CollegeBoard
Advanced Placement Program

AP® Environmental Science
2004 Free-Response Questions

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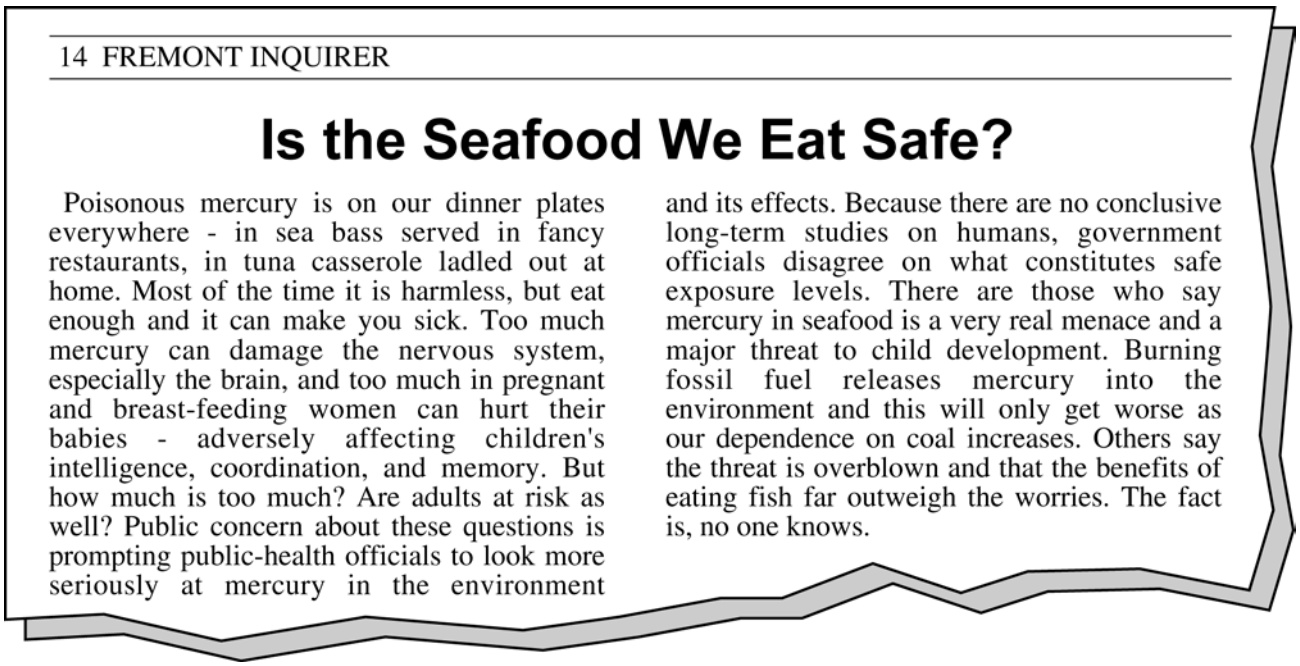
ENVIRONMENTAL SCIENCE
SECTION II
Time—90 minutes
4 Questions

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 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 editorial below and answer the questions that follow.



14 FREMONT INQUIRER

Is the Seafood We Eat Safe?

Poisonous mercury is on our dinner plates everywhere - in sea bass served in fancy restaurants, in tuna casserole ladled out at home. Most of the time it is harmless, but eat enough and it can make you sick. Too much mercury can damage the nervous system, especially the brain, and too much in pregnant and breast-feeding women can hurt their babies - adversely affecting children's intelligence, coordination, and memory. But how much is too much? Are adults at risk as well? Public concern about these questions is prompting public-health officials to look more seriously at mercury in the environment and its effects. Because there are no conclusive long-term studies on humans, government officials disagree on what constitutes safe exposure levels. There are those who say mercury in seafood is a very real menace and a major threat to child development. Burning fossil fuel releases mercury into the environment and this will only get worse as our dependence on coal increases. Others say the threat is overblown and that the benefits of eating fish far outweigh the worries. The fact is, no one knows.

(a) On the basis of the article above, indicate one human activity that releases mercury into the environment. Describe how mercury is transported from that source and enters aquatic systems, often hundreds of miles away.

(b) Describe TWO ways that the amount of mercury released into the environment from the source in part (a) could be reduced.

(c) Explain why there are greater health risks associated with eating large predatory fish, such as tuna and sea bass, than from eating small nonpredatory fish.

(d) Identify a toxic metal other than mercury that has a negative impact on human health and describe how it is introduced into the environment. Describe an acute sublethal effect on humans that results from exposure to this metal.

2. West Fremont is a community consisting of 3,000 homes. A small coal-burning power plant currently supplies electricity for the town. The capacity of the power plant is 12 megawatts (MW) and the average household consumes 8,000 kilowatt hours (kWh) of electrical energy each year. The price paid to the electric utility by West Fremont residents for this energy is $0.10 per kWh. The town leaders are considering a plan, the West Fremont Wind Project (WFWP), to generate their own electricity using 10 wind turbines that would be located on the wooded ridges surrounding the town. Each wind turbine would have a capacity of 1.2 MW and each would cost the town $3 million to purchase, finance, and operate for 25 years.

   (a) Assuming that the existing power plant can operate at full capacity for 8,000 hrs/yr, how many kWh of electricity can be produced by the plant in a year?

   (b) At the current rate of electrical energy use per household, how many kWh of electrical energy does the community consume in one year?

   (c) Compare your answers in (a) and (b) and explain why you would or would not expect the numbers to be the same.

   (d) Assuming that the electrical energy needs of the community do not change during the 25-year lifetime of the wind turbines, what would be the cost to the community of the electricity supplied by the WFWP over 25 years? Express your answer in dollars/kWh.

   (e) Identify and explain TWO environmental benefits to West Fremont of switching from coal to wind power and TWO environmental costs to West Fremont of switching from coal to wind power.

3. Radioactive isotopes are widely used in the field of medicine, in the generation of electricity, and in the military. The use of radioactive isotopes has increased significantly over the past fifty years, leading to a corresponding increase in the amount of radioactive waste produced. The question of how to deal with radioactive waste is a topic of ongoing environmental concern.

   (a) Explain how the properties of low-level radioactive waste differ from those of high-level radioactive waste and how these properties lead to different storage requirements. For one of the two types of radioactive waste, give an example of a specific isotope that may be present in the waste, and explain how human activity generates the waste.

   (b) The United States Department of Energy recently chose Yucca Mountain in Nevada as the site for the deep underground burial of high-level radioactive waste. Describe THREE characteristics of an ideal deep underground storage site for high-level radioactive waste.

   (c) Identify TWO other options that have been suggested for the long-term management of radioactive waste. Discuss the feasibility of each method.

   (d) Exposure to high levels of ionizing radiation has adverse effects on human health and can result in immediate death. Identify one sublethal adverse effect on human health that can result from exposure to ionizing radiation, and explain how this effect is caused by the radiation.

GO ON TO THE NEXT PAGE.

4. Suppose that you have just started a summer internship working for a cooperative extension service, where you will collect soil samples, conduct laboratory and field tests, and make recommendations on soil conservation and agricultural practices.

   (a) Identify and describe one chemical soil test and one physical soil test that could be performed and explain how the results of these tests will allow the cooperative extension service to make specific recommendations for sustainable agriculture.

   (b) Explain one advantage and one disadvantage to using inorganic commercial fertilizers.

   (c) Describe TWO soil conservation practices that are designed to decrease soil erosion.

   (d) Identify one biome that is characterized by soil that is rich in humus. Describe how humus originated in the soils of this biome and TWO ways that humus improves soil conditions for plant growth.

END OF EXAMINATION