2.30 Using the Earth's Resources and Potable Water: 30-minute Pack

AQA 8464 · Calculator allowed · about 30 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 After sedimentation and filtration, water must still be sterilised before it is safe to drink.

(a) State three methods that can be used to sterilise water during the production of potable water. **(3)**

(Total for Question 1 is 3 marks)

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2 A water company tests a different sample. 500 cm^3 of the water sample is evaporated to dryness, leaving 0.15 g of solid residue.

(a) Calculate the concentration of dissolved solids in this water sample, in g/dm3. **(2)**

.....

(b) Convert your answer to part (a) into mg/dm3. **(1)**

.....

(c) For this question, assume the guideline maximum level of dissolved solids in UK drinking water is 500 mg/dm3. State, with a reason, whether this water sample meets that guideline. **(1)**

(Total for Question 2 is 4 marks)

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3 Water companies are increasingly encouraged to consider sustainable development when choosing how to produce potable water and treat waste water.

(a) Explain how using renewable resources, instead of finite resources, to produce potable water and treat waste water can support sustainable development. **(3)**

(Total for Question 3 is 3 marks)

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4 Chlorine is the most widely used method of sterilising water in the UK.

(a) Explain why chlorine is added to water during the production of potable water. **(2)**

(b) Give one disadvantage of using chlorine to sterilise water. **(1)**

(c) Complete and balance the symbol equation for the reaction between chlorine and water, including state symbols: Cl_2 ( ) + H_2O ( ) -> ___ ( ) + ___ ( ) **(2)**

(Total for Question 4 is 5 marks)

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5 The sludge and effluent produced during waste water treatment are treated in different ways.

(a) Describe how sewage sludge is treated after it has been separated by sedimentation. **(2)**

(b) Describe how effluent is treated before it is released into rivers. **(2)**

(Total for Question 5 is 4 marks)

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6 As part of the required practical on the analysis and purification of water samples, a student named Freya investigates the concentration of dissolved solids in a water sample collected from a local canal. She measures 25.0 cm^3 of the water sample into a clean, dry evaporating basin. The mass of the empty evaporating basin is 42.15 g. She heats the basin gently until all the water has evaporated, then allows it to cool and reweighs it. The mass of the basin plus the dry residue is 42.34 g.

(a) Calculate the mass of dissolved solids left in the evaporating basin. **(1)**

.....

(b) Calculate the concentration of dissolved solids in the water sample, in g/dm3. **(2)**

.....

(c) Name one piece of apparatus Freya should use to accurately measure out the 25.0 cm^3 of water sample. **(1)**

(d) State one variable that should be controlled when comparing the dissolved solids concentration of two different water samples. **(1)**

(e) Suggest why Freya should heat the basin, cool it and reweigh it repeatedly until the mass no longer changes, rather than weighing the residue after a single heating. **(1)**

(Total for Question 6 is 6 marks)

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Mark scheme · 2.30 Using the Earth's Resources and Potable Water: 30-minute Pack

Question 1

(a) chlorine/chlorination **B1**

(a) ozone **B1**

(a) ultraviolet (UV) light **B1**

(a) Answer: Chlorination (using chlorine), ozone, and ultraviolet (UV) light.

Question 2

(a) 500 cm^3 / 1000 = 0.500 dm3 (oe) **M1**

(a) 0.3 (g/dm3) cao **A1**

(a) Answer: 0.3 g/dm3

(b) 300 (mg/dm3) cao ft from (a) * 1000 **B1**

(b) Answer: 300 mg/dm3

(c) yes, it meets the guideline, because 300 mg/dm3 is less than 500 mg/dm3 (ft from b) oe **B1**

(c) Answer: Yes, the sample meets the guideline, because 300 mg/dm3 is less than the 500 mg/dm3 limit.

Question 3

(a) renewable resources (e.g. some sources of energy) can be replenished/replaced at the same rate they are used, so they will not run out (oe) **B1**

(a) using them, rather than finite resources, helps to conserve finite resources so they remain available for future generations (oe) **B1**

(a) this reduces the overall environmental impact and helps meet the needs of people today without compromising the ability of future generations to meet their own needs (oe) **B1**

(a) Answer: Renewable resources can be replaced at the same rate they are used, so they do not run out. Using them instead of finite resources helps conserve finite resources for future generations and reduces overall environmental impact, supporting sustainable development.

Question 4

(a) chlorine kills/removes harmful microorganisms/pathogens in the water (oe) **B1**

(a) making the water safe to drink and preventing the spread of disease (oe) **B1**

(a) Answer: Chlorine kills harmful microorganisms in the water, making it safe to drink and preventing the spread of disease.

(b) any suitable disadvantage, e.g. it can give the water an unpleasant taste/smell, or chlorine and its by-products can be harmful/toxic in high concentrations (oe) **B1**

(b) Answer: For example, chlorine can give the water an unpleasant taste, or it (and its by-products) can be harmful in high concentrations.

(c) correct formulae for the products: HOCl and HCl (oe) **M1**

(c) fully balanced equation with correct state symbols: $Cl_2(g)$ + $H_2O(l)$ -> HOCl(aq) + HCl(aq) cao **A1**

(c) Answer: $Cl_2(g)$ + $H_2O(l)$ -> HOCl(aq) + HCl(aq)

Question 5

(a) the sludge is broken down by anaerobic digestion, in which bacteria/microorganisms break down the organic matter in the absence of oxygen (oe) **B1**

(a) this produces biogas (mainly methane), which can be used as a fuel, and the remaining digested sludge can be used as a fertiliser (oe) **B1**

(a) Answer: Sludge is broken down by anaerobic digestion, in which bacteria break down the organic matter without oxygen. This produces biogas (mainly methane), which can be used as a fuel, and the remaining digested sludge can be used as a fertiliser.

(b) effluent undergoes aerobic biological treatment, in which bacteria/microorganisms break down any remaining organic matter and harmful substances (oe) **B1**

(b) this process requires oxygen, which is added to/pumped through the effluent (e.g. by aeration) (oe) **B1**

(b) Answer: Effluent undergoes aerobic biological treatment, in which bacteria break down any remaining organic matter and harmful substances. This process requires oxygen, which is pumped through the effluent.

Question 6

(a) 0.19 (g) cao **B1**

(a) Answer: 0.19 g

(b) converts 25.0 cm^3 to 0.0250 dm3 (oe) and divides the mass of residue by the volume in dm3 **M1**

(b) 7.6 (g/dm3) cao ft from (a) **A1**

(b) Answer: 7.6 g/dm3

(c) a measuring cylinder (accept pipette or burette) cao **B1**

(c) Answer: A measuring cylinder (a pipette or burette would also be accepted).

(d) any suitable control variable, e.g. the volume of water sample evaporated, or the method/rate of heating (oe) **B1**

(d) Answer: For example, the volume of water sample evaporated should be kept the same for each sample.

(e) to make sure that all of the water has evaporated (oe), so that the measured mass of dissolved solids is accurate and not an underestimate (oe) **B1**

(e) Answer: To make sure all the water has evaporated, so the mass of dissolved solids measured is accurate (not an underestimate).

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