

# Cambridge IGCSE<sup>™</sup>

CHEMISTRY 0620/22

Paper 2 Multiple Choice (Extended)

May/June 2021

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.

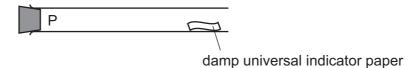
- For each question there are four possible answers **A**, **B**, **C** and **D**. Choose the **one** you consider correct and record your choice in soft pencil on the multiple choice answer sheet.
- Follow the instructions on the multiple choice answer sheet.
- Write in soft pencil.
- Write your name, 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.



**1** A gas is released at point P in the apparatus shown.



Which gas turns the damp universal indicator paper red most quickly?

- A ammonia, NH<sub>3</sub>
- **B** chlorine,  $Cl_2$
- **C** hydrogen chloride, HC*l*
- **D** sulfur dioxide, SO<sub>2</sub>
- **2** A mixture of colourless compounds is separated using chromatography.

Which type of reagent is used to detect these compounds after separation?

- A a dehydrating agent
- B a locating agent
- **C** an oxidising agent
- D a reducing agent
- 3 Which statement about paper chromatography is correct?
  - **A** A solvent is needed to dissolve the paper.
  - **B** Paper chromatography separates mixtures of solvents.
  - **C** The solvent should cover the baseline.
  - **D** The baseline should be drawn in pencil.
- 4 Element X has 7 protons.

Element Y has 8 more protons than X.

Which statement about element Y is correct?

- A Y has more electron shells than X.
- **B** Y has more electrons in its outer shell than X.
- **C** Y is in a different group of the Periodic Table from X.
- **D** Y is in the same period of the Periodic Table as X.

**5** A covalent molecule Q contains only six shared electrons.

What is Q?

- A ammonia, NH<sub>3</sub>
- **B** chlorine, Cl<sub>2</sub>
- C methane, CH<sub>4</sub>
- **D** water, H<sub>2</sub>O
- 6 Information about four substances E, F, G and H is shown.

	melting point/°C	electrical conductivity
Е	1710	does not conduct when solid
F	3500	conducts when solid
G	120	does not conduct
Н	801	conducts when molten

E, F, G and H are graphite, poly(ethene), sodium chloride and silicon(IV) oxide but not in that order.

What are E, F, G and H?

	E	F	G	Н
Α	graphite	poly(ethene)	silicon(IV) oxide	sodium chloride
В	sodium chloride	graphite	poly(ethene)	silicon(IV) oxide
С	poly(ethene)	sodium chloride	graphite	silicon(IV) oxide
D	silicon(IV) oxide	graphite	poly(ethene)	sodium chloride

7 Chemical compounds formed from a Group I element and a Group VII element contain ionic bonds.

How are the ionic bonds formed?

- **A** Electrons are transferred from Group VII atoms to Group I atoms.
- **B** Electrons are shared between Group I atoms and Group VII atoms.
- **C** Electrons are lost by Group I atoms and Group VII atoms.
- **D** Electrons are transferred from Group I atoms to Group VII atoms.

8 Some information about particles P, Q, R and S is shown.

	nucleon number	number of neutrons	number of electrons
Р	12	6	6
Q	24	12	10
R	16	8	10
S	14	8	6

Which two particles are isotopes of the same element?

- A P and Q
- **B** P and S
- **C** Q and R
- **D** R and S

**9** Chlorine gas will react with iron metal.

Exactly 21.3 g of chlorine reacts with 11.2 g of iron.

How many iron atoms react with 30 molecules of chlorine?

- **A** 10
- **B** 15
- **C** 20
- **D** 30
- 10 In separate experiments, electricity was passed through concentrated aqueous sodium chloride and molten lead(II) bromide.

What would happen in **both** experiments?

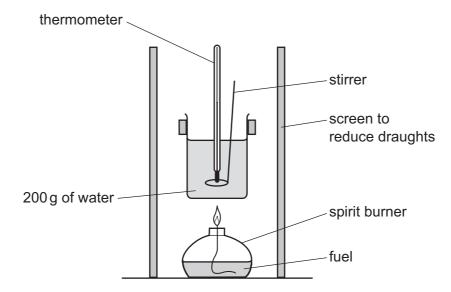
- **A** A halogen would be formed at the anode.
- **B** A metal would be formed at the cathode.
- **C** Hydrogen would be formed at the anode.
- **D** Hydrogen would be formed at the cathode.
- **11** A reaction involving aluminium is shown.

$$xAl + yO_2 + 6H_2O \rightarrow xAl(OH)_3$$

Which values of x and y balance the equation?

	х	у
Α	2	3
В	3	2
С	3	4
D	4	3

**12** Four different fuels are used to heat a beaker of water, for the same amount of time, using the apparatus shown.



The initial temperature of the water and the temperature after heating by the fuel are recorded.

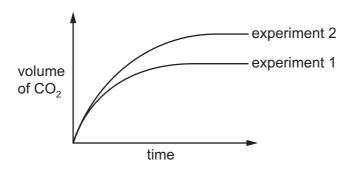
Which fuel releases the most heat energy?

initial temperature /°C		temperature after heating/°C
Α	17	46
В	24	52
С	26	61
D	30	62

**13** An excess of calcium carbonate reacts with dilute hydrochloric acid. The volume of carbon dioxide produced is measured at regular time intervals. The results are shown as experiment 1.

The experiment is repeated with only **one** change to the reaction conditions.

The results are shown as experiment 2.



Which change is made in experiment 2?

- A The concentration of the acid is increased.
- **B** The volume of acid is increased.
- **C** The mass of calcium carbonate is increased.
- **D** The calcium carbonate is powdered.
- **14** When sulfur is heated it undergoes a .....1..... change as it melts.

Further heating causes the sulfur to undergo a .....2..... change and form sulfur dioxide.

Which words complete gaps 1 and 2?

	1	2
Α	chemical	chemical
В	chemical	physical
С	physical	chemical
D	physical	physical

- **15** Four statements about the effect of increasing temperature on a reaction are shown.
  - 1 The activation energy becomes lower.
  - 2 The particles move faster.
  - There are more collisions between reacting particles per second. 3
  - There are more collisions which have energy greater than the activation energy.

Which statements are correct?

**A** 1, 2 and 3

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

**16** An example of a redox reaction is shown.

$$Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$$

Which statement about the reaction is correct?

- **A** Zn is the oxidising agent and it oxidises Cu<sup>2+</sup>.
- **B** Zn is the oxidising agent and it reduces Cu<sup>2+</sup>.
- **C** In is the reducing agent and it oxidises Cu<sup>2+</sup>.
- **D** Zn is the reducing agent and it reduces Cu<sup>2+</sup>.
- 17 When bismuth(III) chloride, BiC $l_3$ , reacts with water, a white precipitate of bismuth(III) oxychloride, BiOC*l*, is formed. The equation for the reaction is shown.

$$BiCl_3(aq) + H_2O(I) \rightleftharpoons BiOCl(s) + 2H^+(aq) + 2Cl^-(aq)$$

The reaction is in equilibrium.

Which changes cause the white precipitate to dissolve?

- 1 adding acid
- 2 adding water
- adding sodium chloride solution
- **A** 1 and 2 only **B** 1 and 3 only **C** 2 and 3 only **D** 1, 2 and 3

**18** Element X forms an oxide, XO, that neutralises sulfuric acid.

Which row describes X and XO?

	element X	nature of oxide, XO
Α	metal	acidic
В	metal	basic
С	non-metal	acidic
D	non-metal	basic

**19** Information about the solubility of salts is shown.

salt	solubility
chlorides soluble (except for lead(II) chloride and silver chloride	
nitrates	soluble
sulfates	soluble (except for barium sulfate and lead(II) sulfate)

Aqueous solutions of which two compounds would produce a precipitate when added together?

- **A** Ba(NO<sub>3</sub>)<sub>2</sub> and CaC $l_2$
- **B** CuSO<sub>4</sub> and Zn(NO<sub>3</sub>)<sub>2</sub>
- C KCl and Na<sub>2</sub>SO<sub>4</sub>
- **D** Pb(NO<sub>3</sub>)<sub>2</sub> and MgSO<sub>4</sub>

**20** The equation shows the reaction between hydrogen and oxygen.

$$2 \text{ H-H} + \text{O=O} \rightarrow 2 \text{ H-O-H}$$

The bond energies are shown.

	bond energy in kJ/mol
H–H	436
O=O	495
O–H	463

Which row shows the energy change and the type of reaction?

	energy change in kJ/mol	type of reaction
<b>A</b> 441		exothermic
В	441	endothermic
С	485	exothermic
D	485	endothermic

21 Burning fossil fuels releases sulfur dioxide which leads to acid rain.

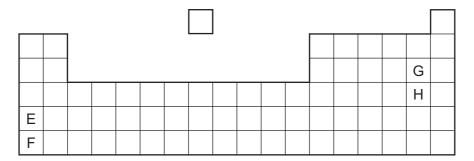
Which ion in the rain water causes it to be acidic?

- $\mathbf{A} \quad \mathbf{H}^{\dagger}$
- **B** OH⁻
- $\mathbf{C} \quad \Omega^{2-}$
- **D**  $SO_4^{2-}$

**22** Which statement about the trends shown by the elements of Period 3 in the Periodic Table is **not** correct?

- **A** The elements become less metallic across the period.
- **B** The group number increases across the period.
- **C** The number of electron shells increases across the period.
- D The number of outer electrons increases across the period.

23 The diagram shows the positions of elements E, F, G and H in the Periodic Table.



Which statements about elements E, F, G and H are correct?

- 1 E has a higher density than F.
- 2 E has a higher melting point than F.
- 3 G has a darker colour than H.
- 4 G has a lower melting point than H.
- **A** 1 and 3
  - **B** 1 and 4
- **C** 2 and 3
- **D** 2 and 4

24 When aqueous iodine is added to a solution of vanadium ions,  $V^{2+}$ , the  $V^{2+}$  ions each lose one electron.

Which property of transition elements is shown by this reaction?

- A Transition elements have variable oxidation states.
- **B** Transition elements form a stable 1+ ion.
- **C** Transition elements are oxidising agents.
- **D** Transition elements can act as catalysts.

**25** A piece of aluminium is dropped into dilute hydrochloric acid.

No immediate reaction is observed.

Which statement explains this observation?

- A Aluminium does not neutralise acids.
- **B** Aluminium is a non-metal so does not react with acids.
- **C** Aluminium is below hydrogen in the reactivity series.
- **D** Aluminium is covered in an unreactive oxide layer.

26 Some metal nitrates and carbonates decompose when heated strongly.

Metal Q has a nitrate that decomposes to give a salt and a colourless gas only.

The carbonate of metal Q does not decompose when heated with a Bunsen burner.

What is metal Q?

- A calcium
- **B** copper
- C sodium
- **D** zinc
- **27** Aluminium is extracted from its ore by electrolysis.

Which equation represents the reaction that occurs at the anode during the electrolysis?

- **A**  $Al^{3+} + 3e^{-} \rightarrow Al$
- $\mathbf{B} \quad \mathsf{A}l^{3+} \rightarrow \mathsf{A}l + 3e^{-}$
- $\label{eq:constraints} \textbf{C} \quad 2O^{2-} \,\rightarrow\, O_2 \,\, + \,\, 4e^-$
- **D**  $2O^{2-} + 2e^{-} \rightarrow O_{2}$
- **28** Mild steel consists mostly of iron. Mild steel can be prevented from rusting by a process called galvanising.

Copper is not a very strong metal. However, if it is mixed with a suitable metal a strong alloy called brass is produced.

Which statement is correct?

- **A** Copper corrodes very quickly when wet and brass does not.
- **B** Copper is mixed with zinc to produce brass.
- **C** Galvanising mild steel changes it from a pure metal into an alloy.
- **D** When a steel object is galvanised this means it is coated with a thin layer of tin.
- **29** Water is used for the irrigation of crops and for drinking water.

For which uses must water be chlorinated?

	irrigation	drinking
A 🗸		✓
В	✓	X
С	X	✓
D	x	x

- 30 Which natural resource cannot provide a raw material for the manufacture of ammonia?
  - A air
  - **B** limestone
  - **C** petroleum
  - **D** water
- 31 Ammonia is made in the Haber process.

Which conditions are used in the Haber process?

	temperature /°C	pressure /atmospheres	catalyst used
Α	450	200	iron
В	450	5	vanadium( $V$ ) oxide
С	200	450	iron
D	200	5	vanadium(V) oxide

- **32** Which process in the carbon cycle is responsible for removing carbon dioxide from the atmosphere?
  - **A** combustion
  - **B** decomposition
  - C photosynthesis
  - **D** respiration
- **33** The equations represent two reactions, P and Q, of lime (calcium oxide).

P CaO + SiO<sub>2</sub> 
$$\rightarrow$$
 CaSiO<sub>3</sub>

Q CaO + SO<sub>2</sub> 
$$\rightarrow$$
 CaSO<sub>3</sub>

In which processes do the reactions occur?

	Р	Q
Α	extraction of iron	extraction of iron
В	extraction of iron	flue gas desulfurisation
С	flue gas desulfurisation	extraction of iron
D	flue gas desulfurisation	flue gas desulfurisation

21	\\/hich	statement	about	athanal	ic not	correct?
<b>34</b>	vvrucn	Statement	aboui	emanoi	IS HOL	conecie

- **A** Ethanol can be made by fermentation.
- **B** Ethanol is oxidised to make ethanoic acid.
- **C** Ethanol reacts with oxygen exothermically, making it a good fuel.
- **D** Ethanol reacts with propanoic acid to make propyl ethanoate.

# 35 Which pair of formulae represents two alkanes?

- A CH<sub>4</sub> and C<sub>8</sub>H<sub>18</sub>
- **B** C<sub>2</sub>H<sub>6</sub> and C<sub>5</sub>H<sub>8</sub>
- $\mathbf{C}$   $C_3H_6$  and  $C_5H_{12}$
- $\mathbf{D}$   $C_{10}H_8$  and  $C_4H_8$

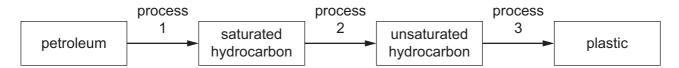
## **36** Which statement about alkanes is correct?

- **A** They burn in oxygen.
- **B** They contain carbon, hydrogen and oxygen atoms.
- **C** They contain double bonds.
- **D** They contain ionic bonds.

### 37 Which statements about ethanoic acid are correct?

- 1 It is a strong acid.
- 2 It reacts with ethanol to form an ester.
- 3 It has the formula CH₃COOH.
- **A** 1 and 2 only **B** 1 and 3 only **C** 2 and 3 only **D** 1, 2 and 3

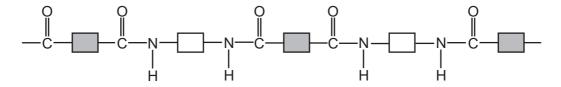
**38** The flow chart shows how petroleum may be turned into a plastic.



What are processes 1, 2 and 3?

	process 1	process 2	process 3
Α	cracking	fractional distillation	polymerisation
В	cracking	polymerisation	fractional distillation
С	fractional distillation	cracking	polymerisation
D	fractional distillation	polymerisation	cracking

**39** The structure of a synthetic polymer is shown.



The structure shows that it is a ......1...... It is formed by ......2...... polymerisation.

Which words complete gaps 1 and 2?

	1	2
Α	polyamide	addition
В	polyamide	condensation
С	polyester	addition
D	polyester	condensation

40 Which substance is a natural polymer?

A ethene

**B** Terylene

C nylon

**D** protein

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The Periodic Table of Elements

	III/	2 :	Не	helium 4	10	Ne	neon 20	18	Ā	argon 40	36	궃	krypton 84	54	Xe	xenon 131	98	R	radon			
	IIA				6	ш	fluorine 19	17	Cl	chlorine 35.5	35	ğ	bromine 80	53	Н	iodine 127	85	Αţ	astatine -			
					8	0	oxygen 16	16	ഗ	sulfur 32	34	Se	selenium 79	52	<u>e</u>	tellurium 128	84	Ъ	molod –	116	^	livermorium -
	>				7	z	nitrogen 14	15	₾	phosphorus 31	33	As	arsenic 75	51	Sp	antimony 122	83	Ξ	bismuth 209			
	>				9	ပ	carbon 12	14	S	silicon 28	32	Ge	germanium 73	50	Sn	tin 119	82	Pb	lead 207	114	ŀΙ	flerovium
	≡				2	М	boron 11	13	Αl	aluminium 27	31	Ga	gallium 70	49	In	indium 115	81	11	thallium 204			
											30	Zu	zinc 65	48	ပ	cadmium 112	80	Нg	mercury 201	112	S	copernicium -
											29	Cn	copper 64	47	Ag	silver 108	62	Αn	gold 197	111	Rg	roentgenium -
Group											28	z	nickel 59	46	Pd	palladium 106	78	చ	platinum 195	110	Ds	darmstadtium -
Gro											27	ဝိ	cobalt 59	45	牊	rhodium 103	77	Ir	iridium 192	109	Mt	meitnerium -
		F :	I	hydrogen 1							26	Ьe	iron 56	44		-		SO	osmium 190	108	Hs	hassium –
											25	M	manganese 55	43	ပ	technetium -	75	Re	rhenium 186			bohrium –
					_	pol	ass				24	ပ်	chromium 52	42	Mo	molybdenum 96	74	≥	tungsten 184	106	Sg	seaborgium -
				Key	atomic number	atomic symbo	name relative atomic mass				23	>	vanadium 51	41	g	niobium 93	73	<u>a</u>	tantalum 181	105	В	dubnium –
						ato	rek				22	i=	titanium 48	40	Zr	zirconium 91	72	士	hafnium 178	104	꿆	rutherfordium —
											21	လွ	scandium 45	39	>	yttrium 89	57–71	lanthanoids		89-103	actinoids	
	=				4	Be	beryllium 9	12	Mg	magnesium 24	20	Ca	calcium 40	38	ഗ്	strontium 88	99	Ba	barium 137	88	Ra	radium -
	_				ဇ	=	lithium 7	1	Na	sodium 23	19	¥	potassium 39	37	В	rubidium 85	55	S	caesium 133	87	Ŧ	francium -

70	g X	thulium ytterbium lutetium 169 173 175	102	<sup>o</sup> Z	nobelium	
		erbium t				ı
29	우	holmium 165	66	Es	einsteinium	I
99	ò	dysprosium 163	86	ರ	californium	I
65	Q L	terbium 159	26	益	berkelium	ı
64	р О	gadolinium 157	96	CB	curium	I
63	Ш	europium 152	92	Am	americium	I
62	Sm	samarium 150	94	Pu	plutonium	I
61	Pn	promethium -	93	ď	neptunium	I
09		neodymium 144	92	$\supset$	uranium	238
26	ቯ	praseodymium 141	91	Ра	protactinium	231
28		cerium 140	06	H	thorium	232
22	Ľa	lanthanum 139	68	Ac	actinium	ı
	lanthanoids			actinoids		

The volume of one mole of any gas is  $24\,\mathrm{dm}^3$  at room temperature and pressure (r.t.p.).