



AP[®] Environmental Science 2010 Free-Response Questions

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2010 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 following article from the *Fremont Gazette* and answer the questions that follow.

Fremont Gazette Page 17

Deadly Pollutants Kill Children in India and China

“Contaminated industrial sites in India and China top a new ranking of the world’s most polluted places, where millions of people are threatened by various chemical pollutants,” said Dr. Egguen, president of Fremont Friends of the Planet, an environmental advocacy organization. She said that the industrial town of Vapi, India, is a new addition to the list of worst-polluted places on Earth, based on the magnitude of the pollution and the number of people who are put at risk. She said, “Thousands of children, who are especially susceptible to toxic pollutants, are sick and dying in these top ten polluted places.”

Dr. Egguen pointed out that mining and unregulated industrial production are the major culprits behind the menacing pollution. She described Vapi as a region overwhelmed by more than 50 chemical manufacturers that poison the local soils and groundwater with toxic pollutants such as PCBs, mercury, and lead. In fact, levels of heavy metals found in local produce are 60 times greater than those found in produce grown in unpolluted areas.

- (a) Choose any ONE of the three pollutants mentioned above and respond to each of the following.
- (i) Describe one specific source, other than the local chemical plants, for the toxic pollutant you chose.
 - (ii) Describe how the pollutant you chose enters the human body and one specific effect it can have on human health.
 - (iii) Describe TWO specific steps, other than an outright ban, that a city or nation can take to reduce the threat posed by this pollutant.

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- (b) Give one reason why Dr. Egguen is correct in asserting that children are particularly susceptible to toxic pollutants.
- (c) An important contributor to global climate change is the release of CO_2 from the rapidly increasing number of coal-burning power plants in China. Assume that the coal burned at these plants to provide the power to manufacture a single MP3 player releases 40 kg of CO_2 and that it costs \$0.75 to capture 1 kg of CO_2 and keep it from entering the atmosphere. Determine the cost, in dollars, to capture the total amount of CO_2 released from manufacturing one MP3 player.
- (d) Coal-burning power plants also release other pollutants, including nitrogen oxides (NO_x), sulfur oxides (SO_x), and particulates. Select one of these pollutants and identify one technology that can be used to remove it from the waste stream of coal-burning power plants.
- (e) Discuss TWO reasons why a multinational company would choose to build a manufacturing facility in India and/or China rather than in the United States or Europe.

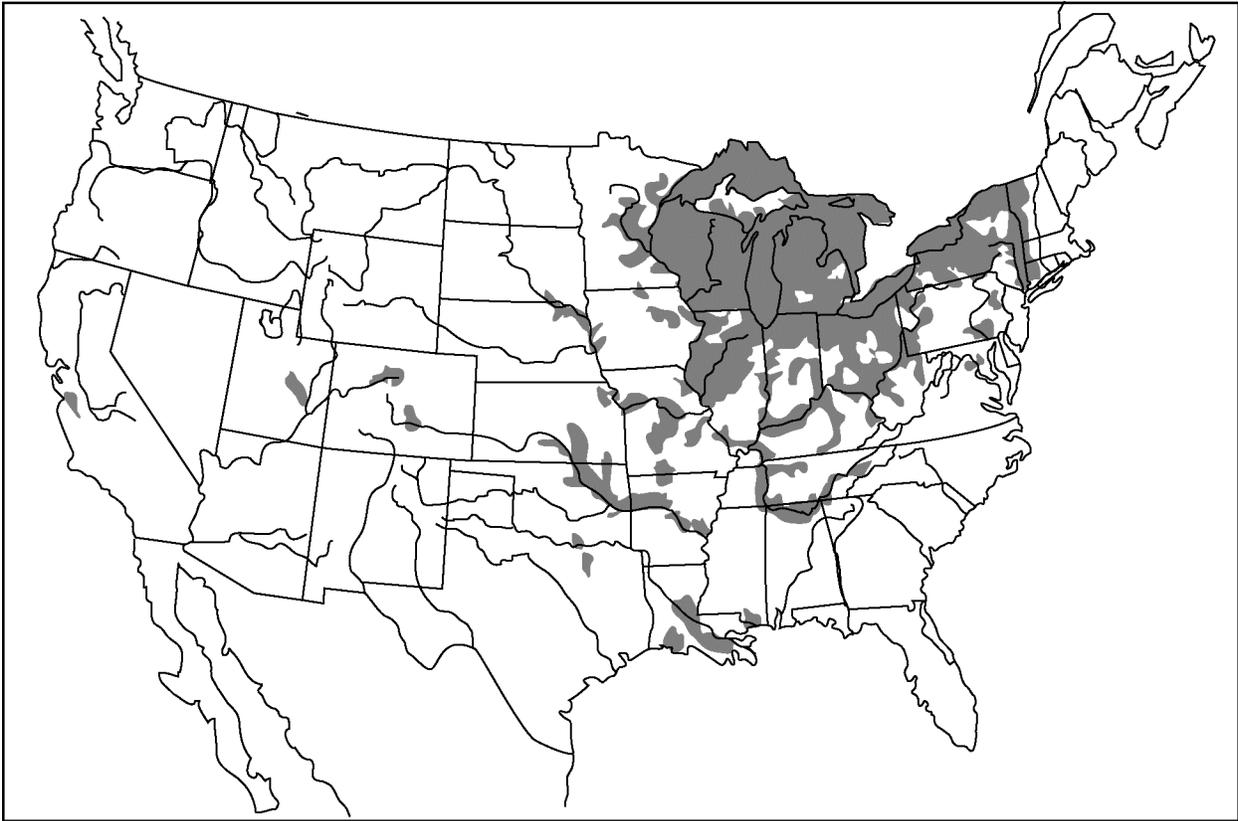
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2. Termites are social insects that are essential decomposers in tropical rain forest ecosystems. Termites may account for up to 95 percent of insect biomass in tropical rain forests. Termites consume vast amounts of dead and decomposing plant material, thanks to the work of mutualistic cellulose-digesting microorganisms that inhabit their guts. In addition to their roles as important decomposers, termites digest plant materials and directly contribute to carbon dioxide and methane emissions into the atmosphere. It is likely that, like many insect species, termites and their symbionts may be sensitive to changes in their microclimate caused by global climate change, especially with regard to temperature and humidity.

		Relative Humidity		
		50%	70%	90%
Temperature	20°C	0.04	0.05	0.05
	25°C	0.05	0.07	0.10
	30°C	0.12	0.13	0.27
	35°C	0.09	0.13	0.15
	40°C	0.00	0.00	0.00

- (a) Respond to the following using the data in the table above, which gives the rate of wood consumption by termites, in mg per day per termite, under various temperature and relative humidity conditions. Under optimal conditions, the emission rate of methane by termites is approximately 70 kilograms of CH₄ per year per 1,000 termites.
- According to the data, what are the optimal temperature and relative humidity for termite activity?
 - Given a density of 4.5×10^7 termites per hectare and optimal conditions, calculate the annual amount of methane emitted, in kilograms, by the termites inhabiting a 2,000-hectare tropical rain forest.
 - Suppose the temperature increases to 35°C and the relative humidity decreases to 50 percent. Using the data provided, determine the amount of methane, in kilograms, that would be emitted by the termites in the 2,000-hectare tropical rain forest.
 - Explain why the population size of termites is also affected by temperature and humidity.
- (b) It has been observed that soon after a tropical rain forest is cleared, termite density increases to an estimated 6.8×10^7 termites per hectare. Thereafter, the termite population size decreases dramatically.
- What is the most likely reason that the density of the termites increases when a tropical rain forest is cleared?
 - Why do the termite populations eventually decrease dramatically?
- (c) Describe one way, other than changes in termite activity, that tropical rain forest destruction contributes to anthropogenic climate change.

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3. The zebra mussel, a mollusk native to Eurasia, was first discovered in the Great Lakes of North America in 1988. Zebra mussels attach to solid substrates and are filter feeders. Adult zebra mussels can survive for several days or even weeks out of water if the temperature and humidity are favorable. An adult female zebra mussel can produce as many as one million eggs per year. The recent range of occurrence of zebra mussels in the United States is indicated by shading in the map above.
- (a) Why are zebra mussels located primarily in areas in the eastern United States rather than in the western United States?
 - (b) How are zebra mussels introduced into isolated lakes? Describe one viable method for preventing the spread of zebra mussels into isolated lakes.
 - (c) Identify and explain one impact that zebra mussels can have on aquatic ecosystems.
 - (d) Identify another invasive species, either terrestrial or aquatic, and describe one negative impact it has had.
 - (e) One strategy for controlling an invasive species has been to introduce another nonnative species to control it; this strategy can often have unintended results. Give a specific example of the use of this strategy and discuss a negative impact of introducing a nonnative species to control an invasive species.
 - (f) Discuss TWO specific characteristics of invasive species that enable them to thrive in new environments.

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4. Scientific evidence shows a direct relationship between sea level and the global mean atmospheric temperature at Earth's surface. Increases in the global mean atmospheric temperature during the past century have been accompanied by a gradual increase in sea level; currently the average rate of increase in sea level is 3.0 mm/yr. Additional increases in sea level are expected during the next century as global mean atmospheric temperatures continue to rise. These increases in sea level will affect coastal ecosystems as well as human activity along coastal margins.
- (a) Based on the rate cited above, calculate the expected increase in sea level, in meters, during the next 50 years.
 - (b) Identify TWO phenomena that result from an increase in global mean atmospheric temperature and that contribute to increases in sea level. For each phenomenon that you identify, explain how it causes sea level to increase.
 - (c) Describe TWO environmental impacts that increasing sea level will have on an estuarine ecosystem such as those in the Mississippi Delta, Chesapeake Bay, and San Francisco Bay.
 - (d) Although sea level has been rising for over a century, human populations in coastal areas have increased dramatically during this period.
 - (i) Describe one negative economic impact that an increase in sea level will have on people who live along a coastline.
 - (ii) Describe TWO viable strategies that governments could use to discourage people from moving to coastal areas.

STOP

END OF EXAM