



AP[®] Environmental Science 2012 Free-Response Questions

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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 this book. 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 following article from the *Fremont Gazette* and answer the questions that follow.

Natural Gas from Rock

The Marcellus Shale is a large domestic natural gas reserve that could meet the United States energy needs for 25 years. The 350-million-year-old geologic formation stretches from New York to West Virginia on land that is largely undeveloped. It was once thought that it was too difficult to extract natural gas from the Marcellus Shale, but new drilling technology allows energy companies to tap this vast reserve. The natural gas is removed by a process

called hydraulic fracturing, or fracking. During this process, the shale is drilled and millions of gallons of water, sand, and chemicals are pumped into the shale at high pressure, shattering the shale and releasing the natural gas trapped within. While some of this water remains below ground, contaminated water is also stored in ponds, trucked to wastewater treatment plants, or disposed of by spraying it on nearby land.

- (a) Identify and describe TWO water-related environmental problems associated with fracking.
- (b) Natural gas is considered to be a better fossil fuel for the environment than coal is. Discuss TWO environmental benefits of using natural gas as a fuel compared to using coal.
- (c) Describe TWO environmental drawbacks, not related to water use, of using the fracking process to extract natural gas from shale.
- (d) Describe one economic benefit to society of using fracking to obtain natural gas from shale.
- (e) Nuclear power is an alternative to using natural gas or coal as a fuel for generating electricity. However, there are also problems associated with nuclear power plants. Describe TWO negative environmental impacts associated with nuclear power.

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2. The Fremont School District uses oil to heat school buildings. Go Green! is a new project the district will implement. The superintendent has declared that the district will dedicate itself to reducing its carbon footprint. In addition to taking serious energy-conservation measures, the district is planning to help offset its carbon dioxide emissions by raising money to help conserve a portion of a large tract of forest land adjacent to the high school campus.
- (a) Describe one alternative energy source that would reduce the carbon footprint of the school district. Discuss one environmental benefit (other than reduced CO₂ emissions) and one environmental drawback of using the alternative source instead of fuel oil.
- (b) Identify TWO ecological benefits provided by intact forest ecosystems (other than reducing CO₂ levels in the atmosphere).
- (c) Use the assumptions below to answer the questions that follow. For each calculation, show all work.

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| The biomass of the forest increases at an annual rate of 2.7×10^5 kg/ha. |
| The forest biomass is 50 percent carbon by mass. |
| Each year the district uses 3.0×10^5 gallons of fuel oil for heating and hot water. |
| 10 kg of CO ₂ is produced when 1 gallon of fuel oil is burned. |
| 1.0 kg of CO ₂ contains 0.27 kg of carbon. |
| The cost of putting 1 ha of the forest into conservancy is \$12,000. |

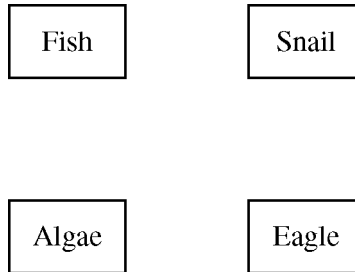
- (i) Calculate the mass of carbon, in kg, that is accumulated and stored in 1.0 ha of forest in one year.
- (ii) Calculate the mass of carbon, in kg, that is emitted by the school as a result of its fuel-oil consumption in one year.
- (iii) Calculate the number of hectares of forest the school district needs to conserve in order to offset the carbon released in one year by the school burning its fuel oil.
- (iv) Calculate the amount of money the school district must raise for the conservation project.

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3. The active ingredients in many pesticides are chemical compounds that kill organisms such as insects, molds, and weeds. Proponents claim that the use of pesticides improves crop yields and thus protects land and soil by reducing the conversion of forests and wetlands to cropland. Opponents of pesticide use claim that pesticides degrade water and soil quality and that other modern agricultural techniques and practices are responsible for the improved crop yields in recent years.
- (a) Design a laboratory experiment to determine whether or not a new pesticide (product X) is toxic to minnows, a type of small fish. For the experiment you design, be sure to do all of the following.
- (i) State the hypothesis.
 - (ii) Describe the method you would use to test your hypothesis.
 - (iii) Identify the control.
 - (iv) Identify the dependent variable.
- (b) Describe experimental results that would lead you to reject your hypothesis in part (a)(i). (Be specific.)
- (c) One strategy for dealing with agricultural pests is integrated pest management (IPM).
- (i) Describe IPM. As part of your description, include TWO specific pest-control approaches that are part of IPM.
 - (ii) Identify one environmental benefit of using IPM.
- (d) Describe TWO agricultural practices, other than those involving pest control, that increase crop yields.

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4. Wetlands were once considered to be wastelands. Over 50 percent of the United States original wetlands have been destroyed.
- (a) Describe TWO characteristics that are used by scientists to define an area as a wetland.
- (b) Wetlands are highly productive ecosystems with complex food webs.
- (i) Complete the diagram of the wetland food web below by drawing arrows that show the direction of energy flow.



- (ii) Explain why it takes many hectares of wetland to support a pair of eagles.
- (c) Describe TWO economic benefits (other than those related to water quality) that wetlands provide.
- (d) Describe one specific human activity that degrades wetlands.
- (e) Wastewater treatment plants perform some of the same water-quality improvement functions that natural wetlands perform. Explain how wetlands perform the equivalent of
- (i) primary treatment, and
- (ii) secondary treatment.

STOP

END OF EXAM