Cambridge Assessment International Education

Cambridge O Level

CHEMISTRY **5070/12**

Paper 1 Multiple Choice **October/November 2023**

1 hour

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.

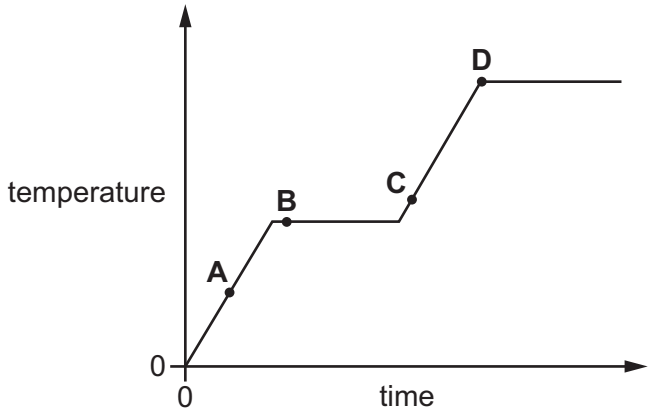
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1 A solid substance is placed in a flask.

The flask is gently heated and the temperature of the substance is recorded at regular time intervals.

The diagram shows a graph of temperature against time for this experiment.

At which point does the flask contain both a solid and a liquid?



2 A crystal of sodium chloride is dropped into a beaker of water and the crystal dissolves.

There are four stages in this process.

1 The water molecules collide with the ions in the crystal lattice.

2 The ionic bonds in the crystal break.

3 The ions move randomly in all directions until they are evenly spread throughout the solution.

4 The ions continue to move randomly in all directions but remain evenly spread throughout the solution.

At which stages is diffusion occurring?

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

3 W is ethene, X is air, Y is iodine and Z is brass.

Which row is correct?

	element	compound	mixture
A	W	Z	X and Y
B	W	Y	X and Z
C	Y	W and Z	X
D	Y	W	X and Z

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4 Which statement about the isotopes of bromine is correct?

A They are atoms with the same number of electrons and a different number of protons.

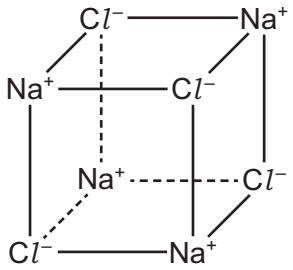
B They are atoms with the same number of neutrons and the same number of electrons.

C They are atoms with the same number of protons and the same chemical properties.

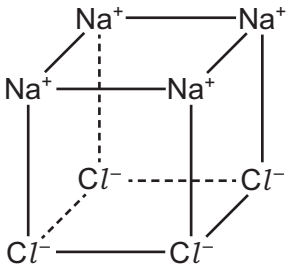
D They are atoms with the same number of protons and the same physical properties.

5 Which diagram shows a section of the ionic lattice of sodium chloride?

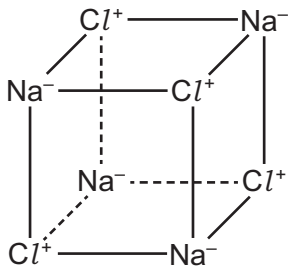
A



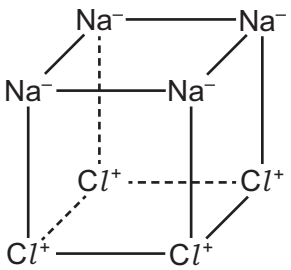
B



C



D



6 When dilute hydrochloric acid is added to aqueous lead(II) nitrate, a white precipitate of lead(II) chloride is formed.

What is the ionic equation for this reaction?

A $Pb^{2+}(aq) + 2HCl(aq) \rightarrow PbCl_2(s) + 2H^+(aq)$

B $Pb^{2+}(aq) + 2HCl(aq) + 2HNO_3(aq) \rightarrow PbCl_2(s) + 4H^+(aq) + 2NO_3^-(aq)$

C $Pb^{2+}(aq) + 2Cl^-(aq) \rightarrow PbCl_2(s)$

D $Pb(NO_3)_2(aq) + 2HCl(aq) \rightarrow Pb^{2+}(aq) + 2Cl^-(aq) + 2HNO_3(aq)$

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7 Which row shows a pair of molecules where the M_r of compound X is exactly half that of compound Y?

[A_r: C, 12; Cl, 35.5; H, 1; O, 16]

	X	Y
A	$CH_3CH_2CH_3$	CO_2
B	CH_3CH_2Cl	CH_2ClCH_2Cl
C	CH_3CO_2H	$CH_3CH_2CH_3$
D	CO_2	$CH_3CO_2C_2H_5$

8 One volume of a gaseous element, X_2, combines with an equal volume of gaseous hydrogen to form two volumes of a gaseous hydride.

What is the formula for the hydride of X?

A H_2X **B** HX **C** HX_2 **D** H_2X_2

9 Which reaction would produce the greatest volume of carbon dioxide at room temperature and pressure?

[M_r: $CaCO_3$, 100; Na_2CO_3, 106; $CuCO_3$, 124]

A burning 1 g of carbon in excess oxygen

$$C(s) + O_2(g) \rightarrow CO_2(g)$$

B thermal decomposition of 10 g of calcium carbonate in the air

$$CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$$

C adding 10 g of sodium carbonate to an excess of dilute hydrochloric acid

$$Na_2CO_3(s) + 2HCl(aq) \rightarrow 2NaCl(aq) + CO_2(g) + H_2O(l)$$

D adding 50 cm^3 of 1 mol / dm^3 sulfuric acid to an excess of copper carbonate

$$CuCO_3(s) + H_2SO_4(aq) \rightarrow CuSO_4(aq) + CO_2(g) + H_2O(l)$$

10 Chrome alum is the common name for a salt which has the formula $CrK(SO_4)_2$.

What is the percentage by mass of chromium in chrome alum?

A 17.3 **B** 18.4 **C** 20.7 **D** 21.3

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11 The equation shows the production of iron by the reduction of iron(III) oxide.

$$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$$

80 tonnes of iron(III) oxide produces 50 tonnes of iron.

What is the percentage yield?

A 45% **B** 63% **C** 68% **D** 89%

12 Aqueous copper(II) sulfate is electrolysed using copper electrodes.

Which row correctly describes what happens?

	mass of anode	mass of cathode	colour of electrolyte
A	increases	decreases	remains blue
B	remains the same	decreases	becomes colourless
C	decreases	increases	remains blue
D	remains the same	increases	becomes colourless

13 Hydrogen reacts with chlorine to form hydrogen chloride.

$$H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$$

The enthalpy change, ΔH, for this reaction can be calculated using bond energies.

bond	bond energy in kJ / mol
H–H	436
Cl–Cl	242
H–Cl	431

What is the value of ΔH for this reaction?

A –247 kJ / mol **B** –184 kJ / mol **C** +184 kJ / mol **D** +247 kJ / mol

14 Nitrogen and oxygen react as shown.

$$N_2(g) + 2O_2(g) \rightarrow 2NO_2(g)$$

The enthalpy change for the reaction shown is +66 kJ.

If two moles of nitrogen and two moles of oxygen are used, what will be the enthalpy change?

A +16.5 kJ **B** +33 kJ **C** +66 kJ **D** +132 kJ

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15 Physical changes and chemical changes can occur in substances.

Which process describes a chemical change?

A covalent bonds in methane molecules are broken

B intermolecular attractions between water molecules are broken

C ionic bonds in a sodium chloride lattice are broken

D the manufacture of brass from copper and zinc

16 Two methods used by students to measure the rate of a reaction are the 'disappearing cross' method and the 'loss of mass' method.

- For the 'disappearing cross' method, the student measures the time taken for the reaction mixture to go cloudy.
- For the 'loss of mass' method, the student measures the loss of mass over a known time interval.

The rates of two reactions are investigated.

reaction 1 Warm aqueous silver nitrate is added to chlorobutane dissolved in ethanol. Two products are formed. One is an organic compound which is soluble in ethanol and the other is silver chloride which is insoluble in ethanol.

reaction 2 Pieces of solid calcium carbonate are added to dilute hydrochloric acid.

Which method should be used for each reaction?

	reaction 1	reaction 2
A	disappearing cross	disappearing cross
B	disappearing cross	loss of mass
C	loss of mass	disappearing cross
D	loss of mass	loss of mass

17 Hydrogen is used as a reactant both in the Haber process and in its addition to alkenes.

Which row is correct?

	catalyst in the Haber process	product of addition of hydrogen to an alkene
A	iron	alkane
B	iron	alcohol
C	nickel	alkane
D	nickel	alcohol

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18 Chlorine, Cl_2, reacts with iron(II), Fe^{2+}, ions.

$$Cl_2 + 2Fe^{2+} \rightarrow 2Cl^- + 2Fe^{3+}$$

Which statement about this reaction is correct?

A Chlorine is oxidised.

B Cl^- ions are formed by loss of electrons.

C Fe^{2+} ions have gained electrons.

D Fe^{3+} ions are formed by oxidation.

19 Which statement is correct?

A A base will react with an ammonium salt to produce a gas that turns damp blue litmus paper red.

B Adding a base to an acidic solution will increase the pH of the solution.

C Aqueous sodium hydroxide is an alkali but **not** a base.

D In a neutralisation reaction, a base donates a proton to an acid.

20 Information about three oxides, Q, R and T, is given.

Q reacts with dilute sulfuric acid to form a salt and water.

R reacts with both acids and bases to form a salt and water.

T reacts with aqueous sodium hydroxide to form a salt and water.

Using only this information, which row correctly classifies the three oxides?

	Q	R	T
A	acidic	amphoteric	basic
B	amphoteric	basic	acidic
C	basic	acidic	amphoteric
D	basic	amphoteric	acidic

21 Which definition of a hydrated substance is correct?

A A hydrated substance is a soluble ionic compound such as barium sulfate.

B A hydrated substance is an ionic compound that contains no water.

C A hydrated substance is one that is chemically combined with hydrogen.

D A hydrated substance is one that is chemically combined with water.

22 A student has five reagents.

- dilute hydrochloric acid
- dilute sulfuric acid
- dilute nitric acid
- solid calcium carbonate
- solid copper(II) carbonate

How many soluble salts can be prepared from these five reagents?

A 3 **B** 4 **C** 5 **D** 6

23 The table shows the number of electrons in one atom of each of the elements W, X, Y and Z.

element	number of electrons in one atom
W	9
X	15
Y	19
Z	35

Which statement is correct?

A W and Z are in the same group.

B X is a metal.

C X and Y will form the compound X_3Y.

D Y is a non-metal.

24 Some properties of elements in Group VII and the reasons for these properties are shown.

Which row shows a property and the reason for this property?

	property	reason for the property
A	all the elements exist as diatomic molecules	each atom has seven electrons in the outer shell and can share a pair of electrons
B	the elements are classified as metals	when solid, the elements are shiny
C	iodine displaces bromine from aqueous potassium bromide	bromine is more reactive than iodine
D	the boiling point increases as the group is descended	as the group is descended it becomes harder to break the covalent bond between the atoms

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25 Aircraft manufacture requires a metal that:

1 has a relatively low density

2 is resistant to corrosion.

Which properties apply to aluminium?

A both 1 and 2

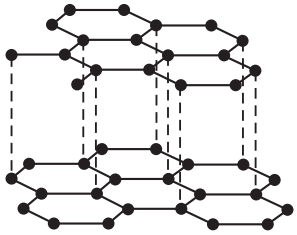
B 1 only

C 2 only

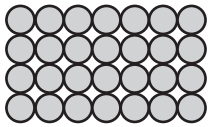
D neither 1 nor 2

26 Which diagram represents an alloy?

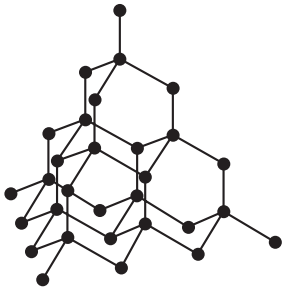
A



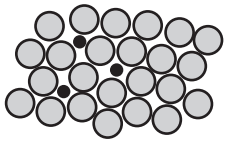
B



C



D



27 A small piece of metal is added to a large beaker of water.

A vigorous reaction occurs.

When the reaction stops, a few drops of litmus are added to the solution.

What is the metal and which colour is the solution after the litmus is added?

	metal	colour of solution
A	calcium	blue
B	calcium	red
C	magnesium	blue
D	magnesium	red

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[Turn over

28 The rusting of iron can be prevented by coating the iron with another material.

Which statement explains why coating with zinc is more effective than painting?

A If the coating is damaged, zinc corrodes instead of iron.

B Iron is above zinc in the reactivity series.

C Zinc does not react with air or with water.

D Zinc forms an unreactive alloy coating with iron.

29 The list shows the position of metal X in the reactivity series of metals.

Na Al Fe X Cu Ag

Which methods could be used to extract metal X?

1 electrolysis of the solid metal oxide

2 heating the metal oxide with carbon

3 heating the metal oxide with copper

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

30 Which statement about water is correct?

A Distillation is used to remove insoluble impurities from the domestic water supply.

B Water containing impurities turns anhydrous copper(II) sulfate blue.

C Water containing impurities turns cobalt(II) chloride paper blue.

D Water containing impurities boils at 100 °C.

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31 Some compounds that can be used as fertilisers are listed.

- ammonium nitrate
- potassium nitrate
- potassium phosphate
- sodium phosphate

Three of the elements required for plant growth have the atomic symbols N, P and K.

How many of these three elements are present in each of the compounds?

	ammonium nitrate	potassium nitrate	potassium phosphate	sodium phosphate
A	1	1	1	2
B	1	2	2	1
C	2	1	1	2
D	2	2	2	1

32 Different strategies to reduce the effects of environmental issues have been suggested.

Which row is correct?

	strategy to reduce the effects of climate change	strategy to reduce the effects of acid rain
A	reduction in livestock farming	planting trees
B	reduction in livestock farming	using low-sulfur fuels
C	reduction in use of renewable energy	planting trees
D	reduction in use of renewable energy	using low-sulfur fuels

33 Which statement about organic compounds is correct?

A Each molecule of propan-1-ol has one –OH group and each molecule of propan-2-ol has two –OH groups.

B Octane and decane are in a homologous series with the general formula C_nH_{2n}.

C The ester butyl butanoate has eight carbon atoms in each molecule.

D The structure of the functional group in a carboxylic acid is –C–O–O–H.

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[Turn over

34 In the fractional distillation of petroleum, different fractions are obtained at the top and bottom of the fractionating column.

Which properties does the fraction obtained at the top of the fractionating column have, compared with the fraction obtained at the bottom?

1 higher viscosity

2 lower boiling point

3 lower volatility

4 shorter chain length

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

35 A chlorine atom can replace a hydrogen atom in a molecule of butane, $CH_3CH_2CH_2CH_3$, to form chlorobutane.

How many different structural isomers of chlorobutane can be formed?

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

36 Two statements are shown.

1 When ethanol is made from glucose by fermentation, each glucose molecule produces three molecules of ethanol.

2 When ethanoic acid is made from ethanol, the ethanol acts as an oxidising agent.

Which row about these statements is correct?

	statement 1	statement 2
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

key

✓ = true

✗ = false

37 Polymer X is an addition polymer. The monomer used to make X is but-1-ene.

Polymer Y is a condensation polymer. The monomers used to make Y are $HOCH_2CH_2OH$ and $HOOCCH_2COOH$.

Which statement about X and Y is correct?

A The repeat unit of X is $-CH(CH_3)CH(CH_3)-$ and Y is a polyamide.

B The repeat unit of X is $-CH(CH_3)CH(CH_3)-$ and Y is a polyester.

C The repeat unit of X is $-CH_2CH(C_2H_5)-$ and Y is a polyamide.

D The repeat unit of X is $-CH_2CH(C_2H_5)-$ and Y is a polyester.

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38 Which statement is correct?

A A filtrate is a substance that remains on the filter paper after filtration.

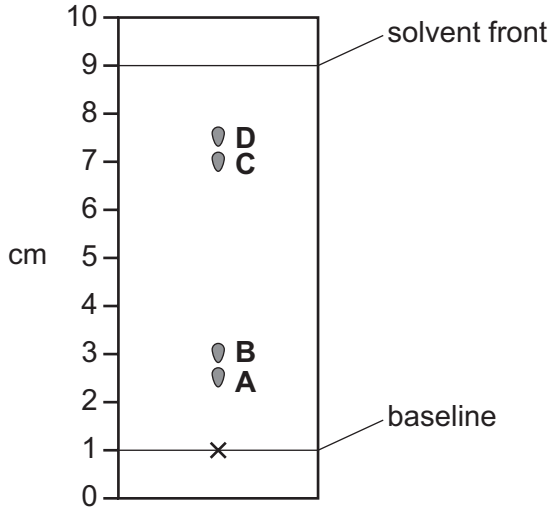
B A saturated solution has the maximum amount of solvent dissolved in the solute.

C A solution is a compound produced when a solute reacts with a solvent.

D A substance that remains in the heated flask after distillation is called a residue.

39 The diagram shows a chromatogram.

Which spot has an R_f value of 0.75?



40 The results of some tests on polluted river water are shown.

reagent	observation on adding reagent slowly	observation on adding excess reagent
aqueous sodium hydroxide	white precipitate	precipitate dissolves to give a colourless solution
aqueous ammonia	white precipitate	no further change

Which metal ion must be present in the water?

A Al^{3+} **B** Ca^{2+} **C** Fe^{2+} **D** Zn^{2+}

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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.).