**M1.**(a) filtration

**or**

by passing through filter beds to remove solids

**1**

sterilisation to kill microbes

*allow chlorine / ozone allow ultraviolet light*

**1**

(b) water needs more / different processes

**1**

because it contains any **two** from:

- more organic matter
- more microbes
- toxic chemicals or detergents

**2**

(c) *(as part of glassware attached to bung)*

salt solution in (conical) flask

*allow suitable alternative equipment, eg boiling tube*

**1**

*(at end of delivery tube)*

pure water in test tube which must not be sealed

*allow suitable alternative equipment, eg, beaker, condenser*

**1**

heat source (to heat container holding salt solution)

**1**

*if no other mark obtained allow for **1** mark suitable equipment*

*drawn as part of glassware attached to bung **and** at end of delivery tube*

(d) determine boiling point

**1**

should be at a fixed temperature 100°C

*allow should be 100°C*

*allow if impure will boil at a temperature over 100°C*

**1**

(e) high energy requirement

**1**

**[11]**

**M2.**(a) filter

**1**

to remove *solids* ***or*** *insoluble particles*

***OR***

*add coagulant (1)*

flocculation / settling / remove solids (1)

**1**

(add) chlorine

*accept ozone / UV*

**1**

to reduce the number of microbes

*accept to kill microbes / bacteria / germs*
*accept sterilise*
*allow disinfect*
*ignore remove microbes*

**1**

(b) (i) ion exchange resin

*allow ion exchange column*
*allow sodium ions / $Na^+$*
*allow hydrogen ions / $H^+$*

**1**

(ii) prevent growth of microbes

*accept sterilise*
*accept to kill microbes / bacteria / germs*
*accept to reduce the number of microbes*
*ignore remove microbes*

**1**

(c) high cost of energy / *heating*

*allow uses a lot of energy*

**1**

(d) any **one** from:

- helps to develop / maintain bones

  *allow any suitable positive effect on bones*
- helps to develop / maintain teeth

  *allow any suitable positive effect on teeth*
- reduces heart disease

**1**

**[8]**

**M3.**(a) (i) distillation

**1**

(ii) 100 / one hundred

**1**

(b) (i) measuring cylinder **or** pipette **or** burette

*allow phonetic spelling*

*do **not** accept teat pipette*

*ignore any additional words or volumes*

**1**

(ii) (re)heat the evaporating basin

*accept heat to constant mass for **2** marks*

**1**

weigh (again) **or** mass will not change

*if no other mark awarded allow **1** mark for a chemical test for water*

**1**

(iii) 33.2 (g)

*correct answer with or without working scores **2** marks*

*allow mass of residue = (24.04 g − 23.21 g) = 0.83 for **1** mark*

*allow ecf (mass of residue × 40) for **1** mark*

**2**

(c) to kill microbes / bacteria **or** to sterilise / disinfect water

*allow to prevent disease*

*ignore 'to make it safe to drink'*

**1**

(d) Marks awarded for this answer will be determined by the Quality of Communication (QoC) as well as the standard of the scientific response. Examiners should also refer to the information on page 4, and apply a 'best−fit' approach to the marking.

**0 marks**
No relevant content

**Level 1 (1 – 2 marks)**
A simple relevant comment has been made on the data from at least one of the graphs.

**Level 2 (3 – 4 marks)**
At least two of the graphs have been considered with a relevant comment made.

**Level 3 (5 – 6 marks)**
All the graphs have been considered and relevant comments made about each.
A justified conclusion may be given.

**examples of chemistry points made in the response:**

***extra information***

- (graph 1 shows) fluoride ions reduce the amount of tooth decay
- (graph 1 shows) the effect in reducing tooth decay is greatest for 55−64 year olds

  *accept any in range 55 − 64*
- (graph 2 shows) the fluoride ions reduce percentage with decayed teeth
- (graph 2 shows) effect is greatest at 2.5 to 3 mg per 1000 g of water then decay increases if more than 2.5 to 3 mg of fluoride ions per 1000 g water

  *accept any in range 2.5 − 3*
- (graph 2 shows percentage) decay decreases from 0 to 2.5 / 3 mg per 1000 g
- (graph 3 shows) more marked / brittle teeth as fluoride level increases
- above points linked together to draw a justified conclusion

**6**

**[14]**

**M4.**(a) any **two** from:

- copper / ores are running out / harder to find
- there are no / very small amounts of high-grade copper ores left
- copper metal is in demand
- copper is expensive
- now economical to extract copper from low-grade ores

  *it = copper*

  *allow new methods of extraction e.g. bioleaching and phytomining*

  *allow high-grade ores are running out for **2** marks*

**2**

(b) (i) large amounts / 98% of rock to dispose of as waste

*accept contains toxic (metal) compounds / bioleacher*

**or**waste rock takes up a lot of space

**1**

(ii) (copper sulfide reacts with oxygen to) produce sulfur dioxide / $SO_2$

*allow (sulfur reacts with oxygen to) produce sulfur dioxide / $SO_2$*

**1**

that causes acid rain

*allow description of effects of acid rain **or** sulfur dioxide*

*if no other mark awarded allow $CO_2$ produced which causes global warming **or** $CO_2$ produced by burning fuel or heating the furnace for **1** mark*

**1**

(iii) any **one** from:

- large amounts of fuels / energy used (for the furnace and electrolysis)

  *allow large amounts of electricity needed*

  *ignore high temperature / electrolysis unqualified*

- (the extraction has) many steps / stages / processes

  *allow (extraction) is a long process / takes a lot of time*

- large amounts of ore / material have to be mined
  *allow ores contain a low percentage of copper*

**1**

(iv) (copper ions move towards) the negative electrode */ cathode*

**1**

because copper ions / $Cu^{2+}$ are positively charged **or** are oppositely charged **or** copper ions need to gain electrons

*allow because metal ions are positive **or** opposites attract*

**1**

(v) (growing) plants

**1**

**[9]**

**M5.** (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**

(b) (i) <u>advantages of portable</u>:

*accept converse throughout*

any **two** from :

- costs less
- little training needed
- water can be tested within 10 seconds / immediately / quicker
- can be used anywhere

**2**

<u>disadvantage of portable</u>

less precise / sensitive

*allow only detect down to 0.1 mg*

*ignore less accurate*

**1**

(ii) (PIWE) is unbiased

*it / they = PIWE*

*allow honest / trusted / respected / reliable*

*ignore professional / scientific / skilled*

**or**

company may be biased

*allow company trying to sell products*

**1**

**[6]**

**M6.** (a) sterilise / disinfect (water)

*ignore removes bacteria / impurities / disease*

**or**

kill bacteria / micro-organisms / microbes / germs / pathogens

*ignore cleans the water / makes (water) safe*

*allow destroy bacteria **or** gets rid of bacteria*

**1**

(b) any **two** from:

*ignore reference to safe / unsafe*

- chlorine is toxic / poisonous
- so (too much) will be dangerous / harmful / kill people / cause illness / health problems

  *allow causes damage*
- cause breathing difficulties **or** cause (more) allergic reactions / skin **or** eye irritation
- too little will not kill bacteria

  *allow bacteria still there*

**2**

(c) cheap / easy / quick to use (process)

*accept prevents typhoid / cholera*

*ignore reference to specialists or equipment*

**1**

(d) (i) fair / more ideas / views / opinions **or** less chance of bias **or** more democratic

*allow idea of different points of view / balanced view*

*allow avoids undue influence owtte*

**1**

(ii) (more likely) to have support / influence / convince people

*ignore well respected*

*allow ideas about trust eg people will have more confidence in their views / more likely to be believed*

*allow ideas about expertise eg more likely to know what they are talking about / have done experiments / tests*

*allow have knowledge / understanding*

*allow (more) reliable*

**1**

(iii) (more likely) to be correct / less likely to be incorrect

*owtte*

**or**

reliable / factual / accurate / based on proof / based on experiments or tests / based on validation

*ignore based on evidence unqualified*

*allow hearsay / opinion can be biased*

**1**

**[7]**