

Cambridge International Examinations

Cambridge International General Certificate of Secondary Education

CHEMISTRY 0620/21

Paper 2 Multiple Choice (Extended) May/June 2017

45 minutes

Additional Materials: Multiple Choice Answer Sheet

Soft clean eraser

Soft pencil (type B or HB is recommended)

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

Write your name, Centre number and candidate number on the Answer Sheet in the spaces provided unless this has been done for you.

DO **NOT** WRITE IN ANY BARCODES.

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 separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

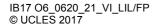
Any rough working should be done in this booklet.

A copy of the Periodic Table is printed on page 16.

Electronic calculators may be used.

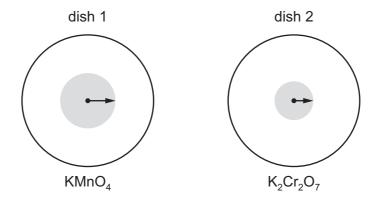
 $The \ syllabus \ is \ approved \ for \ use \ in \ England, \ Wales \ and \ Northern \ Ireland \ as \ a \ Cambridge \ International \ Level \ 1/Level \ 2 \ Certificate.$





1 Small crystals of purple KMnO₄ (M_r = 158) and orange K₂Cr₂O₇ (M_r = 294) were placed at the centres of separate petri dishes filled with agar jelly. They were left to stand under the same physical conditions.

After some time, the colour of each substance had spread out as shown.



The lengths of the arrows indicate the relative distances travelled by particles of each substance.

Which statement is correct?

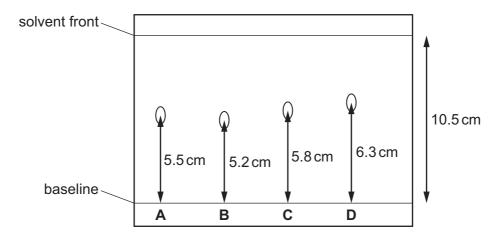
- **A** Diffusion is faster in dish 1 because the mass of the particles is greater.
- **B** Diffusion is faster in dish 2 because the mass of the particles is greater.
- **C** Diffusion is slower in dish 1 because the mass of the particles is smaller.
- **D** Diffusion is slower in dish 2 because the mass of the particles is greater.
- **2** Pure water has a boiling point of 100 °C and a freezing point of 0 °C.

What is the boiling point and freezing point of a sample of aqueous sodium chloride?

	boiling point/°C	freezing point/°C
Α	98	-2
В	98	2
С	102	-2
D	102	2

3 A chromatogram obtained from the chromatography of four substances is shown.

Which substance has an R_f value of 0.6?



4 Sodium reacts with chlorine to form sodium chloride.

Which statements describe what happens to the sodium atoms in this reaction?

- 1 Sodium atoms form positive ions.
- 2 Sodium atoms form negative ions.
- 3 Sodium atoms gain electrons.
- 4 Sodium atoms lose electrons.
- **A** 1 and 3
- **B** 1 and 4
- **C** 2 and 3
- **D** 2 and 4
- **5** Diamond is extremely hard and does not conduct electricity.

Which statement explains these properties?

- **A** It has a lattice of positive carbon ions in a 'sea of electrons'.
- **B** It has delocalised electrons and each carbon atom forms three covalent bonds with other carbon atoms.
- **C** It has no delocalised electrons and each carbon atom forms four covalent bonds with other carbon atoms.
- **D** It has strong ionic bonds between each carbon atom.
- **6** Which statement about metals is **not** correct?
 - **A** Metals are malleable because the metal ions can slide over one another.
 - **B** Metals conduct electricity because electrons can move through the lattice.
 - **C** Metals consist of a giant lattice of metal ions in a 'sea of electrons'.
 - **D** Metals have high melting points because of the strong attraction between the metal ions.

7 Aluminium reacts with fluorine.

$$xAl(s) + yF_2(g) \rightarrow zAlF_3(s)$$

Which values of x, y and z balance the equation?

	Х	У	Z
Α	1	2	1
В	2	3	2
С	3	2	3
D	4	3	4

8 Carbon monoxide burns in oxygen to produce carbon dioxide.

$$2CO(g) \ + \ O_2(g) \ \rightarrow \ 2CO_2(g)$$

Which mass of carbon dioxide is produced from 14 g of carbon monoxide?

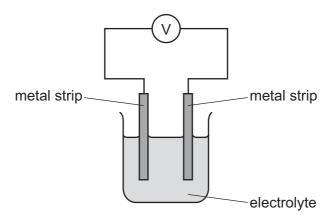
- **A** 22 g
- **B** 28 g
- **C** 44 g
- **D** 88 g
- **9** Which statement about electrolysis is correct?
 - **A** Electrons move through the electrolyte from the cathode to the anode.
 - **B** Electrons move towards the cathode in the external circuit.
 - **C** Negative ions move towards the anode in the external circuit.
 - **D** Positive ions move through the electrolyte towards the anode during electrolysis.

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10 The reactivity series for a number of different metals is shown.

most reactive					least re	eactive	
	magnesium	zinc	iron	copper	silver	platinum	

The diagram shows different metal strips dipped into an electrolyte.



Which pair of metals produces the highest voltage?

- A copper and magnesium
- B magnesium and platinum
- C magnesium and zinc
- **D** silver and platinum
- **11** Some properties of four fuels are shown in the table.

Which fuel is a gas at room temperature and makes two products when it burns in a plentiful supply of air?

	fuel	formula	melting point /°C	boiling point /°C
Α	hydrogen	H ₂	-259	-253
В	methane	CH₄	-182	-164
С	octane	C ₈ H ₁₈	– 57	126
D	wax	C ₃₁ H ₆₄	60	400

- 12 Which statements about exothermic and endothermic reactions are correct?
 - During an exothermic reaction, heat is given out.
 - 2 The temperature of an endothermic reaction goes up because heat is taken in.
 - 3 Burning methane in the air is an exothermic reaction.
 - **A** 1. 2 and 3
- **B** 1 and 2 only
- C 1 and 3 only D 2 and 3 only
- 13 Chlorine reacts with ethane to produce chloroethane and hydrogen chloride.

The reaction is exothermic.

The bond energies are shown in the table.

bond	bond energy in kJ/mol
C-C1	+340
C–C	+350
C–H	+410
C1-C1	+240
H–C1	+430

What is the energy change for the reaction?

- **A** −1420 kJ/mol
- **B** -120 kJ/mol
- C +120 kJ/mol
- **D** +1420 kJ/mol

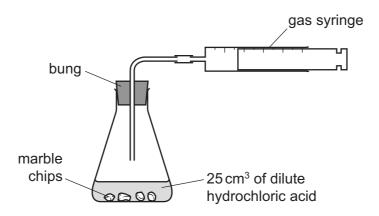
14 When sulfur is heated it undergoes a1..... change as it melts.

Further heating causes the sulfur to undergo a2..... change and form sulfur dioxide.

Which words complete gaps 1 and 2?

	1	2
A chemical		chemical
В	chemical	physical
C physical		chemical
D	physical	physical

15 A student was investigating the reaction between marble chips and dilute hydrochloric acid.



Which changes slow down the rate of reaction?

	temperature of acid	concentration of acid	surface area of marble chips
Α	decrease	decrease	decrease
В	decrease	decrease	increase
С	increase	decrease	decrease
D	increase	increase	increase

16 Nitrogen, hydrogen and ammonia gases are placed inside a container. The container is then sealed. After some time, an equilibrium forms.

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

Which statement describes the equilibrium in this container?

- A The amount of ammonia remains constant from the moment the container is sealed.
- B The amounts of ammonia, nitrogen and hydrogen in the container are always equal.
- **C** The rate of formation of ammonia is equal to the rate of decomposition of ammonia.
- **D** The rate of formation of ammonia is faster than the rate of decomposition of ammonia.
- 17 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 Cu²⁺.
- **B** Zn is the oxidising agent and it reduces Cu²⁺.
- **C** In is the reducing agent and it oxidises Cu²⁺.
- **D** Zn is the reducing agent and it reduces Cu²⁺.
- **18** Zinc oxide is amphoteric.

Which row describes the reactions of zinc oxide?

	reaction with hydrochloric acid	reaction with aqueous sodium hydroxide	
Α	✓	✓	key
В	✓	x	√ = reaction occurs
С	X	✓	x = reaction does not occur
D	X	X	

19 Which row shows how the hydrogen ion concentration and pH of ethanoic acid compare to those of hydrochloric acid of the same concentration?

	ethanoic acid compared to hydrochloric acid		
	hydrogen ion concentration pH		
Α	higher higher		
В	higher lower		
С	lower	higher	
D	lower lower		

- **20** A pure sample of the insoluble salt barium carbonate can be made using the method given.
 - step 1 Dissolve barium chloride in water.
 - step 2 Separately dissolve sodium carbonate in water.
 - step 3 Mix the two solutions together.
 - step 4 Filter the mixture.
 - step 5
 - step 6 Dry the residue between two sheets of filter paper.

Which instruction is missing from step 5?

- A Heat the residue to dryness.
- **B** Heat the residue to the point of crystallisation.
- **C** Place the filtrate in an evaporating basin.
- **D** Wash the residue with water.
- 21 Substance X reacts with warm dilute hydrochloric acid to produce a gas which decolourises acidified aqueous potassium manganate(VII).

Substance X gives a yellow flame in a flame test.

What is X?

- A potassium chloride
- **B** potassium sulfite
- C sodium chloride
- **D** sodium sulfite

22 Which element is less reactive than the other members of its group in the Periodic Table?

	Α	astatine
	В	caesium
	С	fluorine
	D	rubidium
23	The	e elements in Group IV of the Periodic Table are shown.
		carbon
		silicon
		germanium
		tin
		lead
		flerovium
	Wh	at does not occur in Group IV as it is descended?
	Α	The proton number of the elements increases.
	В	The elements become more metallic.
	С	The elements have more electrons in their outer shells.
	D	The elements have more electron shells.
24	Wh	y are weather balloons sometimes filled with helium rather than hydrogen?
	Α	Helium is found in air.
	В	Helium is less dense than hydrogen.

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C Helium is more dense than hydrogen.

D Helium is unreactive.

25 Metal X is added to a colourless aqueous solution of the sulfate of metal Y.

A coloured solution is formed and metal Y is deposited at the bottom of the beaker.

Which row describes elements X and Y and their relative reactivity?

	type of element	relative reactivity
Α	X is a transition element	X is more reactive than Y
В	X is a transition element	Y is more reactive than X
С	Y is a transition element	X is more reactive than Y
D	Y is a transition element	Y is more reactive than X

26 Element E:

- forms an alloy
- has a basic oxide
- is below hydrogen in the reactivity series.

What is E?

- A carbon
- **B** copper
- C sulfur
- **D** zinc
- 27 Zinc metal is extracted from its ore zinc blende in a similar method to that used to extract iron from hematite.

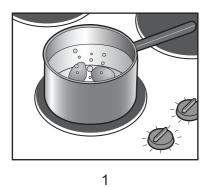
In which way is zinc extraction different from iron extraction?

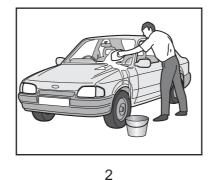
- A Carbon and carbon monoxide are the main reducing agents.
- **B** Hot air at the base of the furnace reacts with coke to keep the furnace hot.
- **C** The metal is removed as a vapour at the top of the furnace.
- **D** The metal oxide is added into the top of the furnace.

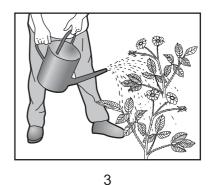
28 Stainless steel is an alloy of iron and other metals. It is strong and does not rust but it costs much more than normal steel.

What is **not** made from stainless steel?

- A cutlery
- B pipes in a chemical factory
- **C** railway lines
- **D** saucepans
- **29** The diagram shows some uses of water in the home.







For which uses is it important for the water to have been treated?

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

30 Oxides of nitrogen are found in polluted air.

Which statement about oxides of nitrogen is correct?

- A Oxides of nitrogen are formed by the reaction of nitrogen with oxygen during the fractional distillation of liquid air.
- **B** Oxides of nitrogen are formed in a car engine by the reaction of petrol with nitrogen from the air.
- **C** Oxides of nitrogen are removed from exhaust gases by reaction with carbon dioxide in a catalytic converter.
- **D** Oxides of nitrogen are removed from exhaust gases by reduction in a catalytic converter.

31 Photosynthesis and respiration are important natural processes.

Which statement is correct?

- A Carbon dioxide is formed by the reaction of glucose with water during photosynthesis.
- **B** Carbon dioxide is removed from the air by respiration.
- **C** Glucose reacts with water to form oxygen during respiration.
- **D** Photosynthesis produces glucose and oxygen.

32 Which row gives the conditions for the Haber process?

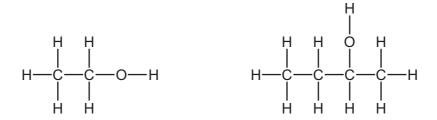
	temperature/°C	pressure /atm	catalyst
Α	200	2	V_2O_5
В	200	450	Fe
С	450	200	Fe
D	500	250	V_2O_5

- 33 Which statement about sulfuric acid is correct?
 - **A** It is made by the Haber process.
 - **B** It is made in the atmosphere by the action of lightning.
 - C It reacts with ammonia to produce a fertiliser.
 - **D** It reacts with copper metal to produce hydrogen gas.
- **34** Which statement is **not** correct?
 - **A** Converting limestone into lime is a thermal decomposition reaction.
 - **B** Flue gas desulfurisation is a neutralisation reaction.
 - **C** In the extraction of iron, calcium carbonate is converted into calcium oxide.
 - **D** Slaked lime is added to soil as a fertiliser.

35 Which fraction of petroleum is not matched to its correct use?

	fraction	use
Α	bitumen	making roads
В	gasoline	fuel for cars
С	kerosene	fuel for ships
D	naphtha	chemical industry

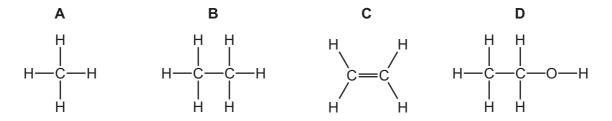
36 The diagram shows the structures of two organic molecules.



Which statement about these molecules is **not** correct?

- A They are both alcohols.
- **B** They both produce carbon dioxide and water when they burn in oxygen.
- **C** They contain different functional groups.
- **D** They have the same general formula.
- 37 The diagram shows part of the molecule of a polymer.

Which diagram shows the monomer from which this polymer could be manufactured?



38 Ethanol is manufactured by fermentation or by the catalytic addition of steam to ethene.

Which statement is correct?

- A Fermentation uses a higher temperature than the catalytic addition of steam to ethene.
- **B** Fermentation uses a non-renewable resource.
- **C** The catalytic addition of steam to ethene produces purer ethanol than fermentation.
- **D** The catalytic addition of steam to ethene uses a biological catalyst.
- **39** The structure of an ester is shown.

Which row is correct?

	name of ester	names of the carboxylic acid and the alcohol used to form the ester
Α	methyl propanoate	methanoic acid and propanol
В	methyl propanoate	methanol and propanoic acid
С	propyl methanoate	methanoic acid and propanol
D	propyl methanoate	methanol and propanoic acid

40 Keratin is a protein that is found in human hair.

Keratin is chemically broken down to produce amino acids.

What is the name of this chemical process?

- A catalysis
- **B** hydration
- C hydrolysis
- D polymerisation

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The Periodic Table of Elements

		2 -	D E	helium 4	10	Ne	neon 20	18	Ā	argon 40	36	호	krypton 84	54	Xe	xenon 131	98	R	radon			
	IIA				6	ш	fluorine 19	17	Cl	chlorine 35.5	35	ä	bromine 80	53	Н	iodine 127	85	Αŧ	astatine			
	I				8	0	oxygen 16	16	ഗ	sulfur 32	34	Se	selenium 79	52	<u>e</u>	tellurium 128	84	Ъ	moloud –	116	^	livermorium -
	>				7	z	nitrogen 14	15	۵	phosphorus 31	33	As	arsenic 75	51	Sp	antimony 122	83	Ξ	bismuth 209			
	\geq				9	O	carbon 12	14	S	silicon 28	32	Ge	germanium 73	20	Sn	tin 119	82	Pb	lead 207	114	Εl	flerovium
	\blacksquare				2	В	boron 11	13	Αl	aluminium 27	31	Ga	gallium 70	49	I	indium 115	81	<i>1</i> 1	thallium 204			
											30	Zu	zinc 65	48	ပ္ပ	cadmium 112	80	Нg	mercury 201	112	S	copernicium
											29	Cn	copper 64	47	Ag	silver 108	62	Au	gold 197	111	Rg	roentgenium -
Group											28	Z	nickel 59	46	Pd	palladium 106	78	귙	platinum 195	110	Ds	darmstadtium -
Gre											27	ဝိ	cobalt 59	45	R	rhodium 103	77	'n	iridium 192	109	¥	meitnerium -
		-]	С	hydrogen 1							26	Fe	iron 56	44	Ru	ruthenium 101	92	SO	osmium 190	108	Hs	hassium
											25	Mn	manganese 55	43	ည	technetium -	75	Re	rhenium 186	107	Bh	bohrium
				Key	_	lod	ass				24	ပ်	chromium 52	42	Mo	molybdenum 96	74	>	tungsten 184	106	Sg	seaborgium -
					atomic number	atomic symbo	name relative atomic mass				23	>	vanadium 51	41	qN	niobium 93	73	Б	tantalum 181	105	Q O	dubnium –
								atc	<u>ə</u>				22	j	titanium 48	40	Zr	zirconium 91	72	Ξ	hafnium 178	104
								ī			21	Sc	scandium 45	39	>	yttrium 89	57–71	lanthanoids		89–103	actinoids	
	=				4	Be	beryllium 9	12	Mg	magnesium 24	20	Ca	calcium 40	38	Š	strontium 88	56	Ba	barium 137	88	Ra	radium
	_				က	=	lithium 7	=	Na	sodium 23	19	×	potassium 39	37	Вb	rubidium 85	55	CS	caesium 133	87	Ŧ	francium

70	Υp	thulium ytterbium lutetium 169 175	102	^o Z	nobelium	
89	щ	erbium 167	100	Fn	fermium	I
29	운	holmium 165	66	Es	einsteinium	ı
99	۵	dysprosium 163	86	ర	californium	ı
65	Tp	terbium 159	26	益	berkelium	ı
64	gg	gadolinium 157	96	Cm	curium	ı
63	Ш	europium 152	92	Am	americium	1
62	Sm	samarium 150	94	Pu	plutonium	1
61	Pm	promethium —	93	d	neptunium	ı
09	PZ	neodymium 144	92	\supset	uranium	238
59	Ą	praseodymium 141	91	Ра	protactinium	231
58	Ce	cerium 140	06	T	thorium	232
22	Га	lanthanum 139	68	Ac	actinium	ı
	lanthanoids			actinoids		

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).