



# Cambridge IGCSE™

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## CHEMISTRY

0620/21

Paper 2 Multiple Choice (Extended)

October/November 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)

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



- 1 Decane has a freezing point of  $-30^{\circ}\text{C}$  and a boiling point of  $174^{\circ}\text{C}$ .

A small sample of decane is placed in an open beaker in an oven at a temperature of  $120^{\circ}\text{C}$  and at atmospheric pressure for 24 hours.

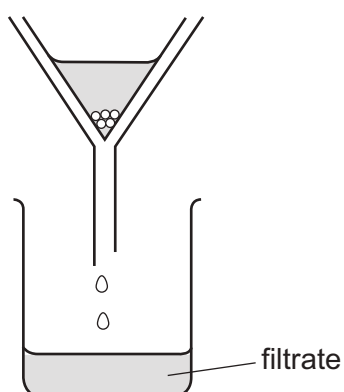
What happens to the sample of decane?

- A It boils.
  - B It evaporates.
  - C It melts.
  - D It sublimates.
- 2 A student put exactly  $25.00\text{ cm}^3$  of dilute hydrochloric acid into a conical flask.

The student added 2.5 g of solid sodium carbonate and measured the change in temperature of the mixture.

Which apparatus does the student need to use?

- A balance, measuring cylinder, thermometer
  - B balance, pipette, stopwatch
  - C balance, pipette, thermometer
  - D burette, pipette, thermometer
- 3 A student separates sugar from pieces of broken glass by dissolving the sugar in water and filtering off the broken glass.



What is the filtrate?

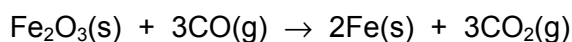
- A broken glass only
- B broken glass and sugar solution
- C pure water
- D sugar solution

- 4 Which statement explains why metals conduct electricity when solid?
- A They have atoms which are free to move.
  - B They have electrons which are free to move.
  - C They have molecules which are free to move.
  - D They have positive ions which are free to move.

- 5 Which description of brass is correct?

- A alloy
- B compound
- C element
- D non-metal

- 6 The equation for the reaction of iron(III) oxide with carbon monoxide is shown.



What is the maximum mass of iron that can be made from 480 g of iron(III) oxide?

- A 56 g
  - B 112 g
  - C 168 g
  - D 336 g
- 7 Which statement describes the attractive forces between molecules?
- A They are strong covalent bonds which hold molecules together.
  - B They are strong ionic bonds which hold molecules together.
  - C They are weak forces formed between covalently-bonded molecules.
  - D They are weak forces which hold ions together in a lattice.
- 8 Which statement about carbon is correct?
- A Diamond and graphite both have simple molecular structures.
  - B Diamond and graphite are both used to make cutting tools.
  - C Each carbon atom in diamond is bonded to three other carbon atoms.
  - D Graphite conducts electricity and has a giant covalent structure.
- 9 The formula of an aluminium ion is  $\text{Al}^{3+}$ .

What is the formula of aluminium sulfate?

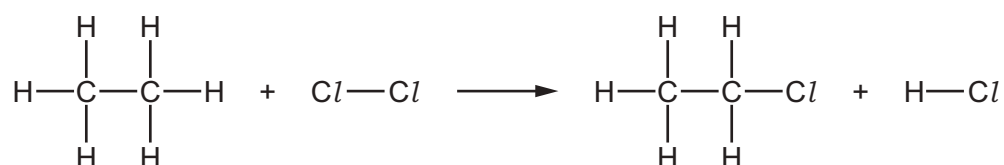
- A  $\text{Al}_2\text{SO}_4$
- B  $\text{Al}(\text{SO}_4)_2$
- C  $\text{Al}_2(\text{SO}_4)_3$
- D  $\text{Al}_3(\text{SO}_4)_2$

10 Which statements about the products of electrolysis, using inert electrodes, are correct?

- 1 When molten lead(II) bromide is electrolysed, bromine is formed at the cathode.
- 2 When dilute sulfuric acid is electrolysed, oxygen is formed at the anode.
- 3 When concentrated aqueous sodium chloride is electrolysed, sodium is formed at the cathode.
- 4 When concentrated hydrochloric acid is electrolysed, chlorine is formed at the anode.

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

11 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-Cl	+340
C-C	+350
C-H	+410
Cl-Cl	+240
H-Cl	+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

12 Hydrogen is used as a fuel in rockets and is also used in hydrogen fuel cells.

Which statements are correct?

- 1 Both uses produce water vapour.
- 2 Burning hydrogen produces polluting gases.
- 3 A fuel cell produces electricity.

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

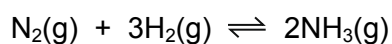
13 Which statements about the effect of increasing the temperature on the rate of a reaction are correct?

- 1 It increases the rate of a reaction.
- 2 It increases the activation energy.
- 3 It increases the frequency of collisions.

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

14 Ammonia is made by reacting nitrogen with hydrogen.

The equation for the reaction is shown.



The forward reaction is exothermic.

Which changes in temperature and pressure decrease the yield of ammonia?

	temperature	pressure
<b>A</b>	decrease	decrease
<b>B</b>	decrease	increase
<b>C</b>	increase	decrease
<b>D</b>	increase	increase

15 X is a pink solid.

Y is a blue solid.

When X is heated, water is produced and the solid turns blue.

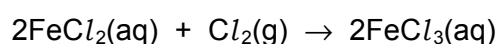
When water is added to Y, the solid turns pink.

What are X and Y?

	X	Y
<b>A</b>	anhydrous cobalt(II) chloride	hydrated cobalt(II) chloride
<b>B</b>	hydrated cobalt(II) chloride	anhydrous cobalt(II) chloride
<b>C</b>	anhydrous copper(II) sulfate	hydrated copper(II) sulfate
<b>D</b>	hydrated copper(II) sulfate	anhydrous copper(II) sulfate

16 Iron(II) chloride solution reacts with chlorine gas.

The equation is shown.



Which statements about this reaction are correct?

- 1  $\text{Fe}^{2+}$  ions are reduced to  $\text{Fe}^{3+}$  ions.
- 2 Chlorine acts as a reducing agent.
- 3  $\text{Fe}^{2+}$  ions each lose an electron.
- 4  $\text{Cl}_2$  molecules are reduced to  $\text{Cl}^-$  ions.

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

17 Which row describes the properties of an acid?

	property 1	property 2
<b>A</b>	proton acceptor	pH less than 7
<b>B</b>	proton acceptor	pH more than 7
<b>C</b>	proton donor	pH less than 7
<b>D</b>	proton donor	pH more than 7

18 Which element forms an amphoteric oxide?

- A aluminium
- B carbon
- C magnesium
- D silicon

19 Copper(II) chloride crystals are made by adding solid copper(II) carbonate to dilute hydrochloric acid until no more dissolves.

Which process is used to obtain pure copper(II) chloride crystals from the mixture?

- A distillation of the mixture
- B evaporation of the mixture
- C filtration followed by drying of the residue
- D filtration followed by evaporation of the filtrate

20 Moving from right to left across the Periodic Table the elements show increasing metallic character.

Why does metallic character increase from right to left across a period?

- A The atoms have more electrons in their outer shells.
- B The atoms more readily gain electrons to form negative ions.
- C The atoms more readily lose electrons to form positive ions.
- D The charge on the nucleus of each atom gets larger.

21 A period of the Periodic Table is shown.

group	I	II	III	IV	V	VI	VII	VIII
element	R	S	T	V	W	X	Y	Z

The letters are not their chemical symbols.

Which statement is correct?

- A Element R does not conduct electricity.
- B Elements R and Y react together to form an ionic compound.
- C Element Z exists as a diatomic molecule.
- D Element Z reacts with element T.

22 Group VII elements show trends in their physical properties going down the group.

element	X	Y	Z
chlorine	-101	-34	0.003
bromine	-7	59	3.1
iodine	114	184	4.9

Which row shows the missing headings for the properties in the table?

	X	Y	Z
<b>A</b>	density in $\text{g/cm}^3$	boiling point in $^{\circ}\text{C}$	melting point in $^{\circ}\text{C}$
<b>B</b>	melting point in $^{\circ}\text{C}$	boiling point in $^{\circ}\text{C}$	density in $\text{g/cm}^3$
<b>C</b>	boiling point in $^{\circ}\text{C}$	density in $\text{g/cm}^3$	melting point in $^{\circ}\text{C}$
<b>D</b>	boiling point in $^{\circ}\text{C}$	melting point in $^{\circ}\text{C}$	density in $\text{g/cm}^3$

23 Some properties of two metals, G and H, are shown.

metal G	metal H
the formula of the chloride is $\text{GCl}$ reacts with cold water	high melting point has more than one oxidation state

Which row about metals G and H is correct?

	metal G	metal H
<b>A</b>	in Group I of the Periodic Table	in Group II of the Periodic Table
<b>B</b>	in Group I of the Periodic Table	transition metal
<b>C</b>	in Group II of the Periodic Table	in Group I of the Periodic Table
<b>D</b>	in Group II of the Periodic Table	transition metal

24 The noble gases are in Group VIII of the Periodic Table.

Which statement explains why noble gases are unreactive?

- A** They all have eight electrons in their outer shells.
- B** They all have full outer shells.
- C** They are all gases.
- D** They are all monoatomic.



25 Which statement is correct for **all** metals?

- A They conduct electricity when molten.
- B They gain electrons when they form ions.
- C They have a low density.
- D They have a low melting point.

26 Which statement about the extraction of metals is correct?

- A Aluminium is extracted from the ore bauxite by electrolysis.
- B Aluminium is extracted from the ore hematite by electrolysis.
- C Iron is extracted from the ore bauxite by electrolysis.
- D Iron is extracted from the ore hematite by electrolysis.

27 Aluminium objects do not need protection from corrosion.

Iron objects must be protected from corrosion.

Which statement explains why aluminium resists corrosion?

- A Aluminium does not form ions easily.
- B Aluminium does not react with water or air.
- C Aluminium has a protective oxide layer.
- D Aluminium is below iron in the reactivity series.

28 Which statements about the thermal decomposition of copper(II) nitrate are correct?

- 1 A brown gas is given off.
- 2 A gas which relights a glowing splint is given off.
- 3 The solid residue is an acidic oxide.

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

**29** Covering iron with zinc prevents the iron from rusting even when the zinc is scratched.

Covering iron with tin prevents the iron from rusting, but when the tin is scratched the iron underneath starts to rust.

Which statement is correct?

- A** Both tin and zinc prevent iron from rusting by sacrificial protection.
- B** Both tin and zinc prevent iron from rusting by stopping water and carbon dioxide reaching the iron.
- C** Tin is more reactive than iron and prevents iron from rusting until it is scratched.
- D** Zinc loses electrons more easily than iron and prevents iron from rusting by corroding first.

**30** Which statements about the Haber process are correct?

- 1 One of the raw materials is extracted from liquid air by fractional distillation.
- 2 One of the raw materials is produced by the reaction of steam and methane.
- 3 The catalyst for the Haber process is vanadium(V) oxide.

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

**31** Which raw material is used in the Contact process?

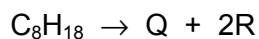
- A** air
- B** ammonia
- C** carbon
- D** nitrogen

**32** Lime (calcium oxide) is used to treat waste water from a factory.

Which substance is removed by the lime?

- A** ammonia
- B** sodium chloride
- C** sodium hydroxide
- D** sulfuric acid

- 33 An alkane molecule of molecular formula  $C_8H_{18}$  undergoes cracking. The equation for the reaction is shown.



Substance R has two carbon atoms per molecule and decolourises aqueous bromine.

What is substance Q?

- A butane
  - B butene
  - C ethane
  - D ethene
- 34 Fuel X produces carbon dioxide and water when it is burned in air. So does fuel Y.

What could X and Y be?

	X	Y
A	C	$H_2$
B	C	$C_8H_{18}$
C	$CH_4$	$H_2$
D	$CH_4$	$C_8H_{18}$

- 35 Which molecule contains only single covalent bonds?

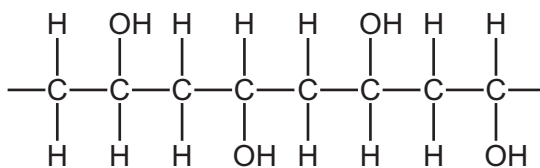
- A propane
- B propanoic acid
- C propene
- D propyl propanoate

- 36 Alkanes react with chlorine to form chloroalkanes.

Which statement about the reactions of alkanes with chlorine is correct?

- A Alkanes react with chlorine by addition.
- B The gaseous product turns red litmus blue.
- C The chlorine atom in chloroethane is covalently bonded.
- D The general formula of the chloroalkanes is  $C_nH_{2n}Cl$ .

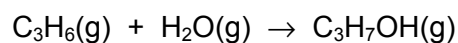
37 Part of the structure of a very large molecule is shown.



Which term describes the small unit used to make this molecule?

- A hydrocarbon
- B monomer
- C polymer
- D saturated

38 Propene reacts with steam to form propanol.



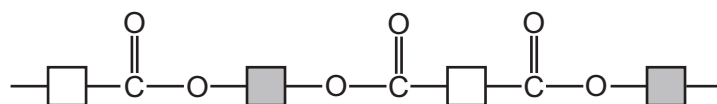
Which type of reaction takes place?

- A addition
- B condensation
- C oxidation
- D substitution

39 Which statement about aqueous ethanoic acid is correct?

- A It reacts with magnesium to produce a salt and hydrogen.
- B It reacts with sodium hydroxide to produce a salt and hydrogen.
- C It reacts with ammonium salts to produce ammonia.
- D It turns red litmus blue.

40 The diagram shows the partial structure of *Terylene*.



From which pair of compounds is it made?

- A**  $\text{HO}-\text{C}(=\text{O})-\square-\text{C}(=\text{O})-\text{OH}$  +  $\text{HO}-\square-\text{OH}$
- B**  $\text{HO}-\square-\text{C}(=\text{O})-\text{OH}$  +  $\text{HO}-\square-\text{C}(=\text{O})-\text{OH}$
- C**  $\text{HO}-\square-\text{OH}$  +  $\text{HO}-\text{C}(=\text{O})-\square-\text{C}(=\text{O})-\text{OH}$
- D**  $\text{HO}-\text{C}(=\text{O})-\square-\text{C}(=\text{O})-\text{OH}$  +  $\text{HO}-\text{C}(=\text{O})-\square-\text{C}(=\text{O})-\text{OH}$



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The Periodic Table of Elements

Group																	
I	II	Group										III	IV	V	VI	VII	VIII
3 <b>Li</b> lithium 7	4 <b>Be</b> beryllium 9	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <b>Key</b>                      atomic number                      atomic symbol                      name                      relative atomic mass                 </div>										5 <b>B</b> boron 11	6 <b>C</b> carbon 12	7 <b>N</b> nitrogen 14	8 <b>O</b> oxygen 16	9 <b>F</b> fluorine 19	10 <b>Ne</b> neon 20
11 <b>Na</b> sodium 23	12 <b>Mg</b> magnesium 24											1 <b>H</b> hydrogen 1	13 <b>Al</b> aluminium 27	14 <b>Si</b> silicon 28	15 <b>P</b> phosphorus 31	16 <b>S</b> sulfur 32	17 <b>Cl</b> chlorine 35.5
19 <b>K</b> potassium 39	20 <b>Ca</b> calcium 40	21 <b>Sc</b> scandium 45	22 <b>Ti</b> titanium 48	23 <b>V</b> vanadium 51	24 <b>Cr</b> chromium 52	25 <b>Mn</b> manganese 55	26 <b>Fe</b> iron 56	27 <b>Co</b> cobalt 59	28 <b>Ni</b> nickel 59	29 <b>Cu</b> copper 64	30 <b>Zn</b> zinc 65	31 <b>Ga</b> gallium 70	32 <b>Ge</b> germanium 73	33 <b>As</b> arsenic 75	34 <b>Se</b> selenium 79	35 <b>Br</b> bromine 80	36 <b>Kr</b> krypton 84
37 <b>Rb</b> rubidium 85	38 <b>Sr</b> strontium 88	39 <b>Y</b> yttrium 89	40 <b>Zr</b> zirconium 91	41 <b>Nb</b> niobium 93	42 <b>Mo</b> molybdenum 96	43 <b>Tc</b> technetium —	44 <b>Ru</b> ruthenium 101	45 <b>Rh</b> rhodium 103	46 <b>Pd</b> palladium 106	47 <b>Ag</b> silver 108	48 <b>Cd</b> cadmium 112	49 <b>In</b> indium 115	50 <b>Sn</b> tin 119	51 <b>Sb</b> antimony 122	52 <b>Te</b> tellurium 128	53 <b>I</b> iodine 127	54 <b>Xe</b> xenon 131
55 <b>Cs</b> caesium 133	56 <b>Ba</b> barium 137	57–71 lanthanoids	72 <b>Hf</b> hafnium 178	73 <b>Ta</b> tantalum 181	74 <b>W</b> tungsten 184	75 <b>Re</b> rhenium 186	76 <b>Os</b> osmium 190	77 <b>Ir</b> iridium 192	78 <b>Pt</b> platinum 195	79 <b>Au</b> gold 197	80 <b>Hg</b> mercury 201	81 <b>Tl</b> thallium 204	82 <b>Pb</b> lead 207	83 <b>Bi</b> bismuth 209	84 <b>Po</b> polonium —	85 <b>At</b> astatine —	86 <b>Rn</b> radon —
87 <b>Fr</b> francium —	88 <b>Ra</b> radium —	89–103 actinoids	104 <b>Rf</b> rutherfordium —	105 <b>Db</b> dubnium —	106 <b>Sg</b> seaborgium —	107 <b>Bh</b> bohrium —	108 <b>Hs</b> hassium —	109 <b>Mt</b> meitnerium —	110 <b>Ds</b> darmstadtium —	111 <b>Rg</b> roentgenium —	112 <b>Cn</b> copernicium —	114 <b>Fl</b> flerovium —	116 <b>Lv</b> livermorium —	—	—	—	—

lanthanoids	57 <b>La</b> lanthanum 139	58 <b>Ce</b> cerium 140	59 <b>Pr</b> praseodymium 141	60 <b>Nd</b> neodymium 144	61 <b>Pm</b> promethium —	62 <b>Sm</b> samarium 150	63 <b>Eu</b> europium 152	64 <b>Gd</b> gadolinium 157	65 <b>Tb</b> terbium 159	66 <b>Dy</b> dysprosium 163	67 <b>Ho</b> holmium 165	68 <b>Er</b> erbium 167	69 <b>Tm</b> thulium 169	70 <b>Yb</b> ytterbium 173	71 <b>Lu</b> lutetium 175
actinoids	89 <b>Ac</b> actinium —	90 <b>Th</b> thorium 232	91 <b>Pa</b> protactinium 231	92 <b>U</b> uranium 238	93 <b>Np</b> neptunium —	94 <b>Pu</b> plutonium —	95 <b>Am</b> americium —	96 <b>Cm</b> curium —	97 <b>Bk</b> berkelium —	98 <b>Cf</b> californium —	99 <b>Es</b> einsteinium —	100 <b>Fm</b> fermium —	101 <b>Md</b> mendelevium —	102 <b>No</b> nobelium —	103 <b>Lr</b> lawrencium —

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