GCSE
CHEMISTRY
8462/2H

Paper 2 Higher Tier

Mark scheme

June 2023

Version: 1.0 Final

2 3 6 G 8 4 6 2 / 2 H / 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.

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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 their judgement
- the Assessment Objectives 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 (for example, a scientifically correct answer that could not reasonably be expected from a student's knowledge of the specification).

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**.
Alternative words in the mark scheme are shown by a solidus 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** magnetic materials.

[2 marks]

Student	Response	Marks awarded
1	iron, steel, tin	1
2	cobalt, nickel, nail*	2

3.2 Use of symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, or uses symbols to denote quantities in a physics equation, 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. At any point in a calculation students may omit steps from their working. If a subsequent step is given correctly, the relevant marks may be awarded.

Full marks are **not** awarded for a correct final answer from incorrect working.

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

An error can be carried forward from one question part to the next and is shown by the abbreviation 'ecf'.

Within an individual question part, an incorrect value in one step of a calculation does not prevent all of the subsequent marks being awarded.

3.6 Phonetic spelling

Marks should be awarded if spelling is not correct but the intention is clear, **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 <u>not</u> 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.

3.11 Numbered answer lines

Numbered lines on the question paper are intended to support the student to give the correct number of responses. The answer should still be marked as a whole.

4. Level of response marking instructions

Extended response questions are marked on level of response mark schemes.

- 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 two marks in each level.

Before you apply the mark scheme to a student's answer, read through the answer and, if necessary, 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. Do **not** look to penalise 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.

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.

You should ignore any irrelevant points made. However, full marks can be awarded only if there are no incorrect statements that contradict a correct response.

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

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	to reduce the escape of gas		1	AO3 4.6.1.1 RPA5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	(mean rate =) $\frac{0.78 + 0.81 + 0.81}{3}$ 0.80 (cm^3/s)	allow $\frac{0.78 + 0.81 + 0.68 + 0.81}{4}$ = 0.77 (cm^3/ s) for **1** mark	1 1	AO3 AO2
	$0.80 = \frac{20}{\text{mean time taken}}$	allow correct use of incorrectly determined mean rate	1	AO2
	(mean time taken =) $\frac{20}{0.80}$		1	AO2
	= 25 (s)		1	AO2 4.6.1.1 RPA5
	alternative approach: $0.78 = \frac{20}{\text{time}}$ **or** $0.81 = \frac{20}{\text{time}}$ (1)			
	(trial 1 time = $\frac{20}{0.78}$ =) 25.6 (1)			
	(trial 2 and 4 time = $\frac{20}{0.81}$ =) 24.7 (1)			

	(mean time =) $\frac{25.6 + (2 \times 24.7)}{3}$ (1) = 25 (s) (1)	allow correct use of incorrectly determined value(s) for time allow $\frac{25.6 + 29.4 + (2 \times 24.7)}{4}$ = 26.1 (s) for **1** mark		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	use a lower temperature use sulfuric acid of a lower concentration		1 1	AO1 4.6.1.2 RPA5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	(test) burning / lit splint (result) burns with a (squeaky) pop sound	MP2 is dependent upon MP1 being awarded allow flame do **not** accept glowing splint allow pops	 1 1	AO1 4.8.2.1

Total Question 1	**10**

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	(mass =) $\frac{39.8}{29.6}$ (×1) = 1.34 (g)	 allow 1.34459459 (g) correctly rounded to at least 2 significant figures	1 1	AO2 4.7.2.3

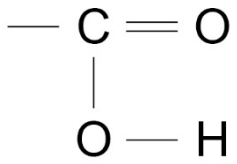
Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	all six points plotted correctly	allow a tolerance of ± ½ a small square allow **1** mark for four or five points plotted correctly	2	AO2 4.7.2.3

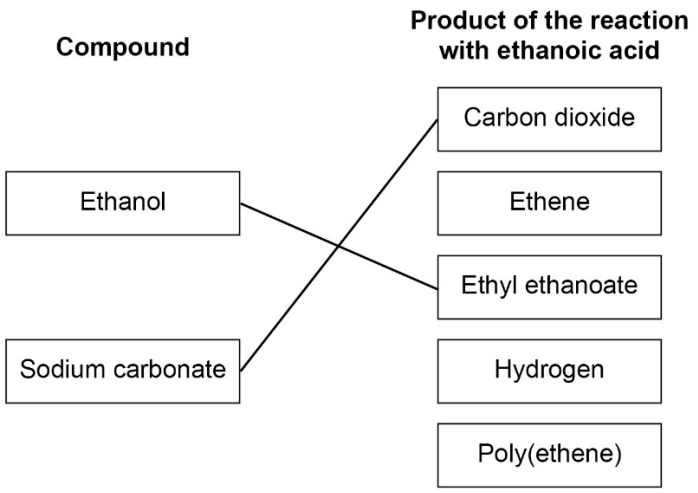
Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	40.6 (kJ)	allow a value in the range 40.4 – 40.8 kJ allow a value consistent with the plotted points	1	AO2 4.7.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	calcium hydroxide		1	AO1 4.8.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	(limewater turns) milky / cloudy	allow white precipitate (formed) allow calcium carbonate is produced	1	AO1 4.8.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	an oxidising agent		1	AO1 4.7.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7			1	AO1 4.7.2.4

Question	Answers	Mark	AO / Spec. Ref.
02.8	 do **not** accept more than **one** line from a box on the left	1 1	AO1 4.7.2.4

Total Question 2	11

Question 3

Question	Answers	Mark	AO / Spec. Ref
03.1	**Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5–6	AO1 4.8.3.1 4.8.3.4 RPA7
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.	3–4	
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	Indicative content (potassium ions) • **place sample on (clean metal) wire** • **introduce into (blue / non-luminous) flame** • using (Bunsen) burner • **observe lilac flame colour** • which shows presence of potassium (ions) (bromide ions) • **dissolve sample** • in (distilled) water • in test tube • add (dilute) nitric acid • **add silver nitrate (solution)** • using (dropping) pipette • **observe cream precipitate (formed after addition of silver nitrate solution)** • which shows presence of bromide (ions)		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	flame emission spectroscopy		1	AO1 4.8.3.7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	any **one** from: • (more) accurate • (more) sensitive • fast(er) • determine the concentration of ions present	allow requires a small(er) sample	1	AO1 4.8.3.6

Total Question 3	**8**

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	water vapour		1	AO1 4.9.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	(increased population so) more energy required (so) more (fossil) fuels burned **OR** (increased population so) more farmland required (1) (so) more deforestation (1)	allow (increased population so) more transport required allow a named fossil fuel	1 1	AO3 4.9.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	(increased population so) more food required (so) more methane-producing food production **OR** (increased population so) more waste produced (1) (which) produces more methane on decomposition (1)	 allow more use of beef cattle (in food production) allow more rice grown	1 1	AO3 4.9.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	any **two** from: • melting ice • rising sea levels • flooding • extremes of weather • loss of habitats	ignore global warming do **not** accept acid rain do **not** accept global dimming do **not** accept references to ozone	2	AO1 4.9.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	there may be other reasons for changes in the (mean) temperature (of the atmosphere at the Earth's surface)	allow difficult to model allow the earth goes through cycles of temperature change	1	AO3 4.9.2.2

Total Question 4	**8**

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	$CuFeS_2$ + **$4O_2$** → $CuSO_4$+$FeSO_4$	allow multiples allow O_2 for **1** mark	2	AO2 4.1.1.1 4.3.1.1 4.10.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	(M_r = 63.5 + 56 + (2 x 32) =) 183.5		1	AO2 4.3.1.2 4.10.1.4
	(% of copper =) $\frac{63.5}{183.5}$ × 100	allow correct use of incorrectly determined M_r	1	
	= 34.6 (%)	allow 34.60490 correctly rounded to at least 2 significant figures	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3		MP2 is dependent upon MP1 being awarded		AO1 4.8.3.2 RPA7
	(test) (add) sodium hydroxide (solution)		1	
	(result) blue precipitate		1	
	OR			
	(test) flame test (1)			
	(result) green (flame) (1)	allow blue-green (flame)		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	(the use of) bacteria to produce leachate solutions (that contain metal / copper compounds)		1 1	AO1 4.10.1.4

Total Question 5	**9**

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	the start line is drawn in ink	allow the start line should be drawn in pencil	1	AO3 4.8.1.3 RPA6
	the start line is below the water level	allow the start line should be above the water level	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	$0.60 = \frac{\text{distance moved by dye}}{12.0}$		1	AO2 4.8.1.3 RPA6
	(distance moved by dye =) 0.60 × 12.0		1	
	= 7.2 (cm)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3		allow converse		
	the R_f value is smaller for Paper **A**		1	AO2
	(because the red dye) is more attracted to Paper **A** (than to Paper **B**)		1	AO3
	(so the red dye) spends a greater (proportion of the) time distributed in Paper **A** (than in Paper **B**)		1	AO3
				4.8.1.3 RPA6
		if no other mark awarded allow **1** mark for the dye has a different attraction to each paper		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	use a different solvent	allow use ethanol (as the solvent)	1	AO1 4.8.1.3 RPA6

Total Question 6	**9**

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	(a catalyst) provides a different pathway for the reaction (which has a) lower activation energy		1 1	AO1 4.6.1.3 4.6.1.4

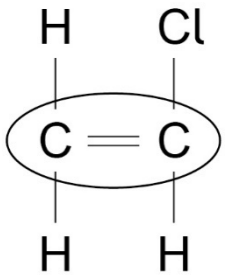
Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	(oxygen is) a gas (which) escaped from the flask		1 1	AO2 4.3.1.3 4.6.1.1

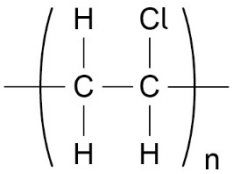
Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	correct value for *x* step **and** *y* step from tangent (rate =) $\frac{\text{value for } y \text{ step}}{\text{value for } x \text{ step}}$ correct calculation of rate answer to 2 significant figures	 allow correct use of incorrectly determined *x* and/or *y* step allow an answer correctly rounded to 2 significant figures from an incorrect calculation which uses values determined from the graph.	1 1 1 1	AO2 4.6.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	line starting at 0,0 which is less steep than existing line which becomes level at 0.80 g	 allow a tolerance of ± ½ a small square	1 1	AO2 4.3.4 4.6.1.2

Total Question 7	**10**

Question 8

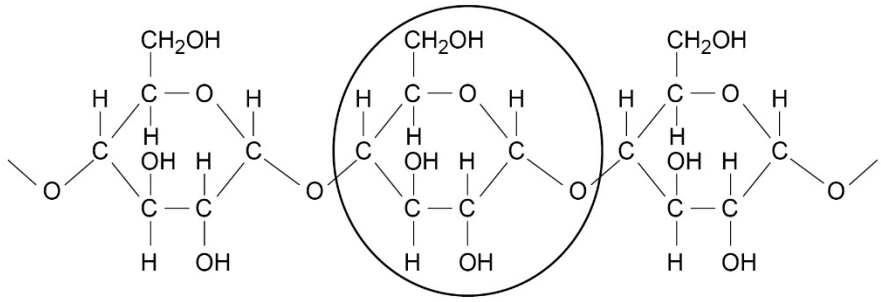
Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1			1	AO1 4.7.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	C-C bond 3x C-H **and** 1x C-Cl bonds 2x single bonds extending through brackets **and** n below halfway	an answer of  scores **3** marks	1 1 1	AO2 4.7.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	composites		1	AO1 4.10.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	water	allow H_2O	1	AO1 4.7.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.5	(M_r of NH_2 and COOH) = (2 × 1) + 14 + 12 + (2 × 16) + 1 =) 61 (M_r of section = 75 – 61) = 14	 allow correct use of incorrectly determined M_r of NH_2 and COOH	1 1	AO2 4.3.1.2 4.7.3.3

Question	Answers	Mark	AO / Spec. Ref.
08.6		1	AO2 4.7.3.1 4.9.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.7	starch	allow cellulose allow glycogen allow polysaccharide	1	AO3 4.7.3.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.8	nucleotides		1	AO1 4.7.3.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.9	double helix	ignore DNA	1	AO1 4.7.3.4

Total Question 8	**12**

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	(mass of water in 4.68 g = 4.68 - 2.99) = 1.69 (g)		1	AO2 4.6.2.2
	(mass of water in 11.7 g =) $\frac{11.7}{4.68}$ × 1.69	allow correct use of an incorrectly determined mass of water in 4.68 g	1	
	= 4.23 (g)	allow 4.2 / 4.225 (g)	1	
	alternative approach: $\left(\text{mass of anhydrous compound} = \frac{11.7}{4.68} \times 2.99\right)$			
	= 7.475 (g) (1)			
	(mass of water =) 11.7 – 7.475 (1)	allow correct use of an incorrectly determined mass of anhydrous compound		
	= 4.23 (g) (1)	allow 4.2 / 4.225 (g)		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.2	(energy =) $\frac{15.0}{2.99}$ × 1.47		1	AO2 4.6.2.2
	= 7.37 (kJ)	allow 7.37458194 correctly rounded to at least 2 significant figures	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.3	shifts to the left		1	AO2 4.6.2.1 4.6.2.4 4.6.2.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.4	the mixture is a lighter shade of brown		1	AO2 4.6.2.4 4.6.2.7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.5	no effect (on equilibrium position) (because) there are equal numbers of (gas) moles / molecules on each side (of the equation)	allow (equilibrium position) stays the same	1 1	AO2 4.6.2.4 4.6.2.7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.6	no effect (on equilibrium position)	allow (equilibrium position) stays the same	1	AO2 4.6.2.3 4.6.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.7	add more hydrochloric acid		1	AO2 4.6.2.4 4.6.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.8	(because the) forward and reverse reactions are taking place at (exactly) the same rate	ignore references to closed systems allow for **1** mark (because) the reactions are taking place at (exactly) the same rate	2	AO1 4.6.2.3

Total Question 9	**13**

Question 10

Question	Answers	Mark	AO/ Spec. Ref
10.1	**Level 3:** A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.	3–4	AO3 4.10.1.1 4.10.2.2 4.10.4.2
	Level 2: Some logically linked reasons are given. There may also be a simple judgement.	1–2	
	No relevant content	0	
	Indicative content **reasons** • compound **A** (potassium chloride) only contains potassium • compound **A** (potassium chloride) is the only source of potassium so is needed. • compound **B** (ammonium nitrate) only contains nitrogen • compound **B** (ammonium nitrate) contains more nitrogen than compound **C** (diammonium hydrogen phosphate) so is preferable • compound **B** (ammonium nitrate) contains more nitrogen and is cheaper than compound **C** (diammonium hydrogen phosphate) and so is more cost effective • compound **C** (diammonium hydrogen phosphate) contains phosphorus which is not needed **judgement** • none of the compounds contain both nitrogen and potassium so a mixture is needed • (both) compound **A** (potassium chloride) and **B** (ammonium nitrate) should be used • (both) compound **A** (potassium chloride) and **C** (diammonium phosphate) could be used		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.2	mining	allow quarrying	1	AO1 4.10.4.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.3	potassium sulfate	ignore potassium chloride allow potassium nitrate allow any other named potassium salt	1	AO1 4.10.4.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.4	ammonia	allow water	1	AO1 4.10.4.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.5	(phosphate rock is) insoluble (in water)	allow (phosphate rock) cannot be absorbed as a solid	1	AO3 4.10.4.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.6	(sulfuric acid) calcium sulfate (phosphoric acid) calcium phosphate	allow single superphosphate allow calcium phosphate allow triple superphosphate	1 1	AO1 4.10.4.2

Total Question 10	**10**