GEO.HU13 Sustainable and Small-Scale Water Supply Solutions

AQA 8035 · Calculators not allowed · about 50 minutes

Total Marks

Name: ________________________________ Date: ____ / ____ / ______

Answer ALL questions. Show all your working.

1 Define the term 'appropriate technology' as used in small-scale water supply projects in rural areas.

(Total for Question 1 is 1 mark)

2 Define 'intermediate technology' in the context of improving water security in a small community.

(Total for Question 2 is 1 mark)

3 Describe how a simple community rainwater-harvesting system works in a rural village, naming the main components and how water is collected and stored.

(Total for Question 3 is 2 marks)

4 Describe how a hand pump on a shallow well provides water to a rural community and one maintenance need for hand pumps.

(Total for Question 4 is 1 mark)

5 Name TWO water-conservation measures that can reduce domestic water demand in a small town.

(Total for Question 5 is 2 marks)

6 Describe how drip irrigation conserves water compared with traditional flood irrigation on smallholder farms.

(Total for Question 6 is 2 marks)

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7 Give ONE advantage of using local materials and labour when building a small-scale water tank for a village scheme.

(Total for Question 7 is 1 mark)

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8 Describe one environmental benefit of reducing leakage in an urban piped water system in a small UK town.

(Total for Question 8 is 2 marks)

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9 Name a small-scale water-supply scheme in Kitui County, Kenya, and state the main objective of that community rainwater-harvesting project.

(Total for Question 9 is 2 marks)

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10 A village roof area totalling 250 square metres collects rain. In a heavy rainfall event the effective rainfall depth is 20 mm. If the system captures 80 percent of the rain, calculate the volume of water collected in litres. Show your working. Context: a rural community rainwater-harvesting event.

(Total for Question 10 is 3 marks)

11 Give ONE social benefit of installing community-managed hand pumps in a rural area of an LIC.

(Total for Question 11 is 1 mark)

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12 Explain TWO limitations of relying solely on small-scale water schemes such as household tanks and hand pumps to meet the needs of a rapidly growing town.

(Total for Question 12 is 2 marks)

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13 Compare and contrast small-scale sustainable water-supply schemes (for example community rainwater harvesting and hand pumps) with large-scale schemes (for example dams and inter-basin transfers). In your answer, consider cost, sustainability, social impact and reliability. Context: planning water supply for a regional urban and rural mix.

(Total for Question 13 is 6 marks)

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14 Assess the advantages of small-scale, sustainable water schemes over large-scale schemes for improving water security in rural communities. Use examples such as community rainwater harvesting in Kitui County, Kenya, and hand pumps. You are asked to assess, so make a balanced judgement. Context: rural community water security.

(Total for Question 14 is 6 marks)

15 A small town has a piped supply with 20 percent leakage. The town system currently treats 5,000 cubic metres of water per day. Calculate the volume of water lost to leakage each day in cubic metres, and suggest one simple measure the council could adopt to reduce leakage. Context: urban water conservation for a small UK town.

(Total for Question 15 is 3 marks)

Mark scheme · GEO.HU13 Sustainable and Small-Scale Water Supply Solutions

Question 1

- **B1** technology that is low-cost, simple to use and maintain and suited to the local social and environmental context, oe
- **Answer: Technology that is low-cost, simple to use and maintain and suited to the local social and environmental context.**

Question 2

- **B1** technology that is more advanced than purely manual methods but still affordable and manageable by local people, oe
- **Answer: Technology more advanced than purely manual methods but still affordable and manageable by local people.**

Question 3

- **B1** collection from roofs and gutters that direct rainwater into pipes or channels, oe
- **B1** storage in a tank, cistern or lined pond with a simple filter or first-flush to remove debris, oe
- **Answer: Rainwater is collected from roofs via gutters and pipes, directed through a simple filter or first-flush device to remove debris, and stored in a tank, cistern or lined pond for later use.**

Question 4

- **B1** a pump is operated by people to lift groundwater from a shallow well to the surface through a cylinder and piston or lever system, oe
- **Answer: A pump is operated by people to lift groundwater from a shallow well to the surface through a cylinder and piston or lever system; it needs regular lubrication and replacement of seals or washers as maintenance.**

Question 5

- **B1** installing water-efficient fittings, e.g. low-flow taps or dual-flush toilets, oe
- **B1** grey-water recycling for garden irrigation or flushing, oe
- **Answer: Installing water-efficient fittings such as low-flow taps or dual-flush toilets; grey-water recycling for garden irrigation or flushing.**

Question 6

- **B1** drip irrigation delivers water slowly to the plant roots through pipes or emitters, reducing evaporation and runoff, oe
- **B1** it applies water only where needed so uses less water than flooding whole fields, oe
- **Answer: Drip irrigation delivers water slowly to plant roots through pipes or emitters, reducing evaporation and runoff, and applies water only where needed so it uses less water than flooding whole fields.**

Question 7

- **B1** it reduces construction costs and creates local ownership and skills, improving maintenance prospects, oe
- **Answer: It reduces construction costs and creates local ownership and skills, improving the prospects for maintenance.**

Question 8

- **B1** reduced demand on water sources such as reservoirs or rivers, oe
- **B1** this helps protect ecosystems and reduces energy use for pumping and treatment, oe
- **Answer: Reducing leakage lowers demand on water sources such as reservoirs or rivers, helping to protect ecosystems and reducing the energy used for pumping and treatment.**

Question 9

- **B1** named scheme, e.g. community rainwater-harvesting projects in Kitui County, Kenya, oe
- **B1** objective, e.g. to capture and store seasonal rains to increase household water supply and reduce time spent collecting water, oe
- **Answer: Community rainwater-harvesting projects in Kitui County, Kenya; their main objective is to capture and store seasonal rains to increase household water supply and reduce time spent collecting water.**

Question 10

- **M1** conversion and multiplication seen, e.g. 250 m2 x 0.020 m x 0.80, oe
- **A1** 4.0 cubic metres or 4000 litres cao
- **B1** working shown or units converted to litres, oe
- **Answer: 4,000 litres.**

Question 11

- **B1** reduced time spent collecting water, often freeing children or women for education or other activities, oe
- **Answer: Reduced time spent collecting water, often freeing children or women to attend school or earn income.**

Question 12

- **B1** limited scalability, e.g. many small tanks and pumps may not provide enough water for a rapidly growing urban population, oe
- **B1** maintenance and coordination issues, e.g. many dispersed systems require organised management and may suffer if funds or skills are lacking, oe
- **Answer: Small-scale schemes can be limited in scalability, so many tanks and pumps may not supply enough water for a rapidly growing town; they also create maintenance and coordination challenges because dispersed systems need organised management and ongoing funds and skills.**

Question 13

- **B1** small-scale schemes are generally lower cost, quicker to implement and use local resources, oe
- **B1** large-scale schemes have high upfront cost, long lead times and often require national funding, oe
- **B1** small-scale schemes often have better social acceptance and create local ownership, oe
- **B1** large-scale schemes can displace communities and cause social or environmental harm, but can supply much larger populations, oe
- **B1** small-scale schemes are often more sustainable environmentally and use less energy, but can be less reliable in prolonged droughts, oe
- **B1** large-scale schemes can be more reliable in dry periods by storing large volumes, but may cause environmental damage and depend on centralised maintenance, oe

Question 14

- **Level 3** (5-6): A well developed assessment that evaluates several advantages of small-scale sustainable schemes with accurate reference to examples and considers limitations of those schemes and advantages of large-scale approaches before reaching a reasoned judgement.
- **Level 2** (3-4): A clear answer that describes advantages of small-scale schemes with some example detail and makes a simple judgement, but with limited balance or development.
- **Level 1** (1-2): One or two simple points about small-scale scheme advantages are made, with little or no supporting example detail and no real judgement.
- **Indicative content:**
  - Advantages: lower upfront cost and quicker implementation, allowing communities to start supplying water sooner; suitable for local maintenance using local skills and materials which increases sustainability and local ownership.
  - Advantages: environmental benefits such as lower energy use and smaller ecological footprint compared with dams and long-distance transfers; they can be tailored to local rainfall patterns and household needs.
  - Advantages: social benefits including community control, improved equity of access and reduced time spent collecting water; examples include rainwater tanks in Kitui County that store seasonal rain for dry months, and hand pumps that reduce walking time.
  - Limitations and counterpoints: small-scale schemes may not scale to meet needs of rapidly growing populations or urban centres, and may be less reliable during multi-year droughts, whereas large reservoirs can store water for long dry periods.
  - Limitations and counterpoints: maintenance funding and technical expertise can still be barriers for small communities, and dispersed systems require coordination; large scale schemes can provide economies of scale and centralised treatment and distribution.
  - Judgement guidance: overall advantages often make small-scale schemes the preferred option for many rural communities because of cost, sustainability and local benefits, but in regions with very low rainfall or rapidly growing

Question 15

- **M1** 5000 x 0.20 seen or equivalent, oe
- **A1** 1000 cubic metres cao
- **B1** one sensible measure, e.g. active leak detection and repair programmes, meter replacement or pressure management, oe
- **Answer: 1,000 cubic metres lost per day; e.g. implement active leak detection and repair programmes to reduce leakage.**