Cambridge Assessment International Education

Cambridge IGCSE™

CHEMISTRY **0620/23**

Paper 2 Multiple Choice (Extended) **October/November 2023**

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.

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1 A sample of a gas occupies 340 cm^3 at room temperature and pressure.

The temperature and pressure are both increased, but the volume occupied by the gas remains 340 cm^3.

Which row describes what happens to the particle speed and the average distance between the particles in the gas when the temperature and pressure are both increased?

	particle speed	average distance between particles
A	unchanged	unchanged
B	unchanged	increased
C	increased	unchanged
D	increased	increased

2 Which statements about the rate of diffusion of the gases ammonia, carbon monoxide, nitrogen and oxygen are correct?

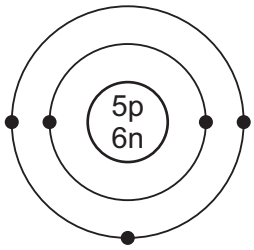
1 Nitrogen and carbon monoxide will diffuse at the same rate.

2 Oxygen will diffuse slowest because it is an element, whereas the others are compounds.

3 Ammonia will diffuse fastest.

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

3 The structure of an atom of element X is shown.



key
● = electron
n = neutron
p = proton

What is element X?

A boron

B carbon

C sodium

D sulfur

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4 Which statement explains why isotopes of an element have the same chemical reactions?

A They have different numbers of neutrons.

B They have ions with different numbers of electrons.

C They have the same number of outer shell electrons.

D They have the same number of protons.

5 Magnesium reacts with oxygen to form magnesium oxide.

What happens to magnesium atoms and oxygen atoms during this reaction?

A Magnesium and oxygen share two electrons.

B Magnesium gains two electrons and oxygen loses two electrons.

C Magnesium loses one electron and oxygen gains one electron.

D Magnesium loses two electrons and oxygen gains two electrons.

6 Which row about the properties of both diamond and silicon(IV) oxide is correct?

	conductor of electricity	type of molecule
A	yes	giant covalent
B	yes	simple covalent
C	no	giant covalent
D	no	simple covalent

7 The equation represents the reaction between solid magnesium oxide and dilute hydrochloric acid to form magnesium chloride and water.

$$MgO + 2HCl \rightarrow MgCl_2 + H_2O$$

Which row shows the state symbols for hydrochloric acid, magnesium chloride and water?

	HCl	$MgCl_2$	H_2O
A	(aq)	(aq)	(l)
B	(aq)	(l)	(l)
C	(l)	(aq)	(aq)
D	(l)	(l)	(aq)

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8 Which substance is a mixture?

A air

B graphite

C oxygen

D water

9 The number of moles of atoms X, Y and Z, in a compound, are shown.

atom	moles
X	0.6
Y	1.2
Z	0.3

What is the formula of the compound?

A XY_2Z_4 **B** XY_4Z_2 **C** X_2YZ_4 **D** X_2Y_4Z

10 1.0 mol of silver nitrate, $AgNO_3$, contains 1.2×10^{24} ions.

How many ions are there in 0.25 mol of iron(III) oxide, Fe_2O_3?

A 1.5×10^{23} **B** 3.0×10^{23} **C** 7.5×10^{23} **D** 3.0×10^{24}

11 Concentrated aqueous magnesium bromide is electrolysed using carbon electrodes.

Which equations represent the reactions occurring at each electrode?

	positive electrode	negative electrode
A	$2Br^-(aq) \rightarrow Br_2(aq) + 2e^-$	$2H^+(aq) + 2e^- \rightarrow H_2(g)$
B	$2H^+(aq) + 2e^- \rightarrow H_2(g)$	$2O^{2-}(aq) \rightarrow O_2(aq) + 4e^-$
C	$Mg^{2+}(aq) + 2e^- \rightarrow Mg(s)$	$2Br^-(aq) \rightarrow Br_2(aq) + 2e^-$
D	$2O^{2-}(aq) \rightarrow O_2(aq) + 4e^-$	$Mg^{2+}(aq) + 2e^- \rightarrow Mg(s)$

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

Which statement is correct?

A Bubbles of hydrogen gas are formed at the anode.

B Bubbles of oxygen gas are formed at the cathode.

C Copper is deposited at the anode.

D The blue colour of the solution fades.

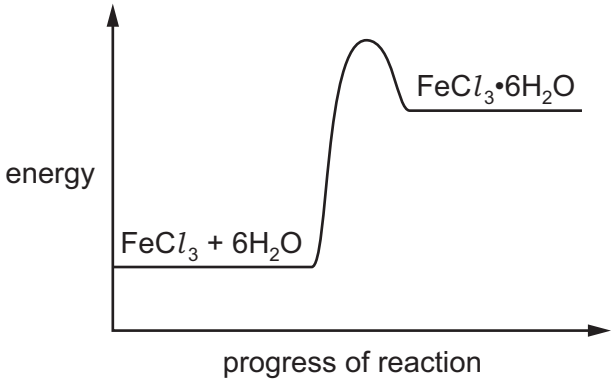
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13 When water is added to anhydrous iron(III) chloride, $FeCl_3$, hydrated iron(III) chloride, $FeCl_3 \cdot 6H_2O$, is formed and energy is given out.

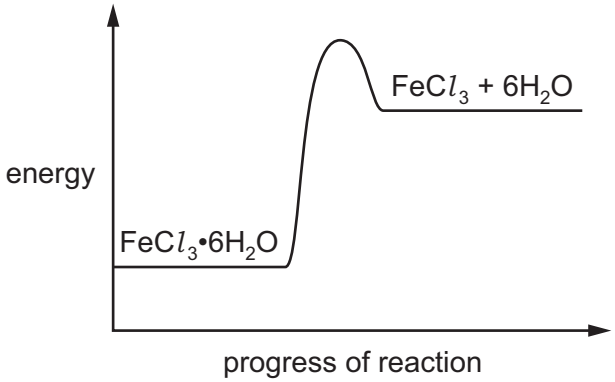
$$FeCl_3 + 6H_2O \rightleftharpoons FeCl_3 \cdot 6H_2O$$

Which reaction pathway diagram represents the formation of anhydrous iron(III) chloride in the **reverse** reaction?

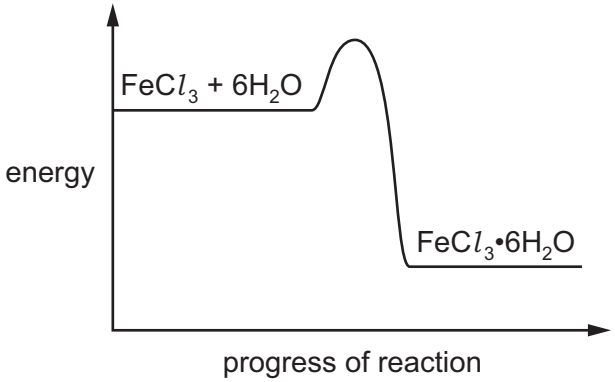
A



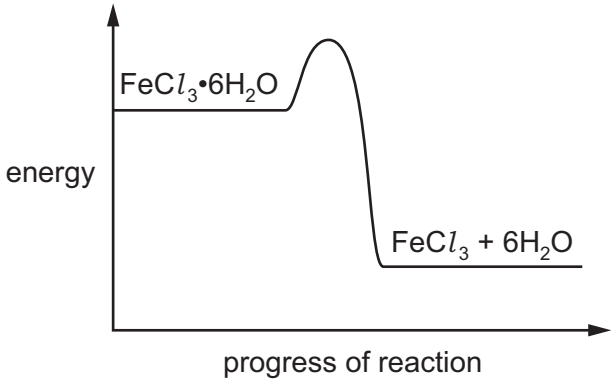
B



C



D



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[Turn over

14 Ethene reacts with hydrogen. The equation is shown.

$$C_2H_4 + H_2 \rightarrow C_2H_6$$

The bond energies are shown.

bond	bond energy in kJ / mol
C–C	+350
C=C	+610
C–H	+410
H–H	+436

What is the energy change for the reaction?

A –560 kJ / mol **B** –124 kJ / mol **C** +486 kJ / mol **D** +5496 kJ / mol

15 Statements about four different acids are listed.

- A 0.0100 mol / dm^3 solution of hydrochloric acid has a pH of 2.
- A 0.0100 mol / dm^3 solution of ethanoic acid has a pH of 3.4.
- Hydrobromic acid, HBr, is a strong acid.
- Ethanoic acid is a slightly stronger acid than trimethylethanoic acid.

What are the pH values of 0.0100 mol / dm^3 HBr and 0.0100 mol / dm^3 trimethylethanoic acid?

	pH of 0.0100 mol / dm^3 HBr	pH of 0.0100 mol / dm^3 trimethylethanoic acid
A	2	3.3
B	2	3.5
C	3.4	3.3
D	3.4	3.5

16 Anhydrous cobalt(II) chloride is blue and turns pink when water is added.

How is this reaction reversed?

A adding dilute acid

B filtering

C heating

D cooling

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17 The reaction between hydrogen and nitrogen is reversible.

The forward reaction is exothermic.

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

Which change to the conditions would increase the yield of ammonia?

A add a catalyst

B increase the pressure

C increase the temperature

D reduce the concentration of nitrogen

18 Ethanol can be turned into ethanoic acid by passing it over hot copper(II) oxide.

$$CH_3CH_2OH + 2CuO \rightarrow CH_3COOH + H_2O + 2Cu$$

What is this type of reaction?

A precipitation

B redox

C thermal decomposition

D neutralisation

19 When heated strongly, silicon(IV) oxide reacts with carbon.

$$SiO_2 + 2C \rightarrow Si + 2CO$$

Which term describes what happens to silicon(IV) oxide?

A thermal decomposition

B neutralisation

C oxidation

D reduction

20 Which statement about aqueous weak acids is correct?

A Weak acids are always dilute aqueous solutions.

B Weak acids dissociate fully in aqueous solution.

C When a weak acid is added to blue litmus paper, it stays blue.

D When a weak acid is added to solid magnesium, effervescence is seen.

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21 Which oxides are basic?

1 calcium oxide

2 sodium oxide

3 iron(II) oxide

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

22 Zinc oxide is an amphoteric oxide.

Zinc oxide is added to excess dilute hydrochloric acid.

Zinc oxide is added to excess aqueous sodium hydroxide.

Which row describes the observations made in these reactions?

	excess dilute hydrochloric acid	excess aqueous sodium hydroxide
A	colourless solution forms	colourless solution forms
B	colourless solution forms	no visible change
C	fizzing	colourless solution forms
D	fizzing	no visible change

23 Which row shows properties of an element that is in the same group of the Periodic Table as lithium?

	electrical conductivity	density in g/cm^3
A	high	0.97
B	high	8.93
C	low	0.07
D	low	3.12

24 The elements in Group VII include chlorine, bromine and iodine.

Which statements are correct?

1 Iodine is more dense than chlorine.

2 Iodine displaces chlorine from a solution containing chloride ions.

3 Bromine is a diatomic non-metal.

4 Chlorine gas is darker in colour than bromine vapour.

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

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25 Cobalt is a transition element.

What is a property of cobalt?

A It can form coloured compounds.

B It is a poor electrical conductor.

C It has a low density.

D It has a low melting point.

26 Which metal has variable oxidation numbers?

A aluminium

B calcium

C copper

D sodium

27 Which statement about alloys is correct?

A Alloys are pure metal elements.

B At least two or more metals react together to make alloys.

C Alloys can be harder and stronger than a pure metal.

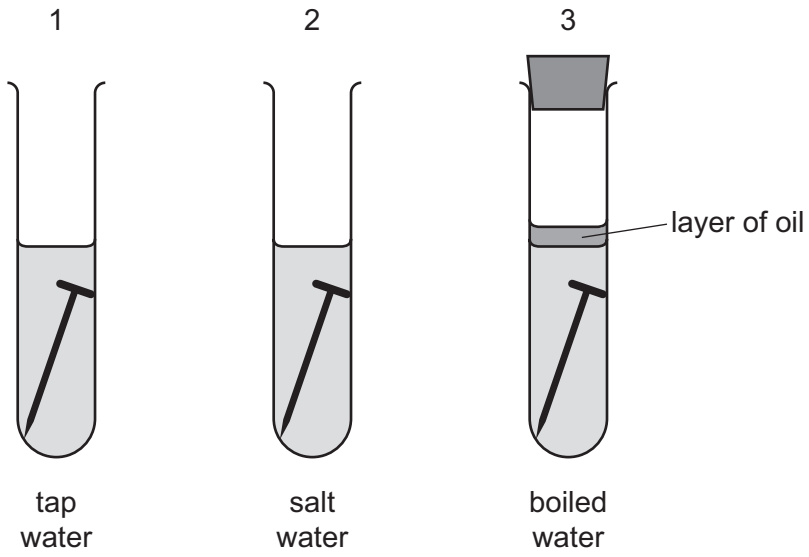
D Steel is **not** an alloy because it can contain the non-metal carbon.

28 A metal M is between sodium and magnesium in the reactivity series.

Which reactions occur with M and its oxide?

	M reacts with steam	M can be extracted by heating its oxide with carbon
A	no	no
B	no	yes
C	yes	no
D	yes	yes

29 The diagrams show experiments to investigate rusting of iron nails.



In which test-tubes do the nails rust?

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

30 Which equation represents a reaction that takes place when iron is extracted from its ore in the blast furnace?

A $CaO + SiO_2 \rightarrow CaSiO_3$

B $CaO + CO_2 \rightarrow CaCO_3$

C $2CO \rightarrow C + CO_2$

D $2Fe + 3CO_2 \rightarrow Fe_2CO_3 + 3CO$

31 Some uses of water are listed.

1 for drinking

2 in chemical reactions

3 in swimming pools

4 in washing

For which uses is it necessary to chlorinate the water?

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

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32 Oxides of nitrogen are formed in car engines and are a source of air pollution.

To decrease this pollution, catalytic converters are fitted to car exhausts.

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

A combustion

B cracking

C oxidation

D reduction

33 Which pair of compounds are structural isomers of each other?

A $CH_3CH_2CH_3$ and $CH_3CH_2CH_2CH_3$

B $CH_2{=}CHCH_3$ and $CH_3CH{=}CH_2$

C $CH_2(OH)CH_2CH_3$ and $CH_3CH_2CH_2OH$

D $CH_3CH_2CH_2COOH$ and $CH_3COOCH_2CH_3$

34 Methane reacts with chlorine in sunlight.

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

Which statements about this reaction are correct?

1 It is a substitution reaction.

2 It is an addition reaction.

3 It is a photochemical reaction.

4 It is catalysed by nickel.

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

35 Propene reacts with bromine to give one product only.

What is the formula of the product?

A $CH_3CH_2CHBr_2$

B $CH_2BrCH_2CH_2Br$

C $CH_3CHBrCH_2Br$

D $CH_3CH_2CH_2Br$

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36 Ethanol can be manufactured by fermentation or by the catalytic addition of steam to ethene.

Which statements describe an advantage of manufacturing ethanol by fermentation?

1 The yield of ethanol is low.

2 The method uses a batch process.

3 The process takes place at a lower temperature.

4 The ethanol is made from a renewable source.

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

37 A compound with the formula $CH_3COOC_2H_5$ is formed from ethanol in two separate reactions.

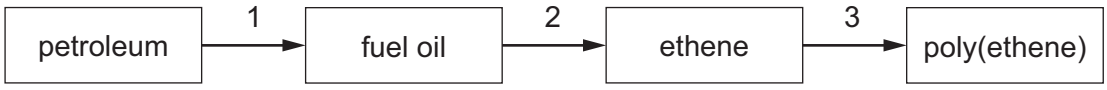
reaction 1 Ethanol reacts to form ethanoic acid.

reaction 2 Ethanoic acid and ethanol react together to form $CH_3COOC_2H_5$.

Which row describes reaction 1 and reaction 2?

	reaction 1	reaction 2
A	oxidation	ester formation
B	oxidation	addition
C	reduction	ester formation
D	reduction	addition

38 The flow diagram shows how poly(ethene) may be made from petroleum.



What are stages 1, 2 and 3?

	1	2	3
A	cracking	polymerisation	fractional distillation
B	cracking	fractional distillation	polymerisation
C	fractional distillation	cracking	polymerisation
D	fractional distillation	polymerisation	cracking

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39 R_f values are used to identify unknown substances using paper chromatography.

Which statements about R_f values are correct?

1 R_f values are always less than 1.0.

2 R_f value = distance travelled by solvent ÷ distance travelled by unknown substance.

3 The higher the R_f value, the further the unknown substance travels.

4 R_f values are **not** affected by the solubility of the unknown substance.

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

40 The results of some tests on an aqueous solution of substance X are listed.

1 A cream precipitate is produced when adding aqueous silver nitrate.

2 Adding aqueous sodium hydroxide produces a green precipitate which dissolves in excess alkali.

3 Adding aqueous ammonia produces a green precipitate which is insoluble in excess ammonia.

What is substance X?

A chromium(III) bromide

B chromium(III) chloride

C iron(II) bromide

D iron(II) chloride

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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.).