AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.8.3.5

Sulfates

Mark schemes and examiner comments

Tier	**Foundation**
Question groups	**15**
Available paper years	**2010–2025**

Using this booklet

1. Booklet answer numbers match the question booklet.
2. Use the original question number within marking tables.
3. Examiner comments are included where available.

Name: _____ **Date:** _____

Where a precise marking extract is unavailable, the full source document is included in an appendix. Any missing mark scheme is explicitly identified.

4.8.3.5 Sulfates

Answer 01 · Mark scheme

January 2010 | CHY3F | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)(i)	yellow		1
4(a)(ii)	lilac		1
4(a)(iii)	melting point		1
4(b)(i)	barium chloride solid		1 1
4(b)(ii)	white dissolved		1 1
Total			**7**

4.8.3.5 Sulfates

Answer 01 · Mark scheme

January 2010 | CHY3F | Original Q4 | Legacy

CHY3F

4.8.3.5 Sulfates

Answer 02 · Mark scheme

Question 1

question	answers	extra information	mark
1(a)	white to blue	accept colourless to blue	1
1(b)	reversible		1
Total			**2**

4.8.3.5 Sulfates

Answer 02 · Mark scheme

June 2010 | CHY2F | Original Q1 | Legacy

CHY2F

4.8.3.5 Sulfates

Answer 03 · Mark scheme

Question 7

question	answers	extra information	mark
7(a)(i)	(different) properties	allow ideas of different property / behaviour / element	1
7(a)(ii)	any **one** from: • they had high status **or** they were lecturers / doctors / professors / famous scientists • other scientists repeated experiments • they had proof **or** lots of / strong / conclusive / enough / clear evidence	they = Crawford + Cruikshank allow experiment could be repeated allow other scientists showed they had different properties ignore evidence unqualified	1
7(a)(iii)	other scientists obtained similar results / proved it **or** experiments were repeated		1

Question 7 continues on the next page

CHY2F

Question 7 continued

question	answers	extra information	mark
7(b)(i)	any **one** from: • mass of solid / strontium (chloride) / barium (chloride) • volume of water • type of container	allow amount / volume allow amount / mass allow initial / starting temperature (of water) ignore room temperature / time / concentration ignore reference to hydrochloric acid	1
7(b)(ii)	2 **and** takes in heat / energy **or** 2 **and** temperature goes down (owtte)		1
7(b)(iii)	temperature increased for one experiment and decreased for the other (owtte) **or** one was exothermic and one was endothermic (owtte)	accept experiment 1 was exothermic	1
7(c)	any **one** from • positive / + (charge) • opposite (charges) attract	do **not** accept incorrect further qualification eg electrons / atoms / electrodes	1
Total			**7**

4.8.3.5 Sulfates

Answer 04 · Mark scheme

Question 4

question	answers	extra information	mark
4(a)(i)	sodium hydroxide green solid		1 1 1
4(a)(ii)	barium chloride white sulfate ions, SO_4^{2-}		1 1 1
4(b)	some indication of contact between (colourless) flame and the chemical	ignore colour of flame	1
4(c)	any **one** from: • accurate • precise • sensitive • reliable • rapid • only small amount needed	ignore reference to cost / safer	1
Total			**8**

4.8.3.5 Sulfates

Answer 04 · Mark scheme

June 2010 | CHY3F | Original Q4 | Legacy

CHY3F

4.8.3.5 Sulfates

Answer 05 · Mark scheme

Question 2

question	answers	extra information	mark
2(a)	stop them reacting	owtte	1
2(b)(i)	fizzing / bubbles / effervescence	owtte	1
2(b)(ii)	(g)		1
2(b)(iii)	limewater		1
2(c)	yellow		1
2(d)(i)	barium chloride		1
2(d)(ii)	white		1
2(d)(iii)	eg don't see what is being bought **or** a comment about quality / purity eg may be impure / contaminated	ignore references to cost	1
Total			**8**

4.8.3.5 Sulfates

Answer 05 · Mark scheme

January 2011 | CHY3F | Original Q2 | Legacy

CHY3F

4.8.3.5 Sulfates

Answer 06 · Mark scheme

Question 3

question	answers	extra information	mark
3(a)(i)	sodium hydroxide solution blue		1 1
3(a)(ii)	barium chloride white		1 1
3(b)	fully ionised in water		1
3(c)(i)	H^+ ions		1
3(c)(ii)	lower than		1
3(d)(i)	(indicator) changed colour / goes colourless	ignore clear / discoloured	1
3(d)(ii)	13.9 **or** (titration) 2		1
3(d)(iii)	13.2	ecf from 3(d)(ii)	1
Total			**10**

4.8.3.5 Sulfates

Answer 06 · Mark scheme

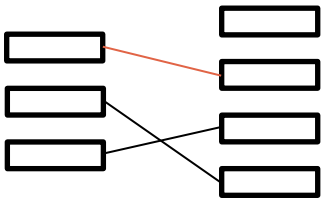
June 2011 | CHY3F | Original Q3 | Legacy

CHY3F

4.8.3.5 Sulfates

Answer 07 · Mark scheme

June 2014 | CH3FP | Original Q6 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
6(a)(i)	*method of introducing sample into flame* *clean wire or colourless flame*	*e.g. wire/splint/spray* *allow blue / roaring flame*	1 1	1 / 3.4	E
6(a)(ii)			1 1	2 / 3.4.1a	G
6(a)(iii)	(potassium) chloride	allow KCl **or** Cl^-	1	2 / 3.4.1e	E
6(b)(i)	copper	allow Cu^{2+}	1	2 / 3.4.1c	E
6(b)(ii)	sulfate		1	2 / 3.4.1f	A
Total			**7**		

4.8.3.5 Sulfates

Answer 07 · Mark scheme

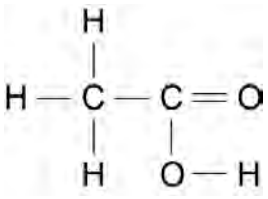
June 2014 | CH3FP | Original Q6 | Legacy



4.8.3.5 Sulfates

Answer 08 · Mark scheme

June 2016 | CH3FP | Original Q5 | Legacy

Question	Answers	Extra information	Mark	AO / SpecRef
5(a)(i)	fizz / effervescence / bubbles	allow calcium carbonate decreases in size or dissolves	1	AO2/AO3 3.4.1d, 3.6.2b
	because carbon dioxide produced / released	allow because gas produced / released	1	
	limewater turns cloudy / milky / white		1	
	because (a precipitate of or solid) calcium carbonate forms	allow because of carbon dioxide if not already credited	1	
5(a)(ii)		allow –OH do not allow lower case 'h'	1	AO1 3.6.2a
5(a)(iii)	acid	must be in this order ignore any name of an acid	1	AO1 3.6.2b
	ester(s)		1	
5(b)	white (precipitate) no change no change no change	all four correct 2 marks any two correct 1 mark	2	AO2 3.4.1e,f
5(c)(i)	lilac red	must be in this order allow purple	1 1	AO1 3.4.1a
5(c)(ii)	colours are masked / changed by each flame colour		1	AO3 3.4.1a
Total			12	

4.8.3.5 Sulfates

Answer 08 · Mark scheme

Question	Answers	Extra information	Mark	AO / SpecRef
6			6	2AO1 / 3AO2 / 1AO3 3.4.1g

Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5 and apply a 'best-fit' approach to the marking.

0 marks	Level 1 (1–2 marks)	Level 2 (3–4 marks)	Level 3 (5–6 marks)
No relevant content.	There is a simple description of using some of the apparatus.	There is a description of an experimental method including addition of acid to alkali which may include an indicator or colour change and may include a measurement of volume.	There is a description of titrations that would allow a comparison to be made between the two solutions of hydrochloric acid.

examples of chemistry points made in the response could include:

- acid in burette **or** flask
- alkali/sodium hydroxide **or** acid in burette or flask
- volume of acid **or** alkali measured using the pipette
- indicator in flask
- white tile under the flask
- slow addition
- swirling/mixing
- colour change of indicator
- burette volume measured

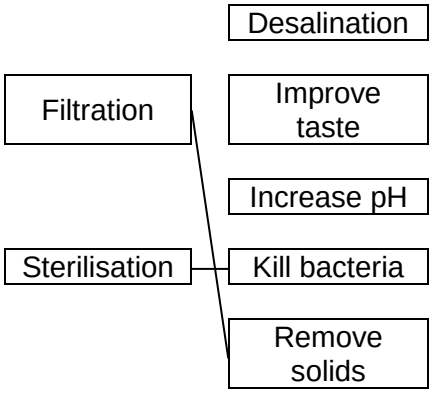
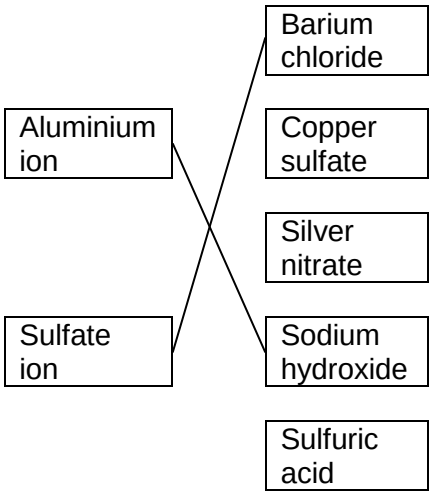
Total		6

4.8.3.5 Sulfates

Answer 09 · Mark scheme

June 2019 | 8462/2F | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1		an extra line from a step to a reason for that step negates that mark	1 1	AO1 4.10.1.2
01.2	chlorine ozone		1 1	AO1 4.10.1.2
01.3	evaporate all water from the sample measure the sample's boiling point		1 1	AO2 4.8.1.1 4.10.1.2
01.4		an extra line from an ion to a compound needed negates that mark	1 1	AO1 4.8.3.2 4.8.3.5
01.5	distillation		1	AO1 4.10.1.2
Total			9	

Answer 10 · Mark scheme

November 2020 | 8462/2F | Original Q8

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	green	allow blue-green	1	AO1 4.8.3.1 RPA 7
08.2	did not clean the metal wire (between tests) **or** copper sulfate (solution) is still present (so) colours are mixed / blended / masked		1 1	AO3 4.8.3.1 RPA 7
08.3	(copper sulfate solution) blue precipitate (calcium iodide solution) white precipitate	allow blue solid allow white solid	1 1	AO1 4.8.3.2 RPA 7
08.4	barium chloride (solution)	allow barium nitrate (solution)	1	AO1 4.8.3.5 RPA 7
08.5	silver nitrate (solution) yellow precipitate	 allow yellow solid allow pale yellow precipitate / solid	1 1	AO1 4.8.3.4 RPA 7
Total			**8**	

4.8.3.5 Sulfates

Answer 11 · Mark scheme

November 2021 | 8462/2F | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	flame emission spectroscopy flame test		1 1	AO1 4.8.3.1 4.8.3.7 RPA7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	white		1	AO2 4.8.3.2 RPA7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	barium chloride (solution)		1	AO1 4.8.3.5 RPA7

Question 6 continued

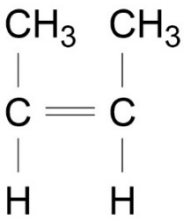
Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	(conversion) (800 cm^3 = $\frac{800}{1000}$ =) 0.8 (dm^3) (mass =) 0.8 × 258 (g) = 206.4 (g) = 206 (g) **alternative approach:** (conversion) (258 g/dm^3 = $\frac{258}{1000}$ =) 0.258 (g/cm^3) (1) (mass =) 0.258 × 800 (g) (1) = 206.4 (g) (1) = 206 (g) (1)	 allow correct use of incorrect / no volume conversion allow an answer correctly calculated to 3 significant figures from an incorrect calculation which uses the values in the question allow correct use of incorrect / no concentration conversion allow an answer correctly calculated to 3 significant figures from an incorrect calculation which uses the values in the question	 1 1 1 1	AO2 4.3.2.5
Total			**8**	

4.8.3.5 Sulfates

Answer 12 · Mark scheme

June 2022 | 8462/2F | Original Q8

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	C=C bond		1	AO2 4.7.3.1
	2x C-H bonds **and** 2x C-CH_3 bonds	do **not** accept extra bonds	1	
		an answer of  scores **2** marks		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	any **one** from: • (otherwise) the copper (produced) would be impure • (otherwise) the copper (produced) would be a mixture • (otherwise) the insulation would burn / melt (during recycling) • copper and poly(butene) are recycled by different methods	allow (otherwise) the copper (produced) would be contaminated allow (otherwise) poly(butene) could produce toxic fumes	1	AO3 4.10.2.2

4.8.3.5 Sulfates

Answer 12 · Mark scheme

June 2022 | 8462/2F | Original Q8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	(wire heated until) copper melts (re)cast / reformed (into pipes)	 allow (re)shaped / extruded / (re)moulded	1 1	AO1 4.10.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	 any **two** from: (recycling scrap copper) • uses less energy • conserves copper (ore) • (produces) less waste • specified environmental impact	allow converse statements for extracting copper from ores ignore references to cost allow less landfill required	 2	AO1 4.10.1.1 4.10.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.5	 sodium hydroxide (solution) blue precipitate	MP2 dependent on MP1 allow NaOH for sodium hydroxide allow blue solid	 1 1	AO1 4.8.3.2 RPA7

4.8.3.5 Sulfates

Answer 12 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.6	(add acidified) barium chloride (solution)	MP2 dependent on MP1 allow $BaCl_2$ for barium chloride allow (add acidified) barium nitrate (solution) do **not** accept add sulfuric acid	1	AO1 4.8.3.5 RPA7
	white precipitate	allow white solid	1	

Total Question 8		11

4.8.3.5 Sulfates

Answer 13 · Mark scheme

June 2024 | 8462/1F | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	(**A**) pipette (**B**) conical flask (**C**) burette		1 1 1	AO1 4.4.2.5 RPA2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	methyl orange (solution) **or** phenolphthalein (solution)	allow litmus (solution) do **not** accept universal indicator	1	AO1 4.4.2.5 RPA2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	colour change	ignore clear	1	AO1 4.4.2.5 RPA2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	any **two** from: • swirl • add the acid drop by drop • read (burette) at eye level • ensure no bubbles in burette • use a white tile • repeat **and** take a mean	allow read (burette) at the bottom of the meniscus	2	AO1 4.4.2.5 RPA2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	16.6 cm^3		1	AO2 4.4.2.5 RPA2

4.8.3.5 Sulfates

Answer 13 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	trial 2 and trial 3		1	AO3 4.4.2.5 RPA2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	$BaCl_2$		1	AO2 4.1.1.1 4.4.2.2

Total Question 2	**10**

4.8.3.5 Sulfates

Answer 14 · Mark scheme

June 2024 | 8462/2F | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	alloy		1	AO1
	reinforcement		1	AO2 4.10.3.2 4.10.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	burning (of methane) releases carbon dioxide	allow burning methane ignore methane is a greenhouse gas	1	AO2 4.9.2.2 4.9.3.1
	decomposition (of limestone) releases carbon dioxide	allow decomposition of limestone	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	hydrochloric acid		1	AO1 4.8.3.3
	limewater		1	RPA7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4		allow converse for plain concrete		AO3 4.10.3.3
	(pre-stressed concrete) can bear the weight of (heavy) traffic	allow (pre-stressed concrete) bridge is less likely to collapse	1	
	(because pre-stressed concrete is) stronger	do **not** accept (because pre-stressed concrete is) more dense	1	

4.8.3.5 Sulfates

Answer 14 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	any **two** from: (plain concrete slabs) • are cheaper • will be lighter (to transport / lay) • do not need to carry vehicles	allow converse for pre-stressed concrete	2	AO3 4.10.3.3

Total Question 7	**10**

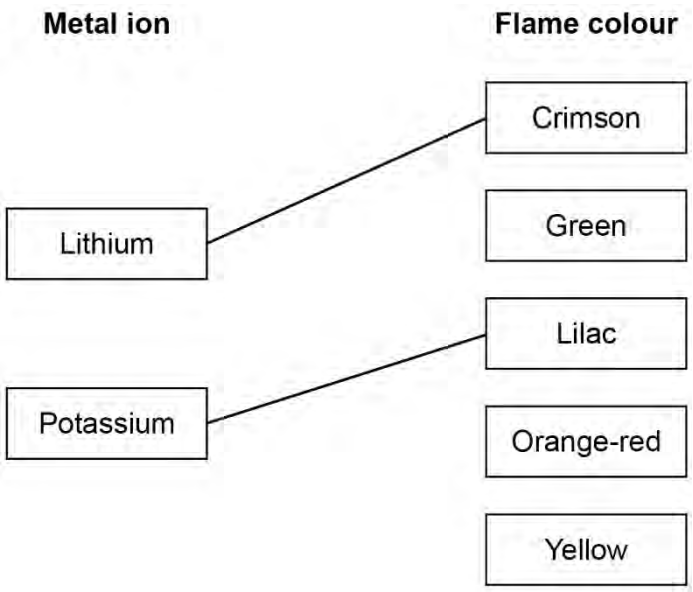
4.8.3.5 Sulfates

Answer 15 · Mark scheme

June 2025 | 8462/2F | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	put sample on (metal) wire hold wire in (blue / non-luminous) flame	ignore references to cleaning	1 1	AO1 4.8.3.1 RPA7

Question	Answers	Mark	AO / Spec. Ref.
01.2	 do **not** accept more than one line from a box on the left	1 1	AO1 4.8.3.1 RPA7

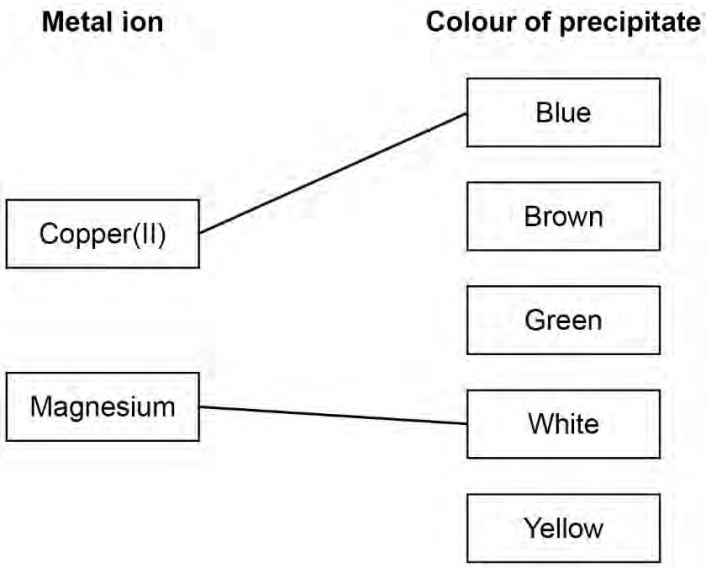
Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	carbon dioxide		1	AO1 4.8.3.3

4.8.3.5 Sulfates

Answer 15 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	barium chloride solution		1	AO1 4.8.3.5 RPA7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	solid		1	AO1 4.2.2.1 4.8.3.5

Question	Answers	Mark	AO / Spec. Ref.
01.6	 do **not** accept more than one line from a box on the left	1 1	AO1 4.8.3.2 RPA7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	yellow		1	AO1 4.8.3.4

Total Question 1	10

4.8.3.5 Sulfates

Answer 12 · Examiner comments

June 2022 | 8462/2F | Original Q8

Question 8 (Standard demand)

08.1 This was well answered by a small minority of students with around 10% of students scoring both marks. The most common errors were to omit the double bond, to add additional bonds or atoms to the carbon atoms. Brackets and/or the inclusion of the letter n were ignored.

08.2 The better responses correctly referred to the insulation being burned or melted or the lack of purity or 'contamination' of the copper produced. Uncreditworthy responses often made comments such as 'so you only get copper'. Around 40% of the students scored this mark.

08.3 This was reasonably well answered as responses such as the copper melting and being reformed/moulded into new pipes were seen. Responses referring to 'heating the wire' were insufficient to gain credit. Around 40% of the students scored both marks.

08.4 The most common correct responses referred to the conservation of copper and the use of less energy in this process. Relatively few answers identified specified environmental impacts.

Weaker responses referred to 'pollution' alone which was too vague to gain credit. Some referred to cost without making a link to the amount of energy needed. Less than 10% of students were able to identify two advantages of recycling, though just over 40% could identify one.

08.5 The test for copper(II) ions was not well known.

A variety of tests were chosen, with the most common incorrect response being the use of flame tests. The addition of acids, especially hydrochloric acid, was also often suggested.

Acceptable results included shades of blue precipitate, e.g. pale/light blue, but answers giving two colours such as green/blue were not credited. Around 1% of students scored both the marks.

08.6 The use of barium chloride or barium nitrate as the reagent for the test was generally followed by the correct result.

The test was often incorrect, with the result, therefore, not able to be awarded a mark. The most common incorrect reponses were the use of a flame test or an incorrect reagent(s). Again, around 1% of students scored both the marks.

4.8.3.5 Sulfates

Answer 13 · Examiner comments

June 2024 | 8462/1F | Original Q2

Question 2 (low and standard demand)

02.1 Over half of students named all three pieces of equipment correctly, with three quarters scoring at least two marks. The burette was often called a measuring cylinder, and the conical flask a beaker. The burette and pipette were sometimes reversed.

02.2 Students found this difficult – many gave names of acids or alkalis, or substances totally unrelated such as iodine. Of those who did give an indicator, many gave universal indicator, which is not suitable for a titration. The most common correctly named indicator was phenolphthalein; any reasonable attempt at the spelling was accepted.

02.3 This was answered well, with nearly two thirds of students giving 'colour change' or a description of one. 'Clear' is not a description of a colour so was insufficient for a mark.

02.4 A third of students scored one mark, but far fewer scored both. Many students did not realise that they had been given the correct apparatus, and merely had to say what they would do to use that apparatus accurately. Instead, most suggested using other, less accurate, equipment such as a measuring cylinder or a beaker. The most common correct answer was to add the acid drop by drop. A few suggested repeating the experiment, without also saying to take a mean of the results. Some students suggested using a measuring cylinder to measure acid into the burette, not understanding what a burette does.

02.5 Two thirds of students gave the correct reading. The most common distractor was 17.4 cm^3.

02.6 Three quarters of students identified the closest pair of results.

02.7 Students found this standard demand question difficult. Just over a third of students identified the formula of barium chloride, but the distractor Ba_2Cl was even more popular.

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4.8.3.5 Sulfates

Answer 14 · Examiner comments

June 2024 | 8462/2F | Original Q7

Question 7 (low and standard demand)

07.1 Approximately two out of five students gained both marks with a one in two gaining one mark. It is important that students read the question carefully as there was a significant number of students who ticked one box instead of two.

07.2 This question asked for two ways in which a greenhouse gas is released in the process described. Less than 25% of students gained both marks with just over 35% more gaining one mark. Incorrect or insufficient responses included 'heating the limestone' and general references to the equation, or that methane might escape during its combustion.

07.3 The carbonate test is poorly understood with less than 15% of students correctly identifying the substance added to the limestone and the test for carbon dioxide. Two in five students gained one mark. The most frequent incorrect response was to mistakenly identify the test as universal indicator.

07.4 Less than 35% of students gained one mark in this question, with less than 15% gaining two marks. Responses which did not gain credit included those referring to carrying heavy weights in general rather than the weight being from lorries or vehicles, responses in terms of the incorrect property from the table or failing to make a valid comparison.

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Answer 14 · Examiner comments

June 2024 | 8462/2F | Original Q7

07.5 This question proved to be easier than that for the concrete bridge with over 50% of students gaining one mark and over 35% gaining both marks. Responses which did not gain credit again included those that failed to make a valid comparison or those that simply quoted data from the table.

4.8.3.5 Sulfates

Answer 15 · Examiner comments

June 2025 | 8462/2F | Original Q1

Question 1

01.1 Three quarters of students scored at least one mark on this item. The most common mark was for putting the wire into the flame. Students should be encouraged to state that the wire is placed in a blue flame when describing a flame test. Many students described the metal wire as being placed under, over or on a Bunsen with no mention of a flame.

01.2 There were nearly two thirds of students who scored at least one mark for this question. Students knew the flame colour for potassium more frequently than that for lithium.

01.3 Carbon dioxide was identified by two thirds of students.

01.4 Only a quarter of students correctly identified barium chloride solution. Sodium chloride solution was the most common distractor.

01.5 Fewer than 1 in 5 students correctly identified a precipitate as a solid. Most students gave a liquid as the answer.

01.6 Fewer than 20% of students correctly identified both precipitate colours. The most common error was identifying the copper precipitate as green. The magnesium precipitate was given the full range of colours available.

01.7 2 in 5 students correctly identified the iodide precipitate as yellow. The other options were both frequently seen.