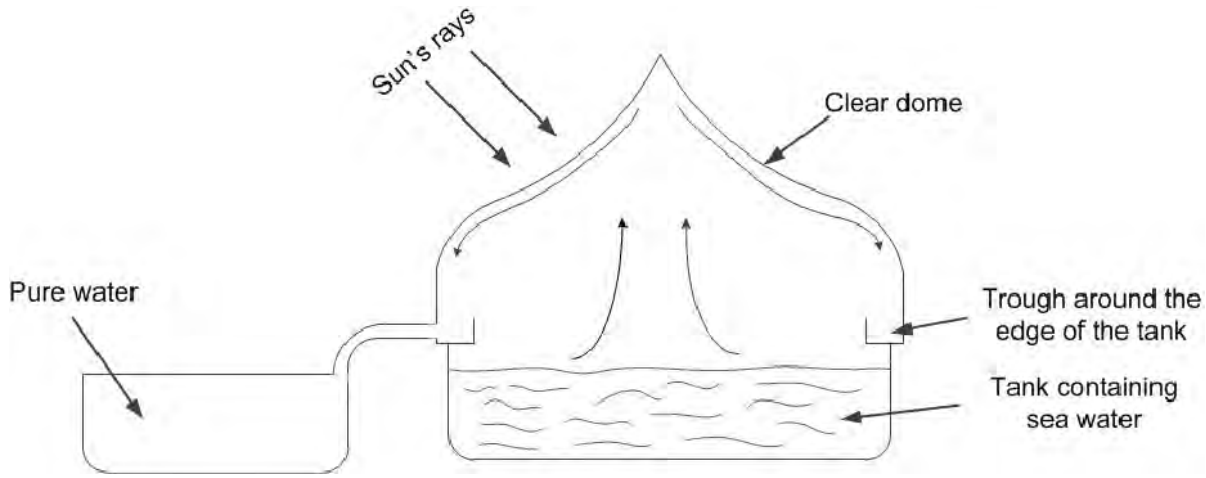
1(a). Chlorine is used in the treatment of drinking water.

Describe how you would test a sample of gas to show that it is chlorine.

---

[2]

(b). A solar still can be used to make sea water safe to drink.



The diagram shows a cross-section through a solar still.

Describe how a solar still produces drinking water from sea water.

---

[2]

2. Chlorine is added to water before it is supplied to homes and businesses.

Describe and explain the advantages and disadvantages of adding chlorine to water supplies.

The quality of written communication will be assessed in your answer.

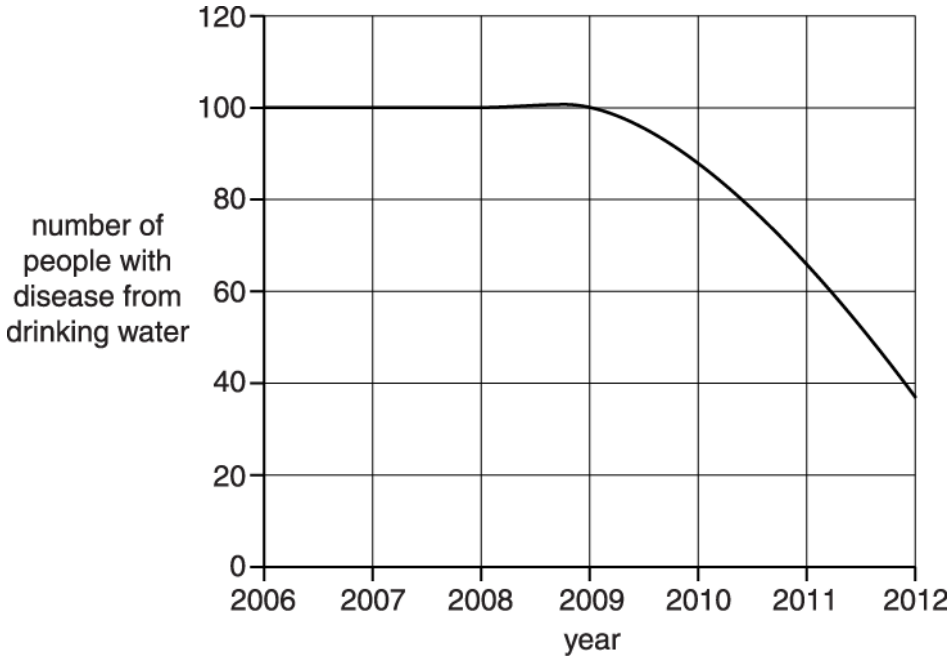
[6]

3. In remote parts of a developing country, the drinking water causes diseases that kill people.

In one area people started to add chlorine to drinking water from 2009.

A charity raised the money to pay for this.

Look at the graph.



Should chlorine be added to drinking water in other remote areas?

In your answer you should:

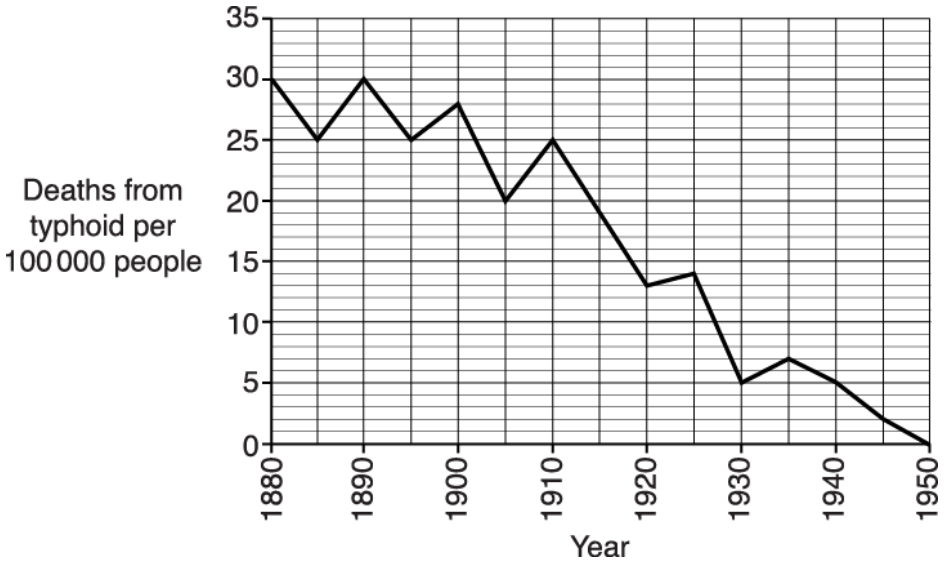
- describe what the graph shows you about adding chlorine
- explain why the chlorine has an effect
- write about the advantages and disadvantages of adding chlorine to drinking water in other parts of the developing country.

The quality of written communication will be assessed in your answer.

---

[6]

4(a). The graph shows the deaths from typhoid in a UK city.



(i) Complete the table which shows the deaths from typhoid in 1890 and 1930.

Year	Total population of city	Deaths from typhoid per 100 000 people	Total deaths from typhoid
1890	60 000	_____	18
1930	200 000	5	_____

[2]

(ii) What does the graph show about the deaths from typhoid between 1880 and 1950?

_____

_____

_____

_____ [2]

(b). From 1910 onwards chlorine was added to the water supply of the city.
Beth and Zac look at the graph.
They talk about the effects of adding chlorine to water.

Beth says that deaths from typhoid fell before chlorine was added to water so chlorine has no effect.

Zac says that adding chlorine to water lowers deaths from typhoid.

Who is right? Explain your answer.

The quality of written communication will be assessed in your answer.

[6]

5(a). Mauritius is a country of small islands surrounded by sea.
There is almost no fresh water in Mauritius.

A distillation process is used to produce fresh water.

Statements **A–G** describe some **correct** and some **incorrect** stages in the distillation process.

A	Cold water is used to cool the steam.
B	Water evaporates.
C	Water condenses.
D	Water is heated.
E	Seawater is taken from the sea.
F	Water is sent through pipes to homes.
G	Salt is filtered out from the seawater.

Put the **correct** statements in the correct order.

The first and last have been done for you.

E					F

[2]

(b).

(i) Chlorine is used to treat drinking water before it is sent to homes.
The waste water from homes is treated with oxygen.

The table shows some information about oxygen and chlorine.

Gas	Formula of gas	Type of water treated	Reason gas is used in water treatment
oxygen		waste water	removes waste dissolved in water
chlorine		drinking water	

Table 3.1

Complete **Table 3.1** by filling in the missing information. **[2]**

(ii) Complete **Table 3.2** below to show the tests and results used to identify oxygen and chlorine gas.

Gas	Test	Result
oxygen		
chlorine	damp blue litmus paper	

Table 3.2

[3]

END OF QUESTION PAPER

Question			Answer/Indicative content	Marks	Guidance
1	a		(blue) Litmus paper ✓ goes red then white / red then bleaches ✓	2	
	b		water evaporates (from sea water) by the heat from the sun ✓ water condenses (on the sides of the dome) and collects in the trough ✓	2	
			Total	4	

Question			Answer/Indicative content	Marks	Guidance
2			**Level 3 (5–6 marks)** Answer gives full details of both advantage and disadvantage. Quality of written communication does not impede communication of the science at this level. **Level 2 (3–4 marks)** Answer gives some details of both advantage and disadvantage, or one in full detail. Quality of written communication partially impedes communication of the science at this level. **Level 1 (1–2 marks)** Answer relates only to advantage or disadvantage in limited detail, not both. Quality of written communication impedes communication of the science at this level. **Level 0 (0 marks)** Insufficient or irrelevant science. Answer not worthy of credit.	6	**This question is targeted at grades up to E** **Indicative scientific points may include:** **Advantages;** • chlorine kills bacteria • bacteria can cause disease • disease can be spread in water supply • example of water-borne disease eg cholera **Disadvantages;** • chlorine reacts with organic materials in water • product is toxic / carcinogen • products of this reaction can affect health **Ignore** taste / colour / smell of water **Use the L1, L2, L3 annotations in Scoris: do not use ticks** **Examiner's Comments** The advantages of adding chlorine were well answered. The chlorine 'Killing bacteria' was a popular correct point made. There were also a number of weak responses of chlorinebeing used to 'clean bacteria', or 'just to get rid of them'. The answers rarely went into any more detail than this. The disadvantages of adding chlorine was more difficult. Asignificant number of candidates simply didn't attempt this section of the question or they described how chlorine itself in water could 'cause cancer'. Very few students knew anything about chlorine reacting with organic material. Very few responses were Level three.
			Total	**6**	

Question			Answer/Indicative content	Marks	Guidance
3			[Level 3] Description of the graph is **linked** to an explanation of action of chlorine **and** comment about advantages and disadvantages of adding chlorine to water (in other areas) Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) [Level 2] Description of the graph with an attempt to link to an explanation of action of chlorine **or** a comment about advantages and disadvantages of adding chlorine to water. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) [Level 1] Some comment about effects of chlorine **or** comment on the graph Quality of written communication impedes communication of the science at this level. (1 – 2 marks) [Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted at grades up to E Indicative scientific points may include: Graph • Graph shows reduction in disease over time after 2009 when chlorine was introduced • Effect of chlorine (also advantages) • chlorine added to water to kill microbes / diseases • disease is caused by (named) bacteria / microbes • sterilises Advantages of chlorine • addition of chlorine to drinking water make a major contribution to public health • chlorine makes the water safer to drink Disadvantages of chlorine • concentration must be controlled • may alter the taste of water • may affect pH • may kill fish • may be harmful • Chlorine can react with organic compounds • Difficult to get chlorine to remote areas in developing countries • Developing countries might not have the funds to purchase the chlorine / equipment • Some people may have an allergy to chlorine Use the L1, L2, L3 annotations in Scoris; do not use ticks. Examiner's Comments The majority of candidates were level 2 or above in standard as they could identify

Question			Answer/Indicative content	Marks	Guidance
					the trend of the graph and provided the explanation that chlorine kills bacteria/microbes in the water. Where candidates didn't refer to the graph, they could provide advantages and disadvantages of adding chlorine to the water supply and so still achieved a level 2 mark. A common disadvantage given was that 'chlorine can cause cancer' rather than the idea that chlorine will react with organic compounds in the water to produce carcinogens. Credit was not given for this without the idea of a reaction firstly taking place. Where candidates were limited to level 1, it was usually because they didn't supply a disadvantage for adding chlorine or discuss the graph.
			Total	6	

Question			Answer/Indicative content	Marks	Guidance
4	a	i	30; (1) 10; (1)	2	Examiner's Comments Most candidates could give the correct response of '30' for the death from Typhoid in the year of 1890 but less were able to give the total number of deaths from Typhoid in 1930 as this required a calculation. Often, the answer put here was 5, thus indicating that the candidate had used the graph instead of inferring from the table that the population in the city was 200 000 and therefore requiring them to double their answer.
		ii	Any **two** from Number of deaths goes down (over time); Fluctuations from year to year; Large drop after 1910; Deaths drop to zero in 1950;	2	**Allow** negative correlation Examiner's Comments Many responses scored the mark for stating that the number of deaths from typhoid decreases. Most of these responses also gained a second mark for either saying that the deaths went down to zero in 1950 or there was a major decrease after 1910.
	b		**[Level 3]** Chooses Zac and justifies this choice by making a comment about the graph after 1910 AND explains an effect of adding chlorine to water. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **[Level 2]** Chooses Zac and justifies this choice by making a comment about the graph after 1910 **OR** chooses Zac and explains an effect of adding chlorine to water **OR** chooses both Zac and Beth and comments on the graph before and after 1910 Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks)	6	**This question is targeted at grades up to E** **Indicative scientific points may include:** **Explanation of the effects of chlorine** • chlorine kills microorganisms / bacteria / typhoid • Sterilisation of water supply • adding chlorine to water made a major contribution to public health **Comments about the graph** • Decrease of cases of typhoid greater after 1910 / chlorine is added • Fluctuations in the graph • Slight / gradual decrease in deaths before 1910 / chlorine is added • Deaths drop to zero after chlorine is added

Question			Answer/Indicative content	Marks	Guidance
			[Level 1] Makes a comment about the graph OR explains an effect of adding chlorine to water. Quality of written communication impedes communication of the science at this level. (1 – 2 marks) [Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)		Ignore germs Use the L1, L2, L3 annotations in Scoris; do not use ticks. Examiner's Comments This question was generally well answered with the majority of responses scoring four marks or higher. Candidates were able to interpret the data, and explained how it showed that the use of chlorine was effective, and also how the chlorine killed bacteria in water. They gave dates and explained the differences before and after 1910. Weaker candidates became distracted with irrelevant information, such as harmful effects of chlorine, or ignored the effect of chlorine altogether. The general pattern of many answers was: 'Zac is correct, deaths lower after chlorination of 1910' often with a statement about the action of chlorine. Some candidates used poor language skills as they spoke of the chlorine 'getting rid of germs that caused typhoid' rather that the action of the bacteria being killed by the chlorine. Some candidates confused Beth's comment and argued solely for her, commenting that chlorination of water could be dangerous, with some mentioning the formation of THMs and the link to cancer. A lot of candidates seemed to think that this answer required a balanced view, stating that Beth was 'kind of right', yet failing to challenge the 'chlorine has no effect' comment. Other candidates that chose Beth as correct only referred to the first part of her comment ('the deaths from typhoid fell before chlorine was added') and again, failed to acknowledge the 'chlorine has no effect' comment.
			Total	10	

Question			Answer/Indicative content	Marks	Guidance
5	a		DBAC	2 (AO 2 × 1.2)	G is left out ✓ others in correct order ✓ Examiner's Comments Although almost all candidates attempted this item, many did not correctly sequence all the steps in distillation. The most common error was to start by filtering in the expectation that this might remove salt from the seawater.
	b	i	**Formula of gas:** O_2 and Cl_2 ✓ **Reason:** kills / removes bacteria ✓	2 (AO 2× 1.1)	**DO NOT ALLOW** 2O or 2Cl **ALLOW** safe to drink / sterilises water **IGNORE** cleans water Examiner's Comments The diatomic nature of oxygen was well known but the equivalent formula for chlorine gas was less commonly given. Most candidates were aware that the chlorine was intended to make drinking water safe, but the mechanism involves removing micro-organisms. Making the water "clean" or "pure" shows a poor understanding of the concept of purity.
		ii	Oxygen **Test:** glowing splint / spill ✓ **Result:** relights✓ Chorine **Result:** (red then) white/bleached ✓	3 (AO 3 × 1.2)	**ALLOW** description of process Mark independently **ALLOW** idea of losing colour Examiner's Comments Many candidates recalled that the test for oxygen involved a splint, but full marks required relighting a glowing splint. This was commonly confused with the test for hydrogen. Some candidates identified that the damp litmus paper would change colour with chlorine but an appreciation of chlorine's bleaching properties was not well known.
			Total	7	