

**OXFORD**

INTERNATIONAL  
AQA EXAMINATIONS

---

**INTERNATIONAL GCSE**  
**CHEMISTRY**

**9202/2**

Paper 2

---

Mark scheme

November 2021

---

Version: 1.0 Final Mark Scheme



2 1 B Y 9 2 0 2 / 2 / M S

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from [oxfordaqaexams.org.uk](http://oxfordaqaexams.org.uk)

#### **Copyright information**

OxfordAQA retains the copyright on all its publications. However, registered schools/colleges for OxfordAQA are permitted to copy material from this booklet for their own internal use, with the following important exception: OxfordAQA cannot give permission to schools/colleges to photocopy any material that is acknowledged to a third party even for internal use within the centre.

Copyright © 2021 Oxford International AQA Examinations and its licensors. All rights reserved.

## Level of response marking instructions

Level of response mark schemes are broken down into levels, each of which has a descriptor. The descriptor for the level shows the average performance for the level. There are marks in each level.

Before you apply the mark scheme to a student's answer read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

### Step 1 Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer and not look to pick holes in small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level and then use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 2 with a small amount of level 3 material it would be placed in level 2 but be awarded a mark near the top of the level because of the level 3 content.

### Step 2 Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the Indicative content to reach the highest level of the mark scheme.

An answer which contains nothing of relevance to the question must be awarded no marks.

## Information to Examiners

### 1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement
- the Assessment Objectives, level of demand and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

### 2. Emboldening and underlining

- 2.1** In a list of acceptable answers where more than one mark is available ‘any **two** from’ is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.
- 2.2** A bold **and** is used to indicate that both parts of the answer are required to award the mark.
- 2.3** Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.
- 2.4** Any wording that is underlined is essential for the marking point to be awarded.

### 3. Marking points

#### 3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that ‘right + wrong = wrong’.

Each error / contradiction negates each correct response. So, if the number of errors / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as \* in example 1) are not penalised.

Example 1: What is the pH of an acidic solution?

[1 mark]

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name two planets in the solar system.

[2 marks]

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

### 3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

### 3.3 Marking procedure for calculations

Marks should be awarded for each stage of the calculation completed correctly, as students are instructed to show their working. Full marks can, however, be given for a correct numerical answer, without any working shown.

### 3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

### 3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation ecf in the marking scheme.

### 3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

### 3.7 Brackets

(...) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

### 3.8 Allow

In the mark scheme additional information, 'allow' is used to indicate creditworthy alternative answers.

### 3.9 Ignore

'Ignore' is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

### 3.10 Do not accept

'Do **not** accept' means that this is a wrong answer which, even if the correct answer is given as well, will still mean that the mark is not awarded.

**Question 1**

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
<b>01.1</b>	<b>model A</b> has no protons	allow converse for <b>model B</b>	1	AO1 AO3 × 3 3.1.2c i
	<b>model A</b> has no neutrons		1	
	<b>model A</b> has no nucleus		1	
	<b>model A</b> does not have electrons in shells / energy levels		1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
<b>01.2</b>	4		1	AO2 3.1.2a

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
<b>01.3</b>	(protons =) 17		1	AO2 3.1.2f h
	(electrons =) 17		1	
	(neutrons =) 18		1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
<b>01.4</b>	neutrons		1	AO1 3.1.2g

<b>Total Question 1</b>		<b>9</b>
-------------------------	--	----------

**Question 2**

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.1	particles spaced apart in box		1	AO1 3.1.1a

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.2	(from) solid (to) liquid		1	AO3 3.1.1a

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.3	diffusion		1	AO1 3.1.1b

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.4	movement (of bromine gas) is faster  (because) the particles are moving faster or (because) the particles have more energy	ignore references to collisions	1	AO2 3.1.1b 3.8.1c
		allow diffusion is faster	1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.5	(number of bromine molecules =) $\frac{0.600 \times 6.02 \times 10^{23}}{24}$ = $1.505 \times 10^{22}$		1	AO2 3.6.3b 3.6.4d
		allow $1.51 \times 10^{22}$	1	

<b>Total Question 2</b>		<b>7</b>
-------------------------	--	----------

**Question 3**

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
<b>03.1</b>	(silver solid) sodium	allow Na	1	AO3 3.7.1a c
	(green gas) chlorine	allow Cl <sub>2</sub>	1	
	(white solid) sodium chloride	allow NaCl	1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
<b>03.2</b>	magnesium atom loses two electrons	if neither MP1 or MP2 awarded allow <b>1</b> mark for magnesium loses <b>and</b> fluorine gains electron(s)	1	AO2 3.2.1c
	fluorine atom gains one electron		1	
	one magnesium atom reacts with two fluorine atoms	1		
	to achieve the electron arrangement of a noble gas	allow to gain a full outer shell of electrons  allow to form positive magnesium ions and negative fluoride ions	1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.3	(in chlorine) outer energy level closer to nucleus	allow shell for energy level throughout  allow converse argument for bromine	1	AO1 3.7.1e 3.7.1f
	(so) has the greater attraction between the nucleus and the outer electrons	allow chlorine is a smaller atom allow chlorine has fewer energy levels	1	
	(therefore) chlorine can gain an electron (into the outer energy level) more easily	allow chlorine has less shielding allow (so has) greater attraction between the nucleus and the incoming electron	1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.4	(Br <sup>-</sup> ions) lose electrons	do <b>not</b> accept gain of oxygen	1	AO1 3.8.4b

<b>Total Question 3</b>		<b>11</b>
-------------------------	--	-----------

## Question 4

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.1	copper sulfate	allow CuSO <sub>4</sub>	1	AO2 3.3.1.2b 3.5.1c
	water	allow H <sub>2</sub> O	1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.2	the volume of gas stopped increasing	allow the volume of carbon dioxide stopped increasing  allow no more fizzing / bubbling  allow no more solid left	1	AO3 3.3.1.2b

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.3	all points plotted correctly	allow 1 mark for 3 or 4 correctly plotted points  allow tolerance of $\pm \frac{1}{2}$ a small square	2	AO2 3.3.1.2b
	line of best fit		1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.4	(the decreasing concentration of sulfuric acid) decreases the rate of reaction		1	AO1 3.8.1e
	(because) frequency of particle collisions will decrease		1	

<b>Total Question 4</b>		<b>8</b>
-------------------------	--	----------

**Question 5**

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.1	(melting points) increase from titanium to vanadium	allow titanium is anomalous allow titanium does not fit trend	1	AO3 3.7.2a
	then decrease (with increasing atomic number)		1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.2	transition metals have higher melting points than Group 1		1	AO1 3.7.2b

Question	Answers	Mark	AO/ Spec. Ref.
05.3	<b>Level 2:</b> A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.	3–4	AO2 × 2 AO3 × 2 3.7.2a 3.7.2b
	<b>Level 1:</b> Some logically linked reasons are given. There may also be a simple judgement.	1–2	
	<b>No relevant content</b>	0	
	<b>Indicative content:</b>  typical of a transition metal <ul style="list-style-type: none"> <li>• zinc has high density</li> <li>• zinc has high hardness</li> <li>• zinc is in the middle block of periodic table which is where transition metals are found</li> </ul> not typical of a transition metal <ul style="list-style-type: none"> <li>• zinc only forms one chloride</li> <li>• zinc only forms Zn<sup>2+</sup> ions</li> <li>• because transition metals have ions with different charges</li> <li>• zinc forms white chloride</li> <li>• because transition metals form coloured compounds</li> </ul> <ul style="list-style-type: none"> <li>• justified conclusion</li> </ul>		

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.4	changes the rate of reaction	allow increases the rate of reaction  ignore activation energy	1	AO1 3.8.1g

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.5	$4V + 5O_2 \rightarrow 2V_2O_5$	allow multiples	1	AO2 3.6.1a

<b>Total Question 5</b>		<b>9</b>
-------------------------	--	----------

**Question 6**

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.1	mixture of colours obtained	allow colours are masked by each other	1	AO3 3.4.3c

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.2	pencil will not move in the solvent	allow pencil line is not soluble in the solvent	1	AO4 3.4.1d

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.3	mixture <b>A</b> contains Cu <sup>2+</sup> and Fe <sup>3+</sup> ions	if no other mark awarded allow <b>1</b> mark for mixture <b>A</b> contains three substances	1	AO3 3.4.1d
	mixture <b>A</b> contains an unknown ion		1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.4	(distance moved by Co <sup>2+</sup> ions =) 2.0 (cm)	allow a value in the range 1.8–2.2 (cm)	1	AO2 3.4.1d
	<b>and</b> (distance moved by solvent =) 5.3 (cm)	allow a value in the range 5.2-5.4 (cm)		
	(R <sub>f</sub> value) = $\frac{2.0}{5.3}$	allow correct use of incorrect measurement(s) for distance moved	1	
	= 0.38	allow 0.377	1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
<b>06.5</b>	Ni <sup>2+</sup> moved furthest  (because) more soluble (in the solvent)	allow converse for Cu <sup>2+</sup>  if no other mark awarded allow <b>1</b> mark for different solubilities (in the solvent)	1  1	AO3 AO2 3.4.1e

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
<b>06.6</b>	calcium bromide	allow CaBr <sub>2</sub>  allow <b>1</b> mark for calcium <b>or</b> allow <b>1</b> mark for bromide	2	AO3 3.4.3 a b e

<b>Total Question 6</b>		<b>11</b>
-------------------------	--	-----------

## Question 7

Question	Answers	Mark	AO/ Spec. Ref.
07.1	<b>Level 3:</b> The method would lead to the production of a valid outcome. Key steps are identified and logically sequenced.	5–6	AO4 3.9.2a
	<b>Level 2:</b> The method would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.	3–4	
	<b>Level 1:</b> The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	<b>No relevant content</b>	0	
	<b>Indicative content:</b> <ul style="list-style-type: none"> <li>• metal can or glass beaker</li> <li>• placed above spirit burner</li> <li>• containing water of known volume or mass</li> <li>• using measuring cylinder or mass balance</li> <li>• measure initial mass of spirit burner</li> <li>• measure initial temperature of water</li> <li>• with a thermometer (placed in the water)</li> <li>• light spirit burner and heat up water</li> <li>• for a fixed period of time</li> <li><b>or</b></li> <li>until temperature rises a fixed amount</li> <li><b>or</b></li> <li>until mass of spirit burner drops 1 g</li> <li>• extinguish flame</li> <li>• measure final temperature</li> <li>• measure final mass of spirit burner</li> <li>• calculate energy change (using <math>Q = mc\Delta T</math>)</li> <li>• divide energy change by mass of biodiesel burnt</li> </ul>		

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.2	increasing percentage of biodiesel will increase amount of oxides of nitrogen		1	AO3 AO1 3.10.1.2d
	(which will cause) more acid rain	allow (which will cause) more smog	1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.3	increasing percentage of biodiesel will decrease amount of solid particles	allow particulates for solid particles	1	AO3 AO1 3.10.1.2d
	(which will cause) less global dimming		1	

Question	Answers	Mark	AO/ Spec. Ref.
07.4	<b>Level 2:</b> A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.	3–4	AO3 3.10.1.2g
	<b>Level 1:</b> Some logically linked reasons are given. There may also be a simple judgement.	1–2	
	<b>No relevant content</b>	0	
	<b>Indicative content:</b> <ul style="list-style-type: none"> <li>• burning biodiesel produces carbon dioxide</li> <li>• which adds to carbon footprint</li>   <li>• but biodiesel <b>A</b> produces less than biodiesel <b>B</b></li> <li>• both biodiesels are produced from plants</li> <li>• plants absorb carbon dioxide when growing</li> <li>• which reduces the carbon footprint</li>   <li>• biodiesel <b>A</b> uses existing farmland so less land available for food production</li> <li>• biodiesel <b>A</b> uses oil grown for food</li> <li>• reduces carbon footprint as using a waste product</li>   <li>• biodiesel <b>B</b> fuel grown on cleared forest. Destroyed trees increases carbon dioxide</li> <li>• this adds to carbon footprint</li> <li>• clearing forests destroys habitats</li>   <li>• justified conclusion</li> </ul>		

<b>Total Question 7</b>		<b>14</b>
-------------------------	--	-----------

**Question 8**

<b>Question</b>	<b>Answers</b>	<b>Extra information</b>	<b>Mark</b>	<b>AO/ Spec. Ref.</b>
<b>08.1</b>	(hydrogen chloride decomposition) reaction would be slower	allow (hydrogen chloride decomposition) reaction would not happen	1	AO2 3.8.1b
	(because) few(er) molecules would have energy greater than the activation energy	allow (because) particles must have more energy to react	1	

<b>Question</b>	<b>Answers</b>	<b>Extra information</b>	<b>Mark</b>	<b>AO/ Spec. Ref.</b>
<b>08.2</b>	energy must be supplied to break bonds		1	AO1 3.9.2e,g
	(and) energy is released when bonds are formed		1	
	(so) the energy needed to break existing bonds is greater than the energy released forming (new) bonds		1	



**Question 9**

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
<b>09.1</b>	$(250 \text{ cm}^3) = 0.25 \text{ dm}^3$		1	AO2
	(moles of KOH =) $(0.25 \times 0.15) = 0.0375 \text{ (mol)}$	allow correct use of incorrectly calculated or not converted value for volume	1	3.6.3a 3.6.4a
	(mass of KOH =) $0.0375 \times 56$	allow correct use of incorrectly calculated value for moles allow correct use of incorrectly calculated value of formula mass	1	
	= 2.1 g		1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
<b>09.2</b>	any <b>three</b> from: <ul style="list-style-type: none"> <li>• add potassium hydroxide from pipette</li> <li>• use a conical flask</li> <li>• add a few drops of indicator</li> <li>• swirling to mix</li> <li>• add sulfuric acid dropwise near end-point</li> <li>• repeat experiment until gained concordant results or within <math>0.1 \text{ cm}^3</math></li> </ul>		3	AO4 3.6.4b

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
<b>09.3</b>	$\left( \text{moles KOH} = 0.150 \times \frac{25}{1000} \right)$ = 0.00375 (mol)		1	AO2
	$\left( \text{moles H}_2\text{SO}_4 = \frac{0.00375}{2} \right)$ = 0.001875 (mol)	allow correct use of an incorrectly calculated value for moles of KOH	1	3.6.4b c
	(conc $\text{H}_2\text{SO}_4$ =) $0.001875 \times \frac{1000}{15}$	allow correct use of an incorrectly calculated value for moles of $\text{H}_2\text{SO}_4$	1	
	= 0.125 (mol/dm <sup>3</sup> )		1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
09.4	ethanoic acid is a weaker acid (than hydrochloric acid) so higher pH of acid X at 0 cm <sup>3</sup>		1	AO3 3.5.1f 3.6.4b 3.10.3.2b
	concentration of 0.1 mol/dm <sup>3</sup> is twice the concentration of hydrochloric acid so double the volume required for neutralisation		1	

<b>Total Question 9</b>		<b>13</b>
-------------------------	--	-----------