of an alkaline catalyst, forming an alcohol.

C Propene undergoes addition polymerisation, forming poly(ethene).

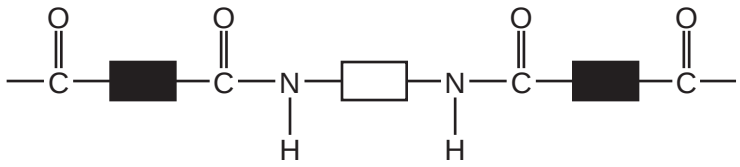
D Propene undergoes an addition reaction to form an alkane.

36 How many of each type of bond are present in ethanoic acid, CH_3COOH?

	type of bond		
	C–H	C–C	C=O
A	3	1	1
B	3	0	2
C	4	0	2
D	4	1	2

37 Which diagram represents the structure of a protein?

A



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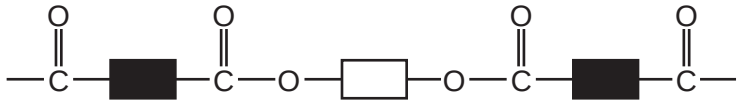

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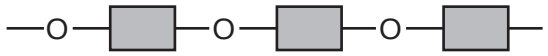

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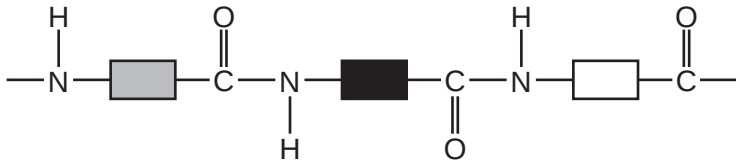
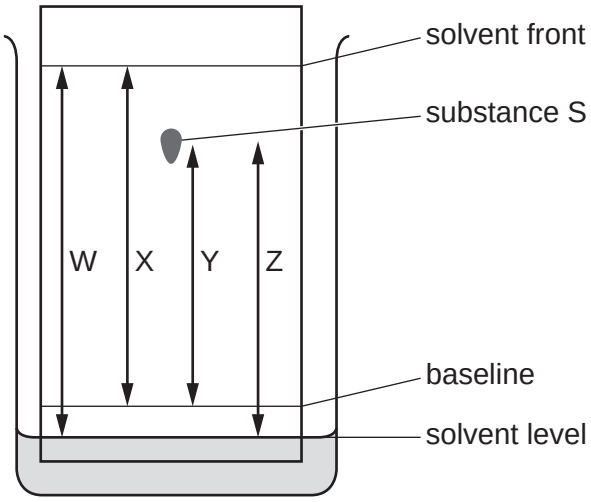


38 The chromatogram of substance S is shown.

Some distances, W, X, Y and Z, are labelled on the diagram.



How is the R_f value of substance S calculated?

A $\frac{X}{Y}$ **B** $\frac{W}{Z}$ **C** $\frac{Y}{X}$ **D** $\frac{Y}{W}$

39 Some information about solid silver chloride and solid sodium chloride is shown.

- Silver chloride and sodium chloride do **not** dissolve in kerosene.
- Silver chloride is insoluble in water, but sodium chloride is soluble in water.
- The boiling point of silver chloride is 1547 °C and the boiling point of sodium chloride is 1413 °C.

Which processes are used to separate a mixture of solid silver chloride and solid sodium chloride?

A add kerosene, stir and then filter

B add water, stir and then filter

C add water, stir and then leave to crystallise

D add water, stir and then perform fractional distillation

40 Which statement describes how a flame test is done?

A The tip of a clean wire is dipped into the substance and the wire is placed in a blue Bunsen burner flame.

B The tip of a clean wire is dipped into the substance and the wire is placed in a yellow Bunsen burner flame.

C A wooden splint is lit and is placed above a test-tube containing the gas being tested.

D A wooden splint is lit, blown out and the glowing splint put into a test-tube of the gas being tested.

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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.).