

**ENVIRONMENTAL SCIENCE**

**SECTION II**

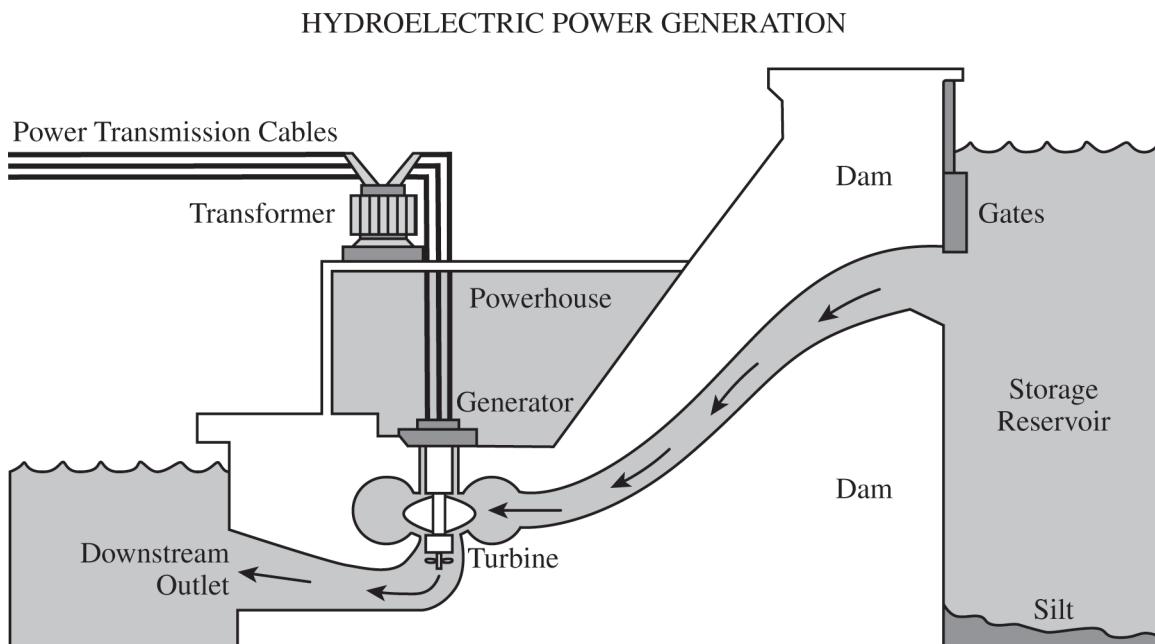
**Time—1 hour and 10 minutes**

**3 Questions**

**Directions:** Answer all three questions, which are weighted equally; the suggested time is about 22 minutes for answering each question. Write all your answers in the Free Response booklet. Where calculations are required, clearly show how you arrived at your answer. Where explanation or discussion is required, support your answers with relevant information and/or specific examples. You may plan your answers in this orange booklet, but no credit will be given for anything written in this booklet. **You will only earn credit for what you write in the separate Free Response booklet.**

1. A homeowner in the Northern Hemisphere is considering installing photovoltaic (PV) panels on the roof of the home to help provide electricity for the home. The homeowner has read conflicting reports on which compass direction the panels should face to maximize the amount of electricity (in kWh) that the panels can produce.
  - (a) The homeowner plans to design an experiment to determine the direction of the panels for maximal electricity production.
    - (i) **Identify** the independent variable in the experiment.
    - (ii) **Identify** the dependent variable in the experiment.
    - (iii) **Identify** a reasonable hypothesis for the experiment.
    - (iv) **Describe** one variable that was not discussed that could affect the results of the study.

- (b) The diagram below shows another way of generating electricity using a renewable resource. The arrows indicate the flow of water.



- (i) **Identify** the location shown in the diagram where the kinetic energy of the water is transformed into mechanical energy.
- (ii) **Explain** why the water in the storage reservoir has potential energy that is useful in hydroelectric power generation.
- (iii) **Explain** how coupling hydroelectric power with solar or wind power is an advantage to providing a constant source of electricity to a community.
- (iv) **Explain** how a hydroelectric power system, like the one depicted, may be negatively affected by climate change.
- (c) Over time, reservoirs that form behind dams can undergo changes.
- (i) **Identify** one advantage, other than the generation of hydroelectric power, of the formation of a reservoir behind a hydroelectric dam.
- (ii) **Explain** the effect of increased silt in the reservoir on the hydroelectric power system.

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**Begin your response to this question at the top of a new page in the separate Free Response booklet and fill in the appropriate circle at the top of each page to indicate the question number.**

**Question 1: Design an Investigation****10 points**


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**(a) (i)** **Identify** the independent variable in the experiment. **1 point**

- Direction the panels face

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**(ii)** **Identify** the dependent variable in the experiment. **1 point**

- Amount of electrical energy produced

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**(iii)** **Identify** a reasonable hypothesis for the experiment. **1 point**

Accept one of the following:

- If the photovoltaic panels face north/south/east/west, then the maximum amount of electricity will be produced.
- The position (compass direction) of solar panels will affect how much energy is produced.
- Solar panels positioned with greatest access to the sun will generate more energy.
- The compass direction the panels face will not have an effect on the amount of electricity produced.

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**(iv)** **Describe** one variable that was not discussed that could affect the results of the study. **1 point**

Accept one of the following:

- Panels tilted to an improper angle that does not match the position of the sun will decrease energy/kWh production.
- Shade or shadows from trees, dust, clouds or snow on the panels would prevent absorption of sunlight, decreasing energy/kWh production.
- Seasonal or daily variations in solar intensity will lead to an increase or decrease in energy/kWh production.
- Cooler temperatures produce more kWh because heat decreases the efficiency of solar panels.

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**Total for part (a)** **4 points**

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**(b) (i)** **Identify** the location shown in the diagram where the kinetic energy of the water is transformed into mechanical energy. **1 point**

- Turbine

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- (c) (i) Identify one advantage, other than the generation of hydroelectric power, of the formation of a reservoir behind a hydroelectric dam. 1 point

Accept one of the following:

- Increase in aquatic habitat behind the dam/increase in lake species in reservoir
- Provision of recreational facilities
- Increased flood control
- Water storage/drinking water source
- Water for irrigation

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- (ii) Explain the effect of increased silt in the reservoir on the hydroelectric power system. 1 point

Accept one of the following:

- Silt in reservoirs decreases water storage capacity and can lead to reduced power generation or reduced potential energy.
- Silt in reservoirs decreases water storage capacity and can lead to the release of water over a spillway, rather than using it to generate electricity.
- Silt can damage the turbine and other mechanical equipment by abrasion of blades. Damaged equipment decreases efficiency and/or requires expensive repairs.

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Total for part (c) 2 points

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Total for question 1 10 points