



## **AP<sup>®</sup> Environmental Science 2007 Free-Response Questions**

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**2007 AP® ENVIRONMENTAL SCIENCE FREE-RESPONSE QUESTIONS**

**ENVIRONMENTAL SCIENCE**

**SECTION II**

**Time—90 minutes**

**4 Questions**

**Directions:** Answer all four questions, which are weighted equally; the suggested time is about 22 minutes for answering each question. Write all your answers on the pages following the questions in the pink 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.

1. Read the *Fremont Examiner* article below and answer the questions that follow.

10	FREMONT EXAMINER	May 15, 2007
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**CITY COUNCIL SEWAGE VOTE**

Last night the Fremont City Council, by a 4-to-1 vote, approved an upgrade of the town's sewage treatment facility. The treatment plant, which currently discharges one million gallons of treated wastewater into the Fremont River daily, will be upgraded from primary to secondary treatment next year. Councilperson

Ramos noted that the upgrade was needed to protect the water quality of the Fremont River. A local environmental scientist, Dr. Goodwin, advised the council members that sewage treatment plants may solve a water quality problem, but they create a solid-waste problem.

- (a) Identify ONE component of the sewage that is targeted for removal by primary treatment and ONE component of the sewage that is targeted for removal by secondary treatment.
- (b) For EACH of the pollutants that you identified in part (a), describe how the pollutant is removed in the treatment process.
- (c) Explain how sewage treatment plants create the solid waste problem that Dr. Goodwin mentioned in the article.
- (d) Two common methods of disposing of solid waste from sewage treatment plants are transporting it to a landfill or spreading it onto agricultural lands. Describe an environmental problem associated with EACH of these methods.
- (e) The final step in sewage treatment is disinfection. Identify ONE pollutant that is targeted during disinfection and identify ONE commonly used method of disinfection.
- (f) Identify ONE United States federal law that requires monitoring the quality of the treated sewage that is discharged into the Fremont River.

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2. The Cobb family of Fremont is looking at ways to decrease their home water and energy usage. Their current electric hot-water heater raises the water temperature to 140°F, which requires 0.20 kWh/gallon at a cost of \$0.10/kWh. Each person in the family of four showers once a day for an average of 10 minutes per shower. The shower has a flow rate of 5.0 gallons per minute.
- (a) Calculate the following. Be sure to show all your work and include units with your answers.
    - (i) The total amount of water that the family uses per year for taking showers
    - (ii) The annual cost of the electricity for the family showers, assuming that 2.5 gallons per minute of the water used is from the hot-water heater
  - (b) The family is considering replacing their current hot-water heater with a new energy-efficient hot-water heater that costs \$1,000 and uses half the energy that their current hot-water heater uses. How many days would it take for the new hot-water heater to recover the \$1,000 initial cost?
  - (c) Describe TWO practical measures that the family could take that would reduce their overall water use at home.
  - (d) Describe TWO conservation measures (other than reducing hot water use) that the family could take to reduce the total amount of energy that they use at home.
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3. In the mid 1970s, Sherwood Rowland and Mario Molina predicted a thinning of the stratospheric ozone layer over Antarctica. The thinning was confirmed in the late twentieth century and has continued into the twenty-first century.
- (a) Identify the class of chemical compounds that is primarily responsible for the thinning of the stratospheric ozone layer and describe TWO major uses for which these chemicals were manufactured.
  - (b) Describe how the chemical compounds that you identified in part (a) destroy stratospheric ozone molecules. You may include chemical equations as part of your answer.
  - (c) Identify the major environmental consequence of the depletion of stratospheric ozone and describe TWO effects on ecosystems and/or human health that can result.
  - (d) Ozone formed at ground level is a harmful pollutant. Describe TWO effects that ground-level ozone can have on ecosystems and/or human health.

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4. Some scientists estimate that by 2025 over 60 percent of the global human population will live in urban areas. Urban residents experience a variety of problems related to the physical environment.
- (a) Describe how the temperature of urban areas like Atlanta, Philadelphia, and Chicago differs from that of surrounding rural areas.
  - (b) Identify and describe TWO differences between urban and surrounding rural areas that contribute to the temperature difference between them.
  - (c) Urban areas typically have levels of air pollution that are significantly higher than those found in surrounding rural areas. Identify a characteristic of the urban microclimate that leads to higher levels of air pollution and describe how that characteristic contributes to the increase.
  - (d) Identify and describe TWO actions that local governments in urban areas could take to reduce outdoor air pollution.
  - (e) Identify and describe TWO ways in which the local hydrologic cycle of urban areas differs from that of nearby rural areas.

**STOP**

**END OF EXAM**