



# **Cambridge IGCSE™**

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## **CHEMISTRY**

**0620/43**

Paper 4 Theory (Extended)

**October/November 2020**

**1 hour 15 minutes**

You must answer on the question paper.

No additional materials are needed.

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### **INSTRUCTIONS**

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

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### **INFORMATION**

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].
- The Periodic Table is printed in the question paper.

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This document has **16** pages. Blank pages are indicated.

- 1 The names of nine substances are shown.

aluminium oxide  
ammonia  
carbon monoxide  
anhydrous cobalt(II) chloride  
hydrated copper(II) sulfate  
iron(III) oxide  
nitrogen dioxide  
silver  
steel

Answer the following questions using these substances. Each substance may be used once, more than once or not at all.

Name the substance that is:

- (a) the main constituent of hematite ..... [1]
- (b) a gas produced in car engines which causes acid rain ..... [1]
- (c) an alkaline gas ..... [1]
- (d) an element ..... [1]
- (e) a gas formed by the incomplete combustion of fossil fuels ..... [1]
- (f) used to test for the presence of water. .... [1]

[Total: 6]

- 2 The table gives information about five particles, **A**, **B**, **C**, **D** and **E**.

particle	number of electrons	number of neutrons	number of protons
<b>A</b>	10	13	11
<b>B</b>	18	20	18
<b>C</b>	18	18	18
<b>D</b>	10	12	8
<b>E</b>	10	10	10

- (a) State the atomic number of **A**.

..... [1]

- (b) State the nucleon number of **B**.

..... [1]

- (c) Write the electronic structure of **C**.

..... [1]

- (d) Give the letters of all the particles which are:

(i) atoms ..... [1]

(ii) positive ions ..... [1]

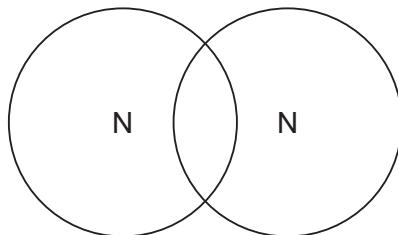
(iii) negative ions ..... [1]

(iv) isotopes of each other. ..... [1]

[Total: 7]

3 This question is about nitrogen and some of its compounds.

- (a) Complete the dot-and-cross diagram to show the electron arrangement in a molecule of nitrogen, N<sub>2</sub>.  
Show the outer shell electrons only.



[2]

- (b) Nitrogen can be converted into ammonia by the Haber process.

- (i) Describe how nitrogen is obtained for the Haber process.

.....  
..... [2]

- (ii) Give the essential reaction conditions and write a chemical equation for the reaction occurring in the Haber process.

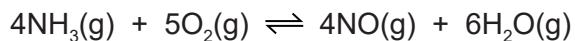
chemical equation: .....

reaction conditions: .....

[5]

- (c) Some of the ammonia made by the Haber process is converted into nitric acid.

The first stage of this process is the oxidation of ammonia to make nitrogen monoxide.



The process is carried out at 900 °C and a pressure of 5 atmospheres using an alloy of platinum and rhodium as a catalyst.

The forward reaction is exothermic.

- (i) State the meaning of the term *catalyst*.

..... [2]

- (ii) State the meaning of the term *oxidation*.

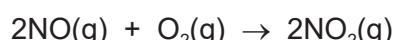
..... [1]

- (iii) Complete the table using the words **increase**, **decrease** or **no change**.

	effect on the rate of the forward reaction	effect on the equilibrium yield of NO(g)
increasing the temperature		
increasing the pressure		

[4]

- (d) Nitrogen monoxide, NO, is converted into nitrogen dioxide, NO<sub>2</sub>.



The nitrogen dioxide reacts with oxygen and water to produce nitric acid as the only product.

Write a chemical equation for this reaction.

..... [2]

(e) Ammonium nitrate,  $\text{NH}_4\text{NO}_3$ , is a fertiliser.

Calculate the percentage by mass of nitrogen in ammonium nitrate.

..... % [2]

[Total: 20]

- 4 Zinc is manufactured from zinc blende. Zinc blende is an ore which consists mainly of zinc sulfide, ZnS.

(a) Zinc blende is roasted in air. One of the products is zinc oxide.

Name the **other** product formed in this reaction.

..... [1]

(b) Zinc oxide is then converted into zinc.

Zinc oxide and coke, a source of carbon, are heated in a furnace. Hot air is blown into the furnace.

(i) Give **two** reasons why coke is needed.

1 .....

2 .....

[2]

(ii) Write a chemical equation for the formation of zinc in the furnace.

..... [1]

(iii) Zinc has a melting point of 420 °C and a boiling point of 907 °C. The temperature inside the furnace is 1200 °C.

Explain how this information shows that the zinc produced inside the furnace is a gas.

..... [1]

(iv) The gaseous zinc is converted to molten zinc.

Name this change of state.

..... [1]

- (c) Zinc reacts with dilute sulfuric acid to produce aqueous zinc sulfate.



Hydrated zinc sulfate crystals are made from aqueous zinc sulfate.

**Step 1** Solid zinc is added to dilute sulfuric acid until zinc is in excess.

**Step 2** Excess zinc is separated from aqueous zinc sulfate by filtration.

**Step 3** Aqueous zinc sulfate is heated until the solution is saturated.

**Step 4** The saturated solution is allowed to cool and crystallise.

**Step 5** The crystals are removed and dried.

- (i) Name the residue in **step 2**.

..... [1]

- (ii) In **step 3**, a saturated solution is produced.

Describe what a saturated solution is.

.....  
.....  
..... [2]

- (iii) Name **two** compounds each of which react with dilute sulfuric acid to produce aqueous zinc sulfate.

1 .....

2 .....

[2]

- (d) When hydrated magnesium sulfate crystals,  $\text{MgSO}_4 \cdot x\text{H}_2\text{O}$ , are heated they give off water.



A student carries out an experiment to determine the value of  $x$  in  $\text{MgSO}_4 \cdot x\text{H}_2\text{O}$ .

**Step 1** Hydrated magnesium sulfate crystals were weighed.

**Step 2** Hydrated magnesium sulfate crystals were heated.

**Step 3** The remaining solid was weighed.

- (i) Describe how the student can ensure that all the water is given off.

.....  
.....  
.....  
..... [2]

- (ii) In an experiment, all the water was removed from 1.23 g of  $\text{MgSO}_4 \cdot x\text{H}_2\text{O}$ . The mass of  $\text{MgSO}_4$  remaining was 0.60 g.

$$M_r: \text{MgSO}_4 = 120; M_r: \text{H}_2\text{O} = 18$$

Determine the value of  $x$  using the following steps.

- Calculate the number of moles of  $\text{MgSO}_4$  remaining.

$$\text{moles of MgSO}_4 = \dots \dots \dots$$

- Calculate the mass of  $\text{H}_2\text{O}$  given off.

$$\text{mass of H}_2\text{O} = \dots \dots \dots \text{ g}$$

- Calculate the moles of  $\text{H}_2\text{O}$  given off.

$$\text{moles of H}_2\text{O} = \dots \dots \dots$$

- Determine the value of  $x$ .

$$x = \dots \dots \dots  
[4]$$

[Total: 17]

- 5 Group I elements, Group VII elements and transition elements are found in different parts of the Periodic Table.

(a) Describe the trend in the reactivity of Group I elements.

.....  
.....

[1]

(b) When potassium is added to water a chemical reaction occurs.

(i) State **two** observations that can be made when potassium is added to water.

.....  
.....

[2]

(ii) Write a chemical equation for the reaction of potassium with water.

.....

[2]

(c) Excess aqueous potassium iodide is added to chlorine.

(i) Write a chemical equation for the reaction that occurs when aqueous potassium iodide is added to chlorine.

.....

[2]

(ii) State the final colour of the reaction mixture.

.....

[1]

(d) Sodium is extracted from sodium chloride by electrolysis.

(i) State the meaning of the term *electrolysis*.

.....  
.....

[2]

(ii) State what must be done to sodium chloride before it can be electrolysed to produce sodium.

.....

[1]

(iii) Write an ionic half-equation for the change that occurs at the cathode during this electrolysis.

.....

[1]

(e) Chromium is a transition element.

- Chromium has a high melting point.
- Chromium is a good conductor of electricity.
- Many chromium compounds are soluble in water.
- Hydrated chromium(III) sulfate is green.
- Chromium forms the chlorides  $\text{CrCl}_2$  and  $\text{CrCl}_3$ .
- Oxides of chromium act as catalysts in the manufacture of poly(ethene).

(i) Use this information to give **two** properties of chromium which are different from properties of Group I elements such as sodium.

1 .....

2 .....

[2]

(ii) Use this information to give **two** properties of chromium which are similar to properties of Group I elements such as sodium.

1 .....

2 .....

[2]

[Total: 16]

- 6 (a) A carboxylic acid and an ester are structural isomers.

- (i) State the meaning of the term *structural isomers*.

.....  
.....  
..... [2]

- (ii) Draw the structures of the carboxylic acid and the ester which both contain two carbon atoms.

Show all of the atoms and all of the bonds.

Name the carboxylic acid and the ester.

carboxylic acid

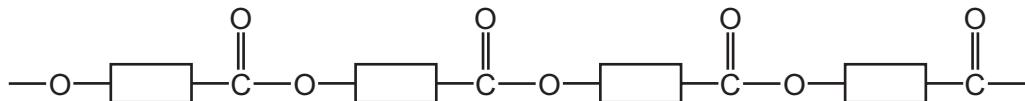
name .....

ester

name .....

[4]

- (b) Part of a polyester chain is shown. This polyester is made from one monomer.



(i) On the diagram draw a ring around one unit of the polymer that is repeated. [1]

(ii) Name the type of polymerisation that produces polyesters.

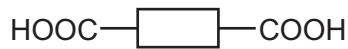
..... [1]

(iii) Complete the diagram to show the structure of the monomer used to produce this polyester. Show all of the atoms and all of the bonds in the functional groups.



[2]

- (c) A polyamide is made from the two monomers shown.



Complete the diagram to show a section of the polyamide made from the two monomers. Show all of the atoms and all of the bonds in the linkages.



[2]

- (d) Naturally occurring polyamides are constituents of food.

(i) State the name given to naturally occurring polyamides.

..... [1]

(ii) Name the monomers which form naturally occurring polyamides.

..... [1]

[Total: 14]

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## The Periodic Table of Elements

I		II		Group																								
				I						II			III			IV		V		VI		VII		VIII				
3 <b>Li</b> lithium 7	4 <b>Be</b> beryllium 9									1 <b>H</b> hydrogen 1																		
11 <b>Na</b> sodium 23	12 <b>Mg</b> magnesium 24																											
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> cesium 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> damarium –		111 <b>Rg</b> roentgenium –	112 <b>Cn</b> copernicium –		114 <b>Fl</b> ferrovium –	116 <b>Lv</b> livmorium –							

16

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
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>Fm</b> fermium –	100 <b>Md</b> mendelevium –	101 <b>Es</b> einsteinium –	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.).



# **Cambridge IGCSE™**

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**CHEMISTRY**

**0620/43**

Paper 4 Theory (Extended)

**October/November 2020**

**MARK SCHEME**

Maximum Mark: 80

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**Published**

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the October/November 2020 series for most Cambridge IGCSE™, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

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This document consists of **12** printed pages.

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

**GENERIC MARKING PRINCIPLE 1:**

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

**GENERIC MARKING PRINCIPLE 2:**

Marks awarded are always **whole marks** (not half marks, or other fractions).

**GENERIC MARKING PRINCIPLE 3:**

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

**GENERIC MARKING PRINCIPLE 4:**

Rules must be applied consistently, e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

**GENERIC MARKING PRINCIPLE 5:**

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

**GENERIC MARKING PRINCIPLE 6:**

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

**Science-Specific Marking Principles**

- 1 Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.
- 2 The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.
- 3 Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).
- 4 The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.

**5 ‘List rule’ guidance**

For questions that require ***n*** responses (e.g. State **two** reasons ...):

- The response should be read as continuous prose, even when numbered answer spaces are provided.
- Any response marked *ignore* in the mark scheme should not count towards ***n***.
- Incorrect responses should not be awarded credit but will still count towards ***n***.
- Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should **not** be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response.
- Non-contradictory responses after the first ***n*** responses may be ignored even if they include incorrect science.

**6 Calculation specific guidance**

Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states ‘show your working’.

For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values.

For answers given in standard form (e.g.  $a \times 10^n$ ) in which the convention of restricting the value of the coefficient ( $a$ ) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme.

Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.

**7 Guidance for chemical equations**

Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.

State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
1(a)	iron(III) oxide	1
1(b)	nitrogen dioxide	1
1(c)	ammonia	1
1(d)	silver	1
1(e)	carbon monoxide	1
1(f)	anhydrous cobalt(II) chloride	1

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
2(a)	11	1
2(b)	38	1
2(c)	2,8,8	1
2(d)(i)	B, C and E	1
2(d)(ii)	A	1
2(d)(iii)	D	1
2(d)(iv)	B and C	1

Question	Answer	Marks
3(a)	triple bond (1)  diagram completely correct (1)	2
3(b)(i)	<b>METHOD 1</b> liquid air (1) fractional distillation (1)  <b>METHOD 2</b> hydrogen burns in air (to remove the oxygen and then scrub out the carbon dioxide)	2
3(b)(ii)	(pressure) 200 atmospheres (1)  (temperature) 450 °C (1)  iron <b>catalyst</b> (1)  $N_2 + 3H_2 \rightarrow 2NH_3$ (1)  equilibrium / reversible (1)	5
3(c)(i)	substance that speeds up a reaction / increases rate (1)  unchanged (chemically) at the end  <b>OR</b> not used <b>up</b>  <b>OR</b> lowers activation energy (1)	2
3(c)(ii)	gain of oxygen / loss of hydrogen / electron loss / increase in oxidation state (oxidation number)	1

Question	Answer		Marks
3(c)(iii)	effect on the rate of the forward reaction	effect on the equilibrium yield of NO(g)	4
	increase (1)	decrease (1)	
	increase (1)	decrease (1)	
3(d)	$4\text{NO}_2 + \text{O}_2 + 2\text{H}_2\text{O} \rightarrow 4\text{HNO}_3$ all formulae (1) equation fully correct(1)		2
3(e)	$(M_r$ of $\text{NH}_4\text{NO}_3 =) 80$ (1) 35% (1)		2

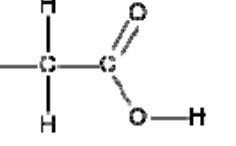
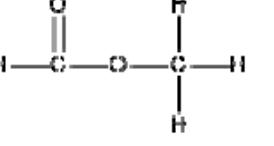
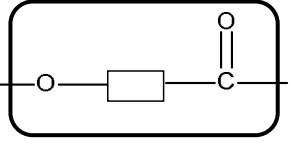
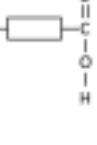
Question	Answer	Marks
4(a)	sulfur dioxide	1
4(b)(i)	<b>Any two from</b> <ul style="list-style-type: none"> <li>(coke)           <ul style="list-style-type: none"> <li>• releases heat or releases energy (when it reacts with oxygen or burns in air) / (acts as a) fuel / increases temperature (in the furnace) / heats (the furnace) / source of energy</li> </ul> </li> <li>(coke)           <ul style="list-style-type: none"> <li>• reduces zinc oxide / is a reducing agent / converts zinc oxide to zinc / removes oxygen from zinc oxide</li> </ul> </li> <li>(coke)           <ul style="list-style-type: none"> <li>• (reacts with oxygen) to produce carbon monoxide / reacts with carbon dioxide to form carbon monoxide</li> </ul> </li> <li>carbon monoxide reduces zinc oxide / converts zinc oxide to zinc / removes oxygen from zinc oxide</li> </ul>	2

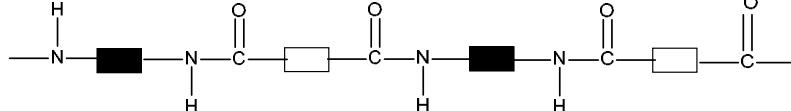
Question	Answer	Marks
4(b)(ii)	$ZnO + CO \rightarrow Zn + CO_2$ <b>OR</b> $2ZnO + C \rightarrow 2Zn + CO_2$ <b>OR</b> $ZnO + C \rightarrow Zn + CO$	1
4(b)(iii)	temperature inside furnace is above / higher than 907 (°C ) <b>OR</b> temperature is above / higher than the boiling point (of zinc) <b>ORA</b> <b>OR</b> 1200 (°C) is above / higher than the boiling point (of zinc) <b>ORA</b> <b>OR</b> 1200 (°C) is above / higher than 907 (°C) <b>ORA</b>	1
4(b)(iv)	condensation / condensing	1
4(c)(i)	zinc	1
4(c)(ii)	(a solution containing the) <b>maximum</b> amount of solute <b>dissolved</b> / <b>no more</b> solute can <b>dissolve</b> (1)  at a given temperature (1)	2
4(c)(iii)	one mark for each of any two from: <ul style="list-style-type: none"> <li>• zinc oxide</li> <li>• zinc hydroxide</li> <li>• zinc carbonate</li> </ul>	2
4(d)(i)	<b>heat</b> again and <b>weigh</b> again / repeat steps 2 and 3 (1)  until <b>mass is constant</b> (1)	2

Question	Answer	Marks
4(d)(ii)	(moles of MgSO <sub>4</sub> = ) 0.005 / 5 × 10 <sup>-3</sup> (1)  mass of water = 0.63 g (1)  moles of water = 0.63 ÷ 18 = 0.035 / 3.5 × 10 <sup>-2</sup> (1)  (x = 0.035 ÷ 0.005 ) = 7 (1)	4

Question	Answer	Marks
5(a)	become more reactive down the group <b>ORA</b> (1)	1
5(b)(i)	one mark each for <b>any two</b> of: <ul style="list-style-type: none"> <li>• floats</li> <li>• dissolves / disappears / melts</li> <li>• moves</li> <li>• bubbles / fizzes / effervesces</li> <li>• lilac flame</li> </ul>	2
5(b)(ii)	2K + 2H <sub>2</sub> O → 2KOH + H <sub>2</sub> all formulae (1) equation fully correct (1)	2
5(c)(i)	Cl <sub>2</sub> + 2KI → 2KCl + I <sub>2</sub> <b>OR</b> Cl <sub>2</sub> + 2I <sup>-</sup> → 2Cl <sup>-</sup> + I <sub>2</sub>  all formulae (1) equation fully correct (1)	2
5(c)(ii)	brown / black	1
5(d)(i)	<b>breakdown</b> by (the passage of) <b>electricity</b> (1) of an <b>ionic compound</b> in <b>molten or aqueous</b> (state) (1)	2

Question	Answer	Marks
5(d)(ii)	heat until it melts / heat to or above melting point	1
5(d)(iii)	$\text{Na}^+ + \text{e} \rightarrow \text{Na}$	1
5(e)(i)	<p>one mark for each of any two from:</p> <ul style="list-style-type: none"> <li>• (chromium has) high melting point <b>ORA</b></li> <li>• (chromium forms) coloured ions / coloured compounds <b>ORA</b></li> <li>• (chromium has) variable valency / variable oxidation state / variable oxidation number <b>ORA</b></li> <li>• catalytic behaviour <b>ORA</b></li> </ul> <p><b>ORA ALLOW group 1 or sodium if stated</b></p> <ul style="list-style-type: none"> <li>• no colour <b>or</b> white <b>or</b> colourless ions or compounds</li> <li>• fixed valency / +1 charge <b>only or one</b> oxidation state / forms <b>one</b> chloride</li> <li>• low melting point</li> <li>• doesn't behave as a catalyst</li> </ul>	2
5(e)(ii)	<p>one mark for each of any two from:</p> <ul style="list-style-type: none"> <li>• (chromium / sodium) <b>conducts</b> electricity</li> <li>• (chromium / sodium) compounds are <b>soluble</b> (in water)</li> <li>• (chromium / sodium) form hydrated salts / form hydrated compounds</li> </ul>	2

Question	Answer	Marks
6(a)(i)	compounds with the same molecular formula (1) different structural formula (1)	2
6(a)(ii)	  diagram (1) ethanoic acid (1)      diagram (1) methyl methanoate (1)	4
6(b)(i)		1
6(b)(ii)	condensation	1
6(b)(iii)	 1 for each correct functional group	2

Question	Answer	Marks
6(c)		2
	one correct linkage fully displayed (1) the whole structure fully correct (1)	
6(d)(i)	proteins	1
6(d)(ii)	amino acids	1



# Cambridge IGCSE™

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## CHEMISTRY

0620/42

Paper 4 Theory (Extended)

October/November 2020

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

### INSTRUCTIONS

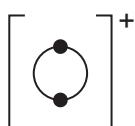
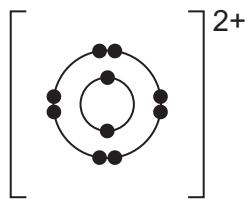
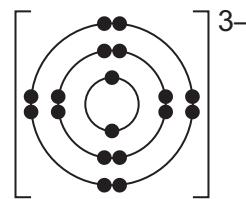
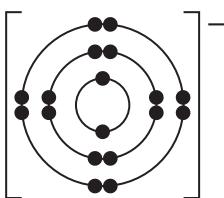
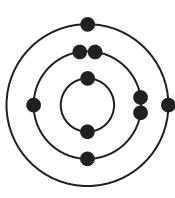
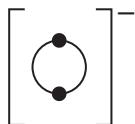
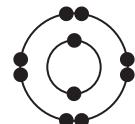
- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

### INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].
- The Periodic Table is printed in the question paper.

This document has **12** pages. Blank pages are indicated.

- 1 The electronic structures of some atoms and ions are shown.

**A****B****C****D****E****F****G****H**

- (a) Write the letters, **A**, **B**, **C**, **D**, **E**, **F**, **G** or **H**, of the electronic structures which show:

- (i) atoms of two different noble gases ..... and ..... [2]
- (ii) an ion of a Group I element ..... [1]
- (iii) an ion of a Group V element ..... [1]
- (iv) a pair of ions that could form a compound with the formula  $XY_2$  ..... and ..... [1]

- (b) State which electronic structure, **A**, **B**, **C**, **D**, **E**, **F**, **G** or **H**, is incorrect.

Explain why.

incorrect electronic structure .....

explanation .....

[2]

- (c) State how many protons are found in the nucleus of ion **C**. ..... [1]

- (d) Use the Periodic Table to deduce:

- (i) the chemical symbol for ion **G** ..... [1]
- (ii) the element which forms an ion with a 3+ charge and the same electronic structure as **H**.  
..... [1]

[Total: 10]

2 Soluble salts can be made by adding a metal carbonate to a dilute acid.

(a) Give the formula of the dilute acid which reacts with a metal carbonate to form a nitrate salt.

..... [1]

(b) A student wanted to make hydrated iron(II) sulfate crystals,  $\text{FeSO}_4 \cdot x\text{H}_2\text{O}$ , by adding excess iron(II) carbonate to dilute sulfuric acid. The student followed the procedure shown.

**step 1** Add dilute sulfuric acid to a beaker.

**step 2** Add small amounts of iron(II) carbonate to the dilute sulfuric acid in the beaker until the iron(II) carbonate is in excess.

**step 3** Filter the mixture formed in **step 2**.

**step 4** Heat the filtrate until it is a saturated solution. Allow to cool.

**step 5** Once cold, pour away the remaining solution. Dry the crystals between filter papers.

(i) Why must the iron(II) carbonate be added in excess in **step 2**?

..... [1]

(ii) State **two** observations in **step 2** that would show that iron(II) carbonate was in excess.

1 .....

2 .....

[2]

(iii) Describe what should be done during **step 3** to ensure there is a maximum yield of crystals.

..... [1]

(iv) A saturated solution is formed in **step 4**.

Describe what a saturated solution is.

..... [2]

(v) Name a different compound that could be used instead of iron(II) carbonate to produce hydrated iron(II) sulfate crystals from dilute sulfuric acid.

..... [1]

- (c) On analysing the crystals, the student found that one mole of the hydrated iron(II) sulfate crystals,  $\text{FeSO}_4 \cdot x\text{H}_2\text{O}$ , had a mass of 278 g.

Determine the value of  $x$  using the following steps:

- calculate the mass of one mole of  $\text{FeSO}_4$

$$\text{mass} = \dots \text{g}$$

- calculate the mass of  $\text{H}_2\text{O}$  present in one mole of  $\text{FeSO}_4 \cdot x\text{H}_2\text{O}$

$$\text{mass of } \text{H}_2\text{O} = \dots \text{g}$$

- determine the value of  $x$ .

$$x = \dots$$

[3]

- (d) Insoluble salts can be made by mixing solutions of two soluble salts.

A student followed the procedure shown to make silver bromide, an insoluble salt.

**step 1** Add aqueous silver nitrate to a beaker. Then add aqueous potassium bromide and stir.

**step 2** Filter the mixture formed in **step 1**.

**step 3** Dry the residue.

- (i) State the term used to describe this method of making salts.

..... [1]

- (ii) Give the observation the student would make during **step 1**.

..... [1]

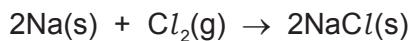
- (iii) Write the ionic equation for the reaction between aqueous silver nitrate and aqueous potassium bromide.

Include state symbols.

..... [3]

- (e) Sodium chloride is an ionic salt. It can be made by reacting sodium with chlorine gas.

The equation for this reaction is shown.



Calculate the volume of chlorine gas, in  $\text{cm}^3$ , that reacts to form 2.34 g of NaCl.

The reaction takes place at room temperature and pressure.

volume of chlorine gas = .....  $\text{cm}^3$  [3]

- (f) Sodium chloride does not conduct electricity when solid, but does conduct electricity when molten.

- (i) Explain why, in terms of structure and bonding.

.....  
.....  
.....  
..... [3]

- (ii) Name the product formed at the positive electrode when electricity is passed through molten sodium chloride.

..... [1]

- (iii) State the type of change that occurs at the positive electrode in (ii).

Explain your answer in terms of electron transfer.

type of change .....

explanation .....

[2]

- (iv) Describe what else can be done to sodium chloride to allow it to conduct electricity.

..... [1]

[Total: 26]

- 3 Group I metals are very reactive. Transition elements are also metals but are less reactive than Group I metals.

(a) State **two** physical properties of Group I metals which are similar to those of transition metals.

1 .....

2 .....

[2]

(b) Describe **two** ways in which the physical properties of Group I metals are different from those of transition metals.

1 .....

.....

2 .....

.....

[2]

(c) When Group I metals are added to water they fizz and an alkaline solution forms.

(i) Name the gas given off.

..... [1]

(ii) Identify the ion present in the solution which makes the solution alkaline.

..... [1]

(iii) Write the chemical equation for the reaction between sodium and water.

..... [2]

(d) When the transition element iron is added to water the iron rusts.

When an iron object is coated with a layer of zinc, rusting is prevented.

(i) Name this process of coating iron objects with a layer of zinc.

..... [1]

(ii) Explain how completely coating an iron object with a layer of zinc prevents rusting.

..... [1]

(iii) Rusting of iron ships can be prevented by attaching zinc blocks to the hull of the ship.

Explain how this prevents rusting.

.....

[2]

[Total: 12]

4 Alkenes and alkanes are homologous series of compounds containing carbon and hydrogen atoms.

(a) State the name of the type of compound made from carbon and hydrogen atoms only.

..... [1]

(b) Alkenes take part in addition reactions.

(i) Describe what is meant by the term *addition reaction*.

..... [1]

(ii) Draw the structure of the product made in the addition reaction between propene and bromine. Show all of the atoms and all of the bonds.

[2]

(iii) Describe the colour change seen when propene is added to aqueous bromine.

from ..... to ..... [2]

(iv) Draw the structures of molecules of **two** different alkenes which both undergo an addition reaction with steam to form butan-2-ol. Show all of the atoms and all of the bonds.

[2]

(c) Propane undergoes a substitution reaction with chlorine.

Write the chemical equation for the reaction between one molecule of propane and one molecule of chlorine.

..... [2]

[Total: 10]

5 This question is about alcohols, carboxylic acids and esters.

(a) Ethanol will react with hot aqueous potassium manganate(VII) to form ethanoic acid.

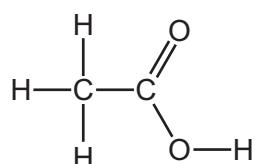
(i) State the other condition needed for this reaction to take place.

..... [1]

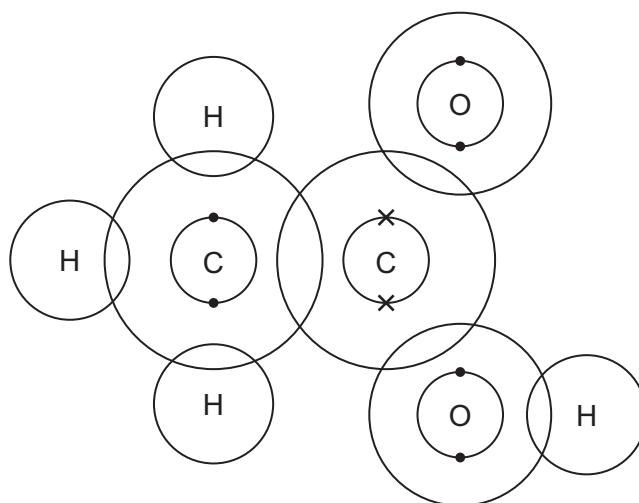
(ii) State the type of chemical change that happens to the ethanol during this reaction.

..... [1]

(iii) The structure of ethanoic acid is shown.



Complete the dot-and-cross diagram to show the electron arrangement in a molecule of ethanoic acid.



[3]

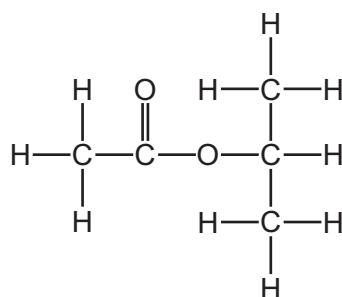
- (b) Ethanoic acid is a weak acid and hydrochloric acid is a strong acid.

Complete the table to show the similarities and differences in the properties of samples of these two acids of equal concentration.

	dilute ethanoic acid	dilute hydrochloric acid
extent of dissociation		
colour after adding universal indicator solution		
observation when magnesium ribbon is added		

[6]

- (c) Ethanoic acid will react with an alcohol to form the ester shown.



- (i) Name the **other** product formed when ethanoic acid reacts with an alcohol to make this ester.

..... [1]

- (ii) Give **one** condition needed when ethanoic acid reacts with the alcohol to make this ester.

..... [1]

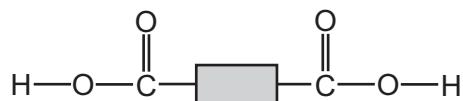
- (iii) Draw the structure of the alcohol which was added to ethanoic acid to make this ester. Show all of the atoms and all of the bonds.

[2]

- (d) Polyesters can be manufactured from carboxylic acids and alcohols.

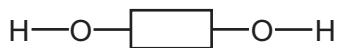
Hexanedioic acid has the structure: HOOC—CH<sub>2</sub>—CH<sub>2</sub>—CH<sub>2</sub>—CH<sub>2</sub>—COOH.

This structure can be simplified as shown.



Ethanediol has the structure: HO—CH<sub>2</sub>—CH<sub>2</sub>—OH.

This structure can be simplified as shown.



The functional groups are found at the end of each molecule.

- (i) State what is meant by the term *functional group*.

..... [1]

- (ii) Determine the empirical formula of hexanedioic acid.

..... [1]

- (iii) Calculate the percentage by mass of oxygen present in ethanediol.

Give your answer to the nearest whole number.

..... % [2]

- (iv) Complete the diagram to show a section of polyester manufactured from hexanedioic acid and ethanediol. Include all of the atoms and all of the bonds in the linkages.



[2]

- (v) State the name of a polyester.

..... [1]

[Total: 22]

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**The Periodic Table of Elements**

I		II		Group														
				I						II								
				Key														
3 <b>Li</b> lithium 7	4 <b>Be</b> beryllium 9	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
11 <b>Na</b> sodium 23	12 <b>Mg</b> magnesium 24	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
19 <b>K</b> potassium 39	56 <b>Cs</b> caesium 133	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> damarium –	111 <b>Rg</b> roentgenium –	112 <b>Cn</b> copernicium –	114 <b>Fl</b> ferrovium –	116 <b>Lv</b> livmorium –	–	–	–		
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	–	–	–	
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>E</b> einsteinium –	100 <b>Fm</b> fermium –	101 <b>Md</b> mendelevium –	102 <b>No</b> nobelium –	103 <b>Lr</b> lawrencium –	–	–		

12

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>E</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.).



# **Cambridge IGCSE™**

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**CHEMISTRY**

**0620/42**

Paper 4 Theory (Extended)

**October/November 2020**

**MARK SCHEME**

Maximum Mark: 80

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**Published**

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the October/November 2020 series for most Cambridge IGCSE™, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

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This document consists of **9** printed pages.

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

**GENERIC MARKING PRINCIPLE 1:**

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

**GENERIC MARKING PRINCIPLE 2:**

Marks awarded are always **whole marks** (not half marks, or other fractions).

**GENERIC MARKING PRINCIPLE 3:**

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

**GENERIC MARKING PRINCIPLE 4:**

Rules must be applied consistently, e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

**GENERIC MARKING PRINCIPLE 5:**

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

**GENERIC MARKING PRINCIPLE 6:**

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

**Science-Specific Marking Principles**

- 1 Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.
- 2 The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.
- 3 Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).
- 4 The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.

**5 'List rule' guidance**

For questions that require ***n*** responses (e.g. State **two** reasons ...):

- The response should be read as continuous prose, even when numbered answer spaces are provided.
- Any response marked *ignore* in the mark scheme should not count towards ***n***.
- Incorrect responses should not be awarded credit but will still count towards ***n***.
- Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should **not** be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response.
- Non-contradictory responses after the first ***n*** responses may be ignored even if they include incorrect science.

**6 Calculation specific guidance**

Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states ‘show your working’.

For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values.

For answers given in standard form (e.g.  $a \times 10^n$ ) in which the convention of restricting the value of the coefficient ( $a$ ) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme.

Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.

**7 Guidance for chemical equations**

Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.

State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
1(a)(i)	A (1) H (1)	2
1(a)(ii)	B	1
1(a)(iii)	D	1
1(a)(iv)	<b>C and G OR C and E</b>	1
1(b)	F (1) third / outer shell is being filled before second shell is full; second shell has 6 electrons: it should have 8 electrons (1)	2
1(c)	12	1
1(d)(i)	H <sup>-</sup>	1
1(d)(ii)	aluminium / Al	1

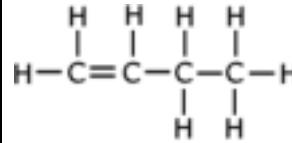
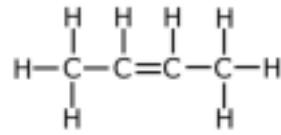
<b>Question</b>	<b>Answer</b>	<b>Marks</b>
2(a)	HNO <sub>3</sub>	1
2(b)(i)	to make sure all the (sulfuric) acid reacts	1
2(b)(ii)	no (more) fizzing (1) (FeCO <sub>3</sub> ) stops dissolving or a solid remains / is visible (in the mixture) (1)	2
2(b)(iii)	rinse the residue (with distilled water)	1
2(b)(iv)	a solution that can dissolve no more solute (1) at the specified temperature (1)	2
2(b)(v)	iron(II) oxide / iron(II) hydroxide	1

Question	Answer	Marks
2(c)	mass of $\text{FeSO}_4 = 152$ (1) mass of $\text{H}_2\text{O} = 278 - 152 = 126$ (1) mol of $\text{H}_2\text{O} = 126 / 18$ and $x = 7$ (1)	3
2(d)(i)	precipitation	1
2(d)(ii)	cream precipitate	1
2(d)(iii)	$\text{Ag}^+(\text{aq}) + \text{Br}^-(\text{aq}) \rightarrow \text{AgBr}(\text{s})$ $\text{AgBr}$ (as only product) (1) $\text{Ag}^+$ and $\text{Br}^-$ (as reactants)(1) state symbols(1)	3
2(e)	$M_1 \text{ mol of NaCl} = 2.34 / 58.5 = 0.04(00)$ $M_2 \text{ mol of Cl}_2 = M_1/2 = 0.04(00)/2 = 0.02(00)$ $M_3 0.02(00) \times 24000 = 480 \text{ (cm}^3\text{)}$	3
2(f)(i)	ions (1) (ions) are fixed (in a lattice) (1) ions are mobile (1)	3
2(f)(ii)	chlorine	1
2(f)(iii)	oxidation (1) electrons are lost (1)	2
2(f)(iv)	dissolve it (in water)	1

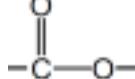
Question	Answer	Marks
3(a)	any two from: <ul style="list-style-type: none"><li>• shiny / lustrous</li><li>• conduct electricity</li><li>• conduct heat</li></ul>	2

Question	Answer	Marks
3(b)	low(er) density (1) low(er) melting points (1)	2
3(c)(i)	hydrogen	1
3(c)(ii)	hydroxide / OH <sup>-</sup>	1
3(c)(iii)	2Na + 2H <sub>2</sub> O → 2NaOH + H <sub>2</sub> NaOH (as a product) (1) rest of equation (1)	2
3(d)(i)	galvanising	1
3(d)(ii)	prevents water or / and oxygen reaching iron	1
3(d)(iii)	zinc more reactive (than iron) (1) zinc corrodes / oxidises / reacts in preference to iron (1)	2

Question	Answer	Marks
4(a)	hydrocarbon	1
4(b)(i)	(only) one product is formed	1
4(b)(ii)	$  \begin{array}{ccccccc}  & \text{H} & \text{H} & \text{H} & & & \\  &   &   &   & & & \\  \text{H} & - \text{C} & - \text{C} & - \text{C} & - \text{H} & & \\  &   &   &   & & & \\  & \text{H} & \text{Br} & \text{Br} & & &  \end{array}  $ 3 single bonded C atoms entire molecule correct	2
4(b)(iii)	orange (1) to colourless (1)	2

Question	Answer	Marks
4(b)(iv)	<p>structure of but-1-ene</p>  <p>structure of but-2-ene</p> 	2
4(c)	$C_3H_8 + Cl_2 \rightarrow C_3H_7Cl + HCl$ HCl as product rest of equation	2

Question	Answer	Marks
5(a)(i)	presence of an acid	1
5(a)(ii)	oxidation	1
5(a)(iii)	all single bonding dot and cross pairs correct (1) double C=O bond dot and cross pairs are correct (1) Complete diagram is correct (1)	3
5(b)	partial (dissociation) (1) full / 100% (dissociation) (1) both acid colours (1) HCl indicating a lower pH acid colour than CH <sub>3</sub> COOH (1) fizzing OR dissolving / disappearing in both (1) either observation happens quicker with HCl (1)	6

Question	Answer	Marks
5(c)(i)	water	1
5(c)(ii)	acid (catalyst)	1
5(c)(iii)	any one alcohol group on a molecule (1) structure of propan-2-ol (1)	2
5(d)(i)	the atoms / group of atoms which give (any molecule its) <b>chemical</b> properties	1
5(d)(ii)	C <sub>3</sub> H <sub>5</sub> O <sub>2</sub>	1
5(d)(iii)	M <sub>r</sub> of HO–CH <sub>2</sub> –CH <sub>2</sub> –OH = 62 (1) %ge = 100 × 32/62 = 52% (1)	2
5(d)(iv)	any correct ester link between any two blocks showing all atoms and all bonds (1)   correct orientation of 3 inter-block ester links and continuation bonds (1)	2
5(d)(v)	Terylene	1



# Cambridge IGCSE™

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## CHEMISTRY

0620/41

Paper 4 Theory (Extended)

October/November 2020

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

### INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

### INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].
- The Periodic Table is printed in the question paper.

This document has **20** pages. Blank pages are indicated.

- 1 (a) This question is about elements.

**aluminium**  
**carbon**  
**iron**  
**hydrogen**  
**oxygen**  
**silicon**  
**sodium**  
**sulfur**

Answer the following questions about these elements.

Each element may be used once, more than once or not at all.

- (i) Name the element that can be used as a fuel.

..... [1]

- (ii) Name the element that forms an oxide with a similar structure to diamond.

..... [1]

- (iii) Name the element that forms an amphoteric oxide.

..... [1]

- (iv) Name the element that has oxidation states of +2 and +3.

..... [1]

- (v) Name the element extracted from bauxite.

..... [1]

- (vi) Name the element that has atoms with the electronic structure 2,6.

..... [1]

(b) Iron rusts when it is in contact with oxygen and water.

(i) Explain how sacrificial protection prevents rusting.

.....  
.....  
.....  
..... [2]

(ii) State one **other** method of rust prevention.

..... [1]  
[Total: 9]

2 Zinc is extracted from an ore containing zinc sulfide.

(a) State the name of this zinc ore.

..... [1]

(b) This ore is converted to zinc oxide, ZnO.

Zinc oxide is then reacted with carbon.

(i) Write a chemical equation for the reaction of zinc oxide with carbon.

..... [1]

(ii) State what type of chemical change happens to the zinc in zinc oxide in this reaction.

Explain your answer.

chemical change .....

explanation .....

.....

[2]

(iii) Explain why aluminium is **not** extracted from aluminium oxide by heating with carbon.

.....

[1]

(iv) Suggest an alternative method for the extraction of zinc from zinc oxide.

..... [1]

(c) Brass is an alloy of zinc.

Explain, in terms of particles, why brass is harder than pure zinc.

.....

.....

.....

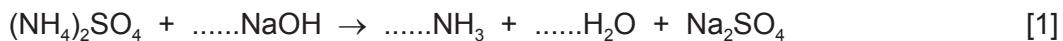
..... [3]

[Total: 9]

- 3 (a) Aqueous ammonium sulfate,  $(\text{NH}_4)_2\text{SO}_4$ , is warmed with aqueous sodium hydroxide.

The pungent-smelling gas ammonia,  $\text{NH}_3$ , is produced.

Balance the equation for this reaction.



- (b) A 2.8 g sample of impure ammonium sulfate is found to contain 0.7 g of impurities.

Calculate the percentage of ammonium sulfate in this sample.

$$\text{percentage of ammonium sulfate} = \dots \% \quad [1]$$

- (c) Describe a test for ammonia gas.

test .....

result .....

[2]

- (d) Ammonia gas is prepared at the front of a laboratory.

The pungent smell of ammonia spreads throughout the laboratory slowly.

- (i) Name the process that occurs when ammonia gas spreads throughout the laboratory.

..... [1]

- (ii) Explain, using ideas about particles, why ammonia gas spreads throughout the laboratory.

.....

.....

..... [2]

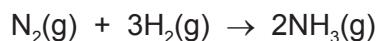
- (iii) Explain why carbon dioxide gas,  $\text{CO}_2$ , will spread throughout the laboratory at a slower rate than ammonia gas,  $\text{NH}_3$ .

.....

..... [1]

- (e) Ammonia is produced in the Haber process.

The equation for the reaction is shown.



- (i) In the Haber process, a temperature of 450°C and a pressure of 200 atmospheres are used in the presence of finely-divided iron.

A larger equilibrium yield of ammonia would be produced if a lower temperature and a higher pressure are used.

Explain why a lower temperature and a higher pressure are **not** used.

lower temperature .....

.....  
higher pressure .....

[2]

- (ii) State the role of iron in the Haber process.

..... [1]

- (f) Ammonia is a weak base.

- (i) Explain the meaning of the term *base*.

.....  
..... [1]

- (ii) Suggest the pH of aqueous ammonia.

..... [1]

[Total: 13]

4 Air is a mixture of gases.

- (a) State the percentage of clean dry air which is oxygen. Give your answer to the nearest whole number.

..... % [1]

- (b) Oxygen and nitrogen are useful gases that can be obtained from air.

- (i) Name the process used to separate oxygen and nitrogen from liquid air.

..... [2]

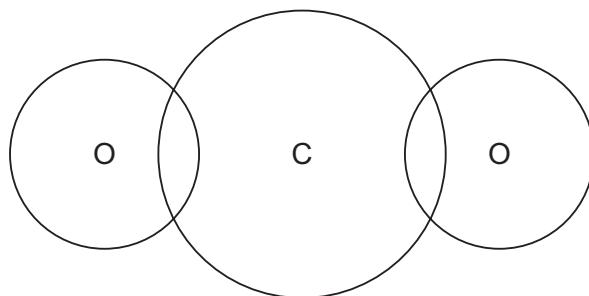
- (ii) State the property of oxygen and nitrogen that allows these gases to be separated using this process.

..... [1]

- (c) Carbon dioxide,  $\text{CO}_2$ , is a covalent molecule.

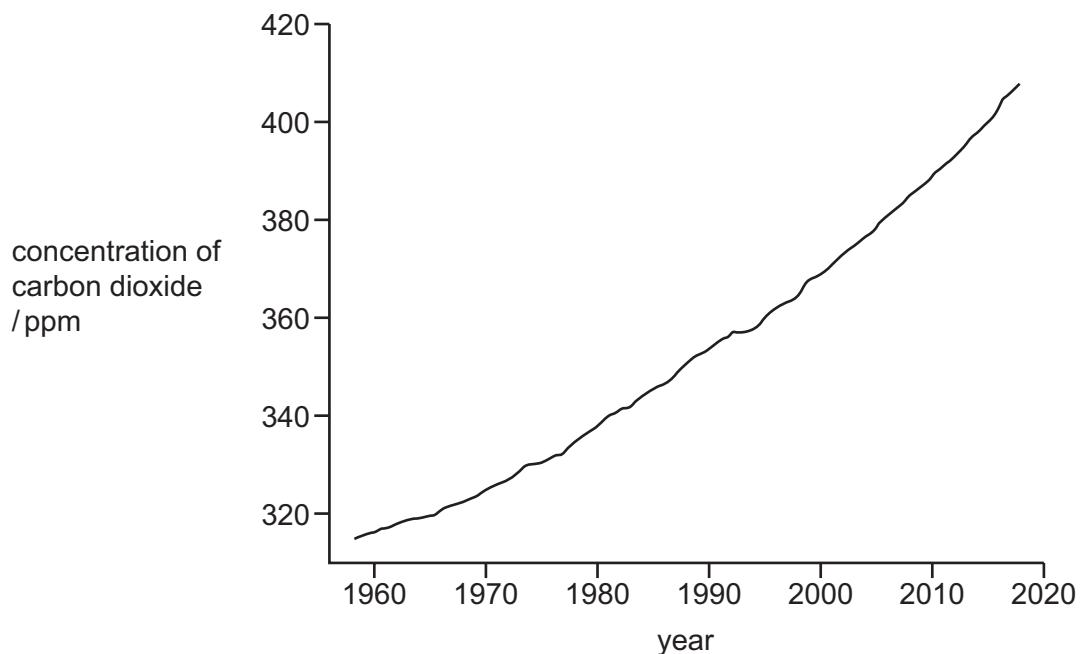
Complete the diagram to show the electron arrangement in one molecule of  $\text{CO}_2$ .

Show only the outer electrons.



[2]

- (d) The graph shows the concentration of carbon dioxide in the atmosphere over a 60-year period, measured in parts per million (ppm).



The data shown in the graph is of global concern.

Explain why.

.....  
.....  
.....  
.....  
.....

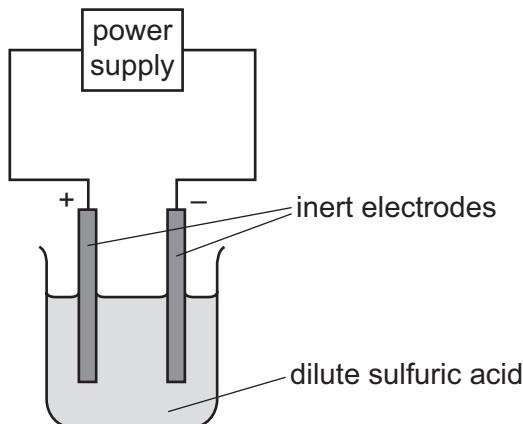
[3]

- (e) Name the process in the carbon cycle by which plants remove carbon dioxide from the atmosphere.

..... [1]

[Total: 10]

- 5 (a) Dilute sulfuric acid is electrolysed using the apparatus shown in the diagram.



- (i) State what is meant by the term *electrolysis*.

.....  
.....  
..... [2]

- (ii) Explain why inert electrodes are used.

.....  
..... [1]

- (iii) Name the products formed at each electrode.

negative electrode .....

positive electrode .....

[2]

- (iv) Write an ionic half-equation for the reaction at the negative electrode.

..... [2]

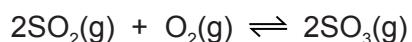
- (b) Sulfuric acid is manufactured using the Contact process. This manufacture involves four stages.

- (i) **Stage 1** involves the combustion of sulfur to form sulfur dioxide.

Write the chemical equation for **stage 1**.

..... [1]

- (ii) The equation for **stage 2** is shown.

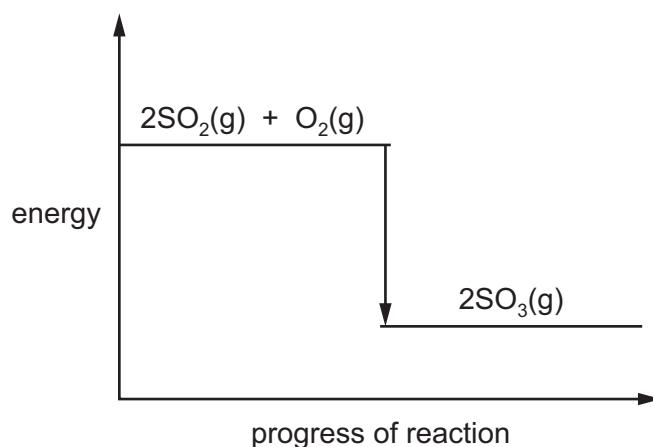


The reaction can reach equilibrium.

Explain what is meant by the term *equilibrium*.

.....  
.....  
.....  
..... [2]

- (iii) The energy level diagram for the forward reaction in **stage 2** is shown.



Explain what the diagram shows about the energy changes in the forward reaction.

.....  
.....  
.....  
..... [2]

- (c) In **stage 3** sulfur trioxide,  $\text{SO}_3$ , is converted to oleum,  $\text{H}_2\text{S}_2\text{O}_7$ .

In **stage 4** oleum reacts to form sulfuric acid,  $\text{H}_2\text{SO}_4$ .

State what oleum reacts with in **stage 4**.

..... [1]

- (d) A sample of sulfuric acid,  $\text{H}_2\text{SO}_4$ , has a concentration of  $0.75 \text{ mol/dm}^3$ .

Calculate the concentration of sulfuric acid in  $\text{g/dm}^3$ .

.....  $\text{g/dm}^3$  [2]

[Total: 15]

6 (a) Ethane, propane and butane are members of the same homologous series.

(i) Name this homologous series.

..... [1]

(ii) State **two** ways members of the same homologous series are similar.

1 .....

2 .....

[2]

(b) One mole of ethane,  $C_2H_6$ , contains  $6.02 \times 10^{23}$  molecules.

Calculate how many molecules are in 15 g of ethane.

number of ethane molecules = ..... [1]

(c) Propane reacts with chlorine.

(i) Write the formula of the product which does not contain carbon.

..... [1]

(ii) Draw the structure of an organic product formed. Show all of the atoms and all of the bonds.

[1]

(iii) State the name of this type of reaction.

..... [1]

- (d) (i) Aqueous bromine was added to a sample of ethene.

Give the colour change seen.

from ..... to ..... [2]

- (ii) Explain, in terms of bonding, why there is no colour change when aqueous bromine is added to ethane.

.....  
..... [1]

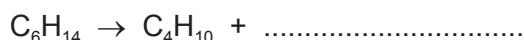
- (e) There are two structural isomers with the formula C<sub>4</sub>H<sub>10</sub>.

- (i) Draw the structures of both of these isomers, showing all of the atoms and all of the bonds.

[2]

- (ii) Butane is formed when longer chain hydrocarbons are cracked.

Complete the chemical equation to show the other product when butane is formed by cracking.



[1]

(f) A compound contains 85.7% carbon and 14.3% hydrogen by mass.

(i) Calculate the empirical formula of this compound.

Show your working.

..... [2]

(ii) The molecular mass of the compound is 112.

Calculate the molecular formula of this compound.

..... [1]

[Total: 16]

- 7 (a) Ethanol can be manufactured by two different methods.

Method 1: fermentation of a sugar, C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>



Method 2: reaction of ethene with steam



- (i) Give **one** advantage of using fermentation compared with Method 2.

..... [1]

- (ii) Give **one** disadvantage of using fermentation compared with Method 2.

..... [1]

- (b) Ethanol reacts with acidified potassium manganate(VII) to form water and a product that turns litmus red.

- (i) State the name of the product that turns the litmus red.

..... [1]

- (ii) State the type of reaction that ethanol undergoes when it reacts with acidified potassium manganate(VII).

..... [1]

- (c) Ethanol reacts with methanoic acid to form an ester.

- (i) Name the ester formed in this reaction.

..... [1]

- (ii) Draw the structure of the ester formed.  
Show all of the atoms and all of the bonds.

[1]

- (d) The table shows the melting points of ethanol and sodium chloride.

substance	melting point/°C
ethanol	-114
sodium chloride	801

The difference in melting points is due to differences in attractive forces between particles in these substances.

Name the type of attractive force in each substance, which is responsible for the difference in melting points.

ethanol .....

sodium chloride .....

[2]

[Total: 8]

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**The Periodic Table of Elements**

I		II		Group														
				I						II								
				Key														
3 <b>Li</b> lithium 7	4 <b>Be</b> beryllium 9	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
11 <b>Na</b> sodium 23	12 <b>Mg</b> magnesium 24	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
19 <b>K</b> potassium 39	56 <b>Cs</b> caesium 133	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> damarium –	111 <b>Rg</b> roentgenium –	112 <b>Cn</b> copernicium –	114 <b>Fl</b> ferrovium –	116 <b>Lv</b> livmorium –	–	–	–		
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	–	–	–	
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>E</b> einsteinium –	100 <b>Fm</b> fermium –	101 <b>Md</b> mendelevium –	102 <b>No</b> nobelium –	103 <b>Lr</b> lawrencium –	–	–		

20

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>E</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.).



# **Cambridge IGCSE™**

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**CHEMISTRY**

**0620/41**

Paper 4 Theory (Extended)

**October/November 2020**

**MARK SCHEME**

Maximum Mark: 80

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**Published**

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the October/November 2020 series for most Cambridge IGCSE™, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

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This document consists of **10** printed pages.

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

#### GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

#### GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

#### GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

#### GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently, e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

**GENERIC MARKING PRINCIPLE 5:**

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

**GENERIC MARKING PRINCIPLE 6:**

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

**Science-Specific Marking Principles**

- 1 Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.
- 2 The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.
- 3 Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).
- 4 The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.

**'List rule' guidance**

For questions that require ***n*** responses (e.g. State **two** reasons ...):

- The response should be read as continuous prose, even when numbered answer spaces are provided.
- Any response marked *ignore* in the mark scheme should not count towards ***n***.
- Incorrect responses should not be awarded credit but will still count towards ***n***.
- Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should **not** be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response.
- Non-contradictory responses after the first ***n*** responses may be ignored even if they include incorrect science.

**6 Calculation specific guidance**

Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states ‘show your working’.

For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values.

For answers given in standard form (e.g.  $a \times 10^n$ ) in which the convention of restricting the value of the coefficient ( $a$ ) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme.

Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.

**7 Guidance for chemical equations**

Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.

State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

Question	Answer	Marks
1(a)(i)	hydrogen / carbon	1
1(a)(ii)	silicon	1
1(a)(iii)	aluminium	1
1(a)(iv)	iron	1
1(a)(v)	aluminium	1
1(a)(vi)	oxygen	1
1(b)(i)	metal higher in reactivity series / metal more reactive (than iron) / allow named metal e.g. magnesium or zinc (1) zinc corrodes/oxidises/reacts in preference to iron (1)	2
1(b)(ii)	any barrier method e.g. painting	1

Question	Answer	Marks
2(a)	zinc blende	1
2(b)(i)	$\text{ZnO} + \text{C} \rightarrow \text{Zn} + \text{CO}$ or $2\text{ZnO} + \text{C} \rightarrow 2\text{Zn} + \text{CO}_2$	1
2(b)(ii)	chemical change: reduction (1) explanation: oxygen is lost (1)	2
2(b)(iii)	aluminium is more reactive than carbon	1
2(b)(iv)	electrolysis	1

Question	Answer	Marks
2(c)	exists as layers (1) (alloy) contains different sized (copper) atoms (1) makes it more difficult for layers (of atoms) to slide over each other (1)	3

Question	Answer	Marks
3(a)(i)	$2 \rightarrow 2 + 2$	1
3(b)	75(%)	1
3(c)	test: (damp red) litmus paper (1) result: (litmus goes) blue (1)	2
3(d)(i)	diffusion	1
3(d)(ii)	particles move from an area of high to low concentration particles move randomly	2
3(d)(iii)	<b>CO<sub>2</sub> molecules</b> are heavier (than NH <sub>3</sub> )	1
3(e)(i)	lower temperature: (rate of reaction) slower (1) higher pressure: expensive/specialist equipment	2
3(e)(ii)	catalyst	1
3(f)(i)	proton acceptor	1
3(f)(ii)	any value greater than 7 up to 12	1

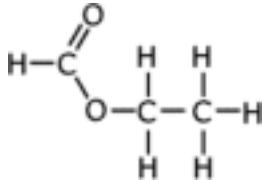
<b>Question</b>	<b>Answer</b>	<b>Marks</b>
4(a)	21	1
4(b)(i)	fractional (1) distillation (1)	2
4(b)(ii)	(different) boiling point	1
4(c)	2 double bonds (1)  whole molecule correct (2 pairs of lone pairs on each O) (1)	2
4(d)	increase in (concentrations of) carbon dioxide  (carbon dioxide is) greenhouse gas/greenhouse effect  contributes to climate change/global warming	3
4(e)	photosynthesis	1

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
5(a)(i)	breakdown by (the passage of) electricity (1)  of an ionic compound in molten/aqueous (state) (1)	2
5(a)(ii)	they do not react	1
5(a)(iii)	negative electrode: hydrogen (gas) (1)  positive electrode: oxygen (gas) (1)	2

Question	Answer	Marks
5(a)(iv)	$H^+ + e^-$ as the only species on the left (1) equation fully correct (1) $2H^+ + 2e^- \rightarrow H_2$ (scores 2)	2
5(b)(i)	$S + O_2 \rightarrow SO_2$	1
5(b)(ii)	rate of forward reaction is equal to rate of reverse reaction (1) constant concentration (of reactants and products) (1)	2
5(b)(iii)	exothermic / heat / energy is released / surroundings warm up products have lower energy than reactants / ORA	2
5(c)	water / $H_2O$	1
5(d)	$(M_r =) 98$ $(0.75 \times 98 =) 73.5$	2

Question	Answer	Marks
6(a)(i)	alkanes	1
6(a)(ii)	one mark each for any two of: <ul style="list-style-type: none"> <li>• same chemical properties</li> <li>• same functional group</li> <li>• same general formula</li> <li>• (consecutive members) differ by <math>CH_2</math></li> <li>• common (allow similar) methods of preparation</li> <li>• physical properties vary in predictable manner / show trends / gradually change OR example of a physical property variation i.e. melting point / boiling point / volatility (1)</li> </ul>	2
6(b)	$3.01 \times 10^{23}$ (molecules)	1



Question	Answer	Marks
7(a)(i)	sugar or $C_6H_{12}O_6$ , is renewable / sustainable	1
7(a)(ii)	slow(er) process	1
7(b)(i)	ethanoic acid	1
7(b)(ii)	oxidation	1
7(c)(i)	ethyl methanoate	1
7(c)(ii)		1
7(d)	ethanol: (forces of attraction) between molecules (1) sodium chloride: (force of attraction) between positive and negative ions/ionic bonding (1)	2



# Cambridge IGCSE™

## CHEMISTRY

0620/23

Paper 2 Multiple Choice (Extended)

October/November 2020

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. A mark will not be deducted for a wrong answer.
- Any rough working should be done on this question paper.
- The Periodic Table is printed in the question paper.

This document has **16** pages. Blank pages are indicated.

1 Which gas has the slowest rate of diffusion?

- A H<sub>2</sub>      B NH<sub>3</sub>      C CH<sub>4</sub>      D CO<sub>2</sub>

2 When a dark grey solid element is heated, it changes directly into a purple gas.

Which word describes this change?

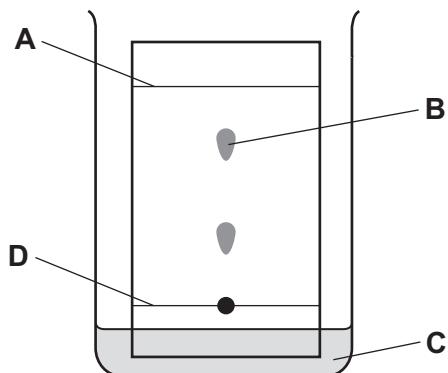
- A boiling  
B evaporation  
C melting  
D sublimation

3 Nickel(II) sulfate is a green solid that is soluble in water.

Which method is used to obtain a pure sample of nickel(II) sulfate crystals from a mixture of nickel(II) sulfate and sand?

- A Heat the mixture with water and distil it to give nickel(II) sulfate.  
B Heat the mixture with water and leave it to crystallise.  
C Heat the mixture with water and filter off the nickel(II) sulfate.  
D Heat the mixture with water, filter and allow the solution to crystallise.

4 In the chromatography experiment shown, which label represents the solvent front?



- 5** Molecules containing only non-metal atoms are covalently bonded.

The formulae of four covalently bonded molecules are given below:

- 1 nitrogen, N<sub>2</sub>
- 2 carbon dioxide, CO<sub>2</sub>
- 3 ethene, C<sub>2</sub>H<sub>4</sub>
- 4 methanol, CH<sub>3</sub>OH

Which of the molecules contain double bonds?

- A** 1 and 4      **B** 2 and 3      **C** 2 and 4      **D** 4 only
- 6** The arrangements of the electrons in two ions formed from elements X and Y are shown.



Which equation represents the reaction between elements X and Y?

- A** X<sub>2</sub> + 2Y → 2X<sup>+</sup> + 2Y<sup>-</sup>  
**B** X<sub>2</sub> + 2Y → 2X<sup>-</sup> + 2Y<sup>+</sup>  
**C** 2X + Y<sub>2</sub> → 2X<sup>+</sup> + 2Y<sup>-</sup>  
**D** 2X + Y<sub>2</sub> → 2X<sup>-</sup> + 2Y<sup>+</sup>

- 7** Magnesium reacts with sulfuric acid.

What are the formulae of the products formed in this reaction?

- A** MgSO<sub>4</sub> and H<sub>2</sub>  
**B** MgSO<sub>4</sub> and H<sub>2</sub>O  
**C** Mg(SO<sub>4</sub>)<sub>2</sub> and H<sub>2</sub>  
**D** Mg(SO<sub>4</sub>)<sub>2</sub> and H<sub>2</sub>O

- 8 Sodium reacts with chlorine to form sodium chloride.

Which row describes the bonding in the three substances?

	sodium	chlorine	sodium chloride
A	covalent	covalent	covalent
B	covalent	metallic	ionic
C	metallic	covalent	ionic
D	metallic	metallic	covalent

- 9 Rubidium is in Group I of the Periodic Table and bromine is in Group VII.

Rubidium reacts with bromine to form an ionic compound.

Which row shows the electron change taking place for rubidium and the correct formula of the rubidium ion?

	electron change	formula of ion formed
A	electron gained	$\text{Rb}^+$
B	electron gained	$\text{Rb}^-$
C	electron lost	$\text{Rb}^+$
D	electron lost	$\text{Rb}^-$

- 10 Which statement explains why graphite is used as a lubricant?

- A All bonds between the atoms are weak.
- B It conducts electricity.
- C It has a low melting point.
- D Layers in the structure can slide over each other.

- 11 The relative atomic mass of chlorine is 35.5.

When calculating relative atomic mass, which particle is the mass of a chlorine atom compared to?

- A a neutron
- B a proton
- C an atom of carbon-12
- D an atom of hydrogen-1

**12** What is the empirical formula of an oxide of iron, formed by reacting 2.24 g of iron with 0.96 g of oxygen?

- A** FeO      **B** Fe<sub>2</sub>O      **C** Fe<sub>2</sub>O<sub>3</sub>      **D** Fe<sub>3</sub>O<sub>4</sub>

**13** Electrolysis is carried out on dilute aqueous potassium bromide.

Which products are formed at the anode and the cathode?

	anode	cathode
<b>A</b>	bromine	hydrogen
<b>B</b>	bromine	potassium
<b>C</b>	hydrogen	bromine
<b>D</b>	hydrogen	potassium

**14** Which substance does **not** require oxygen in order to produce energy?

- A** coal  
**B** hydrogen  
**C** natural gas  
**D** <sup>235</sup>U

**15** Ethanol is used as a fuel.

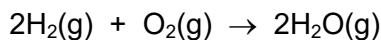


Which statements are correct?

- 1 The reaction is endothermic.
- 2 The products have more energy than the reactants.
- 3 The oxygen for this reaction comes from the air.
- 4 The temperature of the reaction mixture rises during this reaction.

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

- 16 The reaction between hydrogen and oxygen releases 486 kJ/mol of energy.



The bond energy of H–H is 436 kJ/mol and that of H–O is 464 kJ/mol.

What is the bond energy of O=O?

- A 430 kJ/mol
  - B 458 kJ/mol
  - C 498 kJ/mol
  - D 984 kJ/mol
- 17 Which reaction of hydrochloric acid is a redox reaction?

- A  $2\text{Na} + 2\text{HCl} \rightarrow 2\text{NaCl} + \text{H}_2$
- B  $\text{Na}_2\text{O} + 2\text{HCl} \rightarrow 2\text{NaCl} + \text{H}_2\text{O}$
- C  $\text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}$
- D  $\text{Na}_2\text{CO}_3 + 2\text{HCl} \rightarrow 2\text{NaCl} + \text{H}_2\text{O} + \text{CO}_2$

- 18 Which reaction is an example of a photochemical reaction?
- A glucose forming carbon dioxide and water
  - B magnesium reacting with oxygen
  - C potassium reacting with water
  - D silver chloride forming silver metal

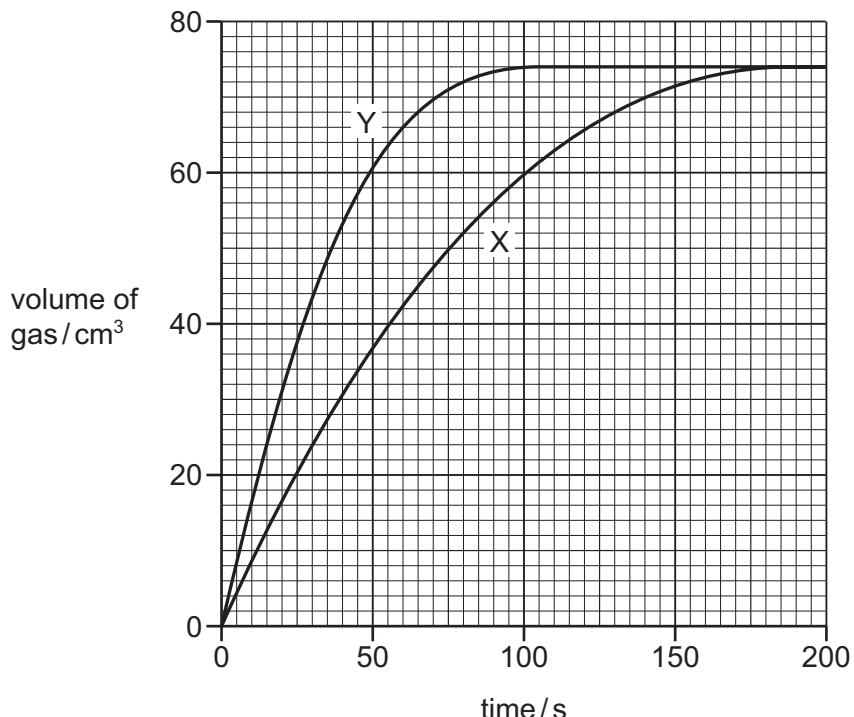
- 19 An excess of calcium carbonate is added to dilute hydrochloric acid, X.

The carbon dioxide gas given off is collected and its volume recorded at regular time intervals.

Line X on the graph shows the results obtained.

The experiment is repeated using dilute hydrochloric acid, Y.

Line Y on the graph shows the results obtained.



Which statement about the two hydrochloric acid samples, X and Y, is correct?

- A They had the same volume but Y had higher concentration.
- B They had the same concentration but Y had a larger volume.
- C X had a higher concentration but Y had a larger volume.
- D Y had a higher concentration but X had a larger volume.

- 20 Period 3 of the Periodic Table contains the elements sodium to argon.

Element Q is a non-metal from this period.

Which statement about Q is correct?

- A It conducts electricity.
- B It has a lower proton number than sodium.
- C It has electrons in only three shells.
- D It is malleable.

21 Which metal has variable oxidation states?

- A aluminium
- B calcium
- C copper
- D sodium

22 An aqueous cation reacts with aqueous sodium hydroxide to form a white precipitate.

The precipitate is insoluble in excess sodium hydroxide.

What is the aqueous cation?

- A aluminium ion
- B calcium ion
- C chromium ion
- D zinc ion

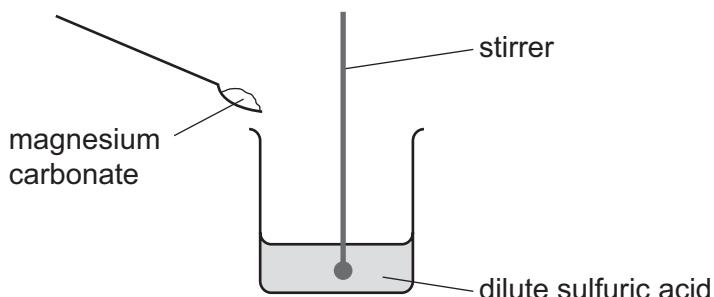
23 Zinc oxide is an amphoteric oxide.

Which row describes the reactions of zinc oxide?

	reaction with alkalis	reaction with acids
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

- 24 A student carries out an experiment to prepare pure magnesium sulfate crystals.

The diagram shows the first stage of the preparation.



He adds magnesium carbonate until no more reacts.

Which process should he use for the next stage?

- A crystallisation
  - B evaporation
  - C filtration
  - D neutralisation
- 25 Which statement about the halogens and their compounds is correct?
- A The colour of the element gets lighter going down Group VII.
  - B The elements get less dense going down Group VII.
  - C When chlorine is added to sodium iodide solution, iodine is formed.
  - D When iodine is added to sodium bromide solution, bromine is formed.
- 26 Elements in Group II of the Periodic Table show the same trends in their reaction with water and their density as Group I.

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

- 27 A flammable gas needs to be removed from a tank at an industrial plant.

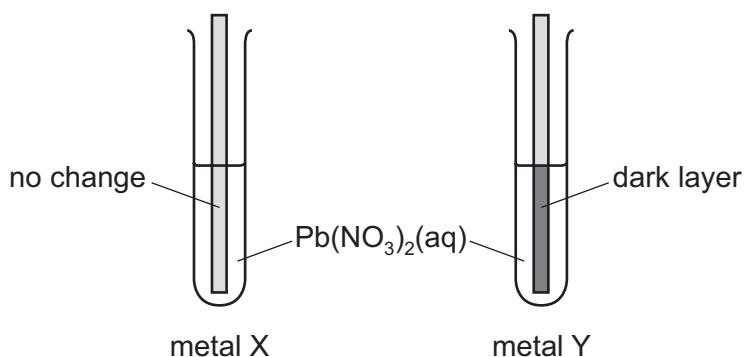
For safety reasons, an inert gas is used.

Which gas is suitable?

- A argon
  - B hydrogen
  - C methane
  - D oxygen
- 28 An experiment is performed to determine the order of reactivity of metals X and Y compared to lead.

Strips of each metal were added to separate test-tubes containing aqueous lead(II) nitrate,  $\text{Pb}(\text{NO}_3)_2$ .

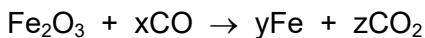
The results are shown.



What is the order of reactivity, least reactive first?

- A  $\text{Pb} \rightarrow \text{X} \rightarrow \text{Y}$
- B  $\text{X} \rightarrow \text{Y} \rightarrow \text{Pb}$
- C  $\text{X} \rightarrow \text{Pb} \rightarrow \text{Y}$
- D  $\text{Y} \rightarrow \text{Pb} \rightarrow \text{X}$

- 29 The equation for the reaction between iron(III) oxide and carbon monoxide is shown.



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

	x	y	z
A	2	2	2
B	2	3	3
C	3	1	3
D	3	2	3

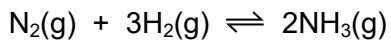
- 30 Which process is used to separate oxygen from liquid air?

- A chromatography
- B distillation
- C filtration
- D fractional distillation

- 31 What is the catalyst in the Haber process?

- A Fe
- B Ni
- C Pt
- D  $\text{V}_2\text{O}_5$

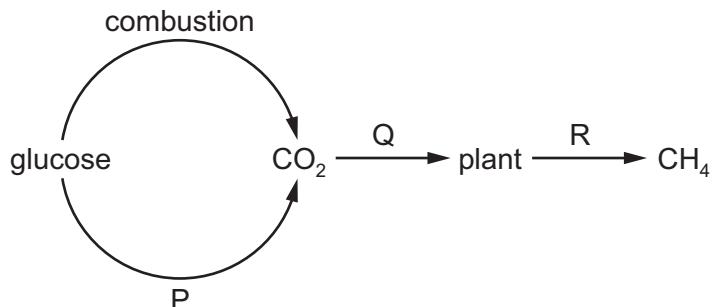
- 32 Ammonia is manufactured in an exothermic reaction.



What is the effect of lowering the pressure on the rate of formation of ammonia and percentage yield of ammonia at equilibrium?

	rate of formation	percentage yield
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

- 33 Part of the carbon cycle is shown.



What are processes P, Q and R?

	P	Q	R
A	decomposition	respiration	photosynthesis
B	respiration	photosynthesis	decomposition
C	respiration	decomposition	photosynthesis
D	photosynthesis	respiration	decomposition

- 34 Which row shows the conditions used for the manufacture of sulfuric acid in the Contact process?

	pressure / atm	temperature / °C	catalyst
A	250	200	vanadium(V) oxide
B	2	450	vanadium(V) oxide
C	250	200	iron
D	2	450	iron

- 35 Which calcium compound does **not** neutralise an acid soil?

- A calcium oxide
- B calcium sulfate
- C calcium hydroxide
- D calcium carbonate

- 36 Which product is obtained when bromine reacts with propene,  $\text{CH}_3\text{CH}=\text{CH}_2$ ?

- A  $\text{CH}_3\text{CH}=\text{CHBr}$
- B  $\text{CH}_3\text{CBr}=\text{CHBr}$
- C  $\text{CH}_3\text{CH}_2\text{CHBr}_2$
- D  $\text{CH}_3\text{CHBrCH}_2\text{Br}$

37 Propanol is oxidised by acidified potassium manganate(VII) in a similar way to ethanol.

Which compound is produced by the oxidation of propanol with acidified potassium manganate(VII)?

- A  $\text{CH}_3\text{CH}_2\text{OH}$
- B  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
- C  $\text{CH}_3\text{COOH}$
- D  $\text{CH}_3\text{CH}_2\text{COOH}$

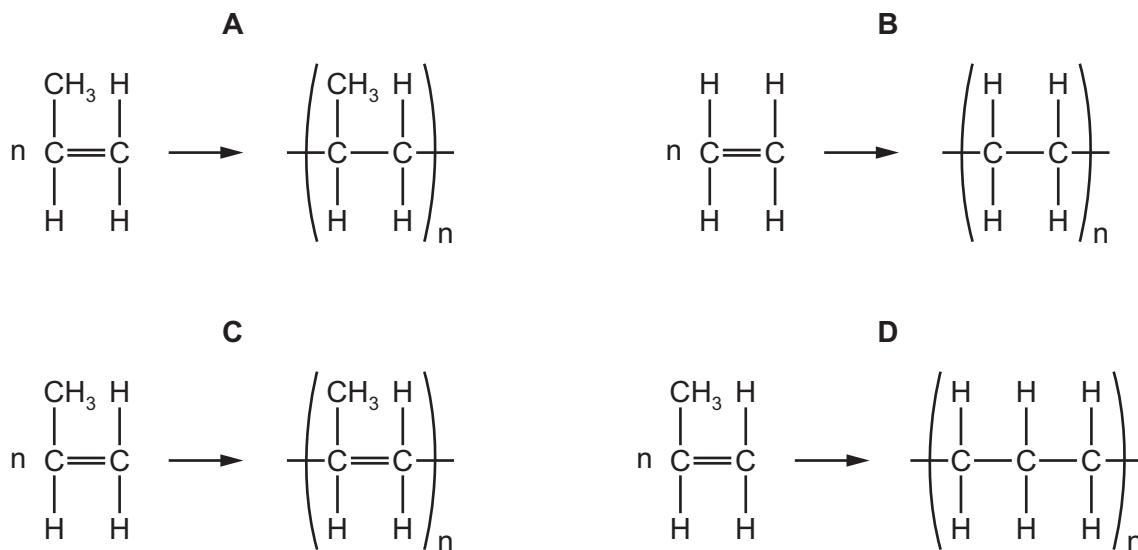
38 The flow chart shows the preparation of ethanol and some important chemistry of ethanol.



What are X, Y and Z?

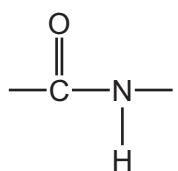
	X	Y	Z
A	yeast	combustion	oxygen
B	glucose	combustion	steam
C	glucose	polymerisation	water
D	yeast	fermentation	glucose

39 Which equation represents the formation of poly(propene) from propene?

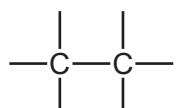


40 Which type of linkage joins the amino acids in a protein?

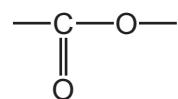
A



B



C



D



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**The Periodic Table of Elements**

I		II		Group																																																																																																																																																																																													
				I						II			III			IV		V		VI		VII		VIII																																																																																																																																																																									
3	Li	4	Be	beryllium 9	5	C	carbon 12	6	N	nitrogen 14	7	O	oxygen 16	8	F	fluorine 19	9	H	hydrogen 1	10	He	helium 4	11	Ne	neon 20																																																																																																																																																																								
11	Na	12	Mg	magnesium 24	13	Si	silicon 28	14	P	phosphorus 31	15	S	sulfur 32	16	Cl	chlorine 35.5	17	Ar	argon 40	18	Xe	xenon 131	19	K	potassium 39																																																																																																																																																																								
19	Ca	20	Sc	scandium 45	21	Ti	titanium 48	22	V	vanadium 51	23	Cr	chromium 52	24	Mn	manganese 55	25	Fe	iron 56	26	Co	cobalt 59	27	Ni	nickel 59	28	Zn	zinc 65	29	Cu	copper 64	30	Ga	gallium 70	31	Ge	germanium 73	32	As	arsenic 75	33	Se	selenium 79	34	Br	bromine 80	35	Kr	krypton 84	36	Rb	rubidium 85																																																																																																																																													
37	Sr	38	Y	yttrium 89	39	Zr	zirconium 91	40	Nb	niobium 93	41	Tc	molybdenum 96	42	Mo	technetium –	43	Ru	ruthenium 101	44	Rh	rhodium 103	45	Pd	palladium 106	46	Ag	silver 108	47	Cd	cadmium 112	48	In	indium 115	49	Sn	tin 119	50	Te	tellurium 122	51	I	iodine 127	52	Rn	radon –	53	Fr	francium –	54	Ac	actinium –	55	Cs	caesium 133	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	Hg	mercury 197	79	Tl	thallium 204	80	Pb	lead 207	81	Bi	bismuth 209	82	Po	polonium –	83	At	astatine –	84	Lv	livmorium –	85	Lu	lutetium 175	86	La	lanthanum 139	58	Ce	cerium 140	59	Pr	praseodymium 141	60	Nd	neodymium 144	61	Pm	promethium –	62	Sm	samarium 150	63	Eu	europlium 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 –	72	Th	thorium 232	90	Pa	protactinium 231	91	U	uranium 238	92	Np	neptunium –	93	Am	americium –	94	Cm	curium –	95	Bk	berkelium –	96	Cf	californium –	97	Fm	fermium –	98	Es	einsteinium –	99	Md	mendelevium –	100	No	nobelium –	101	Lr	lawrencium –	102	Ac	actinium –	103	Fr	francium –

16

lanthanoids	La	57	Ce	58	Pr	59	Nd	60	Pm	61	Sm	62	Eu	63	Gd	64	Tb	65	Dy	66	Ho	67	Er	68	Tm	69	Yb	70	Lu
actinoids	Ac	89	Th	90	Pa	91	U	92	Np	93	Am	94	Pu	95	Cm	96	Bk	97	Cf	98	Es	99	Fm	100	Md	101	No	102	Lr

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



# **Cambridge IGCSE™**

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**CHEMISTRY**

**0620/23**

Paper 2 Multiple Choice (Extended)

**October/November 2020**

**MARK SCHEME**

Maximum Mark: 40

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**Published**

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination.

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This document consists of **3** printed pages.

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
1	D	1
2	D	1
3	D	1
4	A	1
5	B	1
6	C	1
7	A	1
8	C	1
9	C	1
10	D	1
11	C	1
12	C	1
13	A	1
14	D	1
15	D	1
16	C	1
17	A	1
18	D	1
19	D	1
20	C	1
21	C	1
22	B	1
23	A	1
24	C	1
25	C	1
26	A	1
27	A	1
28	C	1

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
29	D	1
30	D	1
31	A	1
32	A	1
33	B	1
34	B	1
35	B	1
36	D	1
37	D	1
38	B	1
39	A	1
40	A	1



# Cambridge IGCSE™

## CHEMISTRY

0620/22

Paper 2 Multiple Choice (Extended)

October/November 2020

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. A mark will not be deducted for a wrong answer.
- Any rough working should be done on this question paper.
- The Periodic Table is printed in the question paper.

This document has **16** pages. Blank pages are indicated.

1 Which gas has the slowest rate of diffusion?

**A** H<sub>2</sub>

**B** NH<sub>3</sub>

**C** CH<sub>4</sub>

**D** CO<sub>2</sub>

2 A chromatography experiment is carried out to analyse the pigments present in four different types of leaf. The student carrying out the experiment forgot to complete his table of results, which is shown.

plant leaf	number of pigments identified	colour of identified pigments	distance travelled by the solvent front (cm)	distance travelled from the origin by each pigment (cm)	R <sub>f</sub> value
maple	<b>F</b>	green /yellow	3.7	green: 3.0 yellow: 3.1	green: 0.81 yellow: 0.83
laurel	2	green /yellow	<b>G</b>	green: 2.5 yellow: 2.5	green: 0.78 yellow: 0.78
lime	3	green /yellow /orange	3.5	green: 2.9 yellow: 3.0 orange: 2.7	green: 0.83 yellow: 0.86 yellow: 0.77
ash	3	green /yellow /orange	3.5	green: 2.8 yellow: 3.0 orange: 2.7	green: 0.80 yellow: <b>H</b> orange: 0.77

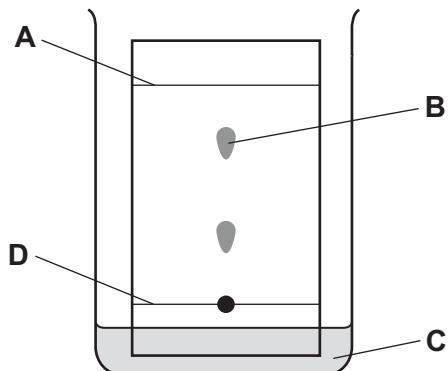
Which row identifies the values of **F**, **G** and **H**?

	<b>F</b>	<b>G</b>	<b>H</b>
<b>A</b>	2	3.2	0.80
<b>B</b>	3	3.5	0.83
<b>C</b>	2	3.2	0.86
<b>D</b>	3	3.5	0.78

3 Which statement about isotopes is correct?

- A** They have different proton numbers.
- B** They have different chemical properties.
- C** They have the same nucleon number.
- D** They have the same number of electrons in their outer shell.

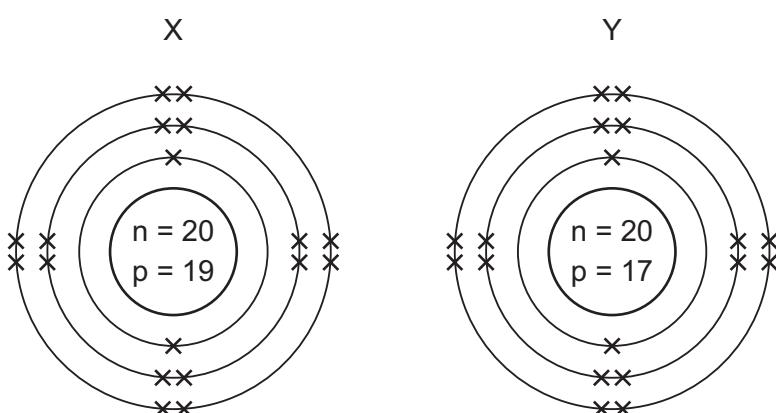
- 4 In the chromatography experiment shown, which label represents the solvent front?



- 5 Different methods of separation rely on substances having different properties.

Which property does distillation make use of?

- A boiling point
  - B colour
  - C particle size
  - D solubility in different solvents
- 6 The arrangements of the electrons in two ions formed from elements X and Y are shown.



Which equation represents the reaction between elements X and Y?

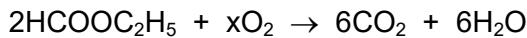
- A  $X_2 + 2Y \rightarrow 2X^+ + 2Y^-$
- B  $X_2 + 2Y \rightarrow 2X^- + 2Y^+$
- C  $2X + Y_2 \rightarrow 2X^+ + 2Y^-$
- D  $2X + Y_2 \rightarrow 2X^- + 2Y^+$

- 7 Which row identifies compounds that contain single covalent bonds only, double covalent bonds only or both single and double covalent bonds?

	single covalent bonds only	double covalent bonds only	both single and double covalent bonds
A	C <sub>2</sub> H <sub>4</sub>	CH <sub>3</sub> OH	CO <sub>2</sub>
B	CH <sub>3</sub> OH	C <sub>2</sub> H <sub>4</sub>	CO <sub>2</sub>
C	CH <sub>3</sub> OH	CO <sub>2</sub>	C <sub>2</sub> H <sub>4</sub>
D	CO <sub>2</sub>	C <sub>2</sub> H <sub>4</sub>	CH <sub>3</sub> OH

- 8 Ethyl methanoate, HCOOC<sub>2</sub>H<sub>5</sub>, burns in excess oxygen to produce carbon dioxide and water.

The equation is shown.



What is the value of x?

- A 2      B 7      C 9      D 18

- 9 Rubidium is in Group I of the Periodic Table and bromine is in Group VII.

Rubidium reacts with bromine to form an ionic compound.

Which row shows the electron change taking place for rubidium and the correct formula of the rubidium ion?

	electron change	formula of ion formed
A	electron gained	Rb <sup>+</sup>
B	electron gained	Rb <sup>-</sup>
C	electron lost	Rb <sup>+</sup>
D	electron lost	Rb <sup>-</sup>

- 10 Which statement explains why graphite is used as a lubricant?

- A All bonds between the atoms are weak.  
 B It conducts electricity.  
 C It has a low melting point.  
 D Layers in the structure can slide over each other.

11 The relative atomic mass of chlorine is 35.5.

When calculating relative atomic mass, which particle is the mass of a chlorine atom compared to?

- A a neutron
- B a proton
- C an atom of carbon-12
- D an atom of hydrogen-1

12 Universal indicator solution is added to a neutral solution of concentrated aqueous sodium chloride.

The solution, which contains  $\text{H}^+$  (hydrogen),  $\text{Na}^+$  (sodium),  $\text{Cl}^-$  (chloride) and  $\text{OH}^-$  (hydroxide) ions, is electrolysed.

The product at the cathode is hydrogen gas and the product at the anode is chlorine gas.

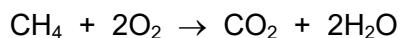
What happens to the colour of the indicator **in the solution** during electrolysis?

- A The colour changes from blue to green.
- B The colour changes from blue to red.
- C The colour changes from green to blue.
- D The colour changes from green to red.

13 What is the empirical formula of an oxide of iron, formed by reacting 2.24 g of iron with 0.96 g of oxygen?

- A  $\text{FeO}$
- B  $\text{Fe}_2\text{O}$
- C  $\text{Fe}_2\text{O}_3$
- D  $\text{Fe}_3\text{O}_4$

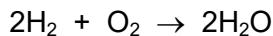
14 The combustion of methane is exothermic.



Which statement about this reaction is correct?

- A The energy needed to break the bonds in methane and oxygen is greater than the energy released in making new bonds in carbon dioxide and water.
- B The energy needed to break the bonds in methane and oxygen is less than the energy released in making new bonds in carbon dioxide and water.
- C The energy released in breaking bonds in methane and oxygen is greater than the energy needed to make new bonds in carbon dioxide and water.
- D The energy released in breaking bonds in methane and oxygen is less than the energy needed to make new bonds in carbon dioxide and water.

- 15 Hydrogen reacts with oxygen in a fuel cell.



The reaction is exothermic.

286 kJ of energy is released for every mole of water formed.

Which volume of hydrogen gas, measured at room temperature and pressure, would react with oxygen with the release of 7000 J of energy?

- A 587 cm<sup>3</sup>      B 1175 cm<sup>3</sup>      C 587 dm<sup>3</sup>      D 1175 dm<sup>3</sup>

- 16 Which substance does **not** require oxygen in order to produce energy?

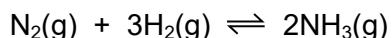
- A coal  
B hydrogen  
C natural gas  
D <sup>235</sup>U

- 17 Nitrogen, N<sub>2</sub>, and hydrogen, H<sub>2</sub>, can be converted into ammonia, NH<sub>3</sub>, using a catalyst.

What is the purpose of the catalyst?

- A to increase the amount of ammonia produced  
B to increase the rate of reaction  
C to reduce the amount of reactants needed  
D to reduce the rate of reaction

- 18 Ammonia is produced by the Haber process. The equation is shown.



The forward reaction is exothermic.

Which statement is correct?

- A Increasing pressure decreases the yield of ammonia, but speeds up the reaction.  
B Increasing temperature decreases the yield of ammonia, but speeds up the reaction.  
C Increasing the concentration of hydrogen and nitrogen results in a lower yield of ammonia.  
D Increasing the temperature increases the yield of ammonia and speeds up the reaction.

- 19** During the manufacture of sulfuric acid, sulfur dioxide is converted to sulfur trioxide.



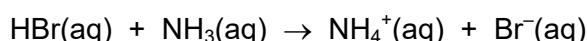
Which type of reaction is this?

- A** displacement
  - B** neutralisation
  - C** oxidation
  - D** thermal decomposition
- 20** The equation for a redox reaction is shown.



Which element is reduced?

- A** chlorine
  - B** iron
  - C** oxygen
  - D** sulfur
- 21** The equation shows a reaction between aqueous hydrogen bromide and aqueous ammonia.



Which statement describes the role of aqueous hydrogen bromide?

- A** It is a catalyst.
  - B** It is a reducing agent.
  - C** It is a proton acceptor.
  - D** It is a proton donor.
- 22** The equations for three reactions are shown.

- 1  $\text{Pb(NO}_3)_2\text{(aq)} + 2\text{KI(aq)} \rightarrow \text{PbI}_2\text{(s)} + 2\text{KNO}_3\text{(aq)}$
- 2  $2\text{AgNO}_3\text{(aq)} + \text{CuI}_2\text{(aq)} \rightarrow \text{Cu(NO}_3)_2\text{(aq)} + 2\text{AgI(s)}$
- 3  $\text{CuO(s)} + \text{H}_2\text{SO}_4\text{(aq)} \rightarrow \text{CuSO}_4\text{(aq)} + \text{H}_2\text{O(l)}$

Which reactions are suitable for making a salt by precipitation?

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

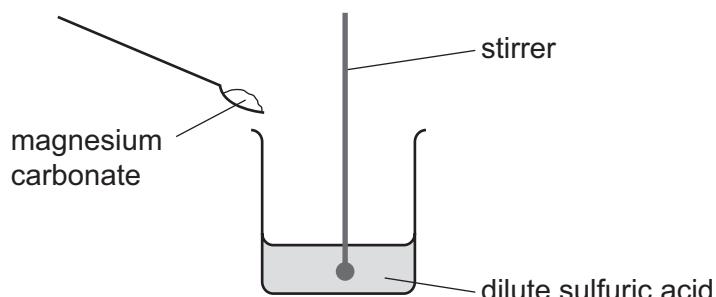
- 23 Zinc oxide is an amphoteric oxide.

Which row describes the reactions of zinc oxide?

	reaction with alkalis	reaction with acids
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

- 24 A student carries out an experiment to prepare pure magnesium sulfate crystals.

The diagram shows the first stage of the preparation.



He adds magnesium carbonate until no more reacts.

Which process should he use for the next stage?

- A crystallisation
  - B evaporation
  - C filtration
  - D neutralisation
- 25 Which row about elements in the Periodic Table is correct?

	statement 1	statement 2
A	two elements in the same group have similar chemical properties	metals are on the left of the table
B	two elements in the same group have similar chemical properties	metals are on the right of the table
C	two elements in the same period have similar chemical properties	metals are on the left of the table
D	two elements in the same period have similar chemical properties	metals are on the right of the table

- 26** A new element oxfordium, Ox, was discovered with the following properties.

solubility	electrical conduction	formula of element	bonding in a molecule of $\text{Ox}_2$
insoluble in water	doesn't conduct	$\text{Ox}_2$	$\text{Ox}\equiv\text{Ox}$

In which group of the Periodic Table should the new element be placed?

- A** Group III
- B** Group V
- C** Group VII
- D** Group VIII

- 27** A flammable gas needs to be removed from a tank at an industrial plant.

For safety reasons, an inert gas is used.

Which gas is suitable?

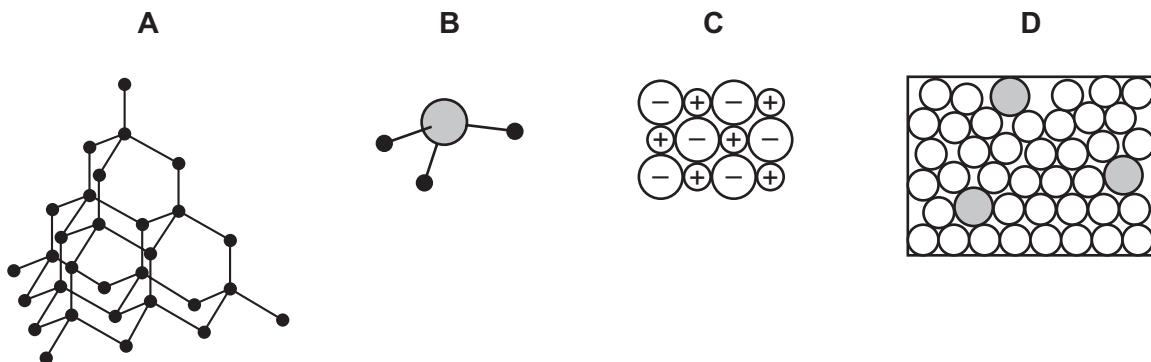
- A** argon
- B** hydrogen
- C** methane
- D** oxygen

- 28** Transition elements can have variable oxidation states.

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

- A**  $\text{Cr}_2\text{O}_3$  and  $\text{Cr}_2(\text{SO}_4)_3$
- B**  $\text{Cu}_2\text{O}$  and  $\text{CuCO}_3$
- C**  $\text{ZnS}$  and  $\text{ZnSO}_4$
- D**  $\text{NiO}$  and  $\text{Ni}(\text{NO}_3)_2$

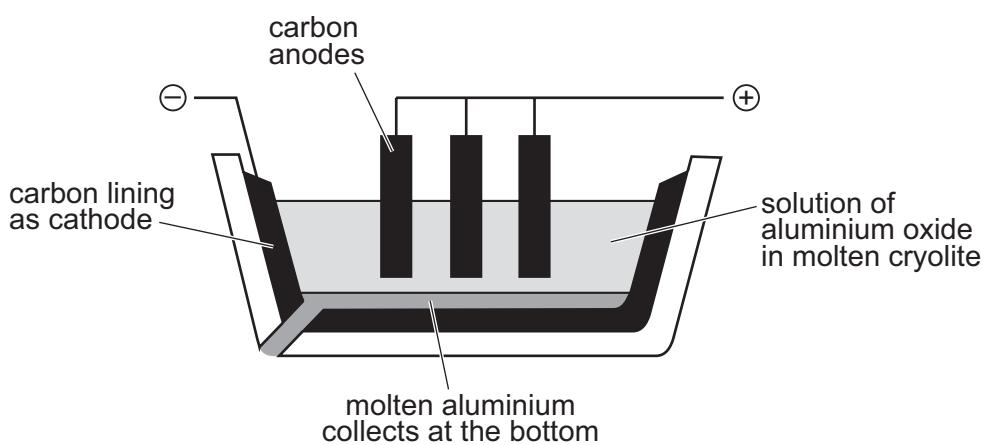
- 29 Which diagram best represents the structure of a substance that is a good conductor of electricity at 25 °C?



- 30 Why is aluminium metal unreactive with air?

- A** It is covered with a layer of oxide.
- B** It is low in the reactivity series.
- C** It is produced by electrolysis of its oxide.
- D** It melts at a high temperature.

- 31 The apparatus used for the extraction of aluminium oxide by electrolysis is shown.



Which equation represents a reaction taking place at the anode?

- A**  $O + 2e^- \rightarrow O^{2-}$
- B**  $2O^{2-} \rightarrow O_2 + 4e^-$
- C**  $Al^{3+} \rightarrow Al + 3e^-$
- D**  $Al^{3+} + 3e^- \rightarrow Al$

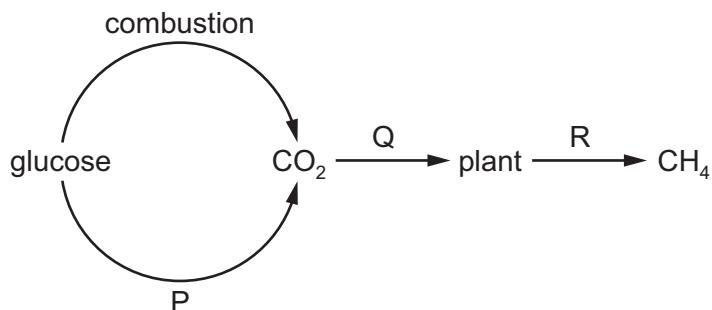
32 The results of tests on solid S and its aqueous solution are shown.

tests on solid S	tests on aqueous solution of S	
effect of heat	effect of aqueous sodium hydroxide	effect of aqueous ammonia
brown gas given off, together with a gas which relights a glowing splint	white ppt., soluble in excess, giving a colourless solution	white ppt., soluble in excess, giving a colourless solution

What is S?

- A aluminium nitrate
- B aluminium sulfate
- C zinc sulfate
- D zinc nitrate

33 Part of the carbon cycle is shown.



What are processes P, Q and R?

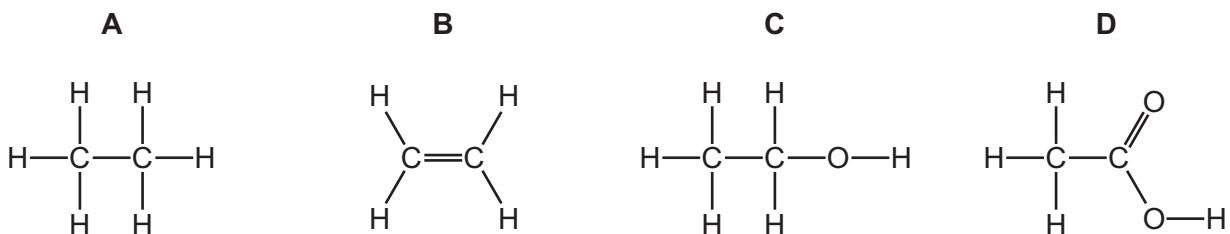
	P	Q	R
A	decomposition	respiration	photosynthesis
B	respiration	photosynthesis	decomposition
C	respiration	decomposition	photosynthesis
D	photosynthesis	respiration	decomposition

34 The element sulfur is found in a number of different minerals.

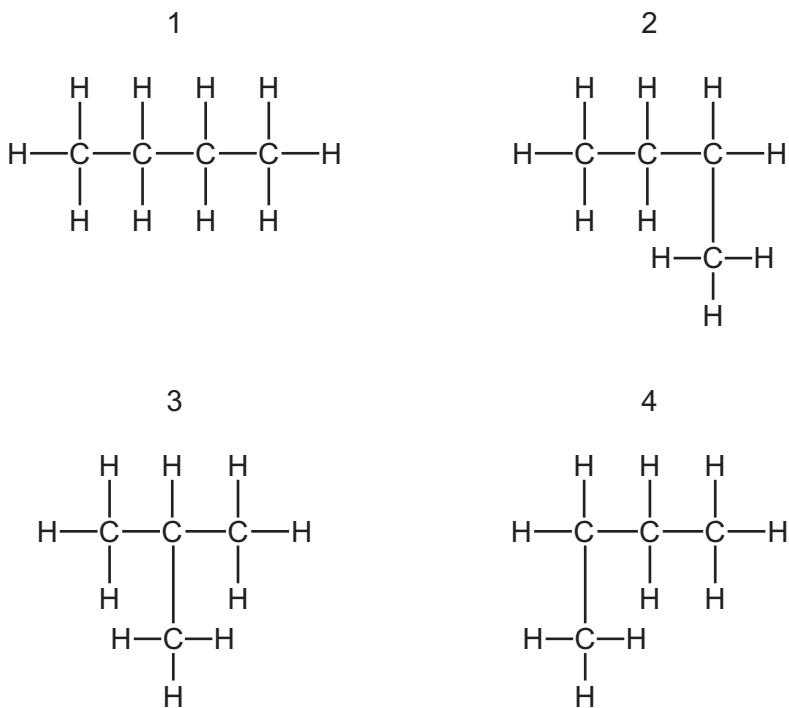
Which mineral contains the greatest percentage by mass of sulfur?

- A barite, BaSO<sub>4</sub>
- B galena, PbS
- C gypsum, CaSO<sub>4</sub>
- D pyrite, FeS<sub>2</sub>

35 Which structure represents a molecule of ethanol?



36 Which structures are structural isomers of each other?

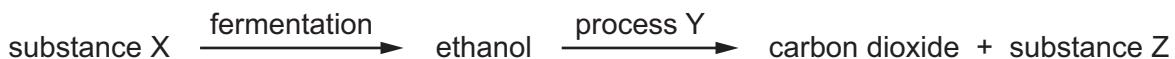


- A** 1, 2, 3 and 4
- B** 1, 2 and 4 only
- C** 1 and 3 only
- D** 2 and 4 only

37 Which molecule is **not** produced by an addition reaction of ethene?

- A**  $\text{CH}_3\text{CH}_3$
- B**  $\text{CH}_2\text{BrCH}_2\text{Br}$
- C**  $\text{CH}_3\text{CH}_2\text{OH}$
- D**  $\text{CH}_3\text{CH}_2\text{CH}_3$

38 The flow chart shows the preparation of ethanol and some important chemistry of ethanol.



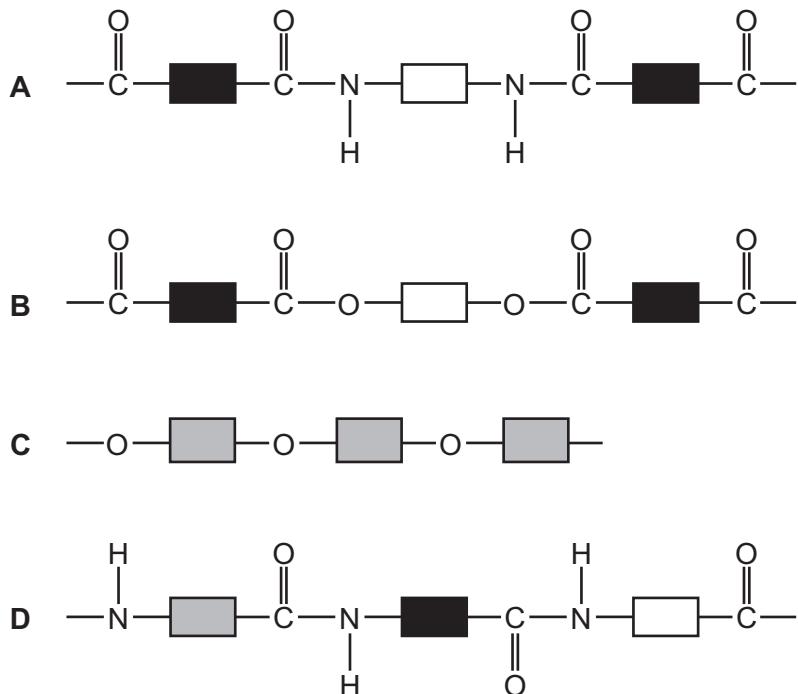
What are X, Y and Z?

	X	Y	Z
A	yeast	combustion	oxygen
B	glucose	combustion	steam
C	glucose	polymerisation	water
D	yeast	fermentation	glucose

39 Which statement about nylon and *Terylene* is correct?

- A Nylon and *Terylene* are made from monomers with C=C bonds.
- B Nylon and *Terylene* contain the same linkage.
- C Nylon is a polyester.
- D *Terylene* is made from two different monomers.

40 Which diagram represents the structure of a protein?



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## The Periodic Table of Elements

		Group														
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Li lithium 7	Be beryllium 9	I				II				1	H hydrogen 1					
K potassium 39	Ca calcium 40	Sc scandium 45	Ti titanium 48	Cr chromium 52	Mn manganese 55	Fe iron 56	Co cobalt 59	Ni nickel 59	Cu copper 64	Zn zinc 65	Ga gallium 70	As germanium 73	Se selenium 79	Br bromine 80	Kr krypton 84	
Rb rubidium 85	Sr strontium 88	Y yttrium 89	Zr zirconium 91	Nb niobium 93	Mo molybdenum 96	Tc technetium —	Ru ruthenium 101	Rh rhodium 103	Pd palladium 106	Ag silver 108	Cd cadmium 112	In indium 115	Sb antimony 119	Te tellurium 122	I iodine 128	Xe xenon 131
Cs caesium 133	Ba barium 137	lanthanoids		Hf hafnium 178	Ta tantalum 181	W tungsten 184	Re rhenium 186	Os osmium 190	Ir iridium 192	Pt platinum 195	Hg mercury 197	Tl thallium 201	Pb lead 207	Bi bismuth 209	Po polonium —	Rn radon —
Fr francium —	Ra radium —	actinoids		Rf rutherfordium —	Db dubnium —	104	105	106	107	108	Hs meitnerium —	Rg roentgenium —	Cn copernicium —	Fm ferrovium —	Lv livernium —	
Key		atomic number name relative atomic mass				atomic symbol				H		He helium 4		Ne neon 20		

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



# **Cambridge IGCSE™**

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**CHEMISTRY**

**0620/22**

Paper 2 Multiple Choice (Extended)

**October/November 2020**

**MARK SCHEME**

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This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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This document consists of **3** printed pages.

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
1	D	1
2	C	1
3	D	1
4	A	1
5	A	1
6	C	1
7	C	1
8	B	1
9	C	1
10	D	1
11	C	1
12	C	1
13	C	1
14	B	1
15	A	1
16	D	1
17	B	1
18	B	1
19	C	1
20	A	1
21	D	1
22	A	1
23	A	1
24	C	1
25	A	1
26	B	1
27	A	1
28	B	1

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
29	D	1
30	A	1
31	B	1
32	D	1
33	B	1
34	D	1
35	C	1
36	C	1
37	D	1
38	B	1
39	D	1
40	D	1



# Cambridge IGCSE™

## CHEMISTRY

0620/21

Paper 2 Multiple Choice (Extended)

October/November 2020

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. A mark will not be deducted for a wrong answer.
- Any rough working should be done on this question paper.
- The Periodic Table is printed in the question paper.

This document has **16** pages. Blank pages are indicated.

1 Which gas has the slowest rate of diffusion?

**A** H<sub>2</sub>

**B** NH<sub>3</sub>

**C** CH<sub>4</sub>

**D** CO<sub>2</sub>

2 A mixture of colourless amino acids is separated using chromatography.

The solvent used is propanol.

The chromatogram is sprayed with a locating agent.

Which row describes the purpose of the propanol and the locating agent?

	purpose of propanol	purpose of locating agent
<b>A</b>	to make the individual amino acids visible	to prevent the amino acids moving any further
<b>B</b>	to move the amino acids up the chromatography paper	to make the individual amino acids visible
<b>C</b>	to move the amino acids up the chromatography paper	to prevent the amino acids moving any further
<b>D</b>	to prevent the amino acids moving too far up the paper	to make the individual amino acids visible

3 Which piece of apparatus can only measure a single fixed volume?

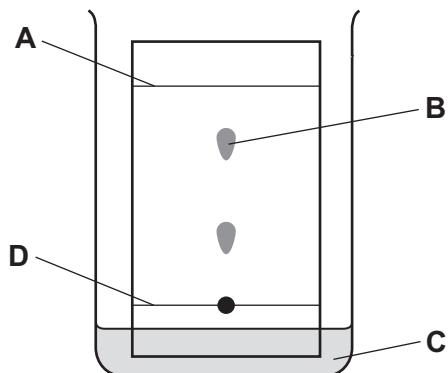
**A** 250 cm<sup>3</sup> beaker

**B** 50 cm<sup>3</sup> burette

**C** 100 cm<sup>3</sup> measuring cylinder

**D** 25 cm<sup>3</sup> pipette

4 In the chromatography experiment shown, which label represents the solvent front?

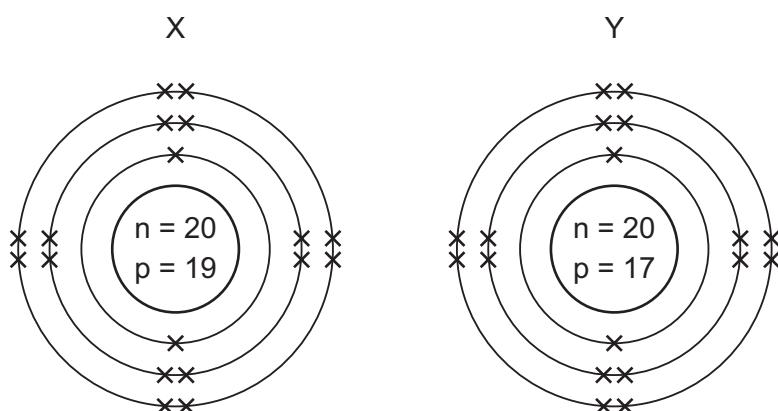


- 5 The atomic structure of four particles are shown.

	electrons	protons	neutrons
P	18	17	18
Q	18	17	20
R	17	17	18
S	17	17	20

Which particles have the same chemical properties?

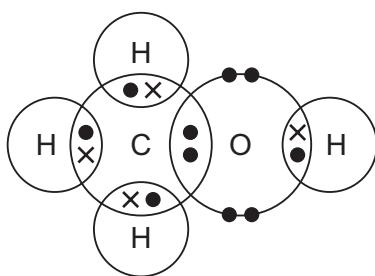
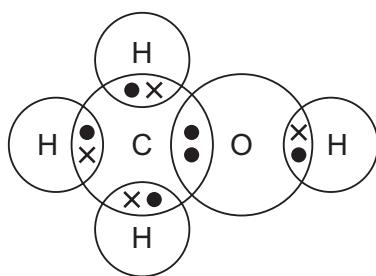
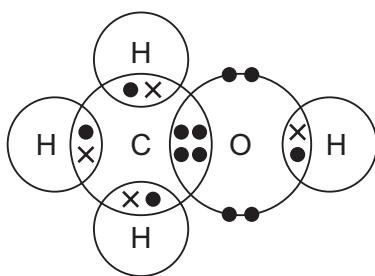
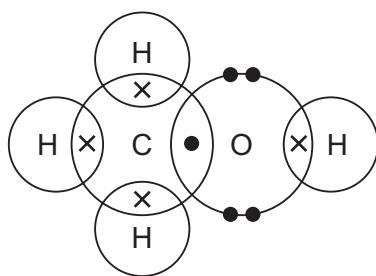
- A P and R only    B P and S    C P, Q and R    D R and S
- 6 The arrangements of the electrons in two ions formed from elements X and Y are shown.



Which equation represents the reaction between elements X and Y?

- A  $X_2 + 2Y \rightarrow 2X^+ + 2Y^-$   
 B  $X_2 + 2Y \rightarrow 2X^- + 2Y^+$   
 C  $2X + Y_2 \rightarrow 2X^+ + 2Y^-$   
 D  $2X + Y_2 \rightarrow 2X^- + 2Y^+$

- 7 Which diagram shows the outer shell electron arrangement in a molecule of methanol, CH<sub>3</sub>OH?

**A****B****C****D**

- 8 Which statement about silicon dioxide, SiO<sub>2</sub>, is correct?

- A** It conducts electricity because it contains free electrons.
- B** It is a macromolecule with four oxygen atoms bonded to each silicon atom.
- C** It is a simple covalent molecule.
- D** Its structure is similar to graphite.

- 9 Rubidium is in Group I of the Periodic Table and bromine is in Group VII.

Rubidium reacts with bromine to form an ionic compound.

Which row shows the electron change taking place for rubidium and the correct formula of the rubidium ion?

	electron change	formula of ion formed
<b>A</b>	electron gained	Rb <sup>+</sup>
<b>B</b>	electron gained	Rb <sup>-</sup>
<b>C</b>	electron lost	Rb <sup>+</sup>
<b>D</b>	electron lost	Rb <sup>-</sup>

**10** Which statement explains why graphite is used as a lubricant?

- A** All bonds between the atoms are weak.
- B** It conducts electricity.
- C** It has a low melting point.
- D** Layers in the structure can slide over each other.

**11** Sodium carbonate reacts with sulfuric acid to form carbon dioxide, water and a sodium salt.

An incomplete equation for the reaction is shown.



What is the formula of the sodium salt?

- A**  $\text{Na}_2(\text{SO}_4)_2$
- B**  $\text{Na}(\text{SO}_4)_2$
- C**  $\text{Na}_2\text{SO}_4$
- D**  $\text{NaSO}_4$

**12** The relative atomic mass of chlorine is 35.5.

When calculating relative atomic mass, which particle is the mass of a chlorine atom compared to?

- A** a neutron
- B** a proton
- C** an atom of carbon-12
- D** an atom of hydrogen-1

**13** What is the empirical formula of an oxide of iron, formed by reacting 2.24 g of iron with 0.96 g of oxygen?

- A**  $\text{FeO}$
- B**  $\text{Fe}_2\text{O}$
- C**  $\text{Fe}_2\text{O}_3$
- D**  $\text{Fe}_3\text{O}_4$

**14** Which reaction takes place at the cathode during the electrolysis of molten nickel(II) chloride?

- A**  $\text{Cl}_2 + 2\text{e}^- \rightarrow 2\text{Cl}^-$
- B**  $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$
- C**  $\text{Ni} \rightarrow \text{Ni}^{2+} + 2\text{e}^-$
- D**  $\text{Ni}^{2+} + 2\text{e}^- \rightarrow \text{Ni}$

- 15 Sodium nitrate is added to water in a beaker and stirred until it dissolves.

At the end of the experiment, the beaker feels cold.

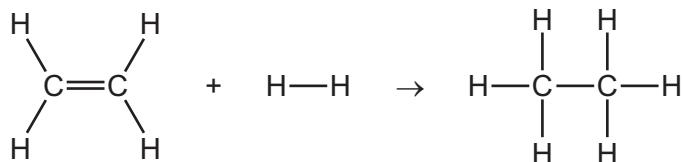
Which row describes the reaction?

	temperature of solution	type of reaction
A	decreases	endothermic
B	decreases	exothermic
C	increases	endothermic
D	increases	exothermic

- 16 Which substance does **not** require oxygen in order to produce energy?

- A coal
- B hydrogen
- C natural gas
- D  $^{235}\text{U}$

- 17 Ethene reacts with hydrogen to form ethane.



The bond energies are shown in the table.

bond	bond energy in kJ/mol
C-C	+350
C-H	+410
H-H	+436
C=C	+614

What is the energy change for the reaction?

- A  $-290 \text{ kJ/mol}$
- B  $-120 \text{ kJ/mol}$
- C  $+120 \text{ kJ/mol}$
- D  $+290 \text{ kJ/mol}$

- 18 A sign displayed in a flour mill is shown.



Which statement explains why there is a danger of explosion in a flour mill?

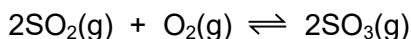
- A Flour burns very quickly because it is a fine powder.  
B Flour is a catalyst for combustion.  
C Flour mills get hot and speed up the rate of combustion.  
D The combustion of flour is exothermic.
- 19 A student investigates the effect of concentration on the rate of reaction between calcium carbonate and hydrochloric acid. He follows the method shown.

- Place 1 g of calcium carbonate in a conical flask.
- Add excess hydrochloric acid.
- Let the reaction continue until no more gas is made.
- Repeat the experiment with different concentrations of hydrochloric acid.

Which essential step has been left out of the method if he is to work out the rate of the reaction?

- A heating the reaction mixture  
B placing a bung in the flask  
C timing the reaction  
D using a catalyst

- 20** The reaction between sulfur dioxide and oxygen is shown.



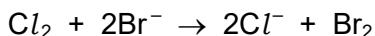
The reaction is exothermic.

Which of the changes shifts the position of equilibrium to the right?

- 1 Increase the concentration of oxygen.
- 2 Increase the pressure.
- 3 Increase the temperature.

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

- 21** The reaction between chlorine and bromide ions is a redox reaction.



What is the change in oxidation state of the reducing agent in this reaction?

- A** -2 to 0      **B** -1 to 0      **C** 0 to -1      **D** 0 to +1

- 22** What is a characteristic of acids?

- A** Acids turn methyl orange indicator yellow.
- B** Acids have a high pH value.
- C** Acids react with ammonium salts to give ammonia gas.
- D** Acids react with carbonates to produce salts.

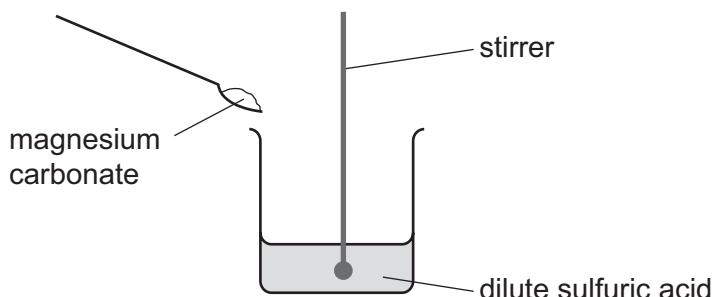
- 23** Zinc oxide is an amphoteric oxide.

Which row describes the reactions of zinc oxide?

	reaction with alkalis	reaction with acids
<b>A</b>	✓	✓
<b>B</b>	✓	✗
<b>C</b>	✗	✓
<b>D</b>	✗	✗

**24** A student carries out an experiment to prepare pure magnesium sulfate crystals.

The diagram shows the first stage of the preparation.



He adds magnesium carbonate until no more reacts.

Which process should he use for the next stage?

- A** crystallisation
- B** evaporation
- C** filtration
- D** neutralisation

**25** Elements P and Q have the same number of electron shells.

Q has more electrons in its outer shell than P.

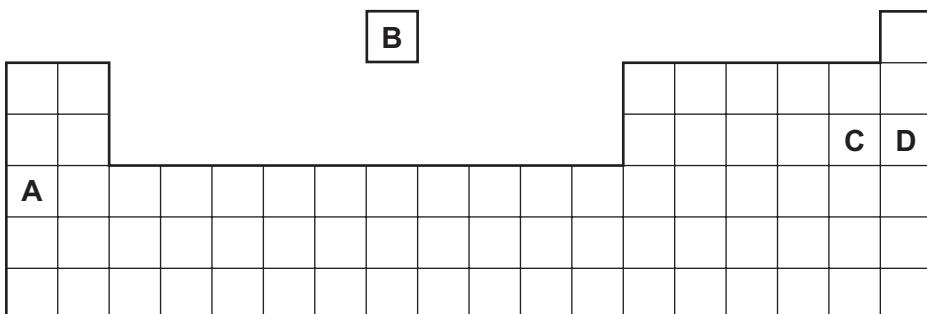
Which statements are correct?

- 1 P and Q are in the same group of the Periodic Table.
- 2 P and Q are in the same period of the Periodic Table.
- 3 P has a greater tendency to form positive ions than Q.
- 4 The oxides of Q are more basic than those of P.

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

**26** The positions of four elements in the Periodic Table are shown.

Which element is a gas that displaces iodine from sodium iodide?



27 A flammable gas needs to be removed from a tank at an industrial plant.

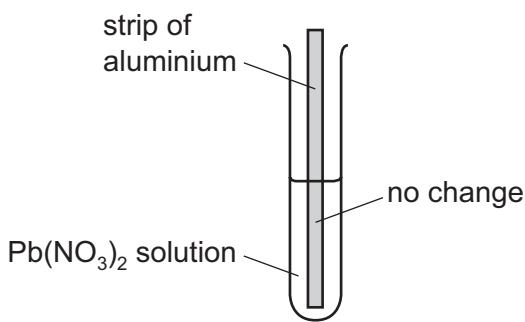
For safety reasons, an inert gas is used.

Which gas is suitable?

- A argon
- B hydrogen
- C methane
- D oxygen

28 A strip of aluminium is placed into a test-tube containing aqueous lead(II) nitrate and left for several minutes.

Aluminium is higher than lead in the reactivity series.



Which statement explains why lead is **not** displaced by this strip of aluminium?

- A A thin insoluble layer of aluminium nitrate forms on the aluminium.
- B Nitrate ions are reduced in aqueous solution.
- C The ionic bonds between lead and nitrate ions are too strong.
- D There is an unreactive oxide layer on the aluminium.

29 Which statements about the metal zinc are correct?

- 1 It is extracted from the ore bauxite.
- 2 It is used to galvanise steel.
- 3 It is used to make the alloy brass.
- 4 It reacts with dilute hydrochloric acid to produce hydrogen gas.

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

30 What is the symbol of the metal used in the manufacture of aircraft because of its strength and low density?

- A Al    B Cu    C Fe    D Zn

**31** Ammonia is manufactured using the Haber process.

Which statement about this process is correct?

- A** The catalyst used for this reaction is vanadium pentoxide.
- B** The hydrogen used is extracted from air.
- C** Using a high pressure increases the yield of ammonia.
- D** Using a high temperature increases the yield of ammonia.

**32** Iron can be protected from rusting by attaching a piece of a more reactive metal, e.g. magnesium, to the iron.

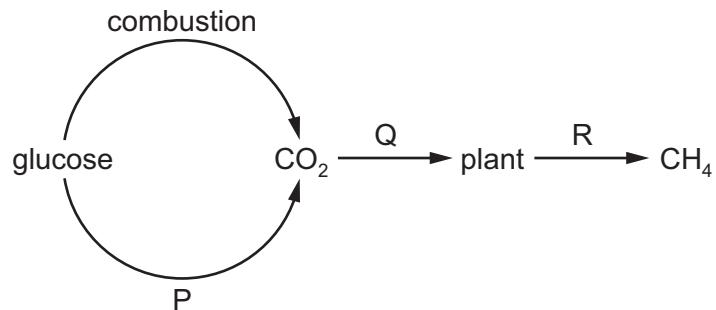
Which equation represents the reaction that takes place?

- A**  $\text{Fe}(\text{s}) \rightarrow \text{Fe}^{2+}(\text{aq}) + 2\text{e}^-$
- B**  $\text{Fe}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Fe}(\text{s})$
- C**  $\text{Mg}(\text{s}) \rightarrow \text{Mg}^{2+}(\text{aq}) + 2\text{e}^-$
- D**  $\text{Mg}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Mg}(\text{s})$

**33** Which row describes two uses of sulfur dioxide?

	use 1	use 2
<b>A</b>	bleaching paper pulp	neutralising acidic industrial waste
<b>B</b>	bleaching paper pulp	preserving food and drink
<b>C</b>	extracting iron from hematite	neutralising acidic industrial waste
<b>D</b>	extracting iron from hematite	preserving food and drink

34 Part of the carbon cycle is shown.

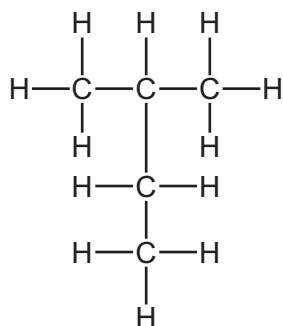


What are processes P, Q and R?

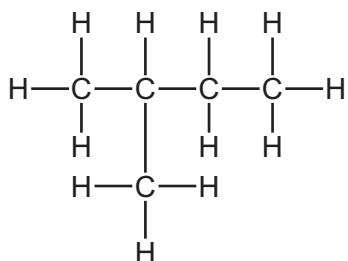
	P	Q	R
A	decomposition	respiration	photosynthesis
B	respiration	photosynthesis	decomposition
C	respiration	decomposition	photosynthesis
D	photosynthesis	respiration	decomposition

**35** The structures of four organic molecules are shown.

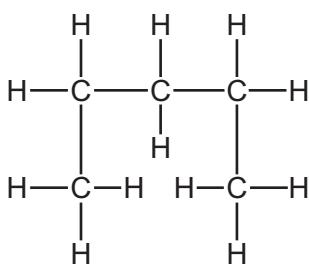
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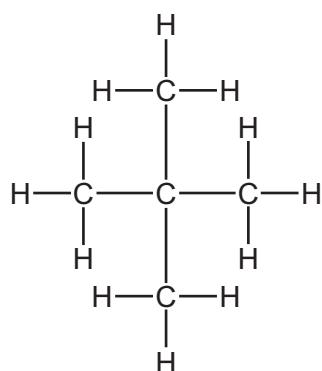
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3



4



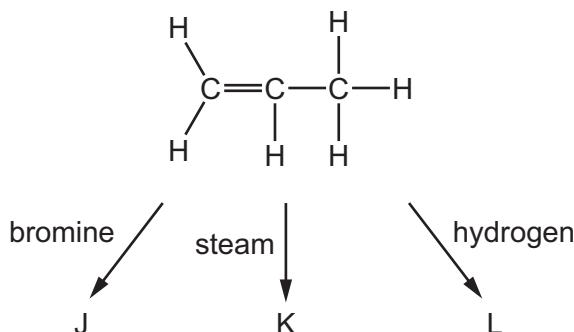
Which molecules are structural isomers of structure 1?

- A** 2 and 4      **B** 2 only      **C** 3 and 4      **D** 3 only

**36** Which chemical equation for the substitution of an alkane with chlorine is correct?

- A**  $\text{C}_3\text{H}_8 + \text{Cl}_2 \rightarrow \text{C}_3\text{H}_7\text{Cl} + \text{HCl}$
- B**  $\text{C}_3\text{H}_6 + \text{Cl}_2 \rightarrow \text{C}_3\text{H}_6\text{Cl}_2$
- C**  $\text{C}_3\text{H}_8 + \text{Cl}_2 \rightarrow \text{C}_3\text{H}_6\text{Cl}_2 + \text{H}_2$
- D**  $\text{C}_3\text{H}_6 + \text{Cl}_2 \rightarrow \text{C}_3\text{H}_5\text{Cl} + \text{HCl}$

- 37 Propene is an alkene that reacts with bromine, steam and hydrogen as shown.



What are the products of these reactions?

	J	K	L
A	bromopropane	propanol	butane
B	dibromopropane	propanoic acid	propane
C	dibromopropane	propanol	propane
D	bromopropane	propanoic acid	butane

- 38 The flow chart shows the preparation of ethanol and some important chemistry of ethanol.



What are X, Y and Z?

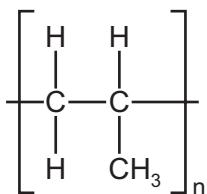
	X	Y	Z
A	yeast	combustion	oxygen
B	glucose	combustion	steam
C	glucose	polymerisation	water
D	yeast	fermentation	glucose

- 39 Which statements about aqueous ethanoic acid are correct?

- 1 It is an alkane.
- 2 It reacts with sodium carbonate to form carbon dioxide.
- 3 It changes the colour of litmus solution from blue to red.
- 4 It is a hydrocarbon.

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

- 40 The structure of a polymer is shown.



Which monomer forms this polymer?

- A ethane
- B ethene
- C propane
- D propene

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**The Periodic Table of Elements**

I		II		Group																													
				I				II				III		IV		V		VI		VII													
				Key																													
				atomic number name		atomic symbol name																											
3	Li	4	B <sub>e</sub> beryllium 9	1	H hydrogen 1																												
11	Na	12	Mg magnesium 24																														
19	K	20	C <sub>a</sub> calcium 40	21	S <sub>c</sub> scandium 45	22	T <sub>i</sub> titanium 48	23	V vanadium 51	24	C <sub>r</sub> chromium 52	25	M <sub>n</sub> manganese 55	26	F <sub>e</sub> iron 56	27	C <sub>o</sub> cobalt 59	28	N <sub>i</sub> nickel 59	29	C <sub>u</sub> copper 64	30	Z <sub>n</sub> zinc 65	31	G <sub>a</sub> gallium 70	32	G <sub>e</sub> germanium 73	33	S <sub>e</sub> arsenic 75	34	B <sub>r</sub> bromine 80	35	K <sub>r</sub> krypton 84
39	Rb	38	S <sub>r</sub> strontium 88	39	N <sub>b</sub> niobium 91	40	M <sub>o</sub> molybdenum 96	41	Z <sub>r</sub> zirconium 93	42	T <sub>c</sub> technetium —	43	R <sub>u</sub> ruthenium 101	44	P <sub>d</sub> palladium 103	45	R <sub>h</sub> rhodium 106	46	A <sub>g</sub> silver 108	47	C <sub>d</sub> cadmium 112	48	I <sub>n</sub> indium 115	49	S <sub>b</sub> antimony 119	50	T <sub>e</sub> tellurium 122	51	P <sub>o</sub> polonium 128	52	I <sub>l</sub> iodine 127	53	X <sub>e</sub> xenon 131
55	Cs	56	B <sub>a</sub> barium 137	57–71	H <sub>f</sub> lanthanoids 178	72	T <sub>a</sub> tantalum 181	73	W tungsten 184	74	R <sub>e</sub> rhenium 186	75	O <sub>s</sub> osmium 190	76	I <sub>r</sub> iridium 192	77	P <sub>t</sub> platinum 195	78	A <sub>u</sub> gold 197	79	H <sub>g</sub> mercury 201	80	T <sub>l</sub> thallium 204	81	P <sub>b</sub> lead 207	82	B <sub>i</sub> bismuth 209	83	P <sub>o</sub> polonium —	84	A <sub>t</sub> astatine —	85	Rn radon —
87	F <sub>r</sub>	88	R <sub>a</sub> radium —	89–103	R <sub>f</sub> actinoids —	104	D <sub>b</sub> dubnium —	105	S <sub>g</sub> seaborgium —	106	B <sub>h</sub> bohrium —	107	H <sub>s</sub> hassium —	108	M <sub>t</sub> meitnerium —	109	D <sub>s</sub> darmstadtium —	110	M <sub>l</sub> meitnerium —	111	R <sub>g</sub> roentgenium —	112	C <sub>n</sub> copernicium —	114	F <sub>l</sub> flerovium —	116	L <sub>v</sub> livemorium —						

16

57	La lanthanum 139	58	C <sub>e</sub> cerium 140	59	Pr praseodymium 141	60	Nd neodymium 144	61	P <sub>m</sub> promethium —	62	S <sub>m</sub> samarium 150	63	E <sub>u</sub> europium 152	64	G <sub>d</sub> gadolinium 157	65	T <sub>b</sub> terbium 159	66	D <sub>y</sub> dysprosium 163	67	H <sub>o</sub> holmium 165	68	E <sub>r</sub> erbium 167	69	T <sub>m</sub> thulium 169	70	Y <sub>b</sub> ytterbium 173	71	L <sub>u</sub> lutetium 175
89	Ac actinium —	90	Th thorium 232	91	P <sub>a</sub> protactinium 231	92	U uranium 238	93	N <sub>p</sub> neptunium —	94	A <sub>m</sub> americium —	95	C <sub>m</sub> curium —	96	B <sub>k</sub> berkelium —	97	C <sub>f</sub> californium —	98	E <sub>s</sub> einsteinium —	99	F <sub>m</sub> fermium —	100	M <sub>d</sub> mendelevium —	101	No nobelium —	102	L <sub>r</sub> lawrencium —	103	—

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



# **Cambridge IGCSE™**

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**CHEMISTRY**

**0620/21**

Paper 2 Multiple Choice (Extended)

**October/November 2020**

**MARK SCHEME**

Maximum Mark: 40

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**Published**

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This document consists of **3** printed pages.

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
1	D	1
2	B	1
3	D	1
4	A	1
5	D	1
6	C	1
7	A	1
8	B	1
9	C	1
10	D	1
11	C	1
12	C	1
13	C	1
14	D	1
15	A	1
16	D	1
17	B	1
18	A	1
19	C	1
20	B	1
21	B	1
22	D	1
23	A	1
24	C	1
25	C	1
26	C	1
27	A	1
28	D	1

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
29	D	1
30	A	1
31	C	1
32	C	1
33	B	1
34	B	1
35	C	1
36	A	1
37	C	1
38	B	1
39	C	1
40	D	1



# **Cambridge IGCSE™**

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NAME

CENTRE  
NUMBER

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CANDIDATE  
NUMBER

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\* 8 5 7 1 2 0 5 3 5 4 \*

## **CHEMISTRY**

**0620/63**

Paper 6 Alternative to Practical

**May/June 2020**

**1 hour**

You must answer on the question paper.

No additional materials are needed.

---

### **INSTRUCTIONS**

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

---

### **INFORMATION**

- The total mark for this paper is 40.
- The number of marks for each question or part question is shown in brackets [ ].

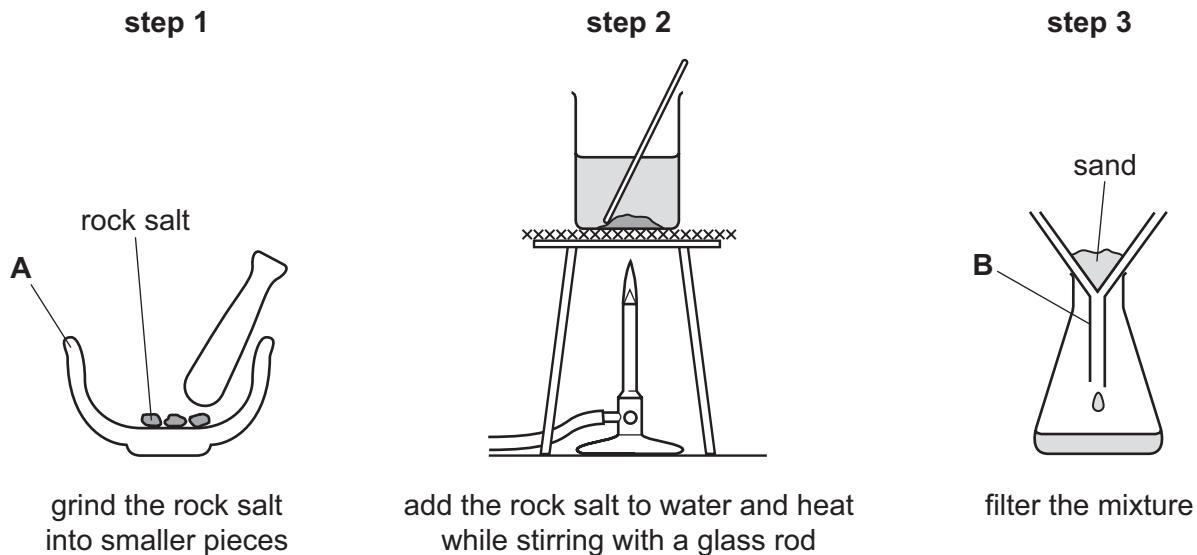
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This document has **12** pages. Blank pages are indicated.

- 1 A sample of rock salt contains sodium chloride and sand.

Sodium chloride is soluble in water. Sand is insoluble in water.

A student obtained dry crystals of pure sodium chloride from a lump of rock salt. These are some of the steps the student used.



- (a) Name the apparatus labelled **A** in **step 1**.

..... [1]

- (b) Explain why the mixture is heated and stirred in **step 2**.

..... [1]

- (c) (i) Name the apparatus labelled **B** in **step 3**.

..... [1]

- (ii) State the scientific term for the sand left on the filter paper in **step 3**.

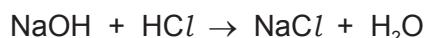
..... [1]

- (d) Describe what the student must do after **step 3** to obtain dry crystals of pure sodium chloride.

.....  
.....  
.....  
..... [3]

[Total: 7]

- 2 A student investigated the temperature change when aqueous sodium hydroxide neutralises dilute hydrochloric acid. The equation for the reaction is shown.



Eight experiments were done.

*Experiment 1*

- A polystyrene cup was placed into a  $250\text{ cm}^3$  beaker for support.
- Using a measuring cylinder,  $5\text{ cm}^3$  of aqueous sodium hydroxide was poured into the polystyrene cup.
- Using a measuring cylinder,  $45\text{ cm}^3$  of dilute hydrochloric acid was poured into the polystyrene cup.
- The mixture was stirred and the maximum temperature reached was measured using a thermometer.
- The polystyrene cup was rinsed with distilled water.

*Experiment 2*

- Experiment 1 was repeated using  $10\text{ cm}^3$  of aqueous sodium hydroxide and  $40\text{ cm}^3$  of dilute hydrochloric acid.

*Experiment 3*

- Experiment 1 was repeated using  $15\text{ cm}^3$  of aqueous sodium hydroxide and  $35\text{ cm}^3$  of dilute hydrochloric acid.

*Experiment 4*

- Experiment 1 was repeated using  $20\text{ cm}^3$  of aqueous sodium hydroxide and  $30\text{ cm}^3$  of dilute hydrochloric acid.

*Experiment 5*

- Experiment 1 was repeated using  $30\text{ cm}^3$  of aqueous sodium hydroxide and  $20\text{ cm}^3$  of dilute hydrochloric acid.

*Experiment 6*

- Experiment 1 was repeated using  $35\text{ cm}^3$  of aqueous sodium hydroxide and  $15\text{ cm}^3$  of dilute hydrochloric acid.

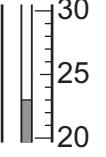
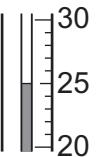
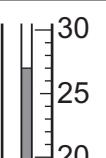
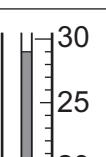
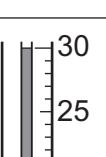
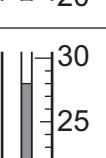
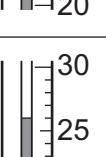
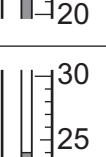
*Experiment 7*

- Experiment 1 was repeated using  $40\text{ cm}^3$  of aqueous sodium hydroxide and  $10\text{ cm}^3$  of dilute hydrochloric acid.

*Experiment 8*

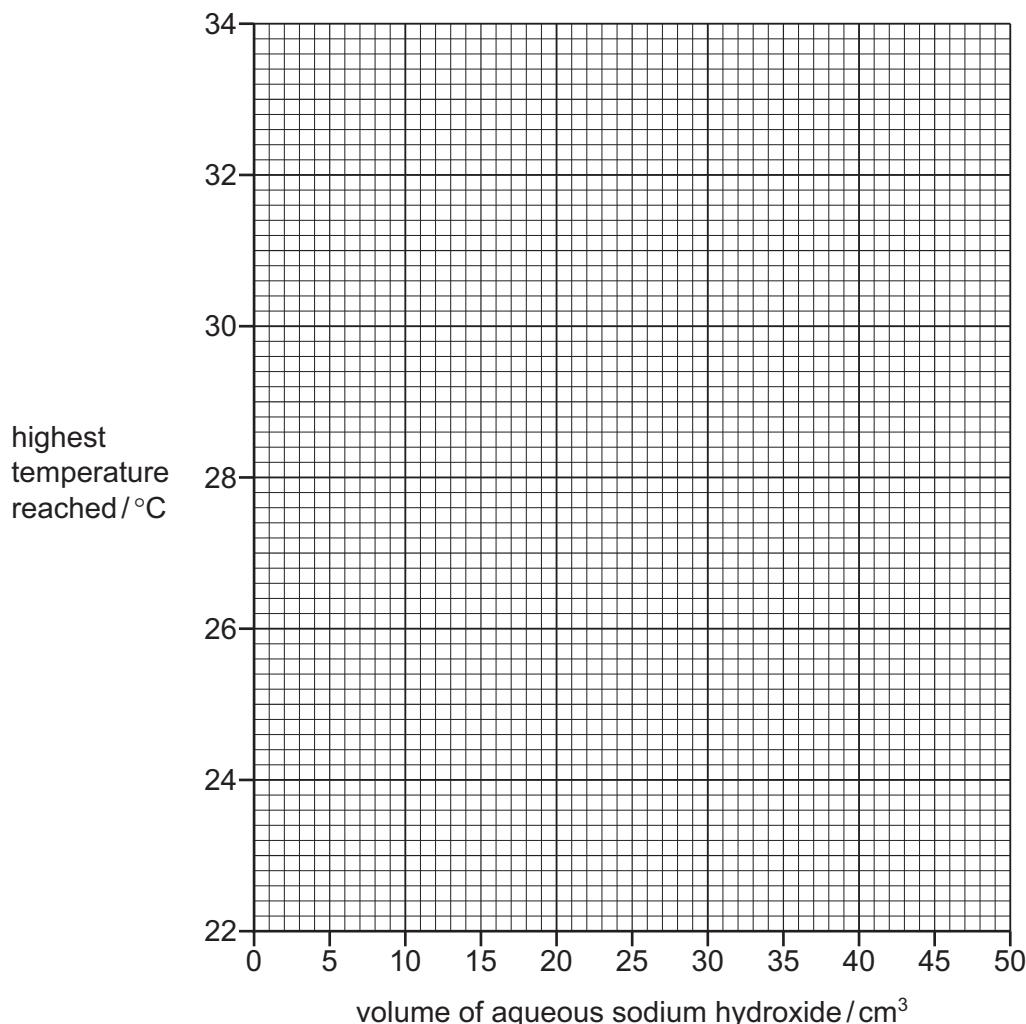
- Experiment 1 was repeated using  $45\text{ cm}^3$  of aqueous sodium hydroxide and  $5\text{ cm}^3$  of dilute hydrochloric acid.

- (a) Use the information in the description of the experiments and the thermometer diagrams to complete the table.

experiment	volume of aqueous sodium hydroxide/cm <sup>3</sup>	volume of dilute hydrochloric acid /cm <sup>3</sup>	thermometer diagram	highest temperature reached/°C
1	5			
2	10			
3	15			
4	20			
5	30			
6	35			
7	40			
8	45			

[4]

- (b) Plot the results from Experiments 1 to 8 on the grid. Draw **two** straight lines through the points. Extend your straight lines so that they cross.



[4]

- (c) The point on the graph where the two straight lines cross is where all of the aqueous sodium hydroxide reacts with all of the dilute hydrochloric acid to form a neutral solution.

- (i) **Use your graph** to deduce the volume of aqueous sodium hydroxide and the volume of dilute hydrochloric acid that react together to produce a neutral solution.  
Show your working **on the grid**.

$$\text{volume of aqueous sodium hydroxide} = \dots \text{cm}^3$$

$$\text{volume of dilute hydrochloric acid} = \dots \text{cm}^3$$

[3]

- (ii) **Use your graph** to determine the highest temperature reached if the volumes in (c)(i) were mixed together.

$$\text{highest temperature reached} = \dots [2]$$

- (iii) Which solution, aqueous sodium hydroxide or dilute hydrochloric acid, was the most concentrated?  
Use your answer to (c)(i) to explain why.

most concentrated solution .....

explanation .....

.....  
[1]

- (d) **On the graph**, sketch the lines you would expect to obtain if a copper can was used instead of a polystyrene cup. [2]

- (e) Give **one** advantage and **one** disadvantage of using a burette, instead of a measuring cylinder, to add the dilute hydrochloric acid directly into the polystyrene cup.

advantage .....

.....  
disadvantage .....

.....  
[2]

- (f) How could the reliability of the results of this investigation be checked?

.....  
.....  
[1]

[Total: 19]

- 3 Two solids, solid N and solid P, were analysed.  
Tests were done on each solid.

**tests on solid N**

Tests were done and the following observations made.

tests on solid N	observations
<p>Solid N was dissolved in distilled water to produce solution N. The solution was divided into three equal portions in three boiling tubes.</p> <p><b>test 1</b></p> <p>Aqueous sodium hydroxide was added slowly until in excess to the first portion of solution N.</p>	white precipitate formed, the precipitate dissolved in excess aqueous sodium hydroxide forming a colourless solution
<p><b>test 2</b></p> <p>Aqueous ammonia was added slowly until in excess to the second portion of solution N.</p>	white precipitate formed, the precipitate dissolved in excess aqueous ammonia forming a colourless solution
<p><b>test 3</b></p> <p>Aluminium foil and aqueous sodium hydroxide were added to the third portion of solution N. The mixture was heated using a Bunsen burner. Any gas produced was tested with damp red litmus paper.</p>	effervescence was seen, the damp red litmus paper turned blue

- (a) Name the gas given off in **test 3**.

..... [1]

- (b) Identify solid N.

..... [2]

**tests on solid P**

Solid P was potassium iodide.

Complete the expected observations.

- (c) Describe the appearance of solid P.

..... [1]

- (d) A flame test was done on solid P.

observations ..... [1]

- (e) Solid P was dissolved in distilled water to produce solution P. Solution P was divided into three equal portions in three test-tubes.

- (i) About 1 cm depth of dilute nitric acid and a few drops of aqueous silver nitrate were added to the first portion of solution P.

observations ..... [1]

- (ii) About 1 cm depth of dilute nitric acid and a few drops of aqueous barium nitrate were added to the second portion of solution P.

observations ..... [1]

- (iii) A few drops of aqueous bromine were added to the third portion of solution P.

observations ..... [1]

[Total: 8]

- 4 Stayclean and Brightwhite are two brands of washing powder. Both contain sodium carbonate. Sodium carbonate is soluble in water and reacts with dilute sulfuric acid to produce carbon dioxide gas.

Plan an investigation to determine which of the two washing powders, Stayclean or Brightwhite, contains the greatest percentage of sodium carbonate.

You are provided with samples of the two washing powders and common laboratory apparatus and chemicals.

[6]





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# **Cambridge IGCSE™**

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**CHEMISTRY**

**0620/63**

Paper 6 Alternative to Practical

**May/June 2020**

**MARK SCHEME**

Maximum Mark: 40

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**Published**

Students did not sit exam papers in the June 2020 series due to the Covid-19 global pandemic.

This mark scheme is published to support teachers and students and should be read together with the question paper. It shows the requirements of the exam. The answer column of the mark scheme shows the proposed basis on which Examiners would award marks for this exam. Where appropriate, this column also provides the most likely acceptable alternative responses expected from students. Examiners usually review the mark scheme after they have seen student responses and update the mark scheme if appropriate. In the June series, Examiners were unable to consider the acceptability of alternative responses, as there were no student responses to consider.

Mark schemes should usually be read together with the Principal Examiner Report for Teachers. However, because students did not sit exam papers, there is no Principal Examiner Report for Teachers for the June 2020 series.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the June 2020 series for most Cambridge IGCSE™ and Cambridge International A & AS Level components, and some Cambridge O Level components.

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This document consists of **8** printed pages.

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

**GENERIC MARKING PRINCIPLE 1:**

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

**GENERIC MARKING PRINCIPLE 2:**

Marks awarded are always **whole marks** (not half marks, or other fractions).

**GENERIC MARKING PRINCIPLE 3:**

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

**GENERIC MARKING PRINCIPLE 4:**

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

**GENERIC MARKING PRINCIPLE 5:**

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

**GENERIC MARKING PRINCIPLE 6:**

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

**Science-Specific Marking Principles**

- 1 Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.
- 2 The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.
- 3 Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).
- 4 The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.

**5 'List rule' guidance (see examples below)**

For questions that require ***n*** responses (e.g. State **two** reasons ...):

- The response should be read as continuous prose, even when numbered answer spaces are provided
- Any response marked *ignore* in the mark scheme should not count towards ***n***
- Incorrect responses should not be awarded credit but will still count towards ***n***
- Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should **not** be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response
- Non-contradictory responses after the first ***n*** responses may be ignored even if they include incorrect science.

**6 Calculation specific guidance**

Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'.

For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values.

For answers given in standard form, (e.g.  $a \times 10^n$ ) in which the convention of restricting the value of the coefficient (*a*) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme.

Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.

**7 Guidance for chemical equations**

Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.

State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

Question	Answer	Marks
1(a)	mortar	1
1(b)	(to) speed up (the dissolving)	1
1(c)(i)	funnel	1
1(c)(ii)	residue	1
1(d)	place in an evaporating basin and heat	1
	to the point of crystallisation	1
	cool <b>and</b> filter <b>and</b> dry crystals with filter / absorbent paper	1

Question	Answer	Marks
2(a)	all volumes of dilute hydrochloric acid completed correctly (45, 40, 35, 30, 20, 15, 10, 5).	2
	all eight temperatures completed correctly (23, 25, 27, 29, 30, 28, 26, 24)	2
2(b)	all eight points plotted correctly	2
	two suitable straight lines drawn	1
	<u>straight</u> lines extended so that they cross	1
2(c)(i)	working shown on graph from where lines cross	1
	volume of aqueous sodium hydroxide correct for their graph	1
	volume of dilute hydrochloric acid correct based on their recorded volume of sodium hydroxide	1

Question	Answer	Marks
2(c)(ii)	correct value based on graph drawn °C	1 1
2(c)(iii)	dilute hydrochloric acid <b>and</b> as volume less than sodium hydroxide	1
2(d)	lines under plotted line maximum temperature at same volume as plotted line	1 1
2(e)(i)	advantage: more accurate disadvantage: slower	1 1
2(f)	repeat and compare	2

Question	Answer	Marks
3	<b>Tests on solid N</b>	
3(a)	ammonia	1
3(b)	zinc / $Zn^{2+}$ nitrate / $NO_3^-$	1 1
	<b>Tests on solid P</b>	
3(c)	white	1
3(d)	lilac	1
3(e)(i)	(pale) yellow precipitate	1

Question	Answer	Marks
3(e)(ii)	no change	1
3(e)(iii)	becomes brown / orange / yellow	1

Question	Answer	Marks
4	<p>any six from:</p> <p><b>gas volume method</b></p> <ul style="list-style-type: none"> <li>• weigh both washing powders or equal masses of both washing powders</li> <li>• place in suitable container (flask / boiling tube / test-tube)</li> <li>• add acid</li> <li>• to excess / until no more fizzing</li> <li>• collect gas</li> <li>• in gas syringe or by downward displacement in measuring cylinder</li> <li>• measure volume of gas</li> <li>• largest volume of gas has most sodium carbonate</li> </ul> <p><b>OR</b></p> <p><b>mass loss method</b></p> <ul style="list-style-type: none"> <li>• weigh both washing powders or equal masses of both washing powders</li> <li>• place in suitable container (flask / boiling tube / test-tube / beaker)</li> <li>• add acid</li> <li>• to excess / until no more fizzing</li> <li>• weigh mixture once acid added</li> <li>• weigh mixture at end</li> <li>• calculate mass drop</li> <li>• largest mass drop has most sodium carbonate</li> </ul>	6

Question	Answer	Marks
4	<p><b>OR</b></p> <p><b>titration method</b></p> <ul style="list-style-type: none"><li>• weigh both washing powders or equal masses of both washing powders</li><li>• place in suitable container (flask / beaker)</li><li>• dissolve in water</li><li>• add named indicator (not UI)</li><li>• add acid from burette</li><li>• stop when indicator changes colour</li><li>• record start and final reading on burette</li><li>• largest volume of acid used has most sodium carbonate</li></ul>	



# **Cambridge IGCSE™**

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CANDIDATE  
NUMBER

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## **CHEMISTRY**

**0620/62**

Paper 6 Alternative to Practical

**May/June 2020**

**1 hour**

You must answer on the question paper.

No additional materials are needed.

### **INSTRUCTIONS**

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

### **INFORMATION**

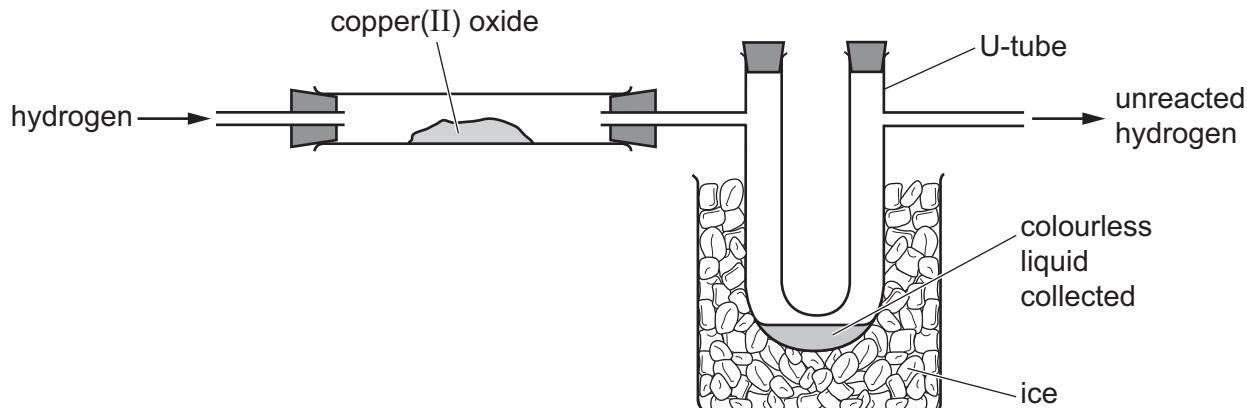
- The total mark for this paper is 40.
- The number of marks for each question or part question is shown in brackets [ ].

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- 1 Hot copper(II) oxide reacts with hydrogen. The products are copper and steam.

The apparatus used to react copper(II) oxide with hydrogen is shown.



(a) Draw an arrow on the diagram to show where the apparatus should be heated. [1]

(b) During the reaction the colour of the copper(II) oxide changes.

State the colour change.

from ..... to .....  
[1]

(c) Identify the colourless liquid collected.

..... [1]

(d) Explain why the U-tube is in ice.

.....  
..... [2]

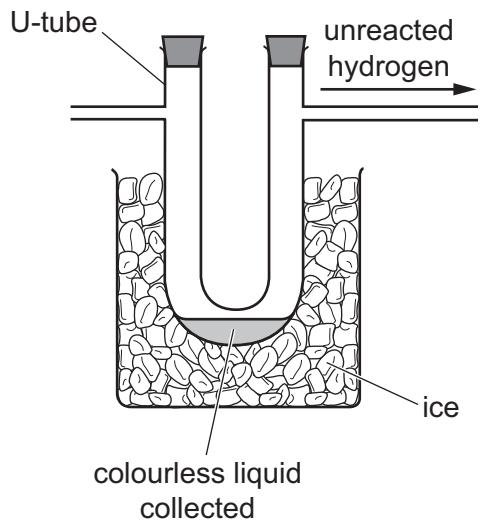
- (e) (i) Large amounts of unreacted hydrogen should **not** be allowed to escape into the laboratory.

State why.

..... [1]

- (ii) Complete the diagram to show how the unreacted hydrogen could be collected and its volume measured.

Label any apparatus that you draw.



[2]

[Total: 8]

- 2 A student investigated the temperature change when magnesium ribbon reacts with dilute sulfuric acid.

Five experiments were done.

*Experiment 1*

- Using a measuring cylinder,  $20\text{ cm}^3$  of dilute sulfuric acid were poured into a boiling tube.
- A thermometer was used to measure the initial temperature of the acid.
- A 1 cm length of magnesium ribbon was added to the acid in the boiling tube.
- The acid and magnesium ribbon in the boiling tube were stirred continuously using a thermometer.
- The highest temperature reached by the mixture was measured.
- The boiling tube was rinsed out with distilled water.

*Experiment 2*

- Experiment 1 was repeated using a 2 cm length of magnesium ribbon instead of the 1 cm length.

*Experiment 3*

- Experiment 1 was repeated using a 3 cm length of magnesium ribbon instead of the 1 cm length.

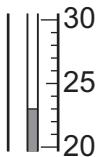
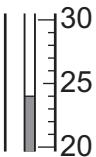
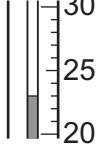
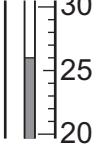
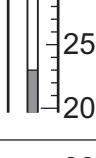
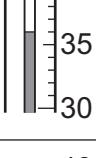
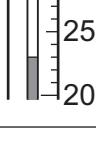
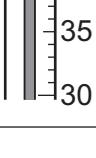
*Experiment 4*

- Experiment 1 was repeated using a 5 cm length of magnesium ribbon instead of the 1 cm length.

*Experiment 5*

- Experiment 1 was repeated using a 6 cm length of magnesium ribbon instead of the 1 cm length.

- (a) Use the information in the description of the experiments and the thermometer diagrams to complete the table.

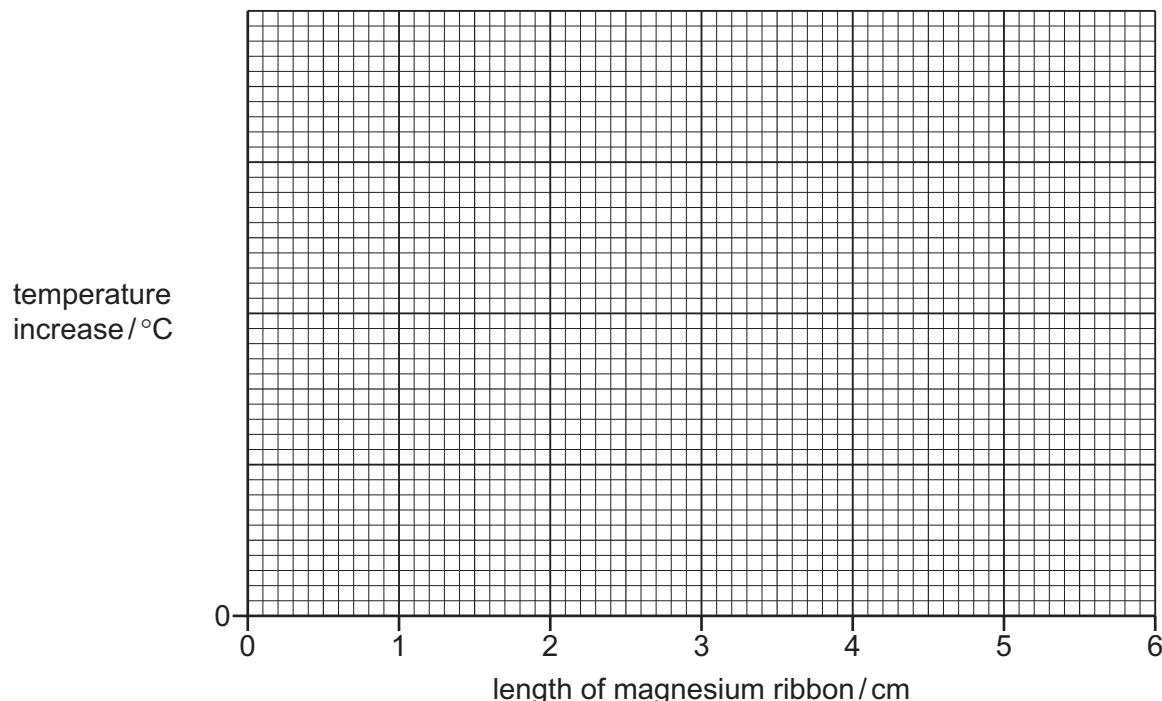
experiment	length of magnesium ribbon/cm	initial temperature		highest temperature		temperature increase /°C
		thermometer diagram	initial temperature of acid/°C	thermometer diagram	highest temperature of acid/°C	
1						
2						
3						
4						
5						

[4]

- (b) In which experiment, 1, 2, 3, 4 or 5, was the temperature increase the largest?

..... [1]

- (c) Add a suitable scale to the y-axis and plot the results from Experiments 1 to 5 on the grid. Draw a smooth line graph, making sure that your line passes through (0,0).



[5]

- (d) Explain why the graph line must pass through (0,0).
- .....

[1]

- (e) From your graph, deduce the temperature increase if Experiment 1 is repeated using a 4 cm length of magnesium ribbon.

Show clearly on the grid how you worked out your answer.

.....

[3]

- (f) (i) Why would carrying out the experiment in a polystyrene cup rather than a boiling tube improve the accuracy of the results?
- .....

[1]

- (ii) Sketch on the grid the graph you would expect if the experiment was repeated using a polystyrene cup instead of a boiling tube. [1]

(g) The volume of dilute sulfuric acid could be measured with a  $20\text{ cm}^3$  pipette.

(i) State **one** advantage of using a pipette rather than a measuring cylinder.

..... [1]

(ii) State **one** disadvantage of using a pipette rather than a measuring cylinder.

..... [1]

[Total: 18]

- 3 Two solids, solid L and solid M, were analysed. Solid L was chromium(III) chloride. Tests were done on each solid.

**tests on solid L**

Complete the expected observations.

Solid L was dissolved in distilled water to produce solution L. Solution L was divided into four portions in three test-tubes and a boiling tube.

- (a) To the first portion of solution L in the boiling tube, about 1 cm depth of dilute hydrochloric acid was added. The boiling tube was warmed gently.

A strip of filter paper was dipped in acidified potassium manganate(VII) solution and held at the mouth of the boiling tube.

observations ..... [1]

- (b) To the second portion of solution L aqueous sodium hydroxide was added slowly until it was in excess and no further changes were seen.

observations .....  
.....  
..... [2]

- (c) To the third portion of solution L aqueous ammonia was added slowly until it was in excess and no further changes were seen.

observations .....  
.....  
..... [2]

- (d) To the fourth portion of solution L about 1 cm depth of dilute nitric acid was added followed by about 1 cm depth of aqueous silver nitrate.

observations .....  
..... [1]

**tests on solid M**

Tests were done and the following observations made.

tests on solid M	observations
<b>test 1</b>  Flame test	yellow flame seen
<b>test 2</b>  About 10 cm <sup>3</sup> of dilute nitric acid was added to solid M. Any gas produced was tested.	effervescence  limewater turned milky
<b>test 3</b>  About 1 cm depth of aqueous barium nitrate was added to the solution formed by adding dilute nitric acid to solid M in <b>test 2</b> .	no change

(e) Identify solid M.

..... [2]

[Total: 8]

- 4 Many window-cleaning products contain aqueous ammonia. Aqueous ammonia is an alkali that reacts with dilute acids.

Plan an investigation to find which of two window-cleaning products contains the most concentrated aqueous ammonia. Include in your plan:

- the method you will use
  - how your results will be used to determine which window-cleaning product contains the most concentrated aqueous ammonia.

You are provided with an aqueous solution of the two window-cleaning products, dilute hydrochloric acid of known concentration and common laboratory apparatus.

[6]

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# **Cambridge IGCSE™**

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**CHEMISTRY**

**0620/62**

Paper 6 Alternative to Practical

**May/June 2020**

**MARK SCHEME**

Maximum Mark: 40

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**Published**

Students did not sit exam papers in the June 2020 series due to the Covid-19 global pandemic.

This mark scheme is published to support teachers and students and should be read together with the question paper. It shows the requirements of the exam. The answer column of the mark scheme shows the proposed basis on which Examiners would award marks for this exam. Where appropriate, this column also provides the most likely acceptable alternative responses expected from students. Examiners usually review the mark scheme after they have seen student responses and update the mark scheme if appropriate. In the June series, Examiners were unable to consider the acceptability of alternative responses, as there were no student responses to consider.

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Cambridge International is publishing the mark schemes for the June 2020 series for most Cambridge IGCSE™ and Cambridge International A & AS Level components, and some Cambridge O Level components.

---

This document consists of 7 printed pages.

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

**GENERIC MARKING PRINCIPLE 1:**

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

**GENERIC MARKING PRINCIPLE 2:**

Marks awarded are always **whole marks** (not half marks, or other fractions).

**GENERIC MARKING PRINCIPLE 3:**

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

**GENERIC MARKING PRINCIPLE 4:**

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

**GENERIC MARKING PRINCIPLE 5:**

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

**GENERIC MARKING PRINCIPLE 6:**

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

**Science-Specific Marking Principles**

- 1 Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.
- 2 The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.
- 3 Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).
- 4 The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.

**5 'List rule' guidance (see examples below)**

For questions that require ***n*** responses (e.g. State **two** reasons ...):

- The response should be read as continuous prose, even when numbered answer spaces are provided
- Any response marked *ignore* in the mark scheme should not count towards ***n***
- Incorrect responses should not be awarded credit but will still count towards ***n***
- Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should **not** be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response
- Non-contradictory responses after the first ***n*** responses may be ignored even if they include incorrect science.

**6 Calculation specific guidance**

Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'.

For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values.

For answers given in standard form, (e.g.  $a \times 10^n$ ) in which the convention of restricting the value of the coefficient (*a*) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme.

Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.

**7 Guidance for chemical equations**

Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.

State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
1(a)	arrow under copper(II) oxide pointing up to the copper(II) oxide	1
1(b)	start: black final: brown	1
1(c)	water	1
1(d)	to cool	1
	so that the steam / gas condenses / turns into a liquid	1
1(e)(i)	flammable / explosive	1
1(e)(ii)	method of collection shown would work	1
	collection apparatus is graduated	1

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
2(a)	lengths completed correctly (1, 2, 3, 5, 6)	1
	10 correct thermometer readings (23 × 5, 24, 26, 29, 36, 40)	2
	All temperature increases worked out correctly (1, 3, 6, 13, 17)	1
2(b)	5	1
2(c)	scale has one big square = 5	1
	all five points plotted correctly	2
	best fit line through points	1
	which passes within half a small square of (0, 0)	1
2(d)	there is no reaction (with no magnesium)	1

Question	Answer	Marks
2(e)	working shown on graph	1
	correct reading	1
	units of °C shown	1
2(f)(i)	(polystyrene is a better) insulator	1
2(f)(ii)	sketch line starts at same point as plotted line for 0 cm magnesium and then is above plotted line at all non-zero lengths of magnesium.	1
2(g)(i)	more accurate	1
2(g)(ii)	slower	1

Question	Answer	Marks
3	<b>Tests on solution L</b>	
3(a)	stays purple or no change	1
3(b)	green ppt	1
	(dissolves / soluble) producing a green solution	1
3(c)	grey-green precipitate	1
	remains in excess / does not dissolve	1
3(d)	white precipitate	1

Question	Answer	Marks
	<b>Tests on solid M</b>	
3(e)	sodium / $\text{Na}^+$	1
	carbonate / $\text{CO}_3^{2-}$	1

Question	Answer	Marks
4	<p>Any six from:</p> <ul style="list-style-type: none"> <li>• stated / equal volumes of each cleaner</li> <li>• measured with pipette / measuring cylinder / burette into a beaker or flask</li> <li>• named indicator added</li> <li>• add hydrochloric acid</li> <li>• from a burette</li> <li>• until indicator changes colour</li> <li>• record / calculate volume acid added</li> <li>• biggest volume of acid is most concentrated</li> </ul>	6



# Cambridge IGCSE™

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CANDIDATE  
NUMBER

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\* 9 1 0 1 2 1 5 0 2 8 \*

## CHEMISTRY

0620/61

Paper 6 Alternative to Practical

May/June 2020

1 hour

You must answer on the question paper.

No additional materials are needed.

### INSTRUCTIONS

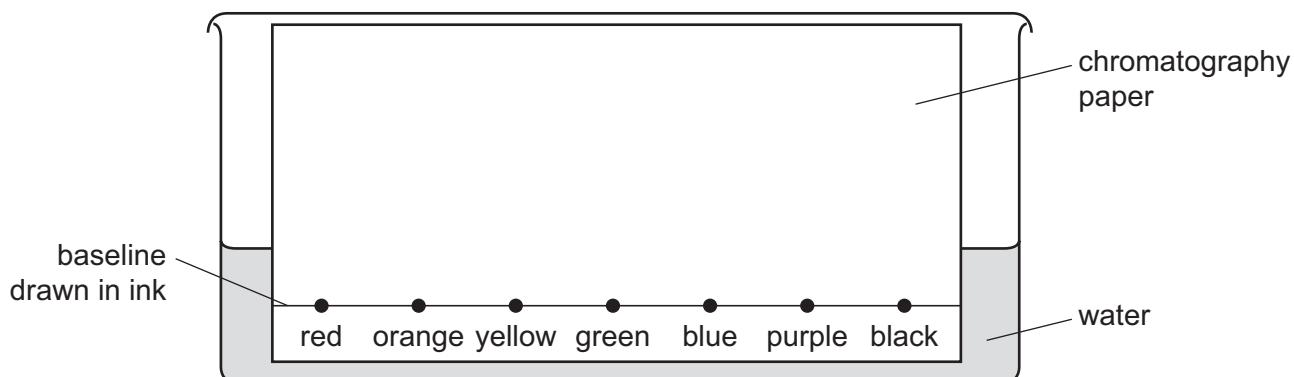
- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

### INFORMATION

- The total mark for this paper is 40.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **8** pages. Blank pages are indicated.

- 1 A student investigated the dyes contained in different coloured inks using chromatography. Water was the solvent. The diagram shows how the student set up the apparatus.



- (a) Identify **two** errors in the way the student set up the apparatus.

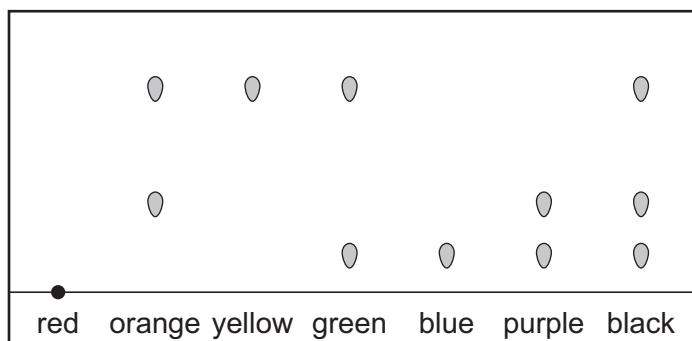
1 .....

2 .....

[2]

- (b) The student then carried out the chromatography correctly.

The diagram shows the results.



- (i) Which ink contains the greatest number of soluble dyes?

..... [1]

- (ii) Which **two** inks are made of a single soluble dye?

..... and .....

[1]

- (iii) From the chromatogram it is **not** possible to tell if the red ink contains different dyes.

Suggest how the experiment could be changed to find out if the red ink contains different dyes.

..... [1]

[Total: 5]

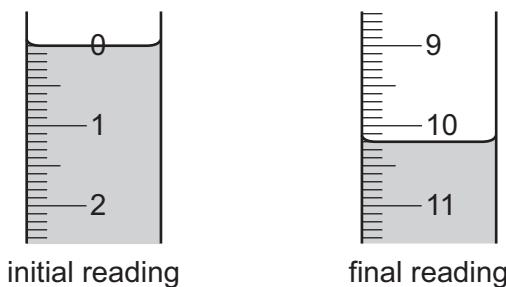
- 2 A student investigated the reaction between dilute hydrochloric acid and two different aqueous solutions of sodium carbonate, solution E and solution F.

Three experiments were done.

**(a) Experiment 1**

- A burette was filled up to the  $0.0\text{ cm}^3$  mark with dilute hydrochloric acid.
- Using a measuring cylinder,  $25\text{ cm}^3$  of solution E was poured into a conical flask.
- Five drops of thymolphthalein indicator were added to the conical flask.
- Dilute hydrochloric acid was slowly added from the burette to the conical flask, while the flask was swirled, until the solution just changed colour.

Use the burette diagrams to complete the table for Experiment 1.

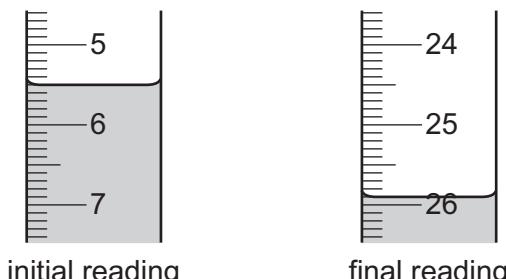


final burette reading / $\text{cm}^3$	
initial burette reading / $\text{cm}^3$	
volume of dilute hydrochloric acid added / $\text{cm}^3$	

**Experiment 2**

- The conical flask was emptied and rinsed with distilled water.
- The burette was refilled with dilute hydrochloric acid.
- Experiment 1 was repeated using five drops of methyl orange indicator instead of thymolphthalein indicator.

Use the burette diagrams to complete the table for Experiment 2.

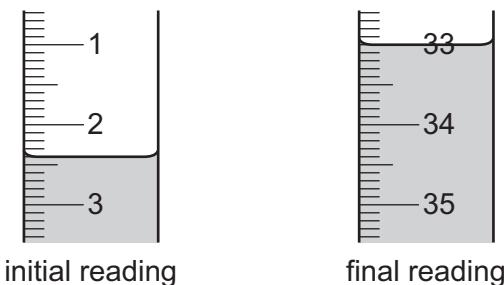


final burette reading / $\text{cm}^3$	
initial burette reading / $\text{cm}^3$	
volume of dilute hydrochloric acid added / $\text{cm}^3$	

**Experiment 3**

- The conical flask was emptied and rinsed with distilled water.
- The burette was refilled with dilute hydrochloric acid.
- Using a measuring cylinder, 25 cm<sup>3</sup> of solution F was poured into the conical flask.
- Five drops of methyl orange indicator were added to the conical flask.
- Dilute hydrochloric acid was slowly added from the burette to the conical flask, while the flask was swirled, until the solution just changed colour.

Use the burette diagrams to complete the table for Experiment 3.



final burette reading /cm <sup>3</sup>	
initial burette reading /cm <sup>3</sup>	
volume of dilute hydrochloric acid added/cm <sup>3</sup>	

[5]

- (b) What colour change was observed in the conical flask in Experiment 2?

from ..... to ..... [2]

- (c) Compare the volumes of dilute hydrochloric acid added in Experiment 2 and Experiment 3. Explain any difference.
- .....  
..... [2]

- (d) Determine the simplest whole number ratio of volumes of dilute hydrochloric acid used in Experiments 1 and 2.

ratio Experiment 1 : Experiment 2 = ..... [1]

- (e) What volume of dilute hydrochloric acid would be required if Experiment 3 was repeated using thymolphthalein indicator instead of methyl orange indicator?

volume = ..... [2]

(f) The conical flask was rinsed with distilled water between each experiment.

(i) Why was the conical flask rinsed?

..... [1]

(ii) Why does it **not** matter if a little distilled water is left in the flask after it has been rinsed?

..... [1]

(g) State **two** sources of error in the experiments. For each error suggest an improvement that would reduce the error.

source of error 1 .....

improvement 1 .....

.....

source of error 2 .....

improvement 2 .....

.....

[4]

[Total: 18]

- 3 Two solids, solid **G** and solid **H**, were analysed. Solid **G** was copper(II) carbonate. Tests were done on each solid.

**tests on solid G**

Complete the expected observations.

- (a) Solid **G** was placed in a boiling tube. An excess of dilute sulfuric acid was added to the boiling tube. Any gas produced was tested.

observations .....

.....

..... [3]

- (b) Identify the gas produced in (a).

..... [1]

- (c) Aqueous ammonia was added slowly until in excess to the solution produced in (a).

observations .....

.....

.....

..... [3]

**tests on solid H**

Tests were done and the following observations were made.

tests on solid H	observations
<b>test 1</b>  Flame test	yellow flame
<b>test 2</b>  Some of solid H was placed in a boiling tube. The boiling tube was heated strongly.	condensation appeared near the mouth of the boiling tube
Solid H was dissolved in distilled water. The solution was divided into two equal portions.  <b>test 3</b>  About 1 cm <sup>3</sup> of dilute nitric acid followed by a few drops of aqueous silver nitrate were added to the first portion of the solution.	the solution remained colourless
<b>test 4</b>  About 1 cm <sup>3</sup> of dilute nitric acid followed by a few drops of aqueous barium nitrate were added to the second portion of the solution.	white precipitate

(d) What conclusion can be made from the result of **test 3**?

.....  
..... [1]

(e) What conclusions can be made about solid H from the results of **test 1**, **test 2** and **test 4**?

.....  
.....  
..... [3]

[Total: 11]

- 4 Cobalt, manganese and nickel are metals. They react with dilute hydrochloric acid to form hydrogen gas.

Plan an investigation to find the order of reactivity of these three metals.

You are provided with:

- samples of each metal
  - dilute hydrochloric acid
  - common laboratory apparatus.

Your plan must make it clear how your investigation will be a fair test and how you will use your results to place the metals in order of reactivity.

[6]

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**CHEMISTRY**

**0620/61**

Paper 6 Alternative to Practical

**May/June 2020**

**MARK SCHEME**

Maximum Mark: 40

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**5 'List rule' guidance (see examples below)**

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For answers given in standard form, (e.g.  $a \times 10^n$ ) in which the convention of restricting the value of the coefficient (*a*) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme.

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**7 Guidance for chemical equations**

Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.

State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

Question	Answer	Marks
1(a)	spots / baseline below solvent level	1
	baseline drawn in ink	1
1(b)(i)	black	1
1(b)(ii)	yellow (and) blue	1
1(b)(iii)	use an organic solvent / different solvent	1

Question	Answer	Marks
2(a)	all six burette readings correct <ul style="list-style-type: none"> <li>• 10.2 / 0.0</li> <li>• 25.9 / 5.5</li> <li>• 33.0 / 2.4</li> </ul>	2
	all readings to 1 dp	1
	initial and final readings the correct way round	1
	all subtractions correct to calculate volume added <ul style="list-style-type: none"> <li>• 10.2</li> <li>• 20.4</li> <li>• 30.6</li> </ul>	1
2(b)	(from) yellow	1
	(to) red / pink / orange	1
2(c)	solution F more concentrated (than solution E)	1
	1.5 times	1
2(d)	1:2	1

Question	Answer	Marks
2(e)	15.3	1
	cm <sup>3</sup>	1
2(f)(i)	clean / remove residues from previous experiment	1
2(f)(ii)	does not change amount of E / F or volumes / amounts already measured	1
2(g)	errors any <b>two</b> from: <ul style="list-style-type: none"><li>• using measuring cylinder</li><li>• missing endpoint / misjudging colour change</li><li>• not repeating</li></ul> improvements any <b>two</b> from: <ul style="list-style-type: none"><li>• use pipette (in place of measuring cylinder)</li><li>• add more slowly</li><li>• repeat (and find mean)</li></ul>	4

Question	Answer	Marks
3	<b>Tests on solid G</b>	
3(a)	any <b>three</b> from: <ul style="list-style-type: none"><li>• bubble / fizz / effervescence</li><li>• blue solution formed</li><li>• (gas made turns) limewater</li><li>• milky</li></ul>	3
3(b)	• carbon dioxide / CO <sub>2</sub>	1

Question	Answer	Marks
3(c)	blue	1
	precipitate	1
	dark(er) / royal blue and dissolves / solution	1
3(d)	not a halide	1
	<b>tests on solid H</b>	
3(e)	hydrated	1
	sodium / $\text{Na}^+$ sulfate / $\text{SO}_4^{2-}$	1
	sodium sulfate = 2 $\text{Na}_2\text{SO}_4 = 2$	

Question	Answer	Marks
4	<p>add metals to <math>\text{HCl}</math> in a beaker / flask / test-tube</p> <p><b>fair test – max 4</b></p> <ul style="list-style-type: none"> <li>• same volume <math>\text{HCl}</math></li> <li>• some concentration <math>\text{HCl}</math></li> <li>• same temperature acid</li> <li>• same mass / moles / amount metals</li> <li>• same surface area / form of metal</li> </ul> <p><b>measure</b></p> <ul style="list-style-type: none"> <li>• start timing when solid added</li> <li>• stop timing when all solid gone / reaction to stop</li> </ul>	6

Question	Answer	Marks
4	<p><b>OR</b></p> <ul style="list-style-type: none"><li>• start timing when solid added</li><li>• stop timing when collected set volume of gas</li></ul> <p><b>OR</b></p> <ul style="list-style-type: none"><li>• start timing when solid added</li><li>• measure volume of gas after a set time</li></ul> <p><b>OR</b></p> <ul style="list-style-type: none"><li>• measure temperature at start</li><li>• measure temperature after reaction <b>OR</b> highest temperature reached</li></ul> <p><b>conclusion</b></p> <ul style="list-style-type: none"><li>• shortest time is most reactive</li></ul> <p><b>OR</b></p> <ul style="list-style-type: none"><li>• biggest volume of gas most reactive</li></ul> <p><b>OR</b></p> <ul style="list-style-type: none"><li>• biggest temperature change most reactive</li></ul>	



# Cambridge IGCSE™

CANDIDATE  
NAME

CENTRE  
NUMBER

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CANDIDATE  
NUMBER

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\* 6 5 9 1 5 8 4 3 1 4 \*

## CHEMISTRY

0620/43

Paper 4 Theory (Extended)

May/June 2020

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

### INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

### INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].
- The Periodic Table is printed in the question paper.

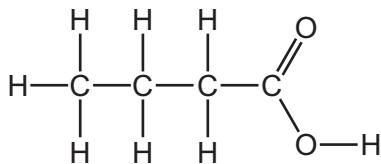
This document has **16** pages. Blank pages are indicated.

- 1 (a) The structures of five organic compounds, **A**, **B**, **C**, **D** and **E**, are shown.

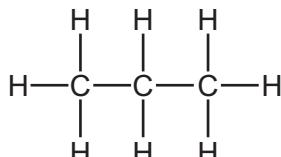
Answer the questions that follow.

Each letter may be used once, more than once or not at all.

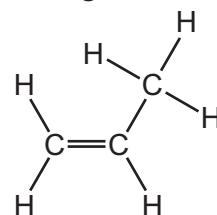
**A**



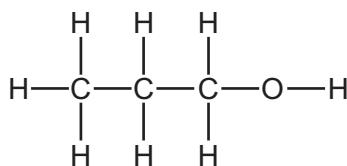
**B**



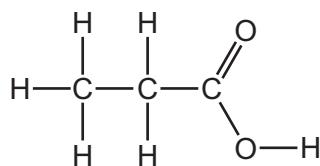
**C**



**D**



**E**



- (i) Give the letter of the compound that is propan-1-ol.

..... [1]

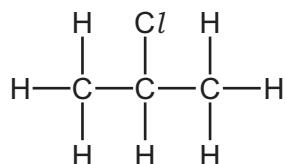
- (ii) Give the letter of the compound that has the empirical formula  $\text{CH}_2$ .

..... [1]

- (iii) Give the letter of **one** compound that reacts with bromine in an addition reaction.

..... [1]

- (iv) Give the letter of **one** compound that reacts with chlorine to form the compound shown.



..... [1]

- (v) Give the letters of **two** compounds that can react with each other to form an ester.

..... and ..... [1]

- (vi) Give the letter of the compound that is in the same homologous series as hex-1-ene.

..... [1]

- (vii) Give the letter of **one** compound that is an acid.

..... [1]

(viii) Draw a structural isomer of compound D.

Show all of the atoms and all of the bonds.

[1]

(b) Some acids are described as weak acids.

State the meaning of the term *weak acid*.

weak .....

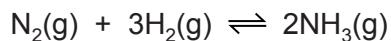
acid .....

[2]

[Total: 10]

2 Ammonia is manufactured by the Haber process.

(a) The equation for the reaction is shown.



(i) State what is meant by the symbol  $\rightleftharpoons$ .

..... [1]

(ii) State **one** source of hydrogen used in the manufacture of ammonia.

..... [1]

(b) The table shows some data for the production of ammonia.

pressure /atm	temperature /°C	percentage yield of ammonia
250	350	58
100	450	28
400	450	42
250	550	20

Deduce the effect on the percentage yield of ammonia of:

- increasing the pressure of the reaction

.....

- increasing the temperature of the reaction.

.....

[2]

(c) Explain, in terms of particles, what happens to the rate of this reaction when the temperature is increased.

.....

.....

.....

.....

.....

[3]

(d) Ammonia,  $\text{NH}_3$ , is used to produce nitric acid,  $\text{HNO}_3$ . This happens in a three-stage process.

**Stage 1** is a redox reaction.



- (i) Identify what is oxidised in **stage 1**.

Give a reason for your answer.

substance oxidised .....

reason .....

[2]

- (ii) In this reaction the predicted yield of NO is 512g. The actual yield is 384g.

Calculate the percentage yield of NO in this reaction.

percentage yield of NO = ..... [1]

- (iii) The equation for the reaction in **stage 2** is shown.



Which major environmental problem does  $\text{NO}_2$  cause if it is released into the atmosphere?

.....  
..... [1]

- (iv) The equation for the reaction in **stage 3** is shown.



Calculate the volume of  $\text{O}_2$  gas, at room temperature and pressure (r.t.p.), needed to produce 1260 g of  $\text{HNO}_3$ .

Use the following steps.

- Calculate the number of moles of  $\text{HNO}_3$ .

$$\text{moles of } \text{HNO}_3 = \dots$$

- Deduce the number of moles of  $\text{O}_2$  that reacted.

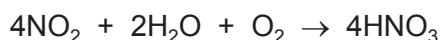
$$\text{moles of } \text{O}_2 = \dots$$

- Calculate the volume of  $\text{O}_2$  gas that reacts at room temperature and pressure (r.t.p.).

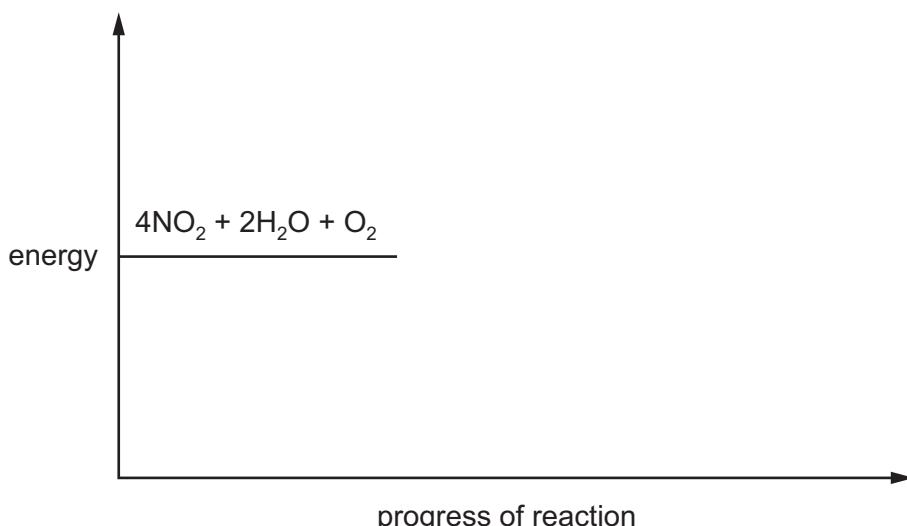
$$\text{volume of } \text{O}_2 \text{ gas} = \dots \text{ dm}^3$$

[4]

- (e) The reaction in **stage 3** is exothermic.



Complete the energy level diagram for this reaction. Include an arrow that clearly shows the energy change during the reaction.



[3]

[Total: 18]

3 Chlorine is in Group VII of the Periodic Table.

(a) Two isotopes of chlorine are chlorine-35 and chlorine-37.

(i) State why these two isotopes of chlorine have the same chemical properties.

.....  
.....  
.....

[2]

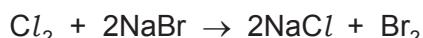
(ii) Complete the table to show the number of electrons, neutrons and protons in each atom and ion.

	number of electrons	number of neutrons	number of protons
$^{35}_{17}\text{Cl}$			
$^{37}_{17}\text{Cl}^-$			

[3]

(b) (i) Chlorine reacts with aqueous sodium bromide.

The equation for the reaction is shown.



State the type of reaction shown.

..... [1]

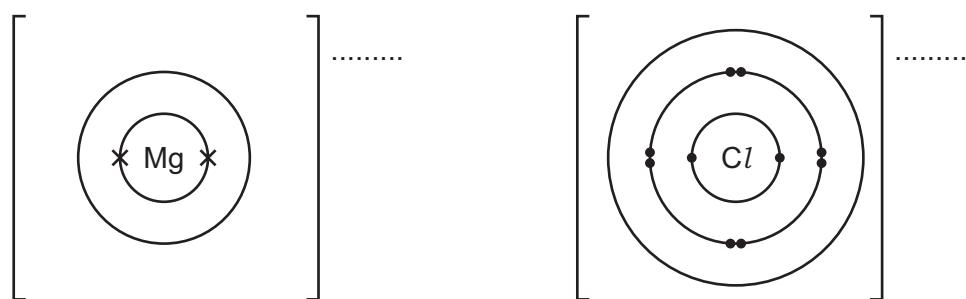
(ii) Why is there **no** reaction between iodine and aqueous sodium bromide?

..... [1]

(c) Magnesium reacts with chlorine to form magnesium chloride.

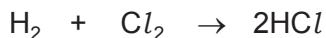
Complete the dot-and-cross diagram to show the electron arrangement of the ions in magnesium chloride. Give the charges on the ions.

The inner shells have been completed.



[3]

(d) Hydrogen and chlorine react to form hydrogen chloride gas, as shown in the equation.



This equation can be represented as shown.



Some bond energies are shown in the table.

bond	bond energy in kJ/mol
H–H	436
Cl–Cl	243
H–Cl	432

Calculate the energy change for the reaction between hydrogen and chlorine, using the following steps.

- Calculate the energy needed to break the bonds.

..... kJ

- Calculate the energy released when bonds are formed.

..... kJ

- Calculate the energy change for the reaction.

..... kJ/mol  
[3]

[Total: 13]

- 4 (a) Filtration and chlorination are two stages in water treatment.

State the purpose of each stage.

filtration .....

chlorination .....

[2]

- (b) A student uses anhydrous copper(II) sulfate to test for the presence of water.

- (i) What colour change is seen if water is present?

from ..... to ..... [2]

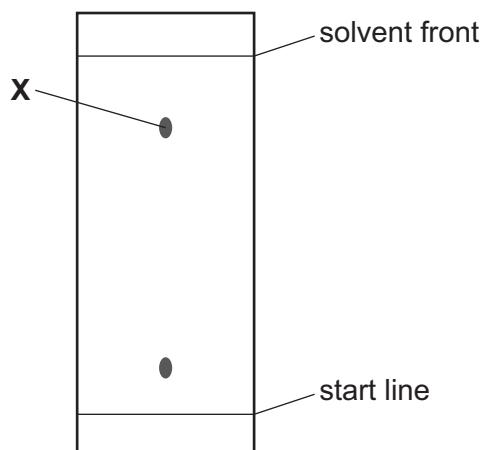
- (ii) The purity of a sample of water can be assessed by measuring its boiling point.

How is the boiling point of water affected by impurities?

..... [1]

- (c) Chromatography can be used to test the purity of substances.

The diagram shows the chromatogram of a coloured substance.



- (i) How does this chromatogram show that this substance is **not** pure?

..... [1]

- (ii) Draw a circle round the correct  $R_f$  value for the spot labelled X.

0.2                  0.4                  0.8                  1.2                  [1]

- (iii) State how a colourless substance can be made visible on a chromatogram.

..... [1]

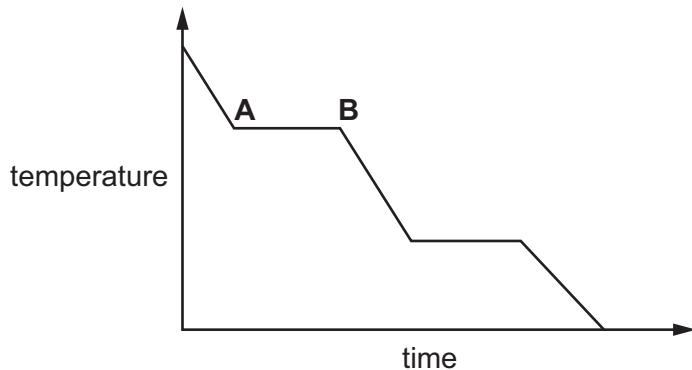
[Total: 8]

- 5 (a) Complete the table about solids, liquids and gases.

	particle separation	particle arrangement	type of motion
solid		regular	vibrate only
liquid	touching		random
gas	apart	random	

[3]

- (b) The graph shows the change in temperature as a sample of a gas is cooled.



Name the change of state taking place between **A** and **B**.

..... [1]

- (c) A bottle of liquid perfume is left open at the front of a room.

After some time, the perfume is smelt at the back of the room.

Name the **two** physical processes taking place.

1 .....

2 .....

[2]

[Total: 6]

6 (a) An endothermic reaction occurs when calcium nitrate is heated.

(i) Balance the equation for this reaction.



[1]

(ii) State the type of reaction shown by the equation.

..... [1]

(b) Describe the test for a nitrate ion.

test .....

.....

result .....

.....

[3]

[Total: 5]

7 Aluminium is extracted by electrolysis. Iron is extracted from its ore by reduction with carbon.

(a) What is meant by the term *electrolysis*?

..... [2]

(b) Name the main ore of aluminium.

..... [1]

(c) (i) Explain why aluminium **cannot** be extracted by reduction with carbon.

..... [1]

(ii) Describe the role of cryolite in the extraction of aluminium by electrolysis.

..... [1]

(iii) Name the product formed at the positive electrode.

..... [1]

(iv) Write the ionic half-equation for the reaction at the negative electrode.

..... [2]

(d) Aluminium is used in overhead electricity cables.

Give **two** properties of aluminium that make it suitable for use in overhead electricity cables.

1 .....

2 .....

[2]

(e) Iron is a transition element.

(i) Iron forms hydrated iron(III) oxide when it rusts.

Write a word equation to represent the formation of rust.

..... [2]

(ii) Give **two** ways in which the properties of transition elements differ from the properties of Group I metals.

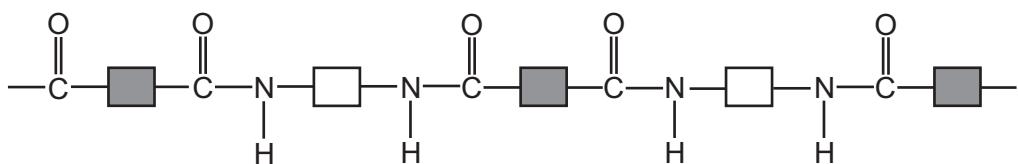
1 .....

2 .....

[2]

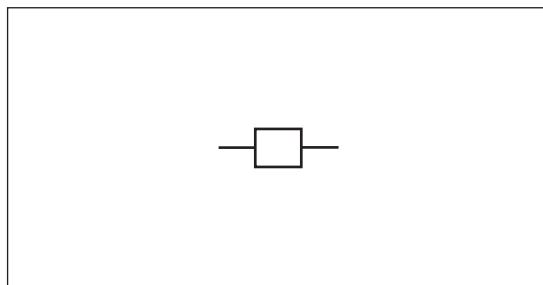
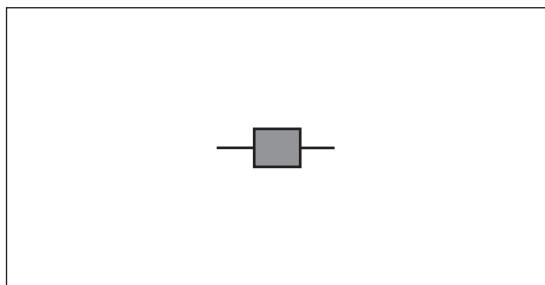
[Total: 14]

- 8 (a) Part of the synthetic polymer, nylon, is shown in the diagram.



(i) Circle **one** amide linkage **on the diagram**. [1]

(ii) Complete the structures of the **two** monomers that react to form nylon.



[2]

(iii) Name the other product formed when nylon is produced.

..... [1]

(b) Items made from nylon are often disposed of by burying them in the ground. This is called landfill.

Why is the disposal of nylon using landfill a problem?

.....  
..... [1]

(c) Give the name of a natural polymer.

..... [1]

[Total: 6]

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## The Periodic Table of Elements

I		II		Group																															
				I						II			III			IV		V		VI		VII		VIII											
3 <b>Li</b> lithium 7	4 <b>Be</b> beryllium 9	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>H</b> hydrogen 1	12 <b>Al</b> aluminum 27	13 <b>P</b> phosphorus 31	14 <b>S</b> sulfur 32	15 <b>Cl</b> chlorine 35.5	16 <b>Ar</b> argon 40	17 <b>K</b> potassium 39	18 <b>Ca</b> calcium 40	19 <b>Sc</b> scandium 45	20 <b>Ti</b> titanium 48	21 <b>V</b> vanadium 51	22 <b>Cr</b> chromium 52	23 <b>Mn</b> manganese 55	24 <b>Fe</b> iron 56	25 <b>Co</b> cobalt 59	26 <b>Ni</b> nickel 59	27 <b>Zn</b> zinc 65	28 <b>Ga</b> gallium 70	29 <b>Cu</b> copper 64	30 <b>Zn</b> zinc 65	31 <b>Ge</b> germanium 73	32 <b>As</b> arsenic 75	33 <b>Se</b> selenium 79	34 <b>Br</b> bromine 80	35 <b>Kr</b> krypton 84			
11 <b>Na</b> sodium 23	12 <b>Mg</b> magnesium 24	13 <b>Al</b> aluminum 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	18 <b>Ar</b> argon 40	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>Ge</b> germanium 73	32 <b>As</b> arsenic 75	33 <b>Se</b> selenium 79	34 <b>Br</b> bromine 80	35 <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> cesium 133	56 <b>Ba</b> barium 137	57–71 lanthanoids 137	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> damascusium –	111 <b>Rg</b> roentgenium –	112 <b>Cn</b> copernicium –	113 <b>Fm</b> ferrovium –	114 <b>Lv</b> livmorium –	115 <b>Md</b> mendelevium –	116 <b>Lv</b> livmorium –	117 <b>Lu</b> lutetium 175																			
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																					
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>Fm</b> fermium –	100 <b>Md</b> mendelevium –	101 <b>No</b> nobelium –	102 <b>Fr</b> lawrencium –	103 <b>Lu</b> lutetium –																					

16

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



# **Cambridge IGCSE™**

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**CHEMISTRY**

**0620/43**

Paper 4 Theory (Extended)

**May/June 2020**

**MARK SCHEME**

Maximum Mark: 80

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**Published**

Students did not sit exam papers in the June 2020 series due to the Covid-19 global pandemic.

This mark scheme is published to support teachers and students and should be read together with the question paper. It shows the requirements of the exam. The answer column of the mark scheme shows the proposed basis on which Examiners would award marks for this exam. Where appropriate, this column also provides the most likely acceptable alternative responses expected from students. Examiners usually review the mark scheme after they have seen student responses and update the mark scheme if appropriate. In the June series, Examiners were unable to consider the acceptability of alternative responses, as there were no student responses to consider.

Mark schemes should usually be read together with the Principal Examiner Report for Teachers. However, because students did not sit exam papers, there is no Principal Examiner Report for Teachers for the June 2020 series.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the June 2020 series for most Cambridge IGCSE™ and Cambridge International A & AS Level components, and some Cambridge O Level components.

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This document consists of **10** printed pages.

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

**GENERIC MARKING PRINCIPLE 1:**

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

**GENERIC MARKING PRINCIPLE 2:**

Marks awarded are always **whole marks** (not half marks, or other fractions).

**GENERIC MARKING PRINCIPLE 3:**

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

**GENERIC MARKING PRINCIPLE 4:**

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

**GENERIC MARKING PRINCIPLE 5:**

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

**GENERIC MARKING PRINCIPLE 6:**

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

**Science-Specific Marking Principles**

- 1 Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.
- 2 The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.
- 3 Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).
- 4 The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.

**5 'List rule' guidance (see examples below)**

For questions that require ***n*** responses (e.g. State **two** reasons ...):

- The response should be read as continuous prose, even when numbered answer spaces are provided
- Any response marked *ignore* in the mark scheme should not count towards ***n***
- Incorrect responses should not be awarded credit but will still count towards ***n***
- Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should **not** be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response
- Non-contradictory responses after the first ***n*** responses may be ignored even if they include incorrect science.

**6 Calculation specific guidance**

Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'.

For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values.

For answers given in standard form, (e.g.  $a \times 10^n$ ) in which the convention of restricting the value of the coefficient (*a*) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme.

Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.

**7 Guidance for chemical equations**

Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.

State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

Question	Answer	Marks
1(a)(i)	<b>D</b>	1
1(a)(ii)	<b>C</b>	1
1(a)(iii)	<b>C</b>	1
1(a)(iv)	<b>B</b>	1
1(a)(v)	<b>D AND E or A</b>	1
1(a)(vi)	<b>C</b>	1
1(a)(vii)	<b>A or E</b>	1
1(a)(viii)	$  \begin{array}{ccccc}  & \text{H} & & & \\  &   & & & \\  \text{H} & -\text{O}- & & & \text{H} \\  &   & & &   \\  \text{H}-\text{C} & -\text{C}- & \text{C}-\text{H} & & \\  &   & &   & \\  & \text{H} & & \text{H} &  \end{array}  $	1
1(b)	donate or lose protons does not fully ionise / partially ionises / forms an equilibrium mixture	2

Question	Answer	Marks
2(a)(i)	reversible reaction	1
2(a)(ii)	hydrocarbons (reacting with steam)	1
2(b)	[increasing pressure] increases yield [increasing temperature] decreases yield	2

Question	Answer	Marks
2(c)	(particles) have more energy OR (particles) move faster more collisions per second OR greater collision rate more (of the) particles OR collisions have sufficient energy / activation energy to react OR a greater percentage / proportion / fraction of collisions are successful	3
2(d)(i)	N / NH <sub>3</sub> change in oxidation state of N from –3 to +2 / increase in oxidation number / gain in oxygen / loss of electrons	2
2(d)(ii)	75	1
2(d)(iii)	(it could react with rain water to) form nitric acid / acid rain	1
2(d)(iv)	(M <sub>r</sub> of HNO <sub>3</sub> =) 63 (1) 20 (1) 5 (1) 120 (dm <sup>3</sup> ) (1)	4
2(e)	<ul style="list-style-type: none"> <li>horizontal product energy line at lower energy level than reactant</li> <li>label of product</li> <li>correct direction of vertical arrow – arrow must start level with reactant energy and finish level with product level and one arrow head ONLY</li> </ul>	3

Question	Answer	Marks												
3(a)(i)	same number of electrons same electronic configuration	2												
3(a)(ii)	<table border="1"> <thead> <tr> <th></th> <th>number of electrons</th> <th>number of neutrons</th> <th>number of protons</th> </tr> </thead> <tbody> <tr> <td><sup>35</sup><sub>17</sub>Cl</td> <td>17</td> <td>18</td> <td>17</td> </tr> <tr> <td><sup>37</sup><sub>17</sub>Cl<sup>–</sup></td> <td>18</td> <td>20</td> <td>17</td> </tr> </tbody> </table>		number of electrons	number of neutrons	number of protons	<sup>35</sup> <sub>17</sub> Cl	17	18	17	<sup>37</sup> <sub>17</sub> Cl <sup>–</sup>	18	20	17	3
	number of electrons	number of neutrons	number of protons											
<sup>35</sup> <sub>17</sub> Cl	17	18	17											
<sup>37</sup> <sub>17</sub> Cl <sup>–</sup>	18	20	17											
3(b)(i)	displacement / redox	1												

Question	Answer	Marks
3(b)(ii)	iodine is less reactive than bromine	1
3(c)	magnesium ion has an outer shell with eight crosses chloride ion has an outer shell with seven dots <b>and</b> one cross chloride has a charge of 1– <b>and</b> magnesium has a charge 2+	3
3(d)	energy needed to break bonds = $436 + 243 = 679$ energy released when bonds formed = $2 \times 432 = 864$ energy change = $679 - 864 = -\text{AND } 185$	3

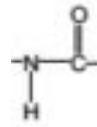
Question	Answer	Marks
4(a)	(filtration:) remove solids from water / remove insoluble substances (chlorination:) sterilises / kill microbes / prevent illness	2
4(b)(i)	white to blue	2
4(b)(ii)	higher boiling point / greater than 100°C	1
4(c)(i)	more than one spot	1
4(c)(ii)	0.8 (circled)	1
4(c)(iii)	use a locating agent	1

Question	Answer				Marks
5(a)		particle separation	particle arrangement	type of motion	
	solid	touching			
	liquid		random		
	gas			random	
5(b)	condensing				1
5(c)	evaporation diffusion				2

Question	Answer	Marks
6(a)(i)	2, 2, 4, 1	1
6(a)(ii)	thermal decomposition	1
6(b)	<ul style="list-style-type: none"> <li>• add aqueous sodium hydroxide</li> <li>• then (reduction with) aluminium (foil) (and warm)</li> <li>• (ammonia gas produced which) turns damp red litmus blue</li> </ul>	3

Question	Answer	Marks
7(a)	breakdown of a molten / or aqueous ionic compound by the passage of electricity	2
7(b)	bauxite	1
7(c)(i)	it is above carbon in the reactivity series / more reactive than carbon	1

Question	Answer	Marks
7(c)(ii)	any <b>one</b> from: <ul style="list-style-type: none"> <li>• aluminium oxide has high melting point / cryolite has lower melting point than aluminium oxide</li> <li>• using cryolite reduces costs / expensive to melt aluminium</li> </ul>	1
7(c)(iii)	oxygen	1
7(c)(iv)	$\text{Al}^{3+} + 3\text{e}^- \rightarrow \text{Al}$	2
7(d)	any <b>two</b> related to use as electricity cables: <ul style="list-style-type: none"> <li>• ductile / malleable</li> <li>• conducts (electricity)</li> <li>• low density</li> <li>• protective oxide layer</li> </ul>	2
7(e)(i)	iron + water + oxygen $\rightarrow$ (hydrated) iron oxide	2
7(e)(ii)	any <b>two</b> from: <ul style="list-style-type: none"> <li>• act as catalysts</li> <li>• variable oxidation numbers</li> <li>• form coloured compounds / coloured ions</li> <li>• higher melting point</li> <li>• higher density</li> <li>• harder</li> </ul>	2

Question	Answer	Marks
8(a)(i)		1

Question	Answer	Marks
8(a)(ii)	 	2
8(a)(iii)	water	1
8(b)	non-biodegradable / running out of space / toxic / leaching	1
8(c)	(complex) carbohydrate / protein	1



# Cambridge IGCSE™

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\* 7 3 3 6 6 1 5 3 1 8 \*

## CHEMISTRY

0620/42

Paper 4 Theory (Extended)

May/June 2020

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

### INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

### INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].
- The Periodic Table is printed in the question paper.

This document has **16** pages. Blank pages are indicated.

1 (a) Give the name of the process that:

- (i) occurs when a gas turns into a liquid

..... [1]

- (ii) occurs when a solid turns into a gas without first forming a liquid

..... [1]

- (iii) is used to separate a mixture of liquids with different boiling points

..... [1]

- (iv) is used to extract aluminium from aluminium oxide

..... [1]

- (v) is used to separate a mixture of amino acids.

..... [1]

(b) The symbols of the elements in Period 2 of the Periodic Table are shown.

Li Be B C N O F Ne

For each of the following, give the symbol of an element from Period 2 which matches the description.

Each element may be used once, more than once or not at all.

Which element:

- (i) combines with hydrogen to produce ammonia

..... [1]

- (ii) makes up approximately 21% of clean, dry air

..... [1]

- (iii) has atoms with only two electrons in the outer shell

..... [1]

- (iv) has atoms with only seven protons

..... [1]

- (v) is a monoatomic gas

..... [1]

- (vi) is a soft metal stored in oil?

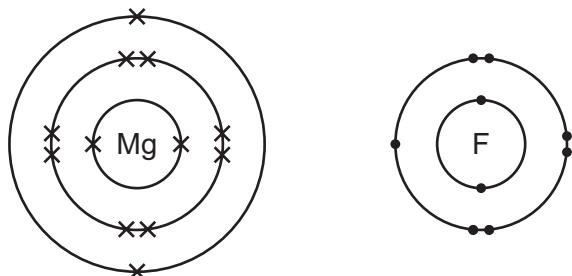
..... [1]

[Total: 11]

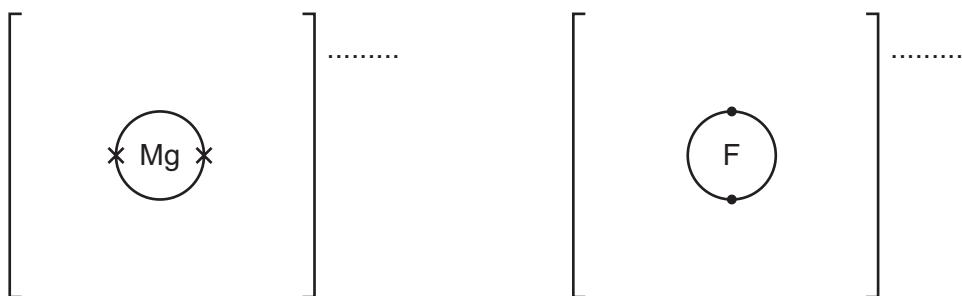
2 Fluorine forms both ionic and covalent compounds.

- (a) Magnesium reacts with fluorine to form the ionic compound magnesium fluoride.

The electronic structures of an atom of magnesium and an atom of fluorine are shown.



- (i) Complete the dot-and-cross diagrams to show the electronic structures of one magnesium ion and one fluoride ion. Show the charges on the ions.



[3]

- (ii) What is the formula of magnesium fluoride?

..... [1]

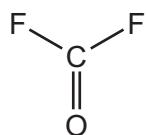
- (iii) Magnesium fluoride does **not** conduct electricity when it is solid.

What can be done to solid magnesium fluoride to make it conduct electricity?

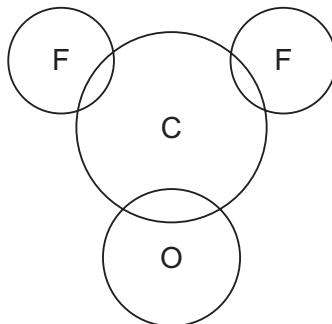
In your answer explain why magnesium fluoride conducts electricity when this change is made.

.....  
 .....  
 .....  
 ..... [2]

- (b) Carbonyl fluoride,  $\text{COF}_2$ , is a covalent compound. The structure of a molecule of  $\text{COF}_2$  is shown.



Complete the dot-and-cross diagram to show the electron arrangement in a molecule of carbonyl fluoride. Show outer shell electrons only.



[3]

- (c) The melting points of magnesium fluoride and carbonyl fluoride are shown.

	melting point/°C
magnesium fluoride	1263
carbonyl fluoride	−111

- (i) Explain, using your knowledge of structure and bonding, why magnesium fluoride has a high melting point.

.....  
.....  
.....

[2]

- (ii) Explain, using your knowledge of structure and bonding, why carbonyl fluoride has a low melting point.

.....  
.....  
.....  
.....

[2]

[Total: 13]

- 3 (a) Sulfuric acid is made from sulfur in a four-stage process.

**stage 1** Sulfur is converted into sulfur dioxide.

**stage 2** Sulfur dioxide is converted into sulfur trioxide.

**stage 3** Sulfur trioxide is converted into oleum.

**stage 4** Oleum is converted into sulfuric acid.

- (i) How is sulfur converted into sulfur dioxide in **stage 1**?

..... [1]

- (ii) Describe how sulfur dioxide is converted into sulfur trioxide in **stage 2**.

Your answer should include:

- an equation for the reaction
- the temperature used
- the name of the catalyst used.

.....  
.....  
.....  
..... [3]

- (iii) The reaction in **stage 2** can reach equilibrium.

What is meant by the term *equilibrium*?

.....  
.....  
..... [2]

- (b) Sulfur trioxide is converted into oleum,  $H_2S_2O_7$ , in **stage 3**.

What is sulfur trioxide reacted with to convert it into oleum?

..... [1]

- (c) Oleum is converted into sulfuric acid in **stage 4**.

Write a chemical equation for the conversion of oleum,  $H_2S_2O_7$ , into sulfuric acid.

..... [2]

- (d) When copper is reacted with hot concentrated sulfuric acid, sulfur dioxide gas is formed.

Balance the chemical equation for this reaction.



[1]

- (e) Sulfur dioxide is a reducing agent.

Give the colour change that occurs when excess sulfur dioxide is bubbled into acidified aqueous potassium manganate(VII).

starting colour of the solution .....

final colour of the solution .....

[1]

- (f) When sulfuric acid reacts with ammonia the salt produced is ammonium sulfate.

Write the chemical equation for this reaction.

..... [2]

- (g) Barium sulfate is an insoluble salt.

Barium sulfate can be made from aqueous ammonium sulfate using a precipitation reaction.

- (i) Name a solution that can be added to aqueous ammonium sulfate to produce a precipitate of barium sulfate.

..... [1]

- (ii) Write an ionic equation for this precipitation reaction. Include state symbols.

..... [2]

[Total: 16]

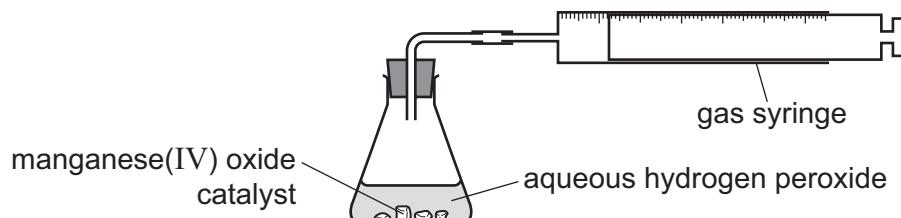
- 4 Oxygen is produced by the decomposition of hydrogen peroxide. Manganese(IV) oxide is the catalyst for this reaction.

(a) What is meant by the term *catalyst*?

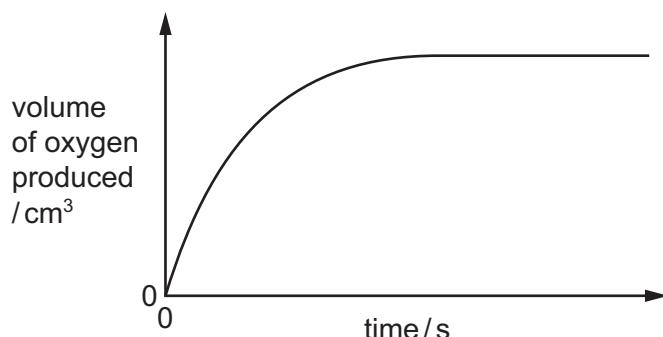
.....  
.....  
.....

[2]

- (b) A student measures the volume of oxygen produced at regular time intervals using the apparatus shown. Large lumps of manganese(IV) oxide are used.



A graph of the results is shown.



What happens to the **rate** of this reaction as time increases?  
In your answer, explain why the rate changes in this way.

.....  
.....  
.....  
.....

[4]

- (c) The experiment is repeated using the same mass of manganese(IV) oxide. Powdered manganese(IV) oxide is used instead of large lumps. All other conditions stay the same.

Sketch a graph on the axes in (b) to show how the volume of oxygen changes with time. [2]

- (d) In terms of particles, explain what happens to the rate of this reaction when the temperature is increased.

.....  
 .....  
 .....  
 .....  
 ..... [3]

- (e) The equation for the decomposition of hydrogen peroxide is shown.



25.0 cm<sup>3</sup> of aqueous hydrogen peroxide forms 48.0 cm<sup>3</sup> of oxygen at room temperature and pressure (r.t.p.).

Calculate the concentration of aqueous hydrogen peroxide at the start of the experiment using the following steps.

- Calculate the number of moles of oxygen formed.

..... mol

- Deduce the number of moles of hydrogen peroxide that decomposed.

..... mol

- Calculate the concentration of hydrogen peroxide in mol/dm<sup>3</sup>.

..... mol/dm<sup>3</sup>  
 [3]

- (f) Oxygen can also be produced by the decomposition of potassium chlorate(V),  $\text{KClO}_3$ .

The only products of this decomposition are potassium chloride and oxygen.

Write a chemical equation for this decomposition.

..... [2]

[Total: 16]

- 5 Electrolysis of concentrated aqueous sodium chloride using inert electrodes forms chlorine, hydrogen and sodium hydroxide.

(a) What is meant by the term *electrolysis*?

.....  
.....  
.....

[2]

(b) Name a substance that can be used as the inert electrodes.

.....

[1]

(c) Write an ionic half-equation for the formation of hydrogen during this electrolysis.

.....

[1]

(d) Give the formulae of the **four** ions present in concentrated aqueous sodium chloride.

.....

[2]

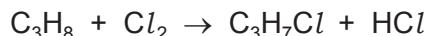
(e) Explain how sodium hydroxide is formed during this electrolysis.

.....  
.....  
.....

[2]

[Total: 8]

- 6 (a) Propane reacts with chlorine in a photochemical reaction as shown.



- (i) What type of reaction is this?

..... [1]

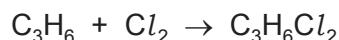
- (ii) What condition is needed for this photochemical reaction to occur?

..... [1]

- (iii) Draw **two** structural isomers of compounds with the formula  $\text{C}_3\text{H}_7\text{Cl}$ . Show all of the atoms and all of the bonds.

[2]

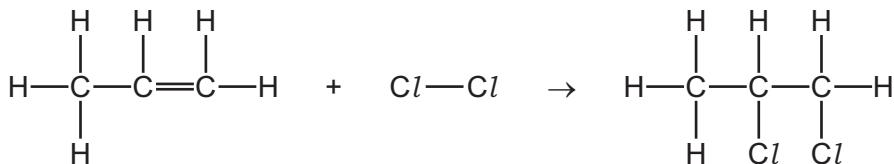
- (b) Propene reacts with chlorine in an addition reaction as shown.



- (i) State why this is an addition reaction.

..... [1]

- (ii) The structures of the reactants and products of this reaction are shown.



Some bond energies are shown in the table.

bond	bond energy in kJ/mol
C–C	347
C=C	612
C–H	413
C–Cl	339
Cl–Cl	242

Calculate the energy change for the reaction between propene and chlorine using the following steps.

- Calculate the energy needed to break the bonds.

..... kJ

- Calculate the energy released when bonds are formed.

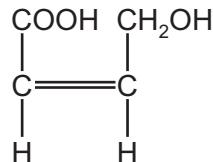
..... kJ

- Calculate the energy change for the reaction between propene and chlorine.

..... kJ/mol  
[3]

- (c) There are three functional groups in compound **A**.

compound **A**



- (i) Name the homologous series of compounds that contains the following structures.

C=C .....

-OH .....

-COOH .....

[3]

- (ii) What would you observe when compound **A** is added to:

aqueous bromine .....

aqueous sodium carbonate? .....

[2]

- (d) Compound **A** can be used as a single monomer to produce two different polymers.

- (i) Draw **one** repeat unit of the addition polymer formed from compound **A**.

[2]

- (ii) What type of condensation polymer is formed from compound **A**?

..... [1]

[Total: 16]





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## The Periodic Table of Elements

I		II		Group																								
				I						II			III			IV		V		VI		VII		VIII				
3 <b>Li</b> lithium 7	4 <b>Be</b> beryllium 9									1 <b>H</b> hydrogen 1																		
11 <b>Na</b> sodium 23	12 <b>Mg</b> magnesium 24																											
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> cesium 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> damascusium –		111 <b>Rg</b> roentgenium –	112 <b>Cn</b> copernicium –		114 <b>Fl</b> ferrovium –	116 <b>Lv</b> livmorium –							

16

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
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>Fm</b> fermium –	100 <b>Md</b> mendelevium –	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.).



# **Cambridge IGCSE™**

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**CHEMISTRY**

**0620/42**

Paper 4 Theory (Extended)

**May/June 2020**

**MARK SCHEME**

Maximum Mark: 80

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**Published**

Students did not sit exam papers in the June 2020 series due to the Covid-19 global pandemic.

This mark scheme is published to support teachers and students and should be read together with the question paper. It shows the requirements of the exam. The answer column of the mark scheme shows the proposed basis on which Examiners would award marks for this exam. Where appropriate, this column also provides the most likely acceptable alternative responses expected from students. Examiners usually review the mark scheme after they have seen student responses and update the mark scheme if appropriate. In the June series, Examiners were unable to consider the acceptability of alternative responses, as there were no student responses to consider.

Mark schemes should usually be read together with the Principal Examiner Report for Teachers. However, because students did not sit exam papers, there is no Principal Examiner Report for Teachers for the June 2020 series.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the June 2020 series for most Cambridge IGCSE™ and Cambridge International A & AS Level components, and some Cambridge O Level components.

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This document consists of **9** printed pages.

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

**GENERIC MARKING PRINCIPLE 1:**

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

**GENERIC MARKING PRINCIPLE 2:**

Marks awarded are always **whole marks** (not half marks, or other fractions).

**GENERIC MARKING PRINCIPLE 3:**

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

**GENERIC MARKING PRINCIPLE 4:**

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

**GENERIC MARKING PRINCIPLE 5:**

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

**GENERIC MARKING PRINCIPLE 6:**

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

**Science-Specific Marking Principles**

- 1 Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.
- 2 The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.
- 3 Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).
- 4 The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.

**5 'List rule' guidance (see examples below)**

For questions that require ***n*** responses (e.g. State **two** reasons ...):

- The response should be read as continuous prose, even when numbered answer spaces are provided
- Any response marked *ignore* in the mark scheme should not count towards ***n***
- Incorrect responses should not be awarded credit but will still count towards ***n***
- Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should **not** be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response
- Non-contradictory responses after the first ***n*** responses may be ignored even if they include incorrect science.

**6 Calculation specific guidance**

Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'.

For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values.

For answers given in standard form, (e.g.  $a \times 10^n$ ) in which the convention of restricting the value of the coefficient (*a*) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme.

Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.

**7 Guidance for chemical equations**

Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.

State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

Question	Answer	Marks
1(a)(i)	condensation	1
1(a)(ii)	sublimation	1
1(a)(iii)	fractional distillation	1
1(a)(iv)	electrolysis	1
1(a)(v)	chromatography	1
1(b)(i)	N	1
1(b)(ii)	O	1
1(b)(iii)	Be	1
1(b)(iv)	N	1
1(b)(v)	Ne	1
1(b)(vi)	Li	1

Question	Answer	Marks
2(a)(i)	magnesium 2.8 (all crosses) (1) fluorine 2.8 (seven dots and one cross in outer shell) (1) $\text{Mg}^{2+}$ and $\text{F}^-$ (1)	3
2(a)(ii)	$\text{MgF}_2$	1
2(a)(iii)	heat until molten or dissolve in water (1) moving ions / mobile ions (1)	2

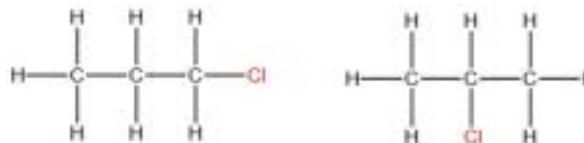
Question	Answer	Marks
2(b)	two single bonds (1) one double bond (1) six non-bonding electrons on both F atoms and four non- bonding electrons on O atom to complete the octet in each case (1)	3
2(c)(i)	forces of attraction between oppositely charged ions / ionic bonds (1) strong / need a lot of energy to break / weaken (1)	2
2(c)(ii)	forces of attraction between molecules (1) weak / need a small of energy to break / weaken (1)	2

Question	Answer	Marks
3(a)(i)	heat in air	1
3(a)(ii)	$2\text{SO}_2 + \text{O}_2 \rightarrow 2\text{SO}_3$ (1) $450^\circ\text{C}$ (1) vanadium(V) oxide (1)	3
3(a)(iii)	rate of forward reaction and rate of backward reaction are equal (1) concentrations of reactants and products are constant (1)	3
3(b)	concentrated sulfuric acid	1
3(c)	$\text{H}_2\text{S}_2\text{O}_7 + \text{H}_2\text{O} \rightarrow 2\text{H}_2\text{SO}_4$	2
3(d)	$\text{Cu} + 2\text{H}_2\text{SO}_4 \rightarrow \text{CuSO}_4 + \text{SO}_2 + 2\text{H}_2\text{O}$	1
3(e)	purple to colourless	1
3(f)	$2\text{NH}_3 + \text{H}_2\text{SO}_4 \rightarrow (\text{NH}_4)_2\text{SO}_4$	2
3(g)(i)	barium nitrate / barium chloride	1
3(g)(ii)	$\text{Ba}^{2+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{BaSO}_4(\text{s})$ formulae (1) state symbols (1)	2

Question	Answer	Marks
4(a)	substance that speeds up a reaction / increases rate (1) unchanged (chemically) at the end <b>OR</b> not used up <b>OR</b> lowers activation energy <b>OR</b> provides alternative pathway (1)	2
4(b)	rate decreases (1) particles further apart / less particles per unit volume (1) fewer collisions per unit time / lower collision frequency (1) reaction stops because all hydrogen peroxide is used up	4
4(c)	steeper gradient (1) reaches same volume of oxygen (1)	2
4(d)	particles gain kinetic energy / particles move faster (1) greater number of collisions with activation energy (or more) / greater number of particles with activation energy (or more) / greater number of particles with energy required for reaction (1) more collisions are successful / more collisions are fruitful / more collisions lead to reaction (1)	3
4(e)	$\text{M1 moles of oxygen} = \frac{48.0}{24\,000}$ or moles of oxygen = 0.002 (1) $\text{M2 moles of hydrogen peroxide} = \text{M1} \times 2$ or moles of hydrogen peroxide = 0.004 (1) $\text{M3 concentration} = \text{M2} \times 40 = 0.16 \text{ mol / dm}^3$ (1) allow ECF	3
4(f)	$2\text{KClO}_3 \rightarrow 2\text{KCl} + 3\text{O}_2$ <b>ALL</b> formulae correct (1) balancing (1)	2

Question	Answer	Marks
5(a)	<b>breakdown</b> of an ionic <b>compound</b> when molten or in aqueous solution (1) (using) electricity / electric current / electrical energy (1)	2
5(b)	platinum / graphite	1
5(c)	$2\text{H}^+ + 2\text{e} \rightarrow \text{H}_2$	1

Question	Answer	Marks
5(d)	$\text{Na}^+$ $\text{H}^+$ $\text{Cl}^-$ $\text{OH}^-$ all four (2) 3 or 2 (1)	2
5(e)	$\text{H}^+$ and $\text{Cl}^-$ are discharged / removed (1) $\text{Na}^+$ and $\text{OH}^-$ remain (1)	2

Question	Answer	Marks
6(a)(i)	substitution	1
6(a)(ii)	ultraviolet light / ultraviolet radiation	1
6(a)(iii)		2
6(b)(i)	only one product / double bond becomes single bond / two molecules join (to make one molecule)	1
6(b)(ii)	(energy required to break bonds =) 854 (1) (energy given out when bonds form =) 1025 (1) overall energy change $854 - 1025 = -171$ (1)	3

Question	Answer	Marks
6(c)(i)	alkene (1) alcohols / alkanols (1) carboxylic acids/alkanoic acids (1)	3
6(c)(ii)	turns colourless / decolourised (1) bubbles / fizzing / effervescence (1)	2
6(d)(i)	$  \begin{array}{c}  \text{COOH} \quad \text{CH}_2\text{OH} \\    \qquad \quad   \\  \text{---C---C---} \\    \qquad \quad   \\  \text{H} \qquad \text{H}  \end{array}  $ C–C (1) each C bonded to $-\text{CH}_2\text{OH}$ / $-\text{COOH}$ and H with no other atoms + extension bonds (1)	2
6(d)(ii)	polyester	1



# Cambridge IGCSE™

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CENTRE  
NUMBER

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CANDIDATE  
NUMBER

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## CHEMISTRY

0620/41

Paper 4 Theory (Extended)

May/June 2020

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

### INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

### INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].
- The Periodic Table is printed in the question paper.

This document has **12** pages. Blank pages are indicated.

1 This question is about elements **X**, **Y** and **Z**.

(a) An atom of element **X** is represented as  $^{34}_{16}\text{X}$ .

(i) Name the different types of particles found in the nucleus of this atom of **X**.

.....  
..... [2]

(ii) What is the term for the total number of particles in the nucleus of an atom?

..... [1]

(iii) What is the total number of particles in the nucleus of an atom of  $^{34}_{16}\text{X}$ ?

..... [1]

(iv) What is the electronic structure of the ion  $\text{X}^{2-}$ ?

..... [1]

(v) Suggest the formula of the compound formed between aluminium and **X**.

..... [1]

(b) (i) What term is used to describe atoms of the same element with different numbers of particles in the nucleus?

..... [1]

(ii) Identify the atom against which the relative masses of all other atoms are compared.

..... [1]

(iii) What is the name of the amount of any substance that contains  $6.02 \times 10^{23}$  particles?

..... [1]

(iv) The constant  $6.02 \times 10^{23}$  has a name.

What is the name of this constant?

..... [1]

- (c) Part of the definition of relative atomic mass is ‘the average mass of naturally occurring atoms of an element’.

Some relative atomic masses are not whole numbers.

Element Y has only two different types of atom,  $^{69}\text{Y}$  and  $^{71}\text{Y}$ .

The ratio of atoms present in element Y is shown.

$$^{69}\text{Y} : ^{71}\text{Y} = 3 : 2$$

- Calculate the relative atomic mass of element Y to **one decimal place**.

relative atomic mass = .....

- Identify element Y.

..... [3]

- (d) Element Z is in Period 3 and Group V.

- (i) Identify element Z.

..... [1]

- (ii) Explain in terms of electron transfer why Z behaves chemically as a non-metal.

..... [2]

[Total: 16]

2 Magnesium is a metal.

- (a) Name and describe the bonding in magnesium.

name .....

description of bonding .....

.....  
.....

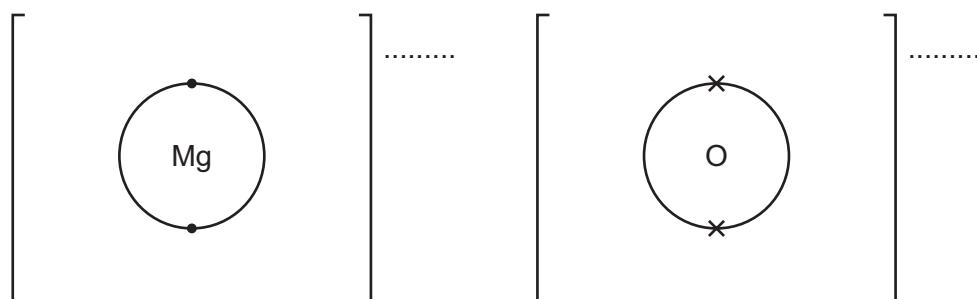
[4]

- (b) Magnesium oxide, MgO, is formed when magnesium burns in oxygen.

- (i) Complete the dot-and-cross diagram to show the electron arrangement of the ions in magnesium oxide.

The inner shells have been drawn.

Give the charges on the ions.



[3]

- (ii) Write the chemical equation for the reaction that occurs when magnesium burns in oxygen.

..... [2]

- (c) Magnesium oxide also forms when magnesium nitrate,  $Mg(NO_3)_2$ , is heated strongly. This is an endothermic reaction.

- (i) Write the chemical equation for this reaction.

..... [2]

- (ii) What type of reaction is this?

..... [1]

- (iii) Name **two** other compounds of magnesium that form magnesium oxide when heated.

.....

[2]

[Total: 14]

- 3 Sulfur dioxide,  $\text{SO}_2$ , is used in the manufacture of sulfuric acid.

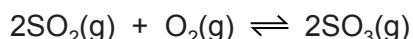
- (a) In the first stage of the process, sulfur dioxide is obtained from sulfur-containing ores.

Name **one** of these ores.

..... [1]

- (b) The next stage of the process is a reaction which can reach equilibrium.

The equation for this stage is shown.



- (i) Describe **two** features of an equilibrium.

..... [2]

- (ii) Name the catalyst used in this stage.

..... [1]

- (iii) Why is a catalyst used?

..... [1]

- (iv) Explain, in terms of particles, why a high temperature increases the rate of this reaction.

.....  
.....  
.....  
.....

..... [3]

- (v) In this stage, only a moderate temperature of  $450^\circ\text{C}$  is used.

What does this suggest about the forward reaction?

..... [1]

- (vi) Calculate the percentage by mass of sulfur in sulfur trioxide,  $\text{SO}_3$ .

percentage = ..... [2]

- (c) Concentrated sulfuric acid is a dehydrating agent which can chemically remove water from substances.

Both hydrated copper(II) sulfate crystals and sucrose (a sugar),  $C_{12}H_{22}O_{11}$ , can be completely dehydrated by concentrated sulfuric acid.

Name the solid product formed in each case.

hydrated copper(II) sulfate crystals .....

sucrose .....

[2]

- (d) When propan-1-ol is heated with concentrated sulfuric acid as a catalyst an unsaturated hydrocarbon of relative molecular mass 42 is formed and one other product.

- (i) What is meant by the term *unsaturated*?

..... [1]

- (ii) Write the chemical equation for this reaction.

..... [2]

- (iii) Name the unsaturated hydrocarbon formed.

..... [1]

[Total: 17]

- 4 This question is about reactions of bases and acids.

- (a) Ammonia is a gas at room temperature.

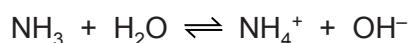
What is the test for ammonia gas? Describe the positive result of this test.

test .....

result .....

[2]

- (b) Ammonia reacts with water to form ions.



- (i) How does this equation show that ammonia,  $\text{NH}_3$ , behaves as a base?

..... [1]

- (ii) Aqueous ammonia is described as a weak base.

Suggest the pH of aqueous ammonia.

pH = ..... [1]

- (iii) Describe what is seen when aqueous ammonia is added to aqueous copper(II) sulfate, until no further change is seen.

.....

.....

[3]

(c) Aqueous sodium hydroxide, NaOH(aq), is a strong alkali that reacts with dilute sulfuric acid exothermically.

(i) What type of reaction is this?

..... [1]

(ii) Complete the equation for the reaction between aqueous sodium hydroxide and dilute sulfuric acid.



[2]

(d) A student wanted to find the concentration of some dilute sulfuric acid by titration. The student found that  $25.0\text{ cm}^3$  of  $0.0400\text{ mol/dm}^3$  NaOH(aq) reacted exactly with  $20.0\text{ cm}^3$  of H<sub>2</sub>SO<sub>4</sub>(aq).

(i) Name a suitable indicator to use in this titration.

..... [1]

(ii) Calculate the concentration of the H<sub>2</sub>SO<sub>4</sub>(aq) in mol/dm<sup>3</sup> using the following steps.

- Calculate the number of moles of NaOH in  $25.0\text{ cm}^3$ .

moles = .....

- Deduce the number of moles of H<sub>2</sub>SO<sub>4</sub> that reacted with the  $25.0\text{ cm}^3$  of NaOH(aq).

moles = .....

- Calculate the concentration of H<sub>2</sub>SO<sub>4</sub>(aq) in mol/dm<sup>3</sup>.

concentration = ..... mol/dm<sup>3</sup>  
[3]

(iii) Calculate the concentration of the  $0.0400\text{ mol/dm}^3$  NaOH(aq) in g/dm<sup>3</sup>.

concentration = ..... g/dm<sup>3</sup> [2]

[Total: 16]

5 Ethanol is manufactured by two different processes.

(a) For each process, name the organic reactant and state the type of reaction.

organic reactant ..... type of reaction .....

organic reactant ..... type of reaction .....

[4]

(b) Alcohols can be oxidised to form carboxylic acids.

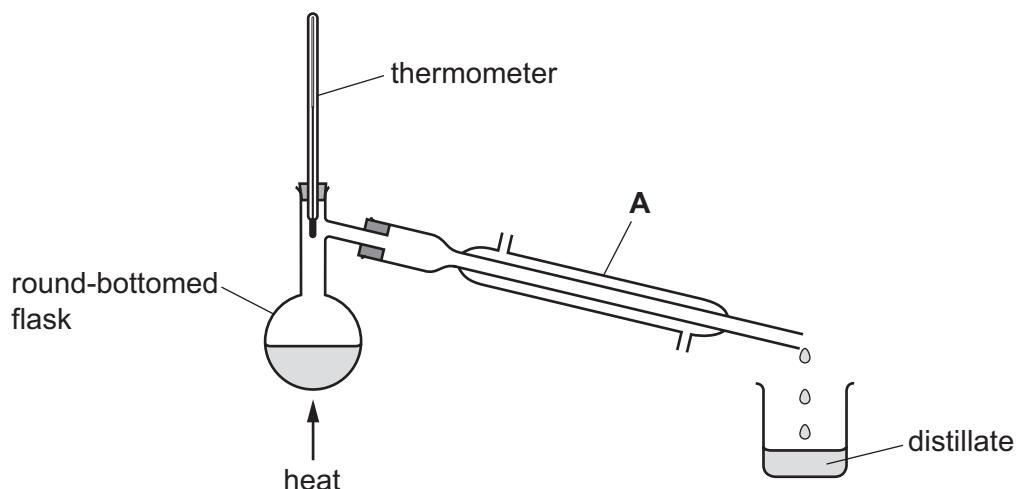
Name a suitable oxidising agent for this reaction.

..... [1]

(c) Alcohols can be partially oxidised to form aldehydes.

Aldehydes are a homologous series of organic compounds.

Partial oxidation is achieved by reacting an alcohol with the oxidising agent in distillation apparatus as shown.



(i) Name apparatus A.

..... [1]

(ii) On the diagram, use **one** arrow to show where water enters apparatus A.

[1]

(d) The table shows some information about aldehydes.

(i) Complete the table.

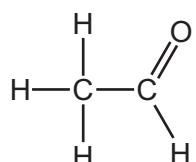
name	.....	ethanal	propanal	butanal
molecular formula	$\text{CH}_2\text{O}$	$\text{C}_2\text{H}_4\text{O}$	$\text{C}_3\text{H}_6\text{O}$	.....

[2]

(ii) Deduce the general formula of aldehydes.

..... [1]

(e) The structural formula of ethanal is shown.

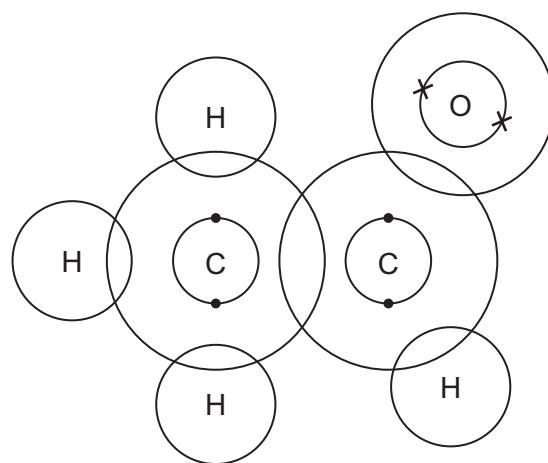


The C=O group in aldehydes is at the end of the carbon chain.  
This is a reactive part of the molecule.

(i) What is the name given to the reactive part of any organic molecule?

..... [1]

(ii) Complete the dot-and-cross diagram to show the electron arrangement of a molecule of ethanal. Inner shells have been drawn.



[3]

- (f) Propanone belongs to a homologous series called ketones. Ketones have the same C=O group as aldehydes but the C=O group is not at the end of the carbon chain. Propanone has the same molecular formula as propanal,  $C_3H_6O$ .

- (i) What term is used to describe molecules with different structures but with the same molecular formula?

..... [1]

- (ii) Suggest the structure of propanone,  $C_3H_6O$ . Show all of the atoms and all of the bonds.

[2]

[Total: 17]

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**The Periodic Table of Elements**

I		II		Group															
				I						II									
				Key															
3 <b>Li</b> lithium 7	4 <b>Be</b> beryllium 9			1 <b>H</b> hydrogen 1															
11 <b>Na</b> sodium 23	12 <b>Mg</b> magnesium 24	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>Rn</b> radon –	
55 <b>Cs</b> cesium 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> –		
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> damarium –	111 <b>Rg</b> roentgenium –	112 <b>Cn</b> copernicium –	114 <b>Fl</b> ferrovium –	116 <b>Lv</b> livmorium –	–	–	–			

12

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
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>Fm</b> einsteinium –	100 <b>Md</b> mendelevium –	101 <b>No</b> nobelium –	102 <b>Lv</b> livermorium –	103 <b>Fr</b> lawrencium –

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



# **Cambridge IGCSE™**

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**CHEMISTRY**

**0620/41**

Paper 4 Theory (Extended)

**May/June 2020**

**MARK SCHEME**

Maximum Mark: 80

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**Published**

Students did not sit exam papers in the June 2020 series due to the Covid-19 global pandemic.

This mark scheme is published to support teachers and students and should be read together with the question paper. It shows the requirements of the exam. The answer column of the mark scheme shows the proposed basis on which Examiners would award marks for this exam. Where appropriate, this column also provides the most likely acceptable alternative responses expected from students. Examiners usually review the mark scheme after they have seen student responses and update the mark scheme if appropriate. In the June series, Examiners were unable to consider the acceptability of alternative responses, as there were no student responses to consider.

Mark schemes should usually be read together with the Principal Examiner Report for Teachers. However, because students did not sit exam papers, there is no Principal Examiner Report for Teachers for the June 2020 series.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the June 2020 series for most Cambridge IGCSE™ and Cambridge International A & AS Level components, and some Cambridge O Level components.

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This document consists of **9** printed pages.

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

**GENERIC MARKING PRINCIPLE 1:**

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

**GENERIC MARKING PRINCIPLE 2:**

Marks awarded are always **whole marks** (not half marks, or other fractions).

**GENERIC MARKING PRINCIPLE 3:**

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

**GENERIC MARKING PRINCIPLE 4:**

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

**GENERIC MARKING PRINCIPLE 5:**

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

**GENERIC MARKING PRINCIPLE 6:**

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

**Science-Specific Marking Principles**

- 1 Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.
- 2 The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.
- 3 Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).
- 4 The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.

**5 'List rule' guidance (see examples below)**

For questions that require ***n*** responses (e.g. State **two** reasons ...):

- The response should be read as continuous prose, even when numbered answer spaces are provided
- Any response marked *ignore* in the mark scheme should not count towards ***n***
- Incorrect responses should not be awarded credit but will still count towards ***n***
- Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should **not** be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response
- Non-contradictory responses after the first ***n*** responses may be ignored even if they include incorrect science.

**6 Calculation specific guidance**

Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'.

For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values.

For answers given in standard form, (e.g.  $a \times 10^n$ ) in which the convention of restricting the value of the coefficient (*a*) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme.

Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.

**7 Guidance for chemical equations**

Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.

State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

Question	Answer	Marks
1(a)(i)	protons	1
	neutrons	1
1(a)(ii)	nucleon number	1
1(a)(iii)	34	1
1(a)(iv)	2 : 8 : 8	1
1(a)(v)	$\text{Al}_2\text{X}_3$	1
1(b)(i)	isotopes	1
1(b)(ii)	$^{12}\text{C}$	1
1(b)(iii)	a mole	1
1(b)(iv)	Avogadro constant	1
1(c)	M1 $(3 \times 69) + (2 \times 71)$ $M2 = \frac{349}{5} = 69.8$ M3 Y = Ga / gallium	3
1(d)(i)	phosphorus / P	1
1(d)(ii)	gains electrons three electrons (when forming ion)	2

Question	Answer	Marks
2(a)	metallic (bonding)	1
	sea of electrons	1
	positive ions	1
	attraction between	1
2(b)(i)	Mg octet of eight dots	1
	O octet of six crosses and two dots.	1
	correct charges on both ions	1
2(b)(ii)	$2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$ M1 species M2 balancing	2
2(c)(i)	$2\text{Mg}(\text{NO}_3)_2 \rightarrow 2\text{MgO} + 4\text{NO}_2 + \text{O}_2$ M1 product species M2 balancing	2
2(c)(ii)	(thermal) decomposition	1
2(c)(iii)	magnesium carbonate	1
	magnesium hydroxide	1

Question	Answer	Marks
3(a)	zinc blende	1
3(b)(i)	reaction is reversible rate of forward reaction = rate of reverse reaction	2
3(b)(ii)	vanadium(V) oxide	1

Question	Answer	Marks
3(b)(iii)	increases the rate of reaction	1
3(b)(iv)	particles have more energy (E) rate of collisions increase	1 1
	a higher proportion of particles have energy greater than activation energy ( $E > E_A$ )	1
3(b)(v)	exothermic	1
3(b)(vi)	$M_r$ of $\text{SO}_3 = 80$ $100 \times \frac{32}{80} = 40\%$	1 1
3(c)	anhydrous copper(II) sulfate carbon	2
3(d)(i)	not all (C–C) bonds are single	1
3(d)(ii)	$\text{C}_3\text{H}_7\text{OH} \rightarrow \text{C}_3\text{H}_6 + \text{H}_2\text{O}$ M1 $\text{C}_3\text{H}_6$ M2 rest of the equation	2
3(d)(iii)	propene	1

Question	Answer	Marks
4(a)	(damp) litmus (turns) blue	1 1
4(b)(i)	proton acceptor	1
4(b)(ii)	Above pH 7 up to 11	1

Question	Answer	Marks
4(b)(iii)	blue precipitate	1
	precipitate dissolves	1
	deep blue solution remains	1
4(c)(i)	neutralisation	1
4(c)(ii)	Na <sub>2</sub> SO <sub>4</sub>	1
	2H <sub>2</sub> O	1
4(d)(i)	methyl orange	1
4(d)(ii)	$M1 \text{ mol of NaOH} = 0.0400 \times \frac{25.0}{1000} = 0.001(00) \text{ mol}$ $M2 \text{ mol of H}_2\text{SO}_4 = \frac{M1}{2} = \frac{0.001}{2} = 0.0005(00)$ $M3 M2 \times \frac{1000}{20.0} = 0.0005 \times \frac{1000}{20.0} = 0.025 \text{ (mol / dm}^3\text{)}$ allow ecf	3
4(d)(iii)	M1 use of 40 g/mol M2 $40 \times 0.04 = 1.6 \text{ (g/dm}^3\text{)}$	2

Question	Answer	Marks
5(a)	M1 sugar(s) M2 fermentation M3 ethene M4 hydration	4

Question	Answer	Marks
5(b)	(acidified) potassium manganate(VII)	1
5(c)(i)	(Liebig) condenser	1
5(c)(ii)	arrow at the lower inlet	1
5(d)(i)	methanal	1
	$C_4H_8O$	1
5(d)(ii)	$C_nH_{2n}O$	1
5(e)(i)	functional group	1
5(e)(ii)	M1 $4 \times C-H$ dot cross bonds and 1 $C-C$ dot cross bond M2 $1 \times C=O$ dot cross bond M3 non-bonding electrons on O	3
5(f)(i)	(structural) isomers	1
5(f)(ii)	M1 any structure with correct valencies and formula of $C_3H_6O$ M2 $C=O$ bond on second carbon (of a chain of 3)	2



# Cambridge IGCSE™

## CHEMISTRY

0620/23

Paper 2 Multiple Choice (Extended)

May/June 2020

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. A mark will not be deducted for a wrong answer.
- Any rough working should be done on this question paper.
- The Periodic Table is printed in the question paper.

This document has **16** pages. Blank pages are indicated.

- 1 A mixture of ice and water is left to stand and the ice melts.

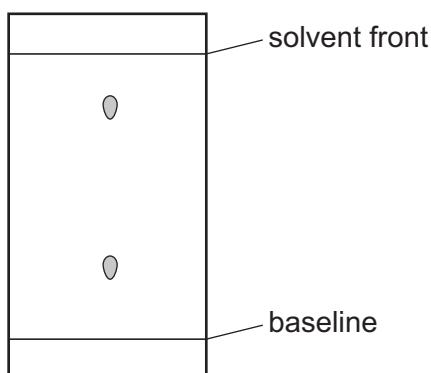
Which row describes what happens as the ice is melting?

	temperature of mixture	energy changes
A	increases	average kinetic energy of particles increases
B	increases	energy is used to overcome attractive forces
C	stays the same	average kinetic energy of particles increases
D	stays the same	energy is used to overcome attractive forces

- 2 Which piece of apparatus is used to measure 13.7 cm<sup>3</sup> of dilute hydrochloric acid?

- A balance
- B burette
- C conical flask
- D pipette

- 3 Chromatography is carried out on a mixture of three substances. The chromatogram is sprayed with a locating agent. The result is shown.

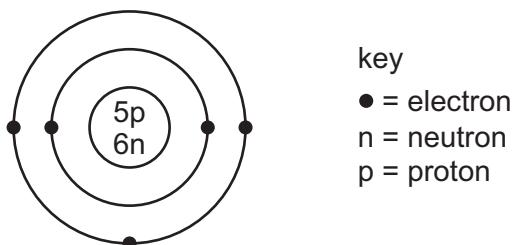


What are possible reasons why the chromatogram shows only two spots?

- 1 One of the substances in the mixture is insoluble in the solvent.
- 2 The locating agent did not react with one of the substances in the mixture.
- 3 Two of the substances in the mixture have the same  $R_f$  values.
- 4 The  $R_f$  value of one of the substances is too small.

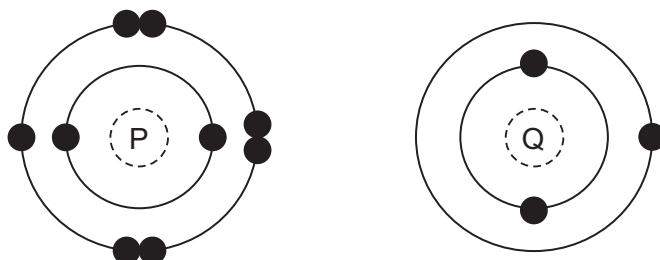
- A 1 and 2
- B 1 and 4
- C 2 and 3
- D 3 and 4

- 4 The structure of an atom of element X is shown.



What is element X?

- A boron
  - B carbon
  - C sodium
  - D sulfur
- 5 The electronic structures of two atoms, P and Q, are shown.



P and Q combine together to form a compound.

What is the type of bonding in the compound and what is the formula of the compound?

	type of bonding	formula
A	ionic	PQ
B	ionic	PQ <sub>2</sub>
C	covalent	PQ <sub>2</sub>
D	covalent	PQ

- 6 Caesium is a metal in Group I of the Periodic Table.

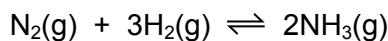
Which description of the bonding in caesium is correct?

- A electrostatic attraction between oppositely charged ions
- B electrostatic attraction between positive metal ions and mobile electrons
- C neighbouring metal atoms sharing pairs of electrons
- D strong attractive forces between atoms

- 7 Why does magnesium oxide, MgO, have a very high melting point?
- A There is a very strong double bond between magnesium and oxygen.  
 B There is a very strong attractive force between the magnesium oxide molecules.  
 C The oxide ions are strongly attracted to positive ions.  
 D The magnesium ions are strongly attracted to a sea of electrons.
- 8 Aluminium metal reacts with iron(III) oxide to form aluminium oxide and iron.

Which chemical equation for the reaction between aluminium and iron(III) oxide is correct?

- A  $\text{FeO} + \text{Al} \rightarrow \text{AlO} + \text{Fe}$   
 B  $\text{Fe}_2\text{O} + 2\text{Al} \rightarrow \text{Al}_2\text{O} + 2\text{Fe}$   
 C  $\text{Fe}_2\text{O}_3 + \text{Al} \rightarrow \text{Al}_2\text{O}_3 + \text{Fe}$   
 D  $\text{Fe}_2\text{O}_3 + 2\text{Al} \rightarrow \text{Al}_2\text{O}_3 + 2\text{Fe}$
- 9 The Haber process is a reversible reaction.



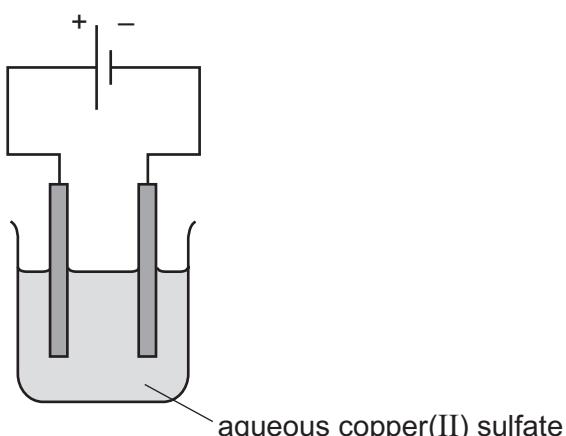
The reaction has a 30% yield of ammonia.

Which volume of ammonia gas,  $\text{NH}_3$ , measured at room temperature and pressure, is obtained by reacting 0.75 moles of hydrogen with excess nitrogen?

- A  $3600 \text{ cm}^3$       B  $5400 \text{ cm}^3$       C  $12000 \text{ cm}^3$       D  $18000 \text{ cm}^3$
- 10 Which row describes the reactions during the electrolysis of dilute aqueous sodium chloride?

	anode (+) reaction	cathode (-) reaction
A	$\text{H}_2 \rightarrow 2\text{H}^+ + 2\text{e}^-$	$2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^- \rightarrow 4\text{OH}^-$
B	$2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$	$4\text{OH}^- \rightarrow 2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^-$
C	$2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^- \rightarrow 4\text{OH}^-$	$\text{H}_2 \rightarrow 2\text{H}^+ + 2\text{e}^-$
D	$4\text{OH}^- \rightarrow 2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^-$	$2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$

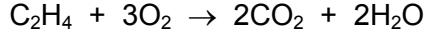
- 11 The electrolysis of aqueous copper(II) sulfate, using inert electrodes, is shown.



Which statement about a reaction at an electrode is correct?

- A Copper ions gain electrons at the negative electrode.
  - B Copper ions gain electrons at the positive electrode.
  - C Hydrogen ions gain electrons at the negative electrode.
  - D Hydrogen ions gain electrons at the positive electrode.
- 12 Ethene gas,  $\text{C}_2\text{H}_4$ , is completely burned in excess oxygen to form carbon dioxide and water.

The equation for this exothermic reaction is shown.



The table shows the bond energies involved in the reaction.

bond	bond energy (kJ/mol)
$\text{C}=\text{C}$	614
$\text{C}-\text{H}$	413
$\text{O}=\text{O}$	495
$\text{C}=\text{O}$	799
$\text{O}-\text{H}$	467

What is the total energy change in this reaction?

- A  $-954 \text{ kJ/mol}$
- B  $-1010 \text{ kJ/mol}$
- C  $-1313 \text{ kJ/mol}$
- D  $-1369 \text{ kJ/mol}$

13 Which statements about hydrogen fuel cells are correct?

- 1 Water is formed as the only waste product.
- 2 Both water and carbon dioxide are formed as waste products.
- 3 The overall reaction is  $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$ .
- 4 The overall reaction is endothermic.

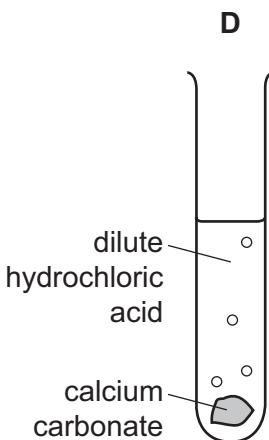
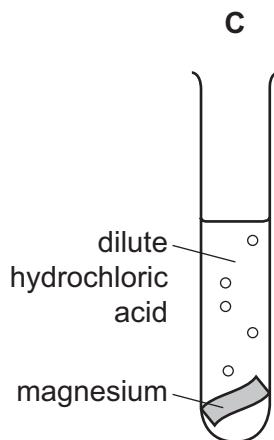
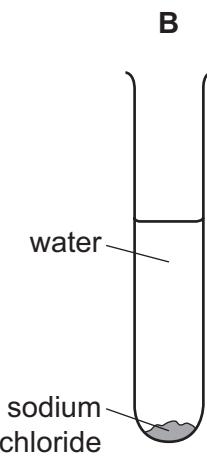
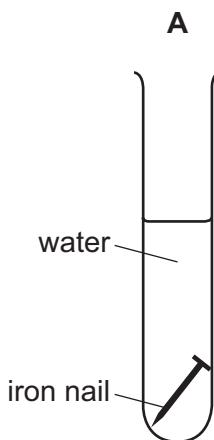
**A** 1 and 3

**B** 1 and 4

**C** 2 and 3

**D** 2 and 4

14 In which tube is a physical change taking place?

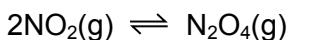


15 A chemical reaction occurs when the reacting particles collide.

Which reaction conditions would produce the greatest rate of particle collisions?

	concentration of acid	reaction temperature
<b>A</b>	decrease	decrease
<b>B</b>	no change	increase
<b>C</b>	increase	increase
<b>D</b>	increase	no change

- 16 At room temperature, the conversion of nitrogen dioxide,  $\text{NO}_2$ , into dinitrogen tetroxide,  $\text{N}_2\text{O}_4$ , is reversible.



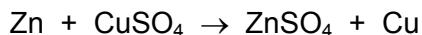
brown colourless  
gas gas

The forward reaction is exothermic.

Which changes cause the equilibrium to shift to the left?

	pressure	temperature
A	decrease	decrease
B	decrease	increase
C	increase	decrease
D	increase	increase

- 17 The equation for the reaction between zinc and aqueous copper(II) sulfate is shown.

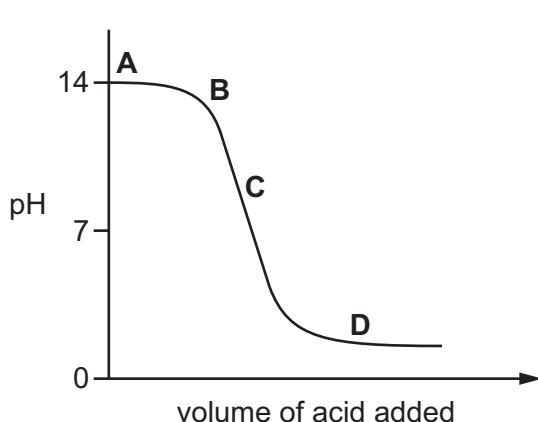


Which statement is correct?

- A The oxidation state of the oxidising agent has changed from 0 to +2.
  - B The oxidation state of the reducing agent has changed from 0 to +2.
  - C The oxidation state of the reducing agent has changed from +2 to 0.
  - D This is not a redox reaction. The solution changes from colourless to blue.
- 18 The graph shows how the pH of a solution changes as an acid is added to an alkali.



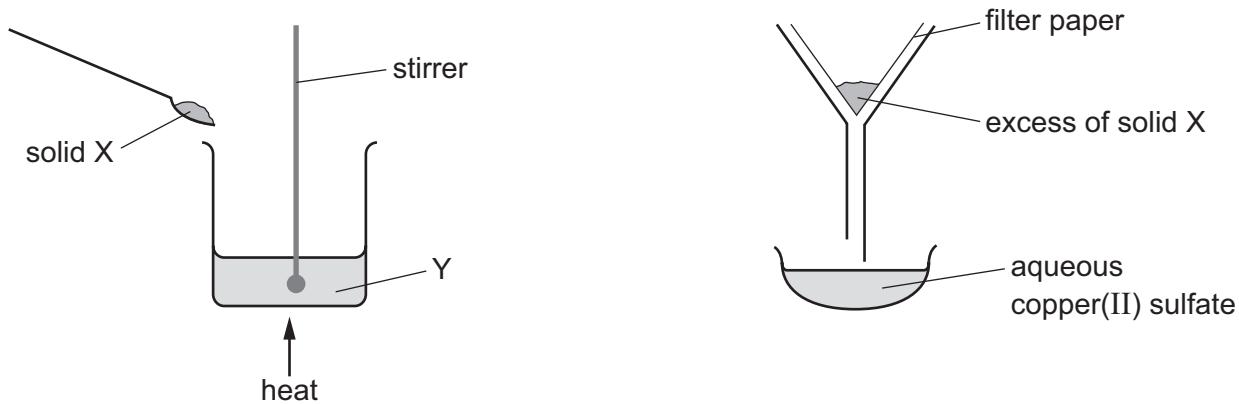
Which letter represents the area of the graph where both acid and salt are present?



19 Which statement describes a weak acid?

- A It is a proton acceptor and is fully ionised in aqueous solution.
- B It is a proton acceptor and is partially ionised in aqueous solution.
- C It is a proton donor and is fully ionised in aqueous solution.
- D It is a proton donor and is partially ionised in aqueous solution.

20 The apparatus shown is used to prepare aqueous copper(II) sulfate.



What are X and Y?

	X	Y
A	copper	aqueous iron(II) sulfate
B	copper(II) chloride	dilute sulfuric acid
C	copper(II) oxide	dilute sulfuric acid
D	sulfur	aqueous copper(II) chloride

21 Which two compounds would react together to form the insoluble salt lead(II) chloride?

	compound	solubility in water
1	lead(II) nitrate	yes
2	lead(II) sulfate	no
3	silver chloride	no
4	sodium chloride	yes

A 1 and 3

B 1 and 4

C 2 and 3

D 2 and 4

**22** The elements in Group I include lithium, sodium and potassium.

Which statements about these elements are correct?

- 1 Sodium is denser than lithium.
- 2 Lithium has a lower melting point than potassium.
- 3 Potassium is a relatively soft metal.
- 4 Sodium is less reactive than lithium but more reactive than potassium.

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

**23** The properties of the element titanium, Ti, can be predicted from its position in the Periodic Table.

Which row identifies the properties of titanium?

	can be used as a catalyst	conducts electricity when solid	has low density	forms coloured compounds
<b>A</b>	✓	✓	✓	✗
<b>B</b>	✓	✓	✗	✓
<b>C</b>	✓	✗	✓	✓
<b>D</b>	✗	✓	✓	✓

**24** Which statement about the noble gases is correct?

- A** Argon is used in light bulbs and balloons.
- B** Helium reacts with oxygen in the air.
- C** They all have full outer electron shells.
- D** They are all diatomic molecules.

**25** Which property is shown by **all** metals?

- A** They are extracted from their ores by heating with carbon.
- B** They conduct electricity.
- C** They form acidic oxides.
- D** They react with hydrochloric acid to form hydrogen.

**26** A salt is heated strongly. The only products are a white solid and a colourless gas.

What is the salt?

- A** copper(II) carbonate
- B** potassium carbonate
- C** calcium nitrate
- D** sodium nitrate

**27** Molten iron from the blast furnace contains impurities.

The process of turning the impure iron into steel involves blowing oxygen into the molten iron and adding calcium oxide.

What are the reasons for blowing in oxygen and adding calcium oxide?

	blowing in oxygen	adding calcium oxide
<b>A</b>	carbon is removed by reacting with oxygen	reacts with acidic impurities making slag
<b>B</b>	carbon is removed by reacting with oxygen	reacts with slag and so removes it
<b>C</b>	iron reacts with the oxygen	reacts with acidic impurities making slag
<b>D</b>	iron reacts with the oxygen	reacts with slag and so removes it

**28** P, Q, R and S are four metals.

P displaces Q from a solution of its sulfate.

Q reacts with hydrochloric acid and can be extracted from its ore using carbon.

R does not react with hydrochloric acid.

The carbonate of S does not decompose when heated strongly.

What is the order of reactivity of the metals, starting with the most reactive?

	most reactive → least reactive			
<b>A</b>	R	P	Q	S
<b>B</b>	R	Q	P	S
<b>C</b>	S	P	Q	R
<b>D</b>	S	Q	P	R

29 Which substances can be used to detect the presence of water?

- 1 cobalt(II) chloride
- 2 copper(II) sulfate
- 3 litmus
- 4 methyl orange

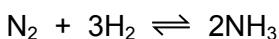
A 1 and 2      B 1 and 3      C 2 and 4      D 3 and 4

30 Which processes increase the amount of carbon dioxide in the atmosphere?

- 1 burning ethanol
- 2 farming cattle
- 3 growing trees

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

31 Hydrogen and nitrogen react to form ammonia in the Haber process.



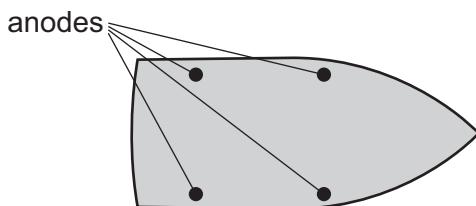
The forward reaction is exothermic.

Which statements about the process are correct?

- 1 Nitrogen is obtained from the air.
- 2 Increasing the temperature of the reaction increases the yield of ammonia.
- 3 Increasing the reaction pressure increases the yield of ammonia.
- 4 Vanadium(V) oxide is used as a catalyst.

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

32 The diagram shows the positions of sacrificial anodes on the steel hull of a yacht.



Which metal is used to make the anodes?

- A** calcium
- B** copper
- C** sodium
- D** zinc

33 A student suggests three uses of calcium carbonate (limestone).

- 1 manufacture of cement
- 2 manufacture of iron
- 3 treating alkaline soils

Which suggestions are correct?

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

34 Which reaction in the Contact process is catalysed by vanadium(V) oxide?

- A**  $\text{S(s)} + \text{O}_2\text{(g)} \rightarrow \text{SO}_2\text{(g)}$
- B**  $2\text{SO}_2\text{(g)} + \text{O}_2\text{(g)} \rightarrow 2\text{SO}_3\text{(g)}$
- C**  $\text{SO}_3\text{(g)} + \text{H}_2\text{SO}_4\text{(l)} \rightarrow \text{H}_2\text{S}_2\text{O}_7\text{(l)}$
- D**  $\text{H}_2\text{S}_2\text{O}_7\text{(l)} + \text{H}_2\text{O(l)} \rightarrow 2\text{H}_2\text{SO}_4\text{(l)}$

35 Ethanol is produced by:

- 1 the catalytic addition of steam to ethene
- 2 fermentation.

Which statement is correct?

- A** Both processes require similar amounts of energy.
- B** Both processes use a catalyst.
- C** Process 1 uses a renewable resource.
- D** Process 2 produces the purest ethanol.

36 Which statement about a homologous series is correct?

- A All members have the same general formula.
- B All members have the same molecular formula.
- C All members have similar physical properties.
- D Members show a trend in their chemical properties.

37 Increasing the number of atoms in one molecule of a hydrocarbon increases the amount of energy released when it burns.

What is the correct order?

	less energy released			more energy released
A	ethene	ethane		methane
B	ethene	methane		ethane
C	methane	ethane		ethene
D	methane	ethene		ethane

38 A small quantity of a solid chemical is added to a large excess of aqueous ethanoic acid.

No bubbles of gas are seen and the solid dissolves to give a colourless solution.

What was the solid chemical?

- A calcium hydroxide
- B copper(II) oxide
- C magnesium
- D sodium carbonate

39 Alkanes undergo substitution reactions with chlorine in the presence of ultraviolet light.

Which equation shows a reaction of this type?

- A  $\text{C}_3\text{H}_6 + \text{Cl}_2 \rightarrow \text{C}_3\text{H}_6\text{Cl}_2$
- B  $\text{C}_3\text{H}_8 + \text{Cl}_2 \rightarrow \text{C}_3\text{H}_6\text{Cl}_2 + \text{H}_2$
- C  $\text{C}_3\text{H}_8 + 2\text{Cl}_2 \rightarrow \text{C}_3\text{H}_6\text{Cl}_2 + 2\text{HCl}$
- D  $\text{C}_3\text{H}_6 + \text{Cl}_2 \rightarrow \text{C}_3\text{H}_5\text{Cl} + \text{HCl}$

40 Which statement about carbohydrates and proteins is correct?

- A Carbohydrates and proteins are constituents of food.
- B Carbohydrates and proteins are natural polymers used to make larger molecules called monomers.
- C Carbohydrates and proteins are synthetic polymers.
- D Carbohydrates and proteins cause pollution as they are non-biodegradable.

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## The Periodic Table of Elements

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# **Cambridge IGCSE™**

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**CHEMISTRY**

**0620/23**

Paper 2 Multiple Choice (Extended)

**May/June 2020**

**MARK SCHEME**

Maximum Mark: 40

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**Published**

Students did not sit exam papers in the June 2020 series due to the Covid-19 global pandemic.

This mark scheme is published to support teachers and students and should be read together with the question paper. It shows the requirements of the exam.

Mark schemes should usually be read together with the Principal Examiner Report for Teachers. However, because students did not sit exam papers, there is no Principal Examiner Report for Teachers for the June 2020 series.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the June 2020 series for most Cambridge IGCSE™ and Cambridge International A & AS Level components, and some Cambridge O Level components.

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This document consists of **3** printed pages.

Question	Answer	Marks
1	D	1
2	B	1
3	C	1
4	A	1
5	A	1
6	B	1
7	C	1
8	D	1
9	A	1
10	D	1
11	A	1
12	C	1
13	A	1
14	B	1
15	C	1
16	B	1
17	B	1
18	D	1
19	D	1
20	C	1
21	B	1
22	B	1
23	B	1
24	C	1
25	B	1
26	D	1
27	A	1
28	C	1

Question	Answer	Marks
29	A	1
30	B	1
31	B	1
32	D	1
33	A	1
34	B	1
35	B	1
36	A	1
37	D	1
38	A	1
39	C	1
40	A	1



# Cambridge IGCSE™

## CHEMISTRY

0620/22

Paper 2 Multiple Choice (Extended)

May/June 2020

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. A mark will not be deducted for a wrong answer.
- Any rough working should be done on this question paper.
- The Periodic Table is printed in the question paper.

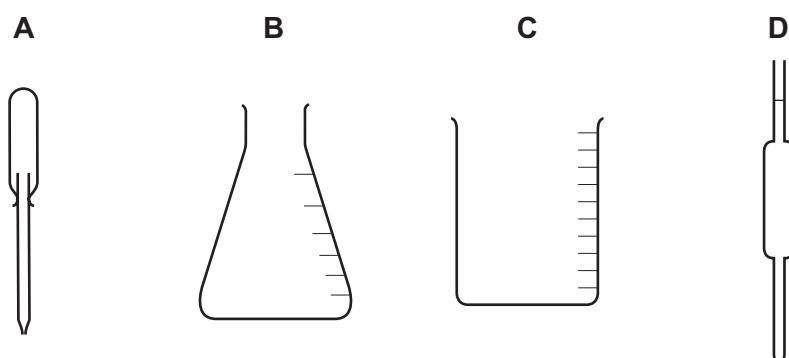
This document has **16** pages. Blank pages are indicated.

- 1 A mixture of ice and water is left to stand and the ice melts.

Which row describes what happens as the ice is melting?

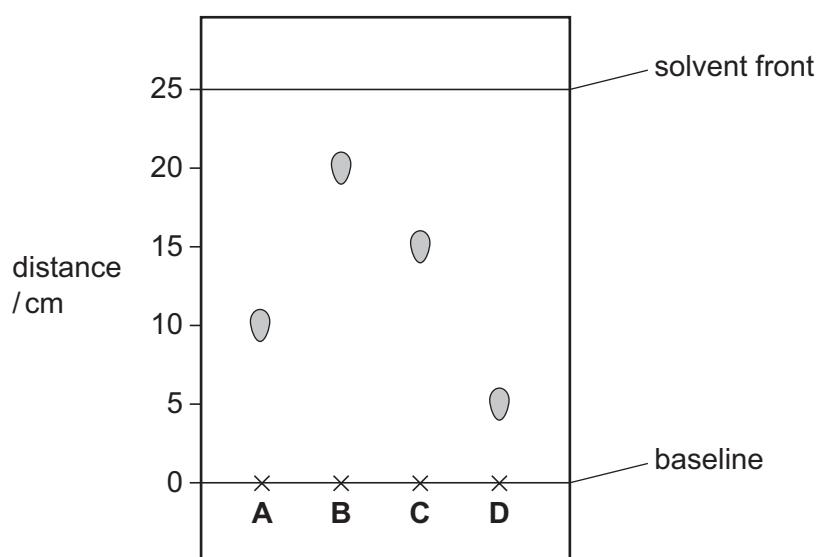
	temperature of mixture	energy changes
A	increases	average kinetic energy of particles increases
B	increases	energy is used to overcome attractive forces
C	stays the same	average kinetic energy of particles increases
D	stays the same	energy is used to overcome attractive forces

- 2 Which piece of apparatus is used to measure  $25.0\text{ cm}^3$  of aqueous sodium hydroxide?

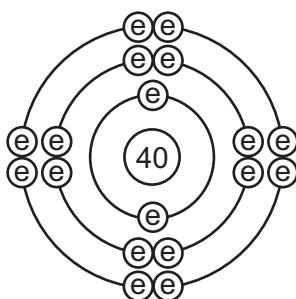


- 3 Paper chromatography is used to determine the  $R_f$  values for four different food colourings.

Which food colouring has an  $R_f$  value of 0.6?



- 4 The diagram shows the electronic structure of a particle with a nucleon number (mass number) of 40.

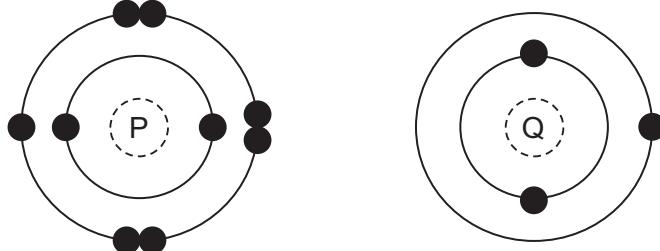


The table shows the suggestions that three students, 1, 2 and 3, made to identify the particle.

	student		
	1	2	3
particle	Ar	Cl	$\text{Ca}^{2+}$

Which students are correct?

- A 1 and 2 only    B 1 and 3 only    C 2 and 3 only    D 1, 2 and 3
- 5 The electronic structures of two atoms, P and Q, are shown.



P and Q combine together to form a compound.

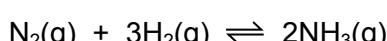
What is the type of bonding in the compound and what is the formula of the compound?

	type of bonding	formula
A	ionic	PQ
B	ionic	$\text{PQ}_2$
C	covalent	$\text{PQ}_2$
D	covalent	PQ

- 6 Which statement about the structure of a metal explains why metals are malleable?
- A The electrons can move freely throughout the lattice.  
 B The layers of metal ions can slide over each other.  
 C The metal ions are positively charged.  
 D There is a strong force of attraction between the metal ions and the electrons.
- 7 The bonding, structure and melting point of sodium chloride and sulfur dichloride are shown.
- | compound          | bonding  | structure        | melting point / °C |
|-------------------|----------|------------------|--------------------|
| sodium chloride   | ionic    | giant lattice    | 801                |
| sulfur dichloride | covalent | simple molecular | -121               |
- Why does sulfur dichloride have a lower melting point than sodium chloride?
- A The covalent bonds in sulfur dichloride are weaker than the attractive forces between molecules in sodium chloride.  
 B The covalent bonds in sulfur dichloride are weaker than the ionic bonds in sodium chloride.  
 C The attractive forces between molecules in sulfur dichloride are weaker than the attractive forces between molecules in sodium chloride.  
 D The attractive forces between molecules in sulfur dichloride are weaker than the ionic bonds in sodium chloride.
- 8 Lead(II) nitrate,  $\text{Pb}(\text{NO}_3)_2$ , reacts with potassium iodide, KI, to form a yellow precipitate,  $\text{PbI}_2$ , and a soluble salt,  $\text{KNO}_3$ .

What is the equation for the reaction?

- A  $\text{Pb}(\text{NO}_3)_2 + \text{KI} \rightarrow \text{PbI}_2 + \text{KNO}_3$   
 B  $\text{Pb}(\text{NO}_3)_2 + 2\text{KI} \rightarrow \text{PbI}_2 + \text{KNO}_3$   
 C  $2\text{Pb}(\text{NO}_3)_2 + 2\text{KI} \rightarrow \text{PbI}_2 + 2\text{KNO}_3$   
 D  $\text{Pb}(\text{NO}_3)_2 + 2\text{KI} \rightarrow \text{PbI}_2 + 2\text{KNO}_3$
- 9 The Haber process is a reversible reaction.



The reaction has a 30% yield of ammonia.

Which volume of ammonia gas,  $\text{NH}_3$ , measured at room temperature and pressure, is obtained by reacting 0.75 moles of hydrogen with excess nitrogen?

- A  $3600 \text{ cm}^3$       B  $5400 \text{ cm}^3$       C  $12\,000 \text{ cm}^3$       D  $18\,000 \text{ cm}^3$

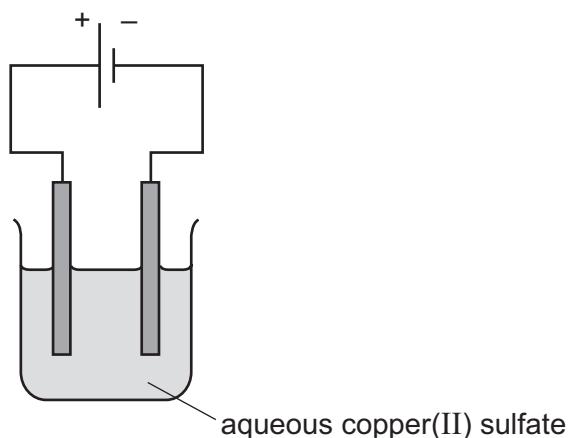
- 10 Electrolytes can be broken down by electrolysis.

Which rows are correct for each electrolyte?

	electrolyte	reaction at cathode	product at anode
1	dilute aqueous sodium chloride	$2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$	oxygen
2	concentrated hydrochloric acid	$2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$	chlorine
3	molten aluminium oxide	$2\text{O}^{2-} \rightarrow \text{O}_2 + 4\text{e}^-$	aluminium
4	concentrated aqueous sodium bromide	$\text{Na}^+ + \text{e}^- \rightarrow \text{Na}$	bromine

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

- 11 The electrolysis of aqueous copper(II) sulfate, using inert electrodes, is shown.

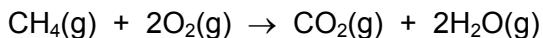


Which statement about a reaction at an electrode is correct?

- A Copper ions gain electrons at the negative electrode.
- B Copper ions gain electrons at the positive electrode.
- C Hydrogen ions gain electrons at the negative electrode.
- D Hydrogen ions gain electrons at the positive electrode.

**12** Methane burns in excess oxygen.

The equation is shown.



Bond energies are shown.

bond	bond energy / kJ mol <sup>-1</sup>
C=O	805
C–H	410
O=O	496
O–H	460

What is the energy change for the reaction?

- A**  $(4 \times 410 + 2 \times 496) - (2 \times 805 + 4 \times 460)$
- B**  $(2 \times 805 + 2 \times 460) - (410 + 2 \times 496)$
- C**  $(410 + 2 \times 496) - (805 + 2 \times 460)$
- D**  $(410 + 496) - (805 + 460)$

**13** Which statements about hydrogen fuel cells are correct?

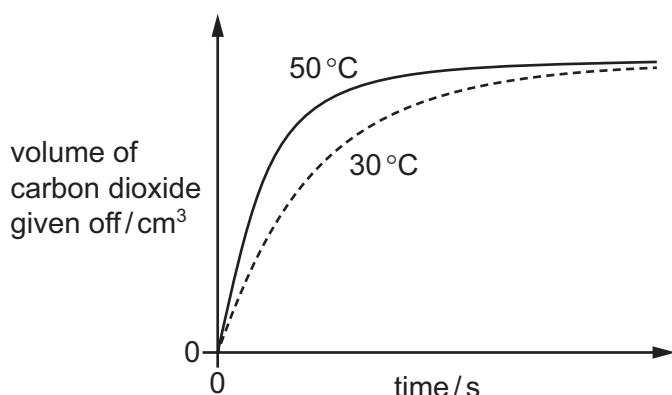
- 1 Water is formed as the only waste product.
- 2 Both water and carbon dioxide are formed as waste products.
- 3 The overall reaction is  $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$ .
- 4 The overall reaction is endothermic.

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

**14** Which list contains **only** chemical changes?

- A** melting, evaporating, dissolving
- B** rusting, freezing, subliming
- C** neutralisation, polymerisation, combustion
- D** boiling, condensing, distillation

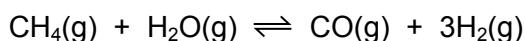
- 15 The results of adding excess marble chips (calcium carbonate) to hydrochloric acid at 50 °C and at 30 °C are shown. Only the temperature is changed.



Which row describes the reacting particles at 30 °C compared to those at 50 °C?

	collision rate	collision energy
A	higher	higher
B	higher	lower
C	lower	higher
D	lower	lower

- 16 Methane reacts with steam and an equilibrium is reached.



The forward reaction is endothermic.

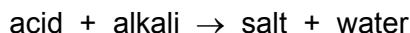
Which row shows how the amount of hydrogen at equilibrium changes when the pressure or temperature is changed as indicated?

	change in temperature	change in pressure	amount of hydrogen
A	decrease	no change	increase
B	increase	no change	decrease
C	no change	increase	decrease
D	no change	decrease	decrease

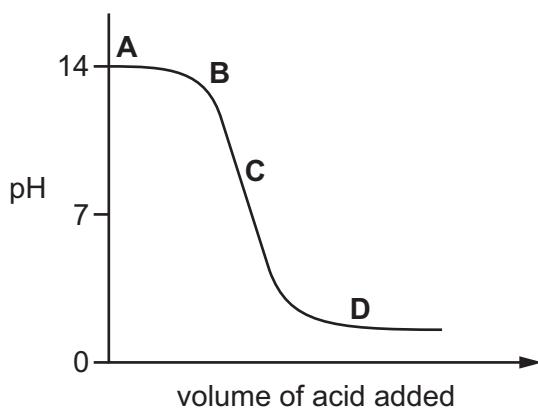
- 17 When aqueous iron(III) chloride is added to aqueous potassium iodide a chemical reaction occurs and iodine is formed.

Which statement is correct?

- A Iodide ions are oxidised, they gain electrons in this reaction.
  - B Iodide ions are oxidised, they lose electrons in this reaction.
  - C Iron(III) chloride is oxidised in this reaction.
  - D Neither iodide ions nor iron(III) chloride is oxidised in this reaction.
- 18 The graph shows how the pH of a solution changes as an acid is added to an alkali.



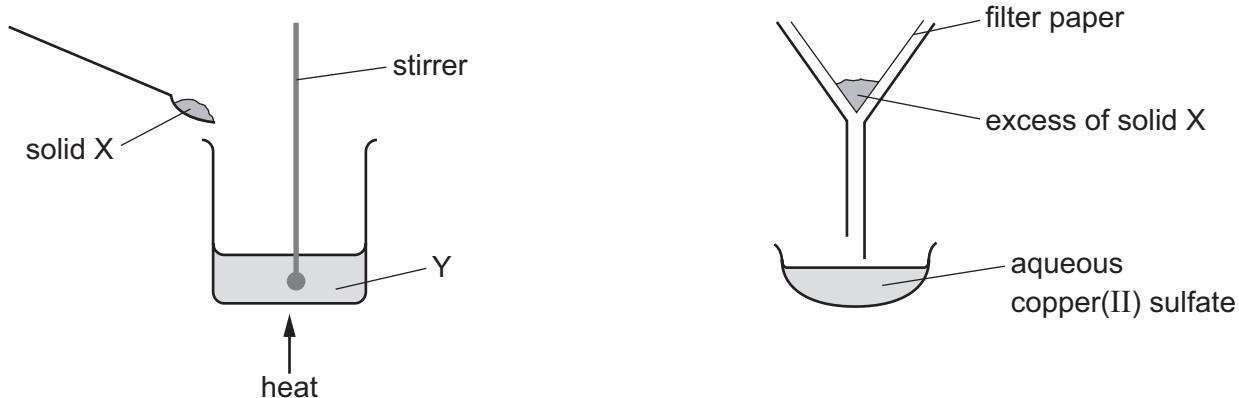
Which letter represents the area of the graph where both acid and salt are present?



- 19 Which statement describes a weak acid?

- A It is a proton acceptor and is fully ionised in aqueous solution.
- B It is a proton acceptor and is partially ionised in aqueous solution.
- C It is a proton donor and is fully ionised in aqueous solution.
- D It is a proton donor and is partially ionised in aqueous solution.

- 20 The apparatus shown is used to prepare aqueous copper(II) sulfate.



What are X and Y?

	X	Y
A	copper	aqueous iron(II) sulfate
B	copper(II) chloride	dilute sulfuric acid
C	copper(II) oxide	dilute sulfuric acid
D	sulfur	aqueous copper(II) chloride

- 21 Which process is **not** used in the preparation of an insoluble salt?

- A filtration
- B washing
- C crystallisation
- D drying

- 22 Which statement about Group I and Group VII elements is correct?

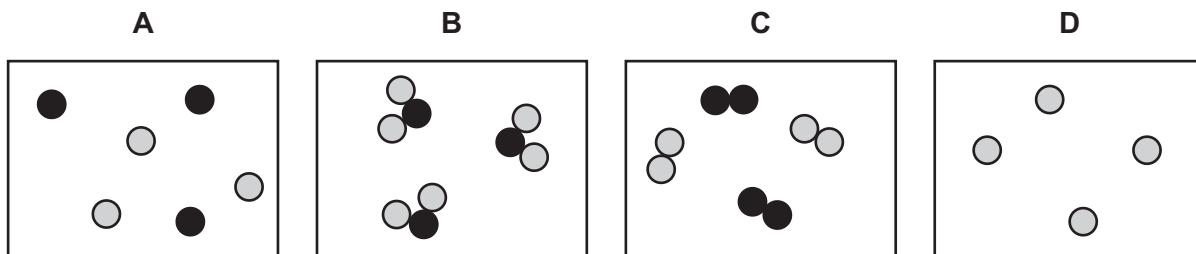
- A Group VII elements are monoatomic non-metals.
- B Lithium is more reactive with water than caesium.
- C The melting points of Group I metals increase down the group.
- D Potassium bromide reacts with chlorine to produce an orange solution.

23 The properties of the element titanium, Ti, can be predicted from its position in the Periodic Table.

Which row identifies the properties of titanium?

	can be used as a catalyst	conducts electricity when solid	has low density	forms coloured compounds
A	✓	✓	✓	✗
B	✓	✓	✗	✓
C	✓	✗	✓	✓
D	✗	✓	✓	✓

24 Which diagram shows a mixture of noble gases?



25 Which property is shown by **all** metals?

- A They are extracted from their ores by heating with carbon.
- B They conduct electricity.
- C They form acidic oxides.
- D They react with hydrochloric acid to form hydrogen.

26 Many metal carbonates decompose when they are heated.

Which row describes what happens when potassium carbonate, calcium carbonate and copper(II) carbonate are heated using a Bunsen burner?

	decomposes easily	decomposes with difficulty	does not decompose at Bunsen temperatures
A	calcium carbonate	copper(II) carbonate	potassium carbonate
B	copper(II) carbonate	calcium carbonate	potassium carbonate
C	copper(II) carbonate	potassium carbonate	calcium carbonate
D	potassium carbonate	calcium carbonate	copper(II) carbonate

- 27** Molten iron from the blast furnace contains impurities.

The process of turning the impure iron into steel involves blowing oxygen into the molten iron and adding calcium oxide.

What are the reasons for blowing in oxygen and adding calcium oxide?

	blowing in oxygen	adding calcium oxide
A	carbon is removed by reacting with oxygen	reacts with acidic impurities making slag
B	carbon is removed by reacting with oxygen	reacts with slag and so removes it
C	iron reacts with the oxygen	reacts with acidic impurities making slag
D	iron reacts with the oxygen	reacts with slag and so removes it

- 28** Four iron nails are added to four different metal sulfate solutions.

In which solution does a displacement reaction occur?

- A copper(II) sulfate
- B magnesium sulfate
- C sodium sulfate
- D zinc sulfate

- 29** Which statement about pure water is **not** correct?

- A It condenses at 100 °C.
- B It freezes at 0 °C.
- C It turns cobalt(II) chloride paper blue.
- D It turns anhydrous copper(II) sulfate blue.

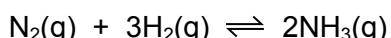
**30** Three processes in the carbon cycle are shown.

- 1 Methane reacts with oxygen producing carbon dioxide and water.
- 2 Carbon dioxide and water are absorbed and used by plants to make oxygen.
- 3 Oxygen is used by living things to release energy.

Which processes have taken place?

	1	2	3
<b>A</b>	combustion	photosynthesis	respiration
<b>B</b>	combustion	respiration	photosynthesis
<b>C</b>	photosynthesis	combustion	respiration
<b>D</b>	respiration	photosynthesis	combustion

**31** In the Haber process, nitrogen and hydrogen are reacted to make ammonia.



The forward reaction is exothermic.

Which conditions produce the maximum yield of ammonia?

	pressure	temperature
<b>A</b>	high	high
<b>B</b>	high	low
<b>C</b>	low	high
<b>D</b>	low	low

**32** Which process, used to prevent iron from rusting, involves sacrificial protection?

- A** alloying
- B** electroplating
- C** galvanising
- D** painting

33 A student suggests three uses of calcium carbonate (limestone).

- 1 manufacture of cement
- 2 manufacture of iron
- 3 treating alkaline soils

Which suggestions are correct?

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

34 One of the reactions used in the manufacture of sulfuric acid is shown.



Which catalyst is used to increase the rate of this reaction?

- A iron  
B manganese(IV) oxide  
C vanadium(V) oxide  
D nickel

35 Ethanol is made on an industrial scale by the fermentation of sugars or by the reaction of ethene with steam in the presence of a suitable catalyst.

What is a **disadvantage** of making ethanol from ethene rather than by fermentation?

- A A continuous production process is used.  
B A non-renewable raw material is used.  
C The product is very pure.  
D The rate of reaction is very high.

36 Which statement about compounds in the same homologous series is correct?

- A They have the same chemical properties because they have the same number of carbon atoms.  
B They have the same physical properties because they have the same number of carbon atoms.  
C They have different chemical properties because they have different numbers of carbon atoms.  
D They have different physical properties because they have different numbers of carbon atoms.

- 37 Increasing the number of atoms in one molecule of a hydrocarbon increases the amount of energy released when it burns.

What is the correct order?

	less energy released	more energy released	
A	ethene	ethane	methane
B	ethene	methane	ethane
C	methane	ethane	ethene
D	methane	ethene	ethane

- 38 An organic compound, P, reacts with zinc to produce a gas, Q.

What are P and Q?

	P	Q
A	ethanoic acid	carbon dioxide
B	ethanoic acid	hydrogen
C	ethanol	carbon dioxide
D	ethanol	hydrogen

- 39 Alkanes undergo substitution reactions in the presence of UV light.

Which equation represents a substitution reaction of ethane?

- A  $\text{C}_2\text{H}_6 + \text{Cl}_2 \rightarrow \text{C}_2\text{H}_4 + 2\text{HCl}$   
 B  $\text{C}_2\text{H}_6 + \text{Cl}_2 \rightarrow \text{C}_2\text{H}_5\text{Cl} + \text{HCl}$   
 C  $\text{C}_2\text{H}_6 + \text{Cl}_2 \rightarrow \text{C}_2\text{H}_4\text{Cl}_2 + \text{H}_2$   
 D  $\text{C}_2\text{H}_6 + \text{HCl} \rightarrow \text{C}_2\text{H}_5\text{Cl} + \text{H}_2$
- 40 Which substances are natural polymers?
- 1 proteins
  - 2 carbohydrates
  - 3 nylon
  - 4 poly(ethene)
- A 1 and 2      B 1 and 3      C 2 and 3      D 3 and 4

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**The Periodic Table of Elements**

I		II		Group																																																																																																																																																																																													
				I						II			III			IV		V		VI		VII		VIII																																																																																																																																																																									
3	Li	4	Be	beryllium 9	5	C	carbon 12	6	N	nitrogen 14	7	O	oxygen 16	8	F	fluorine 19	9	H	hydrogen 1	10	He	helium 4	11	Ne	neon 20																																																																																																																																																																								
11	Na	12	Mg	magnesium 24	13	Si	silicon 28	14	P	phosphorus 31	15	S	sulfur 32	16	Cl	chlorine 35.5	17	Ar	argon 40	18	Xe	xenon 131	19	K	potassium 39																																																																																																																																																																								
19	Ca	20	Sc	scandium 45	21	Ti	titanium 48	22	V	vanadium 51	23	Cr	chromium 52	24	Mn	manganese 55	25	Fe	iron 56	26	Co	cobalt 59	27	Ni	nickel 59	28	Zn	zinc 65	29	Cu	copper 64	30	Ga	gallium 70	31	Ge	germanium 73	32	As	arsenic 75	33	Se	selenium 79	34	Br	bromine 80	35	Kr	krypton 84	36	Rb	rubidium 85																																																																																																																																													
37	Sr	38	Y	yttrium 89	39	Zr	zirconium 91	40	Nb	niobium 93	41	Tc	molybdenum 96	42	Mo	technetium –	43	Ru	ruthenium 101	44	Rh	rhodium 103	45	Pd	palladium 106	46	Ag	silver 108	47	Cd	cadmium 112	48	In	indium 115	49	Sn	tin 119	50	Te	tellurium 122	51	I	iodine 127	52	Rn	radon –	53	Fr	francium –	54	Ac	actinium –	55	Cs	caesium 133	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	Hg	mercury 197	79	Tl	thallium 204	80	Pb	lead 207	81	Bi	bismuth 209	82	Po	polonium –	83	At	astatine –	84	Lv	livmorium –	85	Lu	lutetium 175	86	La	lanthanum 139	58	Ce	cerium 140	59	Pr	praseodymium 141	60	Nd	neodymium 144	61	Pm	promethium –	62	Sm	samarium 150	63	Eu	europlium 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 –	72	Th	thorium 232	90	Pa	protactinium 231	91	U	uranium 238	92	Np	neptunium –	93	Am	americium –	94	Cm	curium –	95	Bk	berkelium –	96	Cf	californium –	97	Fm	fermium –	98	Es	einsteinium –	99	Md	mendelevium –	100	No	nobelium –	101	Lr	lawrencium –	102	Ac	actinium –	103	Fr	francium –

16

lanthanoids	La	57	Ce	58	Pr	59	Nd	60	Pm	61	Sm	62	Eu	63	Gd	64	Tb	65	Dy	66	Ho	67	Er	68	Tm	69	Yb	70	Lu
actinoids	Ac	89	Th	90	Pa	91	U	92	Np	93	Am	94	Pu	95	Cm	96	Bk	97	Cf	98	Es	99	Fm	100	Md	101	No	102	Lr

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



# **Cambridge IGCSE™**

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**CHEMISTRY**

**0620/22**

Paper 2 Multiple Choice (Extended)

**May/June 2020**

**MARK SCHEME**

Maximum Mark: 40

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**Published**

Students did not sit exam papers in the June 2020 series due to the Covid-19 global pandemic.

This mark scheme is published to support teachers and students and should be read together with the question paper. It shows the requirements of the exam.

Mark schemes should usually be read together with the Principal Examiner Report for Teachers. However, because students did not sit exam papers, there is no Principal Examiner Report for Teachers for the June 2020 series.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the June 2020 series for most Cambridge IGCSE™ and Cambridge International A & AS Level components, and some Cambridge O Level components.

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This document consists of **3** printed pages.

Question	Answer	Marks
1	D	1
2	D	1
3	C	1
4	B	1
5	A	1
6	B	1
7	D	1
8	D	1
9	A	1
10	A	1
11	A	1
12	A	1
13	A	1
14	C	1
15	D	1
16	C	1
17	B	1
18	D	1
19	D	1
20	C	1
21	C	1
22	D	1
23	B	1
24	A	1
25	B	1
26	B	1
27	A	1
28	A	1

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
29	C	1
30	A	1
31	B	1
32	C	1
33	A	1
34	C	1
35	B	1
36	D	1
37	D	1
38	B	1
39	B	1
40	A	1



# Cambridge IGCSE™

## CHEMISTRY

0620/21

Paper 2 Multiple Choice (Extended)

May/June 2020

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. A mark will not be deducted for a wrong answer.
- Any rough working should be done on this question paper.
- The Periodic Table is printed in the question paper.

This document has **16** pages. Blank pages are indicated.

- 1 A mixture of ice and water is left to stand and the ice melts.

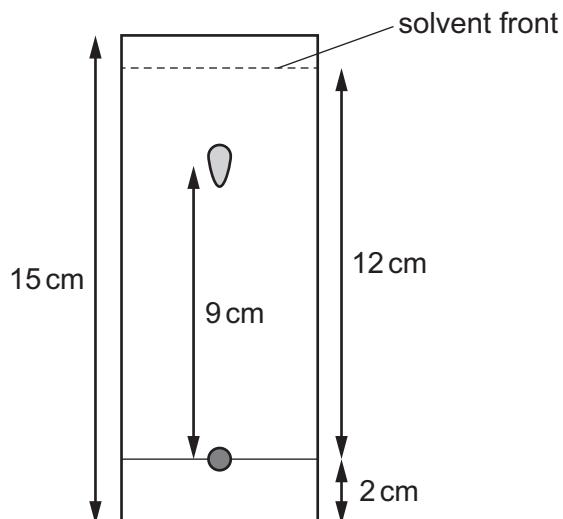
Which row describes what happens as the ice is melting?

	temperature of mixture	energy changes
A	increases	average kinetic energy of particles increases
B	increases	energy is used to overcome attractive forces
C	stays the same	average kinetic energy of particles increases
D	stays the same	energy is used to overcome attractive forces

- 2 Which piece of apparatus should be used to measure exactly  $21.4\text{ cm}^3$  of water?

- A  $25\text{ cm}^3$  beaker
- B  $25\text{ cm}^3$  pipette
- C  $50\text{ cm}^3$  burette
- D  $50\text{ cm}^3$  measuring cylinder

- 3 The chromatogram for an unknown dye is shown.



What is the  $R_f$  value of the dye?

- A 0.60
- B 0.64
- C 0.75
- D 0.82

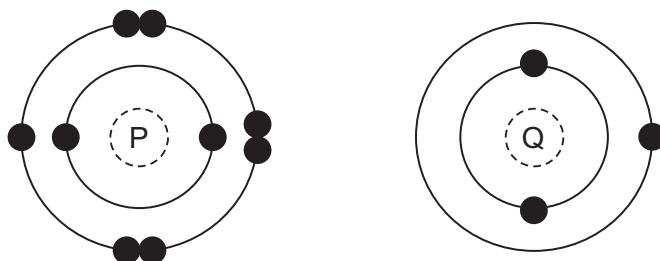
- 4 The atomic number and nucleon number of a potassium atom are shown.

	potassium atom
atomic number	19
nucleon number	39

How many protons, neutrons and electrons are in a potassium ion, K<sup>+</sup>?

	protons	neutrons	electrons
A	19	20	18
B	19	20	20
C	20	19	18
D	20	19	19

- 5 The electronic structures of two atoms, P and Q, are shown.



P and Q combine together to form a compound.

What is the type of bonding in the compound and what is the formula of the compound?

	type of bonding	formula
A	ionic	PQ
B	ionic	PQ <sub>2</sub>
C	covalent	PQ <sub>2</sub>
D	covalent	PQ

- 6 Which row contains a description of metallic bonding and a property that is explained by reference to metallic bonding?

	description of metallic bonding	property explained by metallic bonding
A	a lattice of negative ions in a sea of electrons	a metal will react with an acid, producing hydrogen
B	a lattice of negative ions in a sea of electrons	a piece of a metal can be moulded into different shapes
C	a lattice of positive ions in a sea of electrons	a metal will react with an acid, producing hydrogen
D	a lattice of positive ions in a sea of electrons	a piece of a metal can be moulded into different shapes

- 7 Which statement explains why methane has a lower boiling point than water?

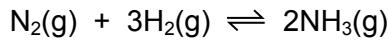
- A Methane has weaker covalent bonds than water.
- B Methane has weaker attractive forces than water.
- C Methane molecules are heavier than water molecules.
- D Methane molecules have more bonds than water molecules.

- 8 A solution of iron(III) sulfate reacts with aqueous sodium hydroxide to form a red–brown precipitate.

What is the balanced equation, including state symbols, for the reaction?

- A  $\text{FeSO}_4(\text{aq}) + 2\text{NaOH}(\text{aq}) \rightarrow \text{Fe(OH)}_2(\text{s}) + \text{Na}_2\text{SO}_4(\text{aq})$
- B  $\text{FeSO}_4(\text{l}) + 2\text{NaOH}(\text{l}) \rightarrow \text{Fe(OH)}_2(\text{s}) + \text{Na}_2\text{SO}_4(\text{l})$
- C  $\text{Fe}_2(\text{SO}_4)_3(\text{aq}) + 6\text{NaOH}(\text{aq}) \rightarrow 2\text{Fe(OH)}_3(\text{s}) + 3\text{Na}_2\text{SO}_4(\text{aq})$
- D  $\text{Fe}_2(\text{SO}_4)_3(\text{l}) + 6\text{NaOH}(\text{aq}) \rightarrow 2\text{Fe(OH)}_3(\text{s}) + 3\text{Na}_2\text{SO}_4(\text{l})$

- 9 The Haber process is a reversible reaction.



The reaction has a 30% yield of ammonia.

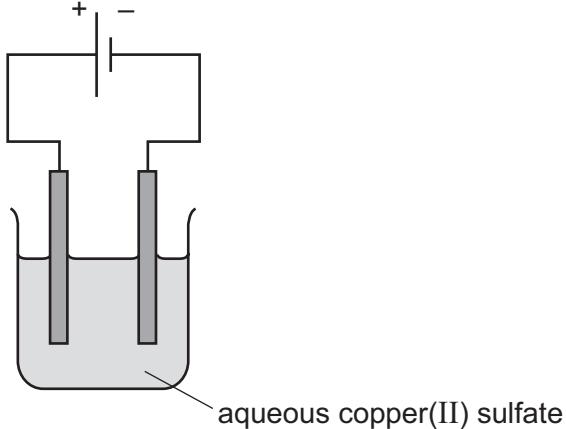
Which volume of ammonia gas,  $\text{NH}_3$ , measured at room temperature and pressure, is obtained by reacting 0.75 moles of hydrogen with excess nitrogen?

- A  $3600 \text{ cm}^3$
- B  $5400 \text{ cm}^3$
- C  $12\,000 \text{ cm}^3$
- D  $18\,000 \text{ cm}^3$

- 10** Dilute aqueous sodium chloride is electrolysed using platinum electrodes.

What is the half-equation for the reaction at the cathode?

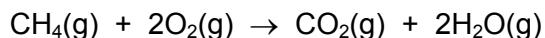
- A**  $2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$
  - B**  $\text{Na}^+ + \text{e}^- \rightarrow \text{Na}$
  - C**  $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$
  - D**  $4\text{OH}^- \rightarrow 2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^-$
- 11** The electrolysis of aqueous copper(II) sulfate, using inert electrodes, is shown.



Which statement about a reaction at an electrode is correct?

- A** Copper ions gain electrons at the negative electrode.
- B** Copper ions gain electrons at the positive electrode.
- C** Hydrogen ions gain electrons at the negative electrode.
- D** Hydrogen ions gain electrons at the positive electrode.

12 The equation for the complete combustion of methane gas is shown.



Bond energies are shown.

bond	bond energy in kJ/mol
C–H	412
H–O	463
C=O	743
O=O	498

What is the overall energy change, in kJ/mol, for the above reaction?

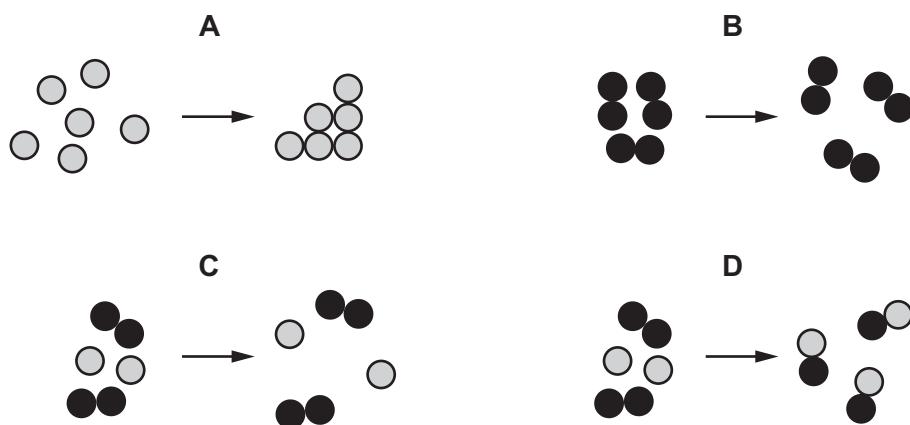
- A -1192      B -694      C +694      D +1192

13 Which statements about hydrogen fuel cells are correct?

- 1 Water is formed as the only waste product.
- 2 Both water and carbon dioxide are formed as waste products.
- 3 The overall reaction is  $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$ .
- 4 The overall reaction is endothermic.

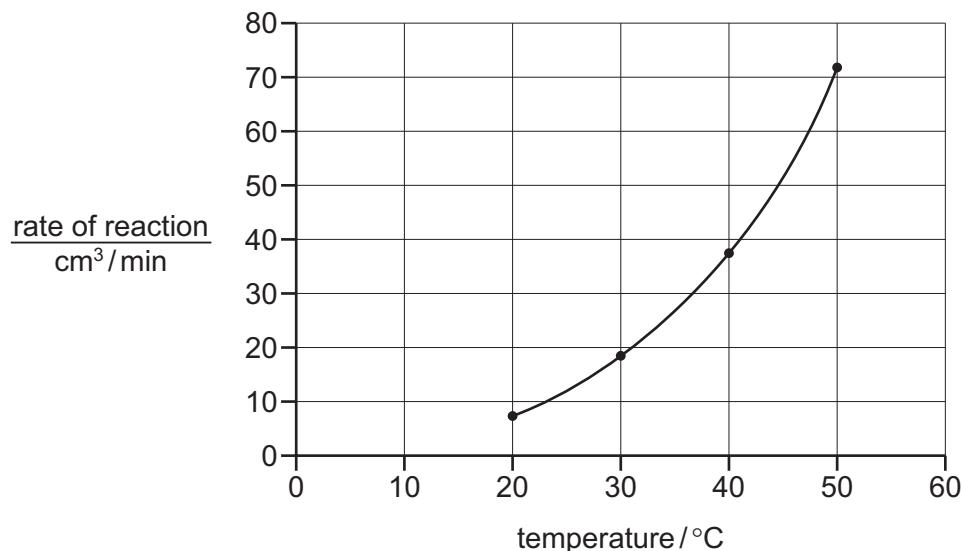
- A 1 and 3      B 1 and 4      C 2 and 3      D 2 and 4

14 Which diagram represents a chemical change?



- 15 The rate of reaction between calcium carbonate chips and hydrochloric acid is studied by collecting the volume of gas released in one minute at different temperatures.

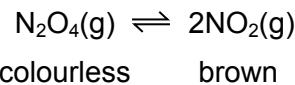
A graph of rate of reaction against temperature is shown.



Which statement fully explains why increasing the temperature has this effect on the rate?

- A The kinetic energy of the particles increases so the collisions are harder.
  - B The number of collisions between particles increases.
  - C The activation energy needed for the particles to react is reduced.
  - D There are more frequent collisions between particles with enough energy to react.
- 16 The equation shows the equilibrium between dinitrogen tetroxide, N<sub>2</sub>O<sub>4</sub>, and nitrogen dioxide, NO<sub>2</sub>.

The colours of the reactant and product are also shown.

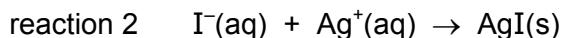
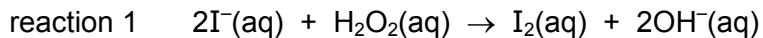


The forward reaction is endothermic.

Which statement is **not** correct?

- A At equilibrium the concentrations of the reactant and the product are constant.
- B At equilibrium the rate of the forward reaction is equal to the rate of the reverse reaction.
- C When the pressure is increased a darker brown colour is seen.
- D When the temperature is increased a darker brown colour is seen.

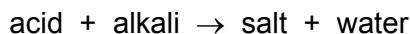
17 The equations for two reactions of iodide ions are shown.



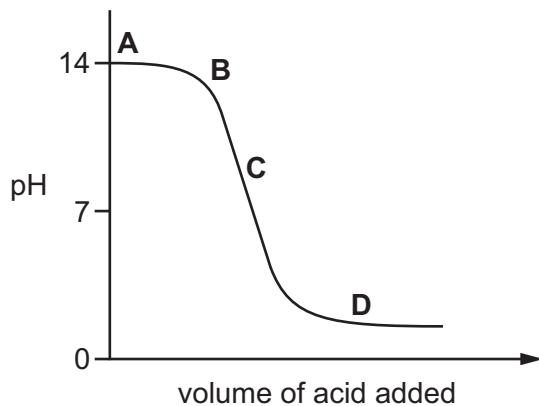
Which statement is correct?

- A Both reactions are redox reactions.
- B Neither reaction is a redox reaction.
- C Only reaction 1 is a redox reaction.
- D Only reaction 2 is a redox reaction.

18 The graph shows how the pH of a solution changes as an acid is added to an alkali.



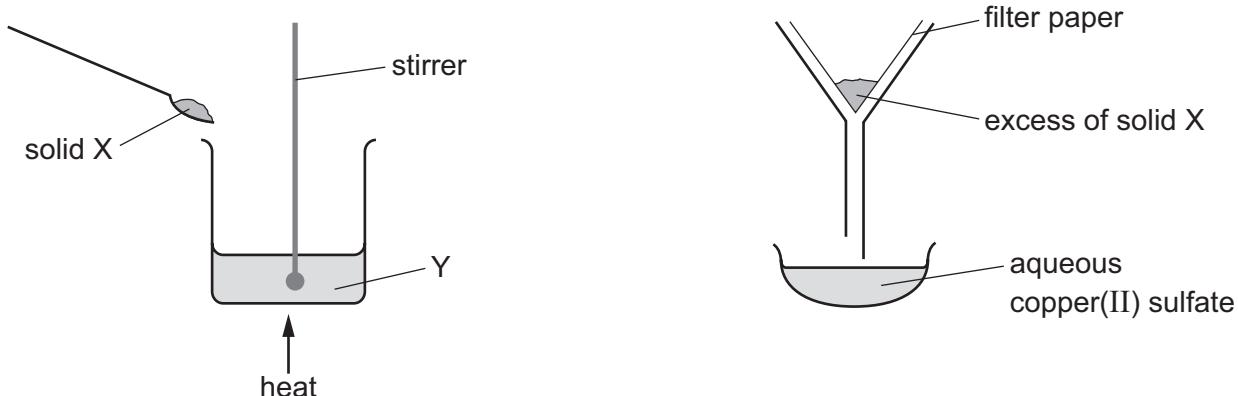
Which letter represents the area of the graph where both acid and salt are present?



19 Which statement describes a weak acid?

- A It is a proton acceptor and is fully ionised in aqueous solution.
- B It is a proton acceptor and is partially ionised in aqueous solution.
- C It is a proton donor and is fully ionised in aqueous solution.
- D It is a proton donor and is partially ionised in aqueous solution.

- 20 The apparatus shown is used to prepare aqueous copper(II) sulfate.



What are X and Y?

	X	Y
A	copper	aqueous iron(II) sulfate
B	copper(II) chloride	dilute sulfuric acid
C	copper(II) oxide	dilute sulfuric acid
D	sulfur	aqueous copper(II) chloride

- 21 Lead(II) sulfate is an insoluble salt.

Which method is suitable for obtaining solid lead(II) sulfate?

- A Mix aqueous lead(II) nitrate and aqueous potassium sulfate, heat to evaporate all of the water, collect the solid and then wash and dry it.
- B Mix aqueous lead(II) nitrate and aqueous potassium sulfate, filter, collect the filtrate, crystallise, then wash and dry the crystals.
- C Mix aqueous lead(II) nitrate and dilute sulfuric acid, filter, then wash and dry the residue.
- D Titrate aqueous lead(II) hydroxide with dilute sulfuric acid, crystallise, then wash and dry the crystals.

- 22 A Group I metal (lithium, sodium or potassium) is reacted with a Group VII element (chlorine, bromine or iodine).

Which compound is formed when the Group I metal of highest density reacts with the Group VII element of lowest density?

- A lithium chloride
- B potassium chloride
- C potassium iodide
- D lithium iodide

- 23 The properties of the element titanium, Ti, can be predicted from its position in the Periodic Table.

Which row identifies the properties of titanium?

	can be used as a catalyst	conducts electricity when solid	has low density	forms coloured compounds
A	✓	✓	✓	✗
B	✓	✓	✗	✓
C	✓	✗	✓	✓
D	✗	✓	✓	✓

- 24 A balloon is filled with helium. Helium is a noble gas and makes the balloon rise up in the air.

The density of air is 1.23 g/dm<sup>3</sup>.

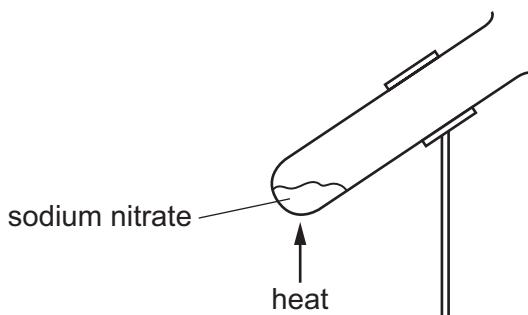
Which gas is helium?

	density in g/dm <sup>3</sup>	reaction with oxygen
A	0.0899	burns rapidly
B	0.179	does not react with oxygen
C	1.78	does not react with oxygen
D	3.75	does not react with oxygen

- 25 Which property is shown by **all** metals?

- A They are extracted from their ores by heating with carbon.
- B They conduct electricity.
- C They form acidic oxides.
- D They react with hydrochloric acid to form hydrogen.

- 26** Sodium nitrate is a white crystalline solid that decomposes on heating.



Which row describes the decomposition products formed when sodium nitrate is heated strongly?

	solid products	gaseous products
<b>A</b>	sodium nitrite	NO <sub>2</sub> and O <sub>2</sub>
<b>B</b>	sodium nitrite	O <sub>2</sub> only
<b>C</b>	sodium oxide	NO <sub>2</sub> and O <sub>2</sub>
<b>D</b>	sodium oxide	O <sub>2</sub> only

- 27** Molten iron from the blast furnace contains impurities.

The process of turning the impure iron into steel involves blowing oxygen into the molten iron and adding calcium oxide.

What are the reasons for blowing in oxygen and adding calcium oxide?

	blowing in oxygen	adding calcium oxide
<b>A</b>	carbon is removed by reacting with oxygen	reacts with acidic impurities making slag
<b>B</b>	carbon is removed by reacting with oxygen	reacts with slag and so removes it
<b>C</b>	iron reacts with the oxygen	reacts with acidic impurities making slag
<b>D</b>	iron reacts with the oxygen	reacts with slag and so removes it

- 28** Element Y reacts with copper(II) oxide to form copper.

Element Y will not react with zinc oxide. Copper has no reaction with zinc oxide.

What is the order of reactivity of these three elements, most reactive first?

- A** Cu → Y → Zn
- B** Cu → Zn → Y
- C** Zn → Cu → Y
- D** Zn → Y → Cu

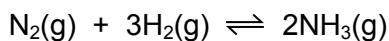
**29** Which statement shows that a liquid is pure water?

- A It boils at 100 °C.
- B It has a pH value of 7.
- C It turns blue cobalt(II) chloride pink.
- D It turns white copper(II) sulfate blue.

**30** Which process removes carbon dioxide from the atmosphere?

- A combustion
- B decomposition
- C photosynthesis
- D respiration

**31** Ammonia is manufactured by the Haber process.



What are the conditions used in the Haber process?

	temperature /°C	pressure /atm
<b>A</b>	400	100
<b>B</b>	400	300
<b>C</b>	20	300
<b>D</b>	20	100

**32** Coating iron helps to prevent rusting.

Which coating will continue to protect the iron even when the coating is damaged?

- A copper
- B paint
- C plastic
- D zinc

**33** A student suggests three uses of calcium carbonate (limestone).

- 1 manufacture of cement
- 2 manufacture of iron
- 3 treating alkaline soils

Which suggestions are correct?

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

**34** The Contact process is used to manufacture concentrated sulfuric acid and consists of four steps.

Which step involves a catalyst?

- A** production of sulfur dioxide gas  
**B** production of sulfur trioxide gas  
**C** production of oleum  
**D** production of concentrated sulfuric acid

**35** Which row about the production of ethanol by fermentation is correct?

	raw materials	energy requirement	rate of reaction
<b>A</b>	non-renewable	high	slow
<b>B</b>	renewable	low	slow
<b>C</b>	non-renewable	low	fast
<b>D</b>	renewable	high	fast

**36** Which statement about homologous series is correct?

- A** Members of a homologous series have the same structural formula.  
**B** Members of a homologous series all have similar chemical properties.  
**C** Members of a homologous series all have similar physical properties.  
**D** Members of all homologous series are hydrocarbons.

- 37** Increasing the number of atoms in one molecule of a hydrocarbon increases the amount of energy released when it burns.

What is the correct order?

	less energy released	→		more energy released
<b>A</b>	ethene	ethane		methane
<b>B</b>	ethene	methane		ethane
<b>C</b>	methane	ethane		ethene
<b>D</b>	methane	ethene		ethane

- 38** Some properties of an organic compound J are listed.

- It is a liquid at room temperature.
- It is soluble in water.
- A solution of J reacts with calcium carbonate to form carbon dioxide.
- A solution of J has a pH of 3.

In which homologous series does J belong?

- A** alkane  
**B** alkene  
**C** alcohol  
**D** carboxylic acid
- 39** Ethane, C<sub>2</sub>H<sub>6</sub>, reacts with chlorine in a substitution reaction.

What are the products of this reaction?

- A** chloroethane and hydrogen  
**B** chloroethane and hydrogen chloride  
**C** chloroethene and hydrogen  
**D** chloroethene and hydrogen chloride

40 Which polymers or types of polymer are synthetic?

1 carbohydrates

2 nylon

3 proteins

4 *Terylene*

A 1 and 3

B 1 and 4

C 2 and 3

D 2 and 4

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**The Periodic Table of Elements**

I		II		Group																													
				III				IV		V		VI		VII		VIII																	
				H																													
		Key																															
3	Li	4	B <sub>e</sub> beryllium 9	5	C <sub>a</sub> calcium 40	6	B <sub>r</sub> bromine 80	7	N <sub>a</sub> nitrogen 14	8	O <sub>xygen</sub> oxygen 16	9	F <sub>luorine</sub> fluorine 19	10	N <sub>e</sub> neon 20	11	H <sub>e</sub> helium 4																
11	Na	12	Mg <sub>agnesium</sub> 24	13	Al <sub>uminum</sub> aluminium 27	14	S <sub>i</sub> silicon 28	15	P <sub>hosphorus</sub> phosphorus 31	16	S <sub>ulfur</sub> sulfur 32	17	C <sub>l</sub> chlorine 35.5	18	A <sub>r</sub> argon 40	19	—																
19	K	20	S <sub>c</sub> scandium 45	21	T <sub>i</sub> titanium 48	22	V <sub>anadium</sub> vanadium 51	23	C <sub>r</sub> chromium 52	24	M <sub>n</sub> manganese 55	25	F <sub>e</sub> iron 56	26	C <sub>o</sub> cobalt 59	27	N <sub>i</sub> nickel 59	28	C <sub>u</sub> copper 64	29	Z <sub>n</sub> zinc 65	30	G <sub>a</sub> gallium 70	31	G <sub>e</sub> germanium 73	32	S <sub>e</sub> selenium 75	33	B <sub>r</sub> bromine 79	34	K <sub>r</sub> krypton 84		
39	Rb	38	S <sub>r</sub> strontium 88	40	N <sub>b</sub> niobium 91	41	M <sub>o</sub> molybdenum 96	42	T <sub>c</sub> technetium —	43	R <sub>u</sub> ruthenium 101	44	R <sub>h</sub> rhodium 103	45	P <sub>d</sub> palladium 106	46	A <sub>g</sub> silver 108	47	C <sub>d</sub> cadmium 112	48	I <sub>n</sub> indium 115	49	S <sub>b</sub> antimony 119	50	T <sub>e</sub> tellurium 122	51	P <sub>o</sub> polonium 128	52	I <sub>odine</sub> iodine 127	53	X <sub>e</sub> xenon 131		
55	Cs	56	B <sub>a</sub> barium 137	57–71	H <sub>f</sub> hafnium 178	72	T <sub>a</sub> tantalum 181	73	W <sub>h</sub> tungsten 184	74	R <sub>e</sub> rhenium 186	75	O <sub>s</sub> osmium 190	76	I <sub>r</sub> iridium 192	77	P <sub>t</sub> platinum 195	78	A <sub>u</sub> gold 197	79	H <sub>g</sub> mercury 201	80	T <sub>l</sub> thallium 204	81	P <sub>b</sub> lead 207	82	B <sub>i</sub> bismuth 209	83	P <sub>o</sub> polonium —	84	A <sub>t</sub> astatine —	85	R <sub>n</sub> radon —
87	F <sub>r</sub>	88	R <sub>a</sub> radium —	89–103	R <sub>f</sub> actinoids —	104	D <sub>b</sub> dubnium —	105	S <sub>g</sub> seaborgium —	106	B <sub>h</sub> bohrium —	107	H <sub>s</sub> hassium —	108	M <sub>t</sub> meitnerium —	109	D <sub>s</sub> darmstadtium —	110	M <sub>l</sub> meitnerium —	111	R <sub>g</sub> roentgenium —	112	C <sub>n</sub> copernicium —	114	F <sub>l</sub> flerovium —	116	L <sub>v</sub> livemorium —	—	—	—	—		
lanthanoids		57	L <sub>a</sub> lanthanum 139	58	C <sub>e</sub> cerium 140	59	P <sub>r</sub> praseodymium 141	60	N <sub>d</sub> neodymium 144	61	P <sub>m</sub> promethium —	62	S <sub>m</sub> samarium 150	63	E <sub>u</sub> europium 152	64	G <sub>d</sub> gadolinium 157	65	T <sub>b</sub> terbium 159	66	D <sub>y</sub> dysprosium 163	67	H <sub>o</sub> holmium 165	68	E <sub>r</sub> erbium 167	69	T <sub>m</sub> thulium 169	70	Y <sub>b</sub> ytterbium 173	71	L <sub>u</sub> lutetium 175		
actinoids		89	A <sub>c</sub> actinium —	90	T <sub>h</sub> thorium 232	91	P <sub>a</sub> protactinium 231	92	U <sub> </sub> uranium 238	93	N <sub>p</sub> neptunium —	94	P <sub>u</sub> plutonium —	95	A <sub>m</sub> americium —	96	C <sub>m</sub> curium —	97	B <sub>k</sub> berkelium —	98	C <sub>f</sub> californium —	99	E <sub>s</sub> einsteinium —	100	F <sub>m</sub> fermium —	101	M <sub>d</sub> mendelevium —	102	N <sub>o</sub> nobelium —	103	L <sub>r</sub> lawrencium —		

16

lanthanoids	La	58	Ce	59	Pr	60	Nd	61	Pm	62	Sm	63	Eu	64	Gd	65	Tb	66	Dy	67	Ho	68	Er	69	Tm	70	Yb	71	Lu		
actinoids	Ac	89	Th	90	Pa	91	U	92	U	93	Np	94	Pu	95	Am	96	Cm	97	Bk	98	Cf	99	Es	100	Fm	101	Md	102	No	103	Lr

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



# **Cambridge IGCSE™**

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**CHEMISTRY**

**0620/21**

Paper 2 Multiple Choice (Extended)

**May/June 2020**

**MARK SCHEME**

Maximum Mark: 40

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**Published**

Students did not sit exam papers in the June 2020 series due to the Covid-19 global pandemic.

This mark scheme is published to support teachers and students and should be read together with the question paper. It shows the requirements of the exam.

Mark schemes should usually be read together with the Principal Examiner Report for Teachers. However, because students did not sit exam papers, there is no Principal Examiner Report for Teachers for the June 2020 series.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the June 2020 series for most Cambridge IGCSE™ and Cambridge International A & AS Level components, and some Cambridge O Level components.

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This document consists of **3** printed pages.

Question	Answer	Marks
1	D	1
2	C	1
3	C	1
4	A	1
5	A	1
6	D	1
7	B	1
8	C	1
9	A	1
10	A	1
11	A	1
12	B	1
13	A	1
14	D	1
15	D	1
16	C	1
17	C	1
18	D	1
19	D	1
20	C	1
21	C	1
22	B	1
23	B	1
24	B	1
25	B	1
26	B	1
27	A	1
28	D	1

Question	Answer	Marks
29	A	1
30	C	1
31	B	1
32	D	1
33	A	1
34	B	1
35	B	1
36	B	1
37	D	1
38	D	1
39	B	1
40	D	1



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## COMPUTER SCIENCE

0478/22

Paper 2 Problem-solving and Programming

February/March 2020

1 hour 45 minutes

You must answer on the question paper.

No additional materials are needed.

### INSTRUCTIONS

- Answer **all** questions.
- **Do not attempt Tasks 1, 2 and 3** in the copy of the pre-release material on page 2; these are for information only.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- **Do not** use an erasable pen or correction fluid.
- **Do not** write on any bar codes.
- Calculators must **not** be used in this paper.

### INFORMATION

- The total mark for this paper is 50.
- The number of marks for each question or part question is shown in brackets [ ].
- No marks will be awarded for using brand names of software packages or hardware.

This document has **16** pages. Blank pages are indicated.

## Section A

**You are advised to spend no longer than 40 minutes answering this section.**

**Here is a copy of the pre-release material.**

**DO NOT** attempt Tasks 1, 2 and 3 now.

Use the pre-release material and your experience from attempting the tasks before the examination to answer Question 1.

### Pre-release material

A car buying service helps customers calculate the price of buying a new car from Snazzy Autos. There are three models of car available: hatchback, saloon and estate. A car can be bought with optional extras.

Model	Price
Hatchback	Rs 5.35 lakh
Saloon	Rs 4.95 lakh
Estate	Rs 6.25 lakh

Optional extra	Price
Set of luxury seats	Rs 45000
Satellite navigation	Rs 5500
Parking sensors	Rs 10000
Bluetooth connectivity	Rs 350
Sound system	Rs 1000

Snazzy Autos customers buying a new car can trade in an old car. Offers from Rs 10000 to Rs 1.00 lakh can be made for an old car. If an old car is not traded in, then a discount of 5% is taken off the price of the new car and any optional extras. In addition, repeat customers are offered a discount of 10% off any optional extras and 10% off the price of the new car before trade-in. Customers can either pay for the new car in full or make monthly payments over several years.

Write and test a program or programs for the car buying service.

- Your program or programs must include appropriate prompts for the entry of data; data must be validated on entry.
- Error messages and other output need to be set out clearly and understandably.
- All variables, constants and other identifiers must have meaningful names.

You will need to complete these **three** tasks. Each task must be fully tested.

#### Task 1 – Calculate the price

Customers choose the model of car and select any optional extras required. Only valid choices can be accepted for the model and the extras. The customer is asked if they are an existing customer and if they have an old car to trade in. If the customer trades in an old car the amount offered by Snazzy Autos is entered. The price of the new car including model and extras is displayed. Any discount or trade-in amounts are displayed and the total price to pay is calculated and displayed.

#### Task 2 – Calculate the payment(s)

Extend **Task 1** to display these payment methods:

- full amount paid now customer receives cashback of 1% on the total price
- equal monthly payments are made over four years with no extra charge
- the total price is increased by 5%; equal monthly payments are made over seven years.

For each payment method display: the total amount to pay, the amount of each payment, the number of payments and cashback where appropriate.

#### Task 3 – New full amount payment offer

Extend **Task 2** to offer customers who decide to pay the full amount now either the 1% cashback or the chosen optional extras free. Customers are shown the offer that is the best value first and the other as an alternative. Details of each offer must be displayed in full.

1 All variables, constants and other identifiers must have meaningful names.

- (a) State the name of **one** constant that you could have used for **Task 1**. Give the value that would be assigned to the constant. State the use of this constant.

Constant name .....

Value .....

Use .....

.....  
[3]

- (b) State the name of the variable that you used to store the amount offered for the trade-in of an old car in **Task 1**. Give the most appropriate data type for this variable. Explain how your program ensured that any data entered for the trade-in offer was valid.

Variable name .....

Data type .....

Validation .....

.....  
.....  
.....  
.....  
[4]

- (c) Snazzy Autos has decided to add another model to the cars available in **Task 1**. The new model is a convertible, price Rs 6.75 lakh. Explain the changes required to your program for **Task 1**.

[4]

- (d) Write an algorithm for **Task 2**, using either pseudocode, programming statements or a flowchart. Assume that **Task 1** has been completed.

[5]

- (e) Explain how your program completed **Task 3**. Assume that **Task 2** has been completed. Any programming statements used in your answer must be fully explained.

[4]

**Section B starts on page 8.**

## Section B

- 2 (a)** An algorithm has been written in pseudocode to input 50 numbers. Positive numbers are stored in the array PosNum[ ]. Negative numbers are stored in the array NegNum[ ]. Zeros are not included in the positive and negative counts.

```

Count ← 0
PosCount ← Count
NegCount ← Count
REPEAT
    INPUT Number
    IF Number > 0
        THEN
            PosCount ← PosCount + 1
            PosNum[PosCount] ← Number
        ELSE
            NegCount ← NegCount + 1
            NegNum[NegCount] ← Number
        ENDIF
    Count ← Count + 1
UNTIL Count >= 50
OUTPUT "There are ", PosCount, " positive numbers"
OUTPUT "There are ", NegCount, " negative numbers"

```

Describe the error in the pseudocode and write the correction for this error.

Error .....

.....

.....

.....

Correction .....

.....

.....

.....

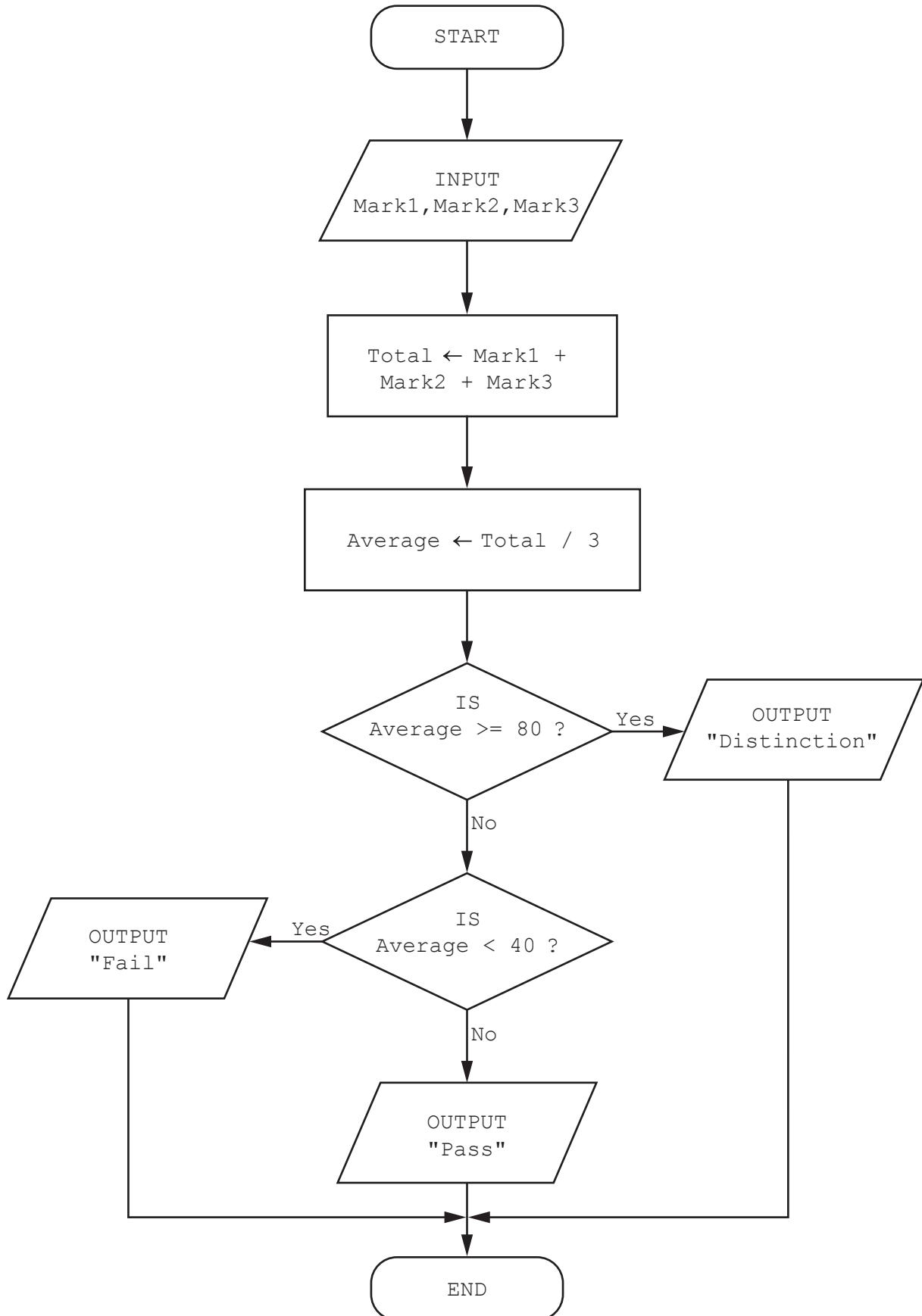
[4]

- (b) The algorithm needs to be changed so there is no limit to how many numbers can be input. When the number 9999 is input, the algorithm stops more numbers being input and outputs the results. The number 9999 is not to be stored nor counted as a positive number.

Explain how you would change the algorithm.

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..... [4]

- 3 This flowchart inputs student percentage marks for three examinations. If the average of these marks is 80% or over then a distinction grade is awarded. If the average of these marks is less than 40% then a fail grade is awarded. Otherwise a pass grade is awarded.



- (a) Complete a trace table for each set of input data:

**Set 1: 88, 74, 60**

Mark1	Mark2	Mark3	Total	Average	OUTPUT

**Set 2:** 20, 33, 67

Mark1	Mark2	Mark3	Total	Average	<b>OUTPUT</b>

**Set 3:** 79, 91, 70

Mark1	Mark2	Mark3	Total	Average	<b>OUTPUT</b>

[5]

- (b) It has been decided to include an extra grade of Merit when the average of the marks is 60% or more, and less than 80%. Describe the changes that will need to be made to the flowchart.

[3]

- 4** Explain why validation and verification checks are needed when data is input. Include an example of each type of check in your answer.

[4]

**Question 5 starts on page 14.**

- 5 A database table, BOX, is used to keep a record of boxes made and sold by a craftsman. Boxes are categorised by:

- SIZE – small, medium or large
- SHAPE – brief description for example ‘star shaped’
- WOOD – maple, beech, walnut or ebony
- PRICE – price in \$
- SOLD – whether the box is sold or not.

A database management system uses these data types:

Text	Number	Currency	Boolean
------	--------	----------	---------

- (a) Select the most appropriate data type for each field from the four types shown. State the reason why you chose the data type.

SIZE data type .....

Reason .....

SHAPE data type .....

Reason .....

WOOD data type .....

Reason .....

PRICE data type .....

Reason .....

SOLD data type .....

Reason .....

[5]

- (b) (i) Complete the query-by-example grid below to only display the price of small walnut boxes.

Field:				
Table:				
Sort:				
Show:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Criteria:				
or:				

[3]

- (ii) The query-by-example grid from part (b)(i) needs to be changed to show both walnut and beech boxes and display the wood used. Only one column needs to be changed. Write the changed column.

Field:	
Table:	
Sort:	
Show:	<input type="checkbox"/>
Criteria:	
or:	

[2]

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# **Cambridge IGCSE™**

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**COMPUTER SCIENCE**

**0478/22**

Paper 2

**March 2020**

**MARK SCHEME**

Maximum Mark: 50

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**Published**

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the March 2020 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

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This document consists of **9** printed pages.

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

**GENERIC MARKING PRINCIPLE 1:**

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

**GENERIC MARKING PRINCIPLE 2:**

Marks awarded are always **whole marks** (not half marks, or other fractions).

**GENERIC MARKING PRINCIPLE 3:**

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

**GENERIC MARKING PRINCIPLE 4:**

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

**GENERIC MARKING PRINCIPLE 5:**

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

**GENERIC MARKING PRINCIPLE 6:**

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

Question	Answer	Marks
<b>Section A</b>		
1(a)	<p>Any appropriate constant, for example:</p> <p><b>Constant name</b> noTradeInDiscount</p> <p><b>Value</b> 0.05/5</p> <p><b>Use</b> Storing the percentage discount if no car is traded in</p>	3
1(b)	<p><b>Variable name</b> TradeInValue // any suitable variable name for trade-in amount</p> <p><b>Data type</b> real/integer</p> <p><b>Validation</b> any <b>two</b> from <ul style="list-style-type: none"> <li>• Use of conditional /loop statement / IF ... THEN / REPEAT ... UNTIL / WHILE</li> <li>• value input is greater than (or equal to) 10 000/0.1 / less than (or equal to) 100 000/1 / numeric // a value is actually input // error message for rejected input</li> <li>• range check // type check // presence check</li> </ul> </p>	4
1(c)	<p>Any <b>four</b> from:</p> <p>MP1 Display extra model/choice</p> <p>MP2 Increase options available to 4</p> <p>MP3 Extend validation rule / selection statement(s) for input selection</p> <p>MP4 Store name of extra model e.g. new variable/constant/extr item in array</p> <p>MP5 Store price of extra model e.g. new variable/ constant/extr item in array</p> <p>MP6 Change code to calculate price to pay to include extra model</p>	4

Question	Answer	Marks
1(d)	<p>Any <b>five</b> from:</p> <ul style="list-style-type: none"> <li>MP1 Calculate cashback for payment method 1</li> <li>MP2 Calculate monthly payments for payment method 2</li> <li>MP3 Calculate amount and monthly payments for payment method 3</li> <li>MP4 Method 1 – output full amount, one payment and cashback</li> <li>MP5 Method 2 – output full amount, full amount divided by 48 and 48 payments</li> <li>MP6 Method 3 – output full amount times 1.05, full amount times 1.05 divided by 84 and 84 payments</li> <li>MP7 Attempt to output showing all 3 payment methods with appropriate messages (MPs 4,5,6 not awarded)</li> </ul> <p>Sample answer:</p> <pre>PRINT "Full Amount ",amountToPay, " to pay. Number of Payments is 1" PRINT "Cashback ", amountToPay * 0.01 PRINT "Over four years ",amountToPay, " to pay. Number of Payments is 48" PRINT "Each monthly payment is ", amountToPay / 48 PRINT "Over seven years ",amountToPay * 1.05, " to pay. Number of Payments is 84" PRINT "Each monthly payment is ", amountToPay * 1.05 / 84</pre>	5
1(e)	<p>Explanation</p> <p>Any <b>four</b> from:</p> <ul style="list-style-type: none"> <li>MP1 Use of selection statement to check if customer chose to pay the full amount</li> <li>MP2 Consideration of special case where there are no optional extras chosen</li> <li>MP3 Comparison of 1% of total price to pay with the total cost of optional extras</li> <li>MP4 Use of selection statement to check for the largest value of cashback or extras /smallest amount to pay</li> <li>MP5 ... display the cost of this option first</li> <li>MP6 ... then display the cost of the other option</li> </ul>	4

Question	Answer	Marks
<b>Section B</b>		
2(a)	<p>Error:</p> <ul style="list-style-type: none"> <li>• Problem with zero ...</li> <li>• ... stored in the negative number array // negative number count increases by 1</li> </ul> <p>Correction:</p> <ul style="list-style-type: none"> <li>• Replace ELSE with IF</li> <li>• IF Number &lt; 0 (THEN)</li> </ul>	<b>4</b>
2(b)	<p>Explanation:</p> <ul style="list-style-type: none"> <li>• Replace REPEAT ... UNTIL with WHILE ... DO ... ENDWHILE</li> <li>• Change condition to WHILE Number &lt;&gt; 9999 DO</li> <li>• Add / Move INPUT Number to before loop // Move / Add extra INPUT Number at end of loop</li> <li>• Remove (Count ← 0 and) Count ← Count + 1</li> </ul> <p>Or</p> <p>Any <b>four</b> from:</p> <ul style="list-style-type: none"> <li>• Include an IF statement after INPUT Number / before updating the arrays</li> <li>• IF Number &lt;&gt; 9999 THEN ... or similar</li> <li>• Move output statements to be executed when Number = 9999</li> <li>• Change UNTIL Count &gt;= 50 to UNTIL Number = 9999</li> <li>• Remove (Count ← 0 and) Count ← Count + 1</li> </ul>	<b>4</b>

Question	Answer	Marks																																				
3(a)	<p><b>One mark for correct input (all sets)</b>  <b>One mark for correct calculations (all sets)</b>  <b>One mark for each correct output</b></p> <p><b>Set 1:</b> 88, 74, 60</p> <table border="1"> <thead> <tr> <th>Mark1</th><th>Mark2</th><th>Mark3</th><th>Total</th><th>Average</th><th>OUTPUT</th></tr> </thead> <tbody> <tr> <td>88</td><td>74</td><td>60</td><td>222</td><td>74</td><td>Pass</td></tr> </tbody> </table> <p><b>Set 2:</b> 20, 33, 67</p> <table border="1"> <thead> <tr> <th>Mark1</th><th>Mark2</th><th>Mark3</th><th>Total</th><th>Average</th><th>OUTPUT</th></tr> </thead> <tbody> <tr> <td>20</td><td>33</td><td>67</td><td>120</td><td>40</td><td>Pass</td></tr> </tbody> </table> <p><b>Set 3:</b> 79, 91, 70</p> <table border="1"> <thead> <tr> <th>Mark1</th><th>Mark2</th><th>Mark3</th><th>Total</th><th>Average</th><th>OUTPUT</th></tr> </thead> <tbody> <tr> <td>79</td><td>91</td><td>70</td><td>240</td><td>80</td><td>Distinction</td></tr> </tbody> </table>	Mark1	Mark2	Mark3	Total	Average	OUTPUT	88	74	60	222	74	Pass	Mark1	Mark2	Mark3	Total	Average	OUTPUT	20	33	67	120	40	Pass	Mark1	Mark2	Mark3	Total	Average	OUTPUT	79	91	70	240	80	Distinction	<b>5</b>
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3(b)	<p>Any <b>three</b> from:</p> <ul style="list-style-type: none"> <li>• Add extra decision box ...</li> <li>• ... in an appropriate position between the average calculation and the output</li> <li>• Check for average greater than or equal to 60 and less than 80</li> <li>• Output Merit if average greater than or equal to 60 (and less than 80) ...</li> <li>• ... otherwise continue</li> </ul>	<b>3</b>																																				

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4	<p><b>One</b> mark for explaining why a validation check is needed when data is input To check that data is sensible / reasonable / meets required criteria</p> <p><b>One</b> mark for explaining why a verification check is needed when data is input To check that data is not changed on entry</p> <p><b>One</b> mark for an example of a validation check Range check // Length check // Type check</p> <p><b>One</b> mark for an example of a verification check Double entry // Visual check</p>	4

Question	Answer	Marks
5(a)	<p>One mark for data type and reason</p> <p>SIZE text, expressed as a single word</p> <p>SHAPE text, short phrase required</p> <p>WOOD text, expressed as a single word</p> <p>PRICE currency, needs to be expressed as dollars / may be used in calculations</p> <p>SOLD Boolean, only two choices</p>	5

Question	Answer	Marks																																			
5(b)(i)	<p><b>One mark for</b></p> <ul style="list-style-type: none"> <li>• correct field and table names must include SIZE, WOOD and PRICE, allow SHAPE or SOLD</li> <li>• correct show for PRICE only</li> <li>• correct criteria to select small and walnut</li> </ul> <table border="1"> <tr> <td>Field:</td> <td>SIZE</td> <td>WOOD</td> <td>PRICE</td> <td></td> </tr> <tr> <td>Table:</td> <td>BOX</td> <td>BOX</td> <td>BOX</td> <td></td> </tr> <tr> <td>Sort:</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Show:</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td>Criteria:</td> <td>='small'</td> <td>='walnut'</td> <td></td> <td></td> </tr> <tr> <td>or:</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>	Field:	SIZE	WOOD	PRICE		Table:	BOX	BOX	BOX		Sort:					Show:	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Criteria:	='small'	='walnut'			or:										3
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5(b)(ii)	<table border="1"> <tr> <td>Field:</td> <td>WOOD</td> </tr> <tr> <td>Table:</td> <td>BOX</td> </tr> <tr> <td>Sort:</td> <td></td> </tr> <tr> <td>Show:</td> <td><input checked="" type="checkbox"/></td> </tr> <tr> <td>Criteria:</td> <td>='walnut' OR 'beech'</td> </tr> <tr> <td>or:</td> <td></td> </tr> </table> <p>(1) (1)</p> <p>One mark for each correct alteration max 2</p>	Field:	WOOD	Table:	BOX	Sort:		Show:	<input checked="" type="checkbox"/>	Criteria:	='walnut' OR 'beech'	or:		2																							
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