

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.

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

- 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?

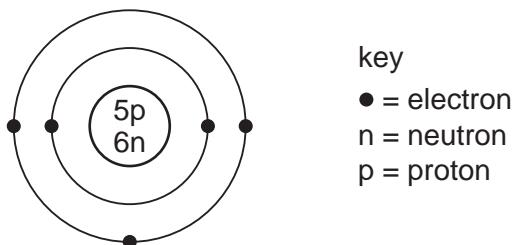
	particle speed	average distance between particles
A	unchanged	unchanged
B	unchanged	increased
C	increased	unchanged
D	increased	increased

- 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.



What is element X?

- A** boron
B carbon
C sodium
D sulfur

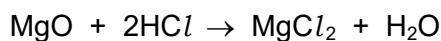
- 4** Which statement explains why isotopes of an element have the same chemical reactions?
- A** They have different numbers of neutrons.
 - B** They have ions with different numbers of electrons.
 - C** They have the same number of outer shell electrons.
 - D** They have the same number of protons.
- 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.



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)

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** $\text{X}_2\text{Y}_4\text{Z}$

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	$2\text{Br}^-(\text{aq}) \rightarrow \text{Br}_2(\text{aq}) + 2\text{e}^-$	$2\text{H}^+(\text{aq}) + 2\text{e}^- \rightarrow \text{H}_2(\text{g})$
B	$2\text{H}^+(\text{aq}) + 2\text{e}^- \rightarrow \text{H}_2(\text{g})$	$2\text{O}^{2-}(\text{aq}) \rightarrow \text{O}_2(\text{aq}) + 4\text{e}^-$
C	$\text{Mg}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Mg}(\text{s})$	$2\text{Br}^-(\text{aq}) \rightarrow \text{Br}_2(\text{aq}) + 2\text{e}^-$
D	$2\text{O}^{2-}(\text{aq}) \rightarrow \text{O}_2(\text{aq}) + 4\text{e}^-$	$\text{Mg}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Mg}(\text{s})$

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

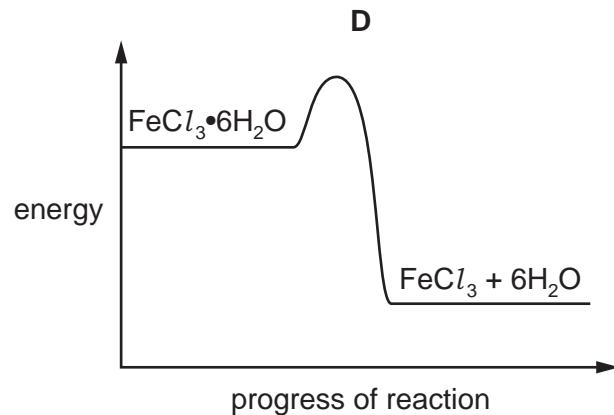
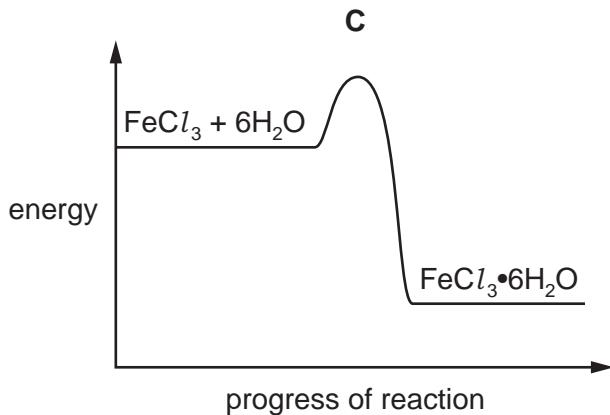
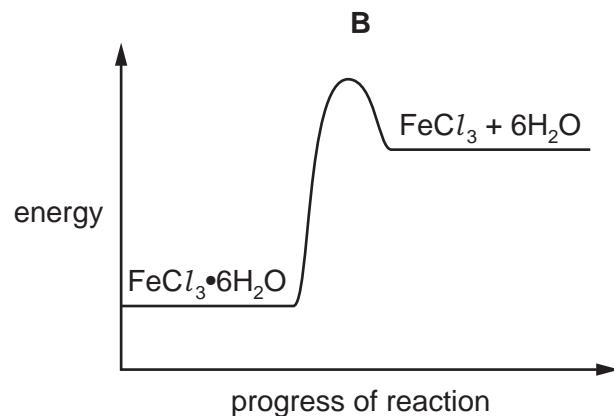
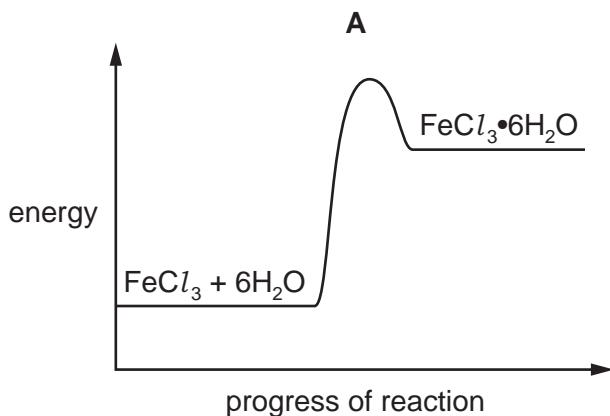
Which statement is correct?

- 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.

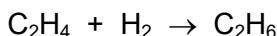
- 13 When water is added to anhydrous iron(III) chloride, FeCl_3 , hydrated iron(III) chloride, $\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$, is formed and energy is given out.



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



14 Ethene reacts with hydrogen. The equation is shown.



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/dm³ solution of hydrochloric acid has a pH of 2.
- A 0.0100 mol/dm³ 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/dm³ HBr and 0.0100 mol/dm³ 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

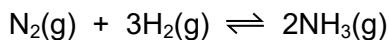
16 Anhydrous cobalt(II) chloride is blue and turns pink when water is added.

How is this reaction reversed?

- A** adding dilute acid
B filtering
C heating
D cooling

17 The reaction between hydrogen and nitrogen is reversible.

The forward reaction is exothermic.



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

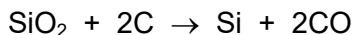
18 Ethanol can be turned into ethanoic acid by passing it over hot copper(II) oxide.



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.



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.

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

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?

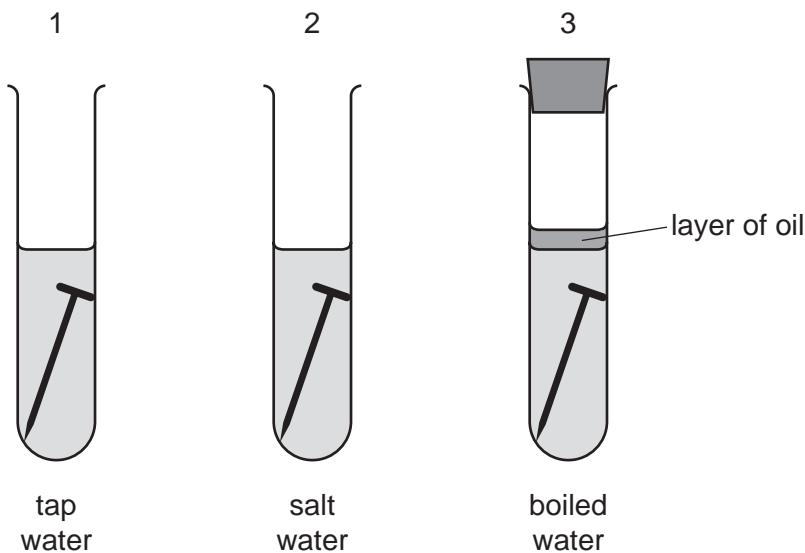
- A Alloys are pure metal elements.
- B At least two or more metals react together to make alloys.
- C Alloys can be harder and stronger than a pure metal.
- D Steel is **not** an alloy because it can contain the non-metal carbon.

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** $\text{CaO} + \text{SiO}_2 \rightarrow \text{CaSiO}_3$
B $\text{CaO} + \text{CO}_2 \rightarrow \text{CaCO}_3$
C $2\text{CO} \rightarrow \text{C} + \text{CO}_2$
D $2\text{Fe} + 3\text{CO}_2 \rightarrow \text{Fe}_2\text{CO}_3 + 3\text{CO}$

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

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.

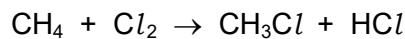
What happens to the oxides of nitrogen in the catalytic converter?

- A combustion
- B cracking
- C oxidation
- D reduction

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

- A $\text{CH}_3\text{CH}_2\text{CH}_3$ and $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$
- B $\text{CH}_2=\text{CHCH}_3$ and $\text{CH}_3\text{CH}=\text{CH}_2$
- C $\text{CH}_2(\text{OH})\text{CH}_2\text{CH}_3$ and $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
- D $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$ and $\text{CH}_3\text{COOCH}_2\text{CH}_3$

34 Methane reacts with chlorine in sunlight.



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 $\text{CH}_3\text{CH}_2\text{CHBr}_2$
- B $\text{CH}_2\text{BrCH}_2\text{CH}_2\text{Br}$
- C $\text{CH}_3\text{CHBrCH}_2\text{Br}$
- D $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$

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 $\text{CH}_3\text{COOC}_2\text{H}_5$ is formed from ethanol in two separate reactions.

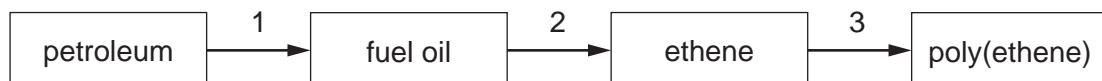
reaction 1 Ethanol reacts to form ethanoic acid.

reaction 2 Ethanoic acid and ethanol react together to form $\text{CH}_3\text{COOC}_2\text{H}_5$.

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

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																											
																										He																											
																										He																											
3	Li	4	Be	beryllium 9																																																	
7	lithium	7																																																			
11	Na	12	Mg	magnesium 24																																																	
19	K	20	Ca	calcium 40	21	Sc	scandium 45	22	Ti	titanium 48	23	V	vanadium 51	24	Cr	manganese 52	25	Mn	cobalt 55	26	Fe	iron 56	27	Co	copper 64	28	Ni	nickel 59	29	Cu	zinc 65	30	Zn	gallium 70	31	Ga	germanium 73	32	Ge	gallium 73	33	As	arsenic 75	34	Se	selenium 79	35	Br	bromine 80	36	Kr	krypton 84	
39	potassium	39	Sr	strontium 88	39	40	Nb	niobium 91	41	42	Mo	molybdenum 96	43	44	Ru	ruthenium 101	45	46	Pd	palladium 106	47	48	Ag	silver 108	49	50	In	cadmium 112	51	52	Te	tin 119	53	I	iodine 122	54	Xe	xenon 131															
37	Rb	38	Sr	Yttrium 89	38	39	Zr	zirconium 91	40	41	Mo	niobium 93	42	43	Tc	technetium –	44	45	Rh	rhodium 103	46	47	Cd	cadmium 108	48	49	In	indium 115	50	51	Sn	tin 119	52	53	Te	tellurium 128	54																
85	rubidium	85	56	57-71	72	73	Ta	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103																
55	Cs	56	Ba	barium 137	57-71	Hf	hafnium 178	72	Ta	tantalum 181	73	W	tungsten 184	74	Re	rhenium 186	75	Os	osmium 190	76	Ir	iridium 192	77	Pt	platinum 195	78	Au	gold 197	79	Hg	mercury 201	80	Tl	thallium 204	81	Pb	lead 207	82	Bi	bismuth 209	83	Po	polonium 207	84	At	astatine –	85	Rn	radon –	86			
133	caesium	–	87	88	89-103	Rf	rutherfordium –	104	105	Db	Dubnium –	106	Sg	seaborgium –	107	108	109	110	111	112	113	114	115	F1	fermium –	116	Lv	moscovium –	117	Ts	tennessine –	118	Og	oganesson –	–																		
–	francium	–	57	La	58	Ce	cerium 140	59	Pr	praseodymium 141	60	Nd	neodymium 144	61	Pm	promethium –	62	Sm	samarium 150	63	Eu	europtium 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							
89	actinoids	89	90	Th	91	Pa	protactinium 231	92	U	uranium 238	93	Np	neptunium –	94	Am	americium –	95	Pu	plutonium –	96	Cm	curium –	97	Bk	berkelium –	98	Cf	californium –	99	Fm	fermium –	100	Md	mendelevium –	101	No	nobelium –	102	Lr	lawrencium –	103												

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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	europtium 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	
89	actinoids	89	90	Th	91	Pa	protactinium 231	92	U	uranium 238	93	Np	neptunium –	94	Am	americium –	95	Pu	plutonium –	96	Cm	curium –	97	Bk	berkelium –	98	Cf	californium –	99	Fm	fermium –	100	Md	mendelevium –	101	No	nobelium –	102	Lr	lawrencium –	103				

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).