Cambridge Assessment International Education

MEM

Cambridge IGCSE™

CHEMISTRY **0620/22**

Paper 2 Multiple Choice (Extended) **February/March 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

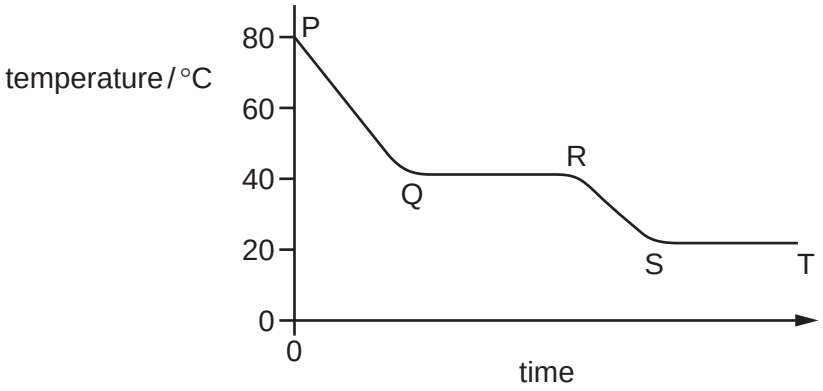
- The total mark for this paper is 40.
- Each correct answer will score one mark.
- Any rough working should be done on this question paper.
- The Periodic Table is printed in the question paper.

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

1 Substance M is a solid at 30 °C.

The substance is heated to 80 °C and its temperature measured as it cools down to room temperature.

The cooling curve is shown.



Between which times is substance M freezing?

A P to Q **B** Q to R **C** R to S **D** S to T

2 Which gas has the fastest rate of diffusion?

A Ar **B** C_2H_6 **C** HCl **D** H_2S

3 There are two stable isotopes of bromine.

The mass number of isotope 1 is 79.

The mass number of isotope 2 is 81.

Which statement is correct?

A The isotopes have the same number of neutrons.

B The isotopes have different chemical properties.

C The isotopes have different numbers of protons.

D The isotopes have the same number of outer electrons.

4 Which statement about ions and ionic bonds is correct?

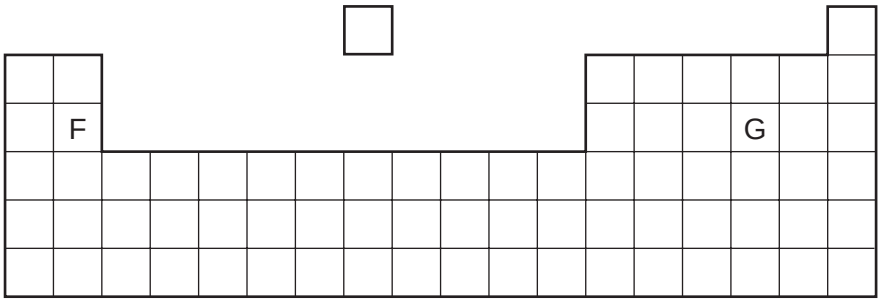
A Bromine atoms form negatively charged bromide ions.

B Ionic bonds form between elements in Group VII of the Periodic Table.

C Positive ions are formed when atoms lose protons.

D Potassium iodide contains negatively charged potassium ions.

5 Part of the Periodic Table is shown.



Which type of chemical bonding is present in the oxide of F and in the oxide of G?

	oxide of F	oxide of G
A	covalent	covalent
B	covalent	ionic
C	ionic	covalent
D	ionic	ionic

6 Elements X and Y react to form a compound.

Element X loses two electrons and element Y gains one electron.

What is the charge on the ions of elements X and Y and what is the formula of the compound?

	charge on X	charge on Y	formula of compound
A	2+	–	X_2Y
B	2+	–	XY_2
C	2–	+	X_2Y
D	2–	+	XY_2

7 Which statement about graphite explains why it is used as an electrode?

A It contains ions.

B It has a giant covalent structure.

C It is a metal.

D It has mobile electrons.

[Turn over

8 Methane, CH_4, burns in air to form carbon dioxide and water.

What is the balanced equation for this reaction?

A $CH_4(g) + O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$

B $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$

C $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + H_2O(g)$

D $CH_4(g) + 3O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$

9 The equation for the thermal decomposition of sodium hydrogencarbonate is shown.

$$2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$$

The M_r of sodium hydrogencarbonate, $NaHCO_3$, is 84.

The M_r of sodium carbonate, Na_2CO_3, is 106.

In an experiment, 2.1 g of sodium hydrogencarbonate is heated but not all of it decomposes. All of the carbon dioxide is collected and measured at room temperature and pressure. The total volume of carbon dioxide produced is 0.21 dm^3.

The volume of 1 mole of a gas at room temperature and pressure is 24 dm^3.

Which statement is correct?

A The mass of sodium carbonate produced is 0.93 g.

B The mass of sodium carbonate produced is 1.33 g.

C The percentage yield of carbon dioxide is 10%.

D The percentage yield of carbon dioxide is 35%.

10 An electrolysis experiment is done using carbon electrodes.

Hydrogen and oxygen are formed at the electrodes.

What is the electrolyte?

A aqueous copper(II) sulfate

B concentrated hydrochloric acid

C dilute aqueous sodium chloride

D molten potassium oxide

11 Concentrated aqueous copper(II) sulfate is electrolysed using copper electrodes.

Which ionic half-equation describes the reaction taking place at the cathode?

A $2H^+ + 2e^- \rightarrow H_2$

B $4OH^- \rightarrow O_2 + 2H_2O + 4e^-$

C $Cu \rightarrow Cu^{2+} + 2e^-$

D $Cu^{2+} + 2e^- \rightarrow Cu$

12 When powdered sodium carbonate and aqueous ethanoic acid are mixed, the temperature of the mixture falls.

Which statement about this reaction is correct?

A The reaction is endothermic and ΔH is negative.

B The reaction is endothermic and ΔH is positive.

C The reaction is exothermic and ΔH is negative.

D The reaction is exothermic and ΔH is positive.

13 Magnesium powder reacts with an excess of dilute hydrochloric acid to produce hydrogen gas.

Which statements about this reaction are correct?

1 The smaller the particles of magnesium powder, the more slowly the hydrogen is produced.

2 The higher the temperature, the faster the magnesium powder disappears.

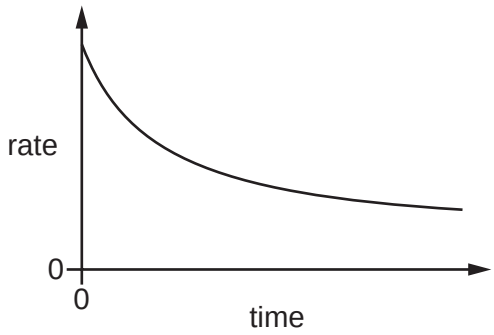
3 The lower the concentration of dilute hydrochloric acid, the faster the rate of reaction.

4 The faster the magnesium powder disappears, the faster the rate of reaction.

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

14 The reaction between two aqueous compounds, X and Y, is slow and exothermic.

The graph shows how the rate of this reaction changes with time.



A student suggests that the rate of reaction decreases with time because:

1 the activation energy decreases

2 the speed of the molecules of X and Y decreases

3 the concentration of both X and Y decreases with time.

Which suggestions are correct?

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

15 Hydrogen reacts with iodine to form hydrogen iodide.

$$H_2(g) + I_2(g) \rightarrow 2HI(g)$$

Which statements explain why the reaction is faster when the pressure is increased, at constant temperature?

1 At higher pressure, the molecules are moving faster.

2 At higher pressure, more of the molecules have the required activation energy.

3 At higher pressure, the molecules are closer together.

4 At higher pressure, the molecules collide more frequently.

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

16 Ammonium sulfate is used as a fertiliser.

It is made from ammonia and sulfuric acid.

The .....1..... is made by the .....2..... process in which .....3..... is used as a catalyst.

Which words complete gaps 1, 2 and 3?

	1	2	3
A	ammonia	Contact	iron
B	ammonia	Haber	vanadium(V) oxide
C	sulfuric acid	Contact	vanadium(V) oxide
D	sulfuric acid	Haber	iron

17 The reversible reaction shown takes place in a closed system at constant temperature.

$$P(g) + Q(g) + R(g) \rightleftharpoons S(g) + T(g)$$

When the reaction has reached equilibrium, more T is added.

After the addition of T, which other substances increase in concentration?

A P, Q, R and S

B P and Q only

C P, Q and R only

D S only

18 In which equation is the underlined substance acting as a reducing agent?

A $3\underline{CO} + Fe_2O_3 \rightarrow 2Fe + 3CO_2$

B $\underline{CO_2} + C \rightarrow 2CO$

C $\underline{CuO} + H_2 \rightarrow Cu + H_2O$

D $\underline{CaO} + H_2O \rightarrow Ca(OH)_2$

[Turn over

19 An aqueous solution reacts with a solid. The products are an alkaline gas, a salt and water.

What are the aqueous solution and the solid?

	aqueous solution	solid
A	sodium hydroxide	magnesium carbonate
B	hydrochloric acid	magnesium carbonate
C	hydrochloric acid	ammonium chloride
D	sodium hydroxide	ammonium chloride

20 Butanoic acid partially dissociates in aqueous solution.

Which row about butanoic acid is correct?

	pH	effect on thymolphthalein
A	3	turns blue
B	5	turns colourless
C	8	turns blue
D	10	turns colourless

21 Copper(II) sulfate is prepared by adding excess copper(II) carbonate to sulfuric acid.

Why is an **excess** of copper(II) carbonate added?

A to ensure all the copper(II) carbonate has reacted

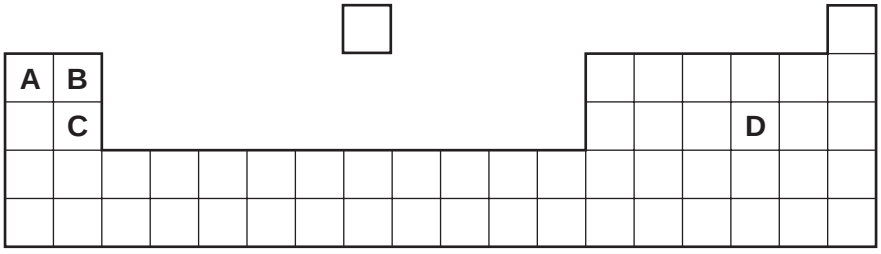
B to ensure all the sulfuric acid has reacted

C to increase the rate of reaction

D to increase the amount of copper(II) sulfate produced

22 Part of the Periodic Table is shown.

Which element has two electrons in its outer shell and three electron shells?



23 Elements in Group I and Group II show the same trends in their reactions with water and in their density.

Which row shows how the properties of barium compare with calcium?

	reaction with water	density
A	faster	higher
B	faster	lower
C	slower	higher
D	slower	lower

24 Which pair of compounds shows a transition element in two different oxidation states?

A Cr_2O_3 and $Cr_2(SO_4)_3$

B Cu_2O and $CuCO_3$

C ZnS and $ZnSO_4$

D NiO and $Ni(NO_3)_2$

25 Which description of brass is correct?

A a compound of copper and zinc

B a compound of copper and tin

C a mixture of copper and zinc

D a mixture of copper and tin

26 What is the symbol of the metal used in the manufacture of aircraft because of its low density?

A Al **B** Cu **C** Fe **D** Zn

27 Which substances react to form hydrogen gas?

1 calcium and water

2 silver and dilute hydrochloric acid

3 magnesium and steam

4 zinc and dilute hydrochloric acid

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

28 Coke (carbon) and limestone are two raw materials used in the extraction of iron from hematite.

Which type of reaction occurs when each substance is heated during the process?

	coke	limestone
A	redox	redox
B	redox	thermal decomposition
C	thermal decomposition	redox
D	thermal decomposition	thermal decomposition

29 Some combustion reactions produce pollutant gases.

Which reactions produce a pollutant gas that is **not** present in clean air?

1 $2CH_4 + 3O_2 \rightarrow 2CO + 4H_2O$

2 $2H_2 + O_2 \rightarrow 2H_2O$

3 $C + O_2 \rightarrow CO_2$

4 $N_2 + O_2 \rightarrow 2NO$

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

30 One mole of alkane Y produces 72 dm^3 of carbon dioxide when burned in excess oxygen, measured at room temperature and pressure.

What is Y?

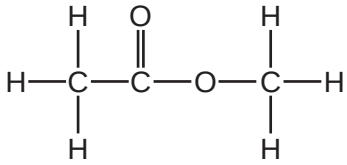
A butane

B ethane

C methane

D propane

31 The structure of organic compound X is shown.



What is X?

A ethyl ethanoate

B ethyl methanoate

C methyl ethanoate

D methyl methanoate

32 What is the structural formula of the compound formed in the addition reaction of propene with bromine?

A $CH_3CHBrCH_2Br$

B $CH_2BrCH_2CH_2Br$

C $CHBr_2CH_2CH_3$

D $CH_3CBr_2CH_3$

33 Ethanol is produced industrially by fermentation and also by a catalysed addition reaction involving steam.

Which row describes one advantage of each process?

	fermentation	catalysed addition reaction involving steam
A	the reactant used is renewable	it is a continuous process
B	the reactant used is renewable	it requires little energy
C	it is a very rapid reaction	it is a continuous process
D	it is a very rapid reaction	it requires little energy

34 Carboxylic acids react with alcohols when warmed with an acid catalyst.

Which type of substance is formed in this reaction?

A an alkene

B an ester

C a salt

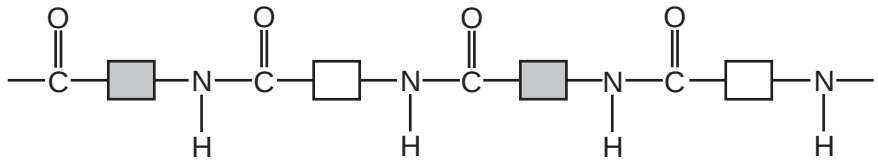
D a polymer

[Turn over

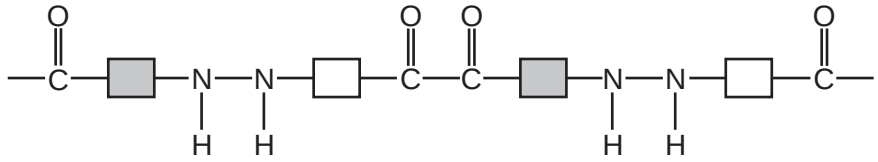
35 Nylon is formed by condensation polymerisation.

Which structure represents nylon?

A



B



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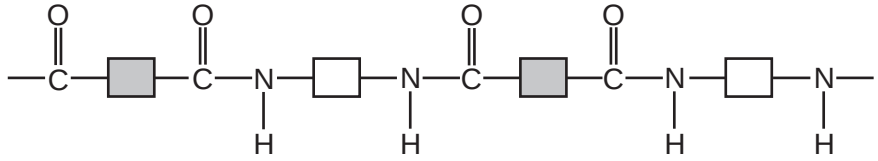

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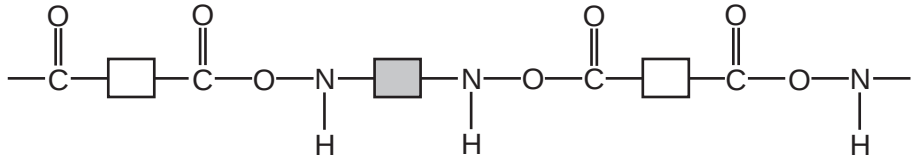
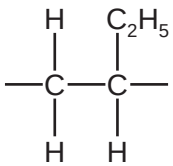


36 Which structure represents the repeat unit of the addition polymer formed from but-1-ene?

A



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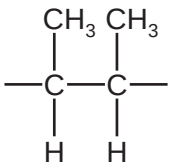
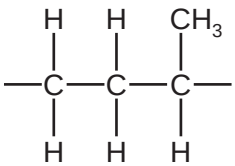


C



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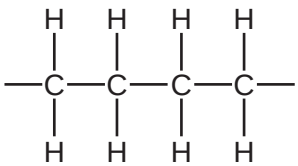
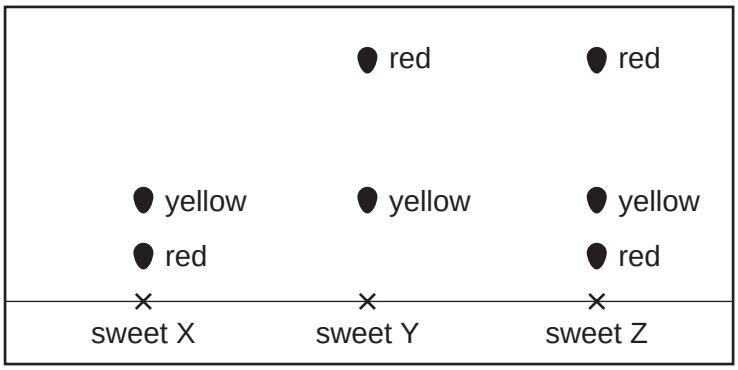


37 2.00 g of powdered calcium carbonate is added to 50.0 cm^3 of hydrochloric acid.

Which apparatus is used to measure these quantities of calcium carbonate and hydrochloric acid?

	calcium carbonate	hydrochloric acid
A	balance	burette
B	balance	thermometer
C	pipette	burette
D	pipette	thermometer

38 The diagram shows a chromatogram obtained from the colours of three different sweets, X, Y and Z.



How many different **red** dyes are present in the sweets?

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

39 A mixture contains sand and an aqueous solution of sodium chloride.

Which processes are used to obtain a sample of solid sand **and** a sample of solid sodium chloride from the mixture?

A crystallisation followed by filtration

B evaporation followed by filtration

C filtration followed by crystallisation

D simple distillation followed by crystallisation

40 A student tests an unknown compound M.

The compound:

- produces a lilac flame using a flame test
- produces a gas which turns limewater cloudy when dilute hydrochloric acid is added.

What is M?

A sodium sulfate

B sodium carbonate

C potassium sulfate

D potassium carbonate

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The Periodic Table of Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 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.).