AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.10.1.2

Potable water

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**11**
Available paper years	**2008–2024**

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.

4.10.1.2 Potable water

Answer 01 · Mark scheme

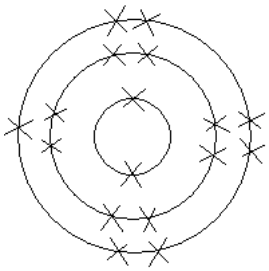
June 2008 | CHY3H | Original Q8 | Legacy

question	answers	extra information	mark
8	**two** methods and **1 linked** explanation **or 1** method and **two** explanations, **1** linked = **3** marks no linking of method and explanation then max **2** marks	ignore references to removal of hardness	3
	method 1: filter	ignore screening / sedimentation	
	explanation 1: remove insoluble substances / remove solids / small bits / dirt / mud/ soil / sand / silt		
	method 2: precipitate / flocculate / add eg. alum	allow other named substances	
	explanation 2: removes (some) soluble material as solids / removes (some) metal ions		
	method 3: add chlorine / chlorine dioxide / ozone		
	explanation 3: sterilise / kill bacteria / microorganisms / microbes	ignore 'remove bacteria' ignore disinfect	
Total			**3**

4.10.1.2 Potable water

Answer 02 · Mark scheme

Question 1

question	answers	extra information	mark
1(a)		accept dots / crosses / e must be drawn on diagram electrons do not need to be paired ignore brackets or + or −charges ignore 2,8,7	1
1(b)	(one) electron lost / given away / transferred from sodium / transferred to chlorine owtte	recognition that electrons are involved must be linked to electrons accept loses electron(s) for **2** marks NB loses 2 or more electrons gains **1** mark reference to sharing / covalent max **1** mark ignore charges on ions formed	1 1
1(c)(i)	any **one** from: • ions / atoms / they are / it is negatively charged / anions • opposite (charges) attract	 accept they are negative accept they are attracted or it is oppositely charged ignore opposite forces attract	1
1(c)(ii)	hydrogen	accept H_2 ignore H or H^+	1

Question 1 continues on next page

4.10.1.2 Potable water

CHY2H

Question 1 continued

question	answers	extra information	mark
1(d)(i)	poisons released into environment (owtte)	accept any sensible idea of harm / harmful / poisons / poisonous / pollution / damaging do **not** accept answers such as global warming / ozone layer etc. ignore safety unless qualified	1
1(d)(ii)	any **one** sensible idea eg • loss of work / unemployment **or** company goes out of business • any adverse effect on local economy (owtte) • any adverse effect on paper production / cost of paper / cost of water (treatment) • chlorine (compounds) have been used (for many years) without causing harm owtte • only a tiny amount of chlorine is released so it would not cause harm	eg shops / house prices etc. allow less expensive to use chlorine or converse ignore uses of chlorine to treat drinking water unless qualified	1
1(d)(iii)	ideas related to bias	accept more reliable or valid or fair ignore more accurate / fair test	1
Total			**8**

4.10.1.2 Potable water

Answer 02 · Mark scheme

January 2010 | CHY2H | Original Q1 | Legacy

CHY2H

4.10.1.2 Potable water

Answer 03 · Mark scheme

Question 8

question	answers	extra information	mark
8	use of (water) filters / ion exchange		1
	containing carbon / charcoal / silver / resins	ignore other substances	1
	any **two** from: • carbon / charcoal removes chlorine • carbon / charcoal removes soluble / dissolved substances • silver kills / prevents growth of microorganisms • ion exchange removes calcium ions / magnesium ions / metal ions • ion exchange replaces (metal ions) with H^+ / Na^+ • ion exchange removes hardness	allow exchange for replace	2
Total			**4**

4.10.1.2 Potable water

Answer 04 · Mark scheme

January 2011 | CHY3H | Original Q2 | Legacy

Question 2

question	answers	extra information	mark
2(a)	filtered: removes insoluble / solid	Ignore named substances / minerals do **not** accept ions	1
	chlorine: kills microorganisms / microbes / bacteria / disinfects (water)	allow kills germs / pathogens **or** sterilises allow chlorine is a disinfectant ignore cleans water or removes impurities / bacteria	1
2(b)(i)	<u>advantages of portable</u>: any **two** from : • costs less • little training needed • water can be tested within 10 seconds / immediately / quicker • can be used anywhere	accept converse throughout	2
	<u>disadvantage of portable</u> less precise / sensitive	allow only detect down to 0.1 mg ignore less accurate	1
2(b)(ii)	(PIWE) is unbiased **or** company may be biased	it / they = PIWE allow honest / trusted / respected / reliable ignore professional / scientific / skilled allow company trying to sell products	1
Total			**6**

4.10.1.2 Potable water

Answer 04 · Mark scheme

January 2011 | CHY3H | Original Q2 | Legacy

CHY3H

4.10.1.2 Potable water

Answer 05 · Mark scheme

June 2012 | CH2HP | Original Q2 | Legacy

Question 2

question	answers	extra information	mark
2(a)	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 2, and apply a 'best-fit' approach to the marking.		6

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 a laboratory procedure for obtaining potassium chloride.	There is a clear description of a laboratory procedure for obtaining potassium chloride from potassium hydroxide solution and hydrochloric acid that does not necessarily allow the procedure to be completed successfully by another person. The answer must include the use of an indicator / pH meter **or** a method of obtaining crystals.	There is a detailed description of a laboratory procedure for obtaining potassium chloride from potassium hydroxide solution and hydrochloric acid that can be followed by another person. The answer must include the use an indicator / pH meter **and** a method of obtaining crystals

examples of the chemistry points made in the response:

- One reagent in beaker (or similar)
- Add (any named) indicator
- Add other reagent
- Swirl **or** mix
- Add dropwise near end point
- Stop addition at change of indicator colour
- Note volume of reagent added
- Repeat without indicator, adding same volume of reagent **or** remove indicator using charcoal
- Pour solution into basin / dish
- Heat (using Bunsen burner)
- Leave to crystallise / leave for water to evaporate / boil off water

Accept any answers based on titration

Question 2 continues on the next page . .

CH2HP

Question 2 cont'd…

question	answers	extra information	mark
2(b)	nitric (acid)	allow HNO_3 ignore incorrect formula	1
2(c)(i)	because it is a fertiliser / helps plants grow	allow plant food do **not** accept pesticide / herbicide / neutralising soil	1
2(c)(ii)	tick by: 'Should farmers stop using ammonium nitrate on their land?' any **two** from: • cannot be done by experiment • based on opinion / view • ethical **or** economic issue	 accept difficult to get / not enough evidence allow must be done by survey if top box ticked allow **1** mark for drinking water varies from place to place	1 2
Total			**11**

4.10.1.2 Potable water

Answer 05 · Mark scheme

June 2012 | CH2HP | Original Q2 | Legacy

CH2HP

4.10.1.2 Potable water

Answer 06 · Mark scheme June 2014 | CH3HP | Original Q1 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
1(a)	filter to remove <u>solids</u> ***or*** *insoluble particles* ***OR*** *add coagulant (1)* flocculation / settling / remove <u>solids</u> (1) (add) chlorine to reduce the number of microbes	 *accept ozone / UV* accept to kill microbes / bacteria / germs accept sterilise *allow disinfect* *ignore remove microbes*	1 1 1 1	1 / 3.2.2a/c	E
1(b)(i)	ion exchange resin	allow ion exchange column *allow sodium <u>ions</u> / Na^+* *allow hydrogen <u>ions</u> / H^+*	1	1 / 3.2.2b	E
1(b)(ii)	prevent growth of microbes	*accept sterilise* *accept to kill microbes / bacteria / germs* *accept to reduce the number of microbes* *ignore remove microbes*	1	1 / 3.2.2b	E
1(c)	high cost of energy / *heating*	*allow uses a lot of energy*	1	2 / 3.2.2d	E
1(d)	any **one** from: • helps to develop / maintain bones • helps to develop / maintain teeth • reduces heart disease	 allow any suitable positive effect on bones allow any suitable positive effect on teeth	1	1 / 3.2.1f	E
Total			**8**		

4.10.1.2 Potable water

Answer 06 · Mark scheme

June 2014 | CH3HP | Original Q1 | Legacy



4.10.1.2 Potable water

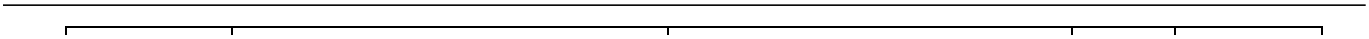
Answer 07 · Mark scheme June 2016 | CH3HP | Original Q4 | Legacy

Question	Answers	Extra information	Mark	AO / SpecRef
4(a)	development / maintenance of teeth / bones	allow lowers risk of heart disease	1	AO1 3.2.1f
	because contains calcium ions / compounds	allow contains calcium	1	
4(b)	scum or calcium stearate		1	AO1 3.2.1a
4(c)	temporary hard water contains calcium hydrogencarbonate or hydrogencarbonate ions	allow hydrogencarbonate	1	1AO1 / 2AO2 / 1AO3 3.2.1c,d,e
	when heated / boiled these decompose	allow decompose (in the kettle)	1	
	to produce a precipitate / scale or to produce calcium carbonate		1	
	coats the heating element or coats the kettle	allow prevents heat / energy transfer to the water	1	
4(d)		ions must be mentioned once to gain both of the first two marking points		2AO1 / 1AO2 3.2.1g, 3.2.2b
	ion exchange resins contain sodium / hydrogen ions		1	
	which replace / remove the calcium / magnesium ions	allow displace, but do not allow references to reactivity series	1	
	so removing the hardness or producing soft water		1	
Total			**10**	

4.10.1.2 Potable water

Answer 07 · Mark scheme

June 2016 | CH3HP | Original Q4 | Legacy



4.10.1.2 Potable water

Answer 08 · Mark scheme

June 2019 | 8462/2H | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	add sodium hydroxide (solution to water sample) white precipitate (forms) (precipitate which is) soluble in excess (NaOH)	 dependent on correct test in MP1	1 1 1	AO1 4.8.3.2
07.2	add barium chloride (solution) **and** (dilute) hydrochloric acid (to water sample) white precipitate (forms)	allow barium nitrate (solution) allow (dilute) nitric acid dependent on addition of barium chloride / nitrate (solution) in MP1	1 1	AO1 4.8.3.5
07.3	**Level 2:** The design/plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.		3–4	AO1 4.10.1.2
	Level 1: The design/plan 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 • weigh (evaporating) basin / dish • add measured volume of water • weigh (evaporating) basin / dish and water • heat to evaporate water • reweigh • repeat heating until constant mass obtained • subtract mass of (evaporating) basin / dish from mass • repeat and calculate a mean, discarding anomalous results • calculate the mass in 100 cm^3 water if necessary			
Total			**9**	

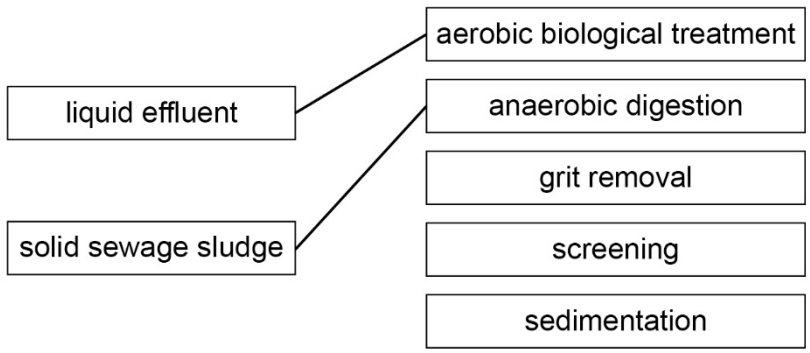
4.10.1.2 Potable water

Answer 09 · Mark scheme

November 2020 | 8462/2H | Original Q2

Question 2

Question	Answers	Mark	AO/ Spec. Ref
02.1	**Level 2**: Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.	3–4	AO1 4.10.1.2
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	
	No relevant content	0	
	Indicative content • choose an appropriate source of fresh water • such as rivers, streams, lakes, boreholes • pass through filter beds • (which) removes undissolved solids • sterilise • using chlorine / ozone / UV light • (which) destroys harmful microbes		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	any **one** from: • distillation • reverse osmosis	allow use of membranes allow desalination	1	AO3 4.10.1.2
02.3	 additional line from a box on the left negates the mark for that box		1 1	AO1 4.10.1.3

Question 2 (continued)

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	$\frac{260}{1413}$ x 100 = 18.40056617 (%) = 18.4 (%)	 allow an answer correctly calculated to 3 significant figures from an incorrect percentage calculation which uses values in the question	1 1 1	AO2 4.10.1.3
02.5	any **one** from: • the population increased • more waste water produced • less untreated sewage discharged		1	AO3 4.10.1.3
02.6	any **two** from: • increased demand for food (due to increasing population) • conserves energy / resources • landfill space is running out • increased demand for organic fertiliser	ignore references to cost allow more farming allow more sustainable allow more awareness of the negative environmental impacts of landfill ignore less sent to landfill allow lifestyle choice for organic food	2	AO3 4.10.1.3
Total			**13**	

4.10.1.2 Potable water

Answer 10 · Mark scheme

June 2022 | 8462/2H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1		allow a description of each process		AO1 4.10.1.3
	screening **or** grit removal	allow filtering to remove (large) solids	1	
	sedimentation (to produce sewage sludge and effluent)		1	
	anaerobic digestion of (solid sewage) sludge		1	
	aerobic biological treatment of (liquid) effluent	allow aerobic digestion of effluent	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	Na^+ : 0.003 mol/dm^3 Cl^- : 0.003 mol/dm^3		1	AO3 4.10.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	the ions pass through the filter	allow the ions are not trapped / removed by the filter	1	AO3 4.1.1.2 4.10.1.2
	(because) the ions are in solution	allow (because) the ions are smaller than the filter pores	1	

4.10.1.2 Potable water

Answer 10 · Mark scheme

June 2022 | 8462/2H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	(the ground water) contains microbes which are harmful (to health) (so) the water is sterilised **or** (so) the microbes are destroyed		1 1	AO3 AO1 4.10.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	(the water is) unadulterated **or** (the water is) in its natural state	allow nothing is added (to the water) allow (the water) contains no microbes	1	AO2 4.8.1.1 4.10.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	(use) damp litmus paper (the paper) is bleached **or** (the paper) turns white	MP2 is dependent upon MP1 ignore paper turns red	1 1	AO1 4.8.2.4

Total Question 5		12

4.10.1.2 Potable water

Answer 11 · Mark scheme

June 2024 | 8462/2H | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	combustion reversible		1 1	AO2 4.6.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	water molecules break down and reform at the same rate		1	AO2 4.6.2.3

4.10.1.2 Potable water

Answer 11 · Mark scheme

Question	Answers	Mark	AO / Spec. Ref.
03.3	**Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO1 4.10.1.2 4.10.1.3
	Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3–4	
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	
	No relevant content	0	
	Indicative content **Potable water production** • pass water through filter beds • to remove solids • use chlorine / ozone / UV light • to sterilise water • to destroy microbes **Waste water treatment** • screening • using a metal grid • to remove solids • to remove grit • sedimentation • to produce sewage sludge and effluent • anaerobic digestion of sewage sludge • aerobic biological treatment of effluent access to **Level 3** requires reference to **both** potable water production **and** waste water treatment.		

Total Question 3	9

4.10.1.2 Potable water

Answer 09 · Examiner comments

November 2020 | 8462/2H | Original Q2

Question 2 (standard demand)

02.1 Some good answers were seen, with many students giving a Level 2 response. However, the sources of fresh water were frequently omitted, and many students went beyond the requirements of the specification and added information about screening, flocculation and sedimentation, often adding confusion to the filtration process. The sterilisation phase was quite well known, but then further information about addition of fluoride and water softening was often added. A significant minority thought that water treatment works boiled the water as part of the process.

02.2 Many students made the link between sea water and energy and scored this mark. The most common errors were to mention only boiling the water with qualification or filtration.

02.3 A number of students knew neither of the processes. Some of these reversed the two responses but overall there was no discernible pattern in the errors.

02.4 This part was extremely well done. A minority of students used data for the wrong year or showed that they didn't understand the concept of significant figures.

02.5 The majority of students were able to make the link with population increase. Weaker responses merely referred to an increase in the amount of unspecified waste produced or treated.

02.6 Many students were able to give one valid reason – usually linked to increased demand for food or food production. Few though were able to give a second reason. The most common response that gave insufficient detail was that less sludge was sent to landfill.

4.10.1.2 Potable water

Answer 10 · Examiner comments

June 2022 | 8462/2H | Original Q5

Question 5 (Standard, standard/high and high demand)

05.1 About a fifth of the students gained all the available marks. Many students answered the question in terms of treating water to make it potable, rather than treating sewage. Those who did answer in terms of treating sewage initially answered well though many answers broke down after mention of screening and sedimentation.

05.2 Half of the students were able to give the correct pair of concentrations in this multiple choice question.

05.3 The common error in this question was to concentrate on what Process 1 (filtering) did do, rather than the lack of effect on the ions. Of those who did correctly answer the question, more were awarded the first mark on the mark scheme. Around a quarter of the students gained both of the marks.

05.4 Students needed to state that the microbes were harmful and because of this some did not gain the first mark, although many were awarded the second. About 40% of the students scored both marks.

05.5 Less than a third of students answered this successfully with many responses stating the company meant the water was chemically pure, in spite of this being explicitly negated in the question.

05.6 Most students knew the test for chlorine gas; however a significant number did not refer to the need for the litmus paper to be damp and therefore did not gain the first mark. Over one-third of the students gained both marks.

4.10.1.2 Potable water

Answer 11 · Examiner comments June 2024 | 8462/2H | Original Q3

Question 3 (standard demand)

03.1 This multiple-choice question proved challenging, with around a quarter of students gaining two marks. However, the vast majority were able to score one mark.

03.2 This multiple-choice question was extremely well answered, with more than 90% of students gaining credit.

03.3 This standard demand item was generally answered quite well. A majority of students had a good overall understanding of the sequence of steps involved in potable water production and wastewater treatment and so scored highly on this item. Weaker responses tended to focus on wastewater treatment, for which the diagram in the stem provided more scaffolding.

Most students recognised that ground water needed to be filtered initially. A few responses referred to screening before the use of filter beds, although only referring to screening in potable water production was considered insufficient. Sometimes the descriptions of things removed by filter beds did not make it clear that they were solid. The process of sterilisation was generally well described, although removal of microbes rather than their destruction was not creditworthy.

Removal of solids using a metal grid was included by most students. Fewer students referred to this step as screening and again things removed by screening were not always clearly identified as solid. Organic matter in sewage is not removed by screening as this is treated subsequently. The final steps were less well addressed overall. Most students referred to sludge and effluent (again these featured in the diagram), but many failed to recognise that these were separated by sedimentation. Some responses confused the separation of sludge and effluent with their biological treatment afterwards. Some students recognised that sludge is treated anaerobically and effluent aerobically but did not refer to digestion or biological treatment or an equivalent description of microbial action.

References to flocculation, desalination, fluoridation or pH adjustment were considered irrelevant and ignored in the marking of this item.

Around a third of students gained a Level 3 mark, with roughly another third achieving Level 2.