



## **AP<sup>®</sup> Environmental Science 2006 Free-Response Questions**

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# 2006 AP<sup>®</sup> 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. Upon receiving notice from their electric utility that customers with solar power systems are permitted to sell excess power back to the utility, an Arizona family is considering the purchase of a photovoltaic solar energy system for their 2,700-square-foot suburban home. The initial costs of the systems they are considering range from \$7,000 to \$30,000. While gathering information prior to making a decision, the homeowners find the following information at the Web site of the United States Department of Energy.

#### Stand-Alone vs. Grid-Connected Systems

Stand-alone systems produce power independently of the utility grid. In some off-the-grid locations as near as one-quarter mile from the power lines, stand-alone photovoltaic systems can be more cost-effective than extending power lines. Direct-coupled systems need no electrical storage because they operate only during daylight hours, but most systems rely on battery storage so that energy produced during the day can be used at night. Some systems, called hybrid systems, combine solar power with additional power sources such as wind or diesel.

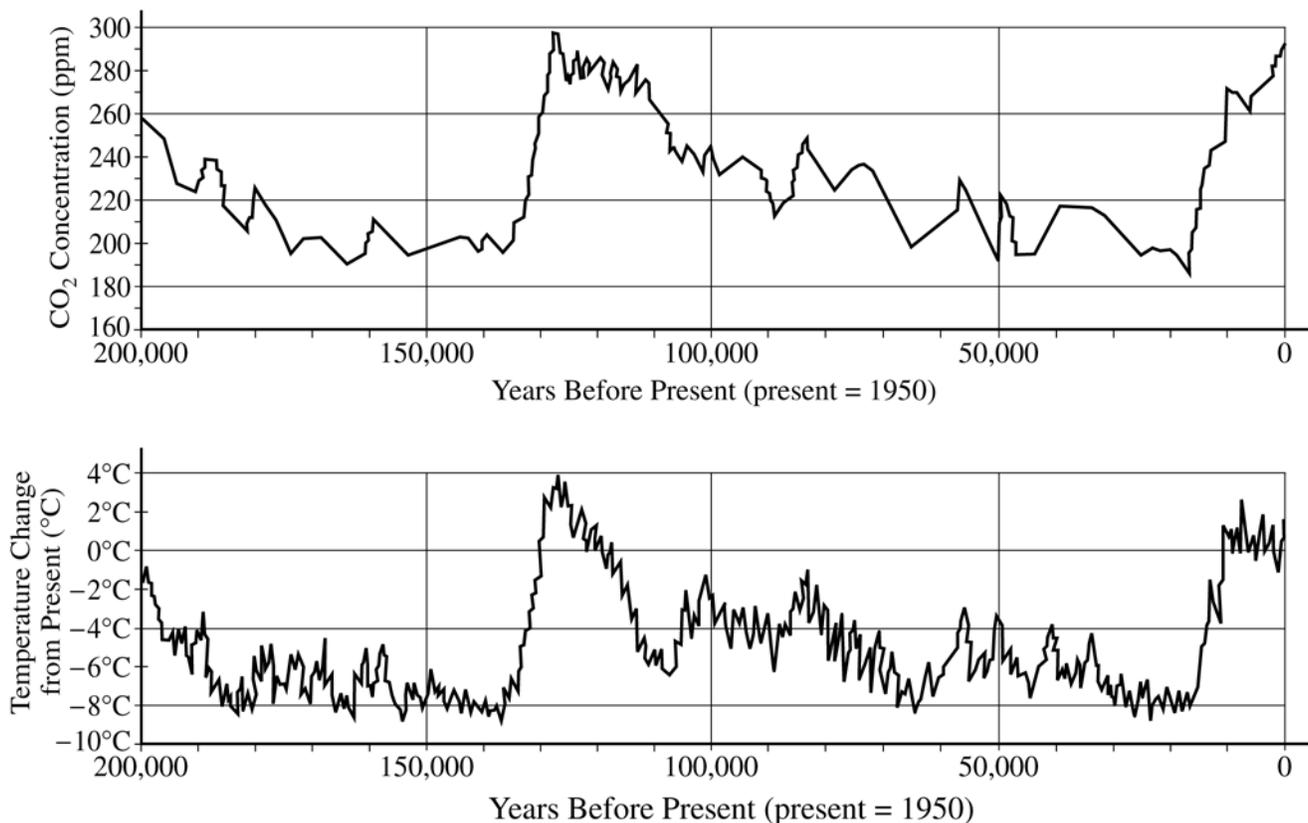
Grid-connected photovoltaic systems supply surplus power back through the grid to the utility and take from the utility grid when the home system's power supply is low. These systems remove the need for battery storage, although arranging for the grid interconnection can be difficult. In some cases, utilities allow net metering, which allows the owner to sell excess power back to the utility.

- (a) Describe one environmental benefit and one environmental cost of photovoltaic systems.
- (b) From the two types of solar systems described on the government Web site, select the system (either stand-alone or grid-connected) that you think best meets the needs of the homeowners. Write an argument to persuade them to purchase the system you selected. Include the pros and cons of each system in your argument.
- (c) Describe TWO ways that government or industry could promote the use of photovoltaic power systems for homeowners in the future.
- (d) Describe TWO ways that homeowners could use passive solar designs and/or systems and, for each way, explain how it would reduce the homeowners' energy costs.

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2. According to atmospheric temperature and CO<sub>2</sub> concentration records derived from Antarctic ice cores, Earth's climate has undergone significant changes over the past 200,000 years. Two graphs are shown below. The upper graph shows the variation in atmospheric CO<sub>2</sub> concentration, and the lower graph shows the variation in air temperature. Both graphs cover the same time period from approximately 200,000 years ago up until the year 1950, which is represented as year 0 on the graphs.

TEMPERATURE AND CO<sub>2</sub> CONCENTRATION IN THE ATMOSPHERE  
OVER THE PAST 200,000 YEARS



- (a) Answer the following questions that relate to the graphs above. Remember that for any calculations you must clearly indicate how you arrived at your answer. Answers must also include appropriate units.
- Determine the net change in atmospheric CO<sub>2</sub> concentration between 140,000 years ago and 125,000 years ago.
  - Calculate the ratio of the change in mean global temperature to the change in atmospheric CO<sub>2</sub> concentration between 140,000 years ago and 125,000 years ago.
  - Scientists predict that between 1950 and 2050, the atmospheric CO<sub>2</sub> concentration will increase by 200 ppm. Predict the change in mean global temperature between 1950 and 2050 using the ratio that you calculated in part (ii).
  - Describe one major assumption that was necessary to make the prediction in part (iii) above. Discuss the validity of the assumption.

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**GO ON TO THE NEXT PAGE.**

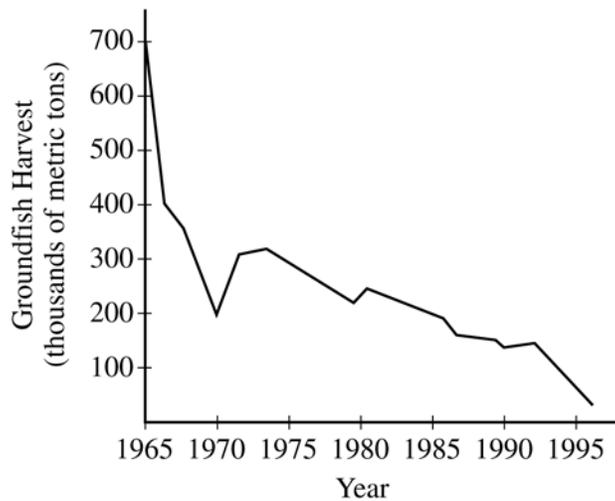
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- (b) Identify and describe TWO major causes for the predicted 200 ppm increase in atmospheric CO<sub>2</sub> concentration between 1950 and 2050.
  - (c) Identify TWO gases other than CO<sub>2</sub> that contribute to the anthropogenic increase in mean global temperature. For each gas, describe a major human activity that leads to its release.
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3. The city of Fremont has a large brownfield located along the Fremont River. The brownfield is a former industrial site where contamination by hazardous chemicals impedes redevelopment. The city council is considering two options for reclaiming the brownfield. The first option is to excavate and remove the contaminated soil, and the second option is to decontaminate the soil on the site using vegetation.
- (a) Assume that the city council chooses the first option. Describe TWO problems that result from removing the contaminated soil from the brownfield.
  - (b) Assume that the city council chooses the second option. Explain how vegetation could be used to decontaminate the soil. Discuss one advantage and one disadvantage of using this reclamation method.
  - (c) Describe and explain one environmental benefit and one societal benefit of brownfield reclamation.
  - (d) Identify and describe
    - (i) one method currently used to reduce the production of hazardous waste and
    - (ii) one method of legally disposing of hazardous waste.

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GEORGES BANK GROUND FISH HARVEST



4. The graph above shows the decline in the catch of groundfish (such as cod, haddock, and flounder) from Georges Bank from 1965 to 1995. This decline in the fish harvest resulted in the closure of large portions of the fishery.
- (a) Identify the five-year period during which the greatest rate of decline in the fish harvest took place. For that five-year period, calculate the rate of decline in the fish harvest, in metric tons per year. Show clearly how you determined your answer.
- (b) Choose any TWO commercial fishing practices from the list below. For each of your choices, describe the practice and explain the role it plays in the depletion of marine organisms.
- Bottom trawling
  - Long-line fishing
  - Using drift nets/gill nets/purse seines
  - Using sonar
- (c) Identify one international regulation or United States federal law that applies to the harvesting of marine food resources and explain how that regulation or law helps to manage marine species.
- (d) The oceans of the world are often referred to as a commons. Give an example of one other such commons, explain how human activities affect that commons, and suggest one practical method for managing that commons.

**STOP**

**END OF EXAM**