



AP[®] Environmental Science 2002 Free-Response Questions

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2002 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 this 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.

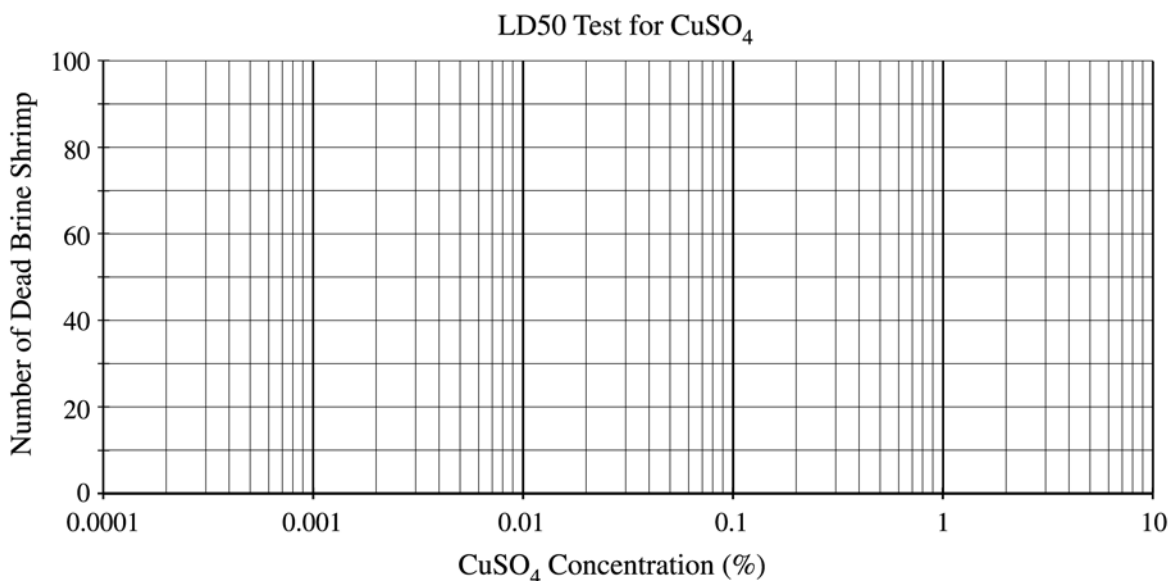
1. Electric vehicles often have been proposed as an environmentally sound alternative to the gasoline engine for transportation. In response to state initiatives, several car manufacturers now include electric vehicles among their available models. In spite of these state initiatives, the penetration of electric vehicles into the transportation sector of the United States, as well as other countries, remains modest.
 - (a) Identify and describe two environmental benefits to using electric vehicles in place of gasoline-powered engines for transportation.
 - (b) Estimate the potential reduction in petroleum consumption (in gallons of gasoline per year) that could be achieved in the United States by introducing electric vehicles under the following assumptions:
 1. The mileage rate for the average car is 25 miles per gallon of gasoline.
 2. The average car is driven 10,000 miles per year.
 3. The United States has 150 million cars.
 4. 10 percent of United States cars could be replaced with electric vehicles.
 - (c) Some people have suggested that electric vehicles only shift the emission of air pollutants from dispersed sources to point sources. Explain and defend or refute this statement.
 - (d) Propose two potential new United States government policies that would encourage the widespread use of electric vehicles. Explain.
2. The Colorado River runs 1,450 miles from the headwaters of the Rocky Mountains to the Gulf of California. The river has many dams, aqueducts, and canals that divert water in order to supply water for electricity, irrigation, recreation, and domestic use.
 - (a) Describe and discuss two environmental problems that are associated with water diversion.
 - (b) If there is a shortage of water, choices will have to be made as to whether water should be diverted to urban areas, agricultural areas, or natural ecosystems. Make an argument for diverting water for urban consumption and an argument for permitting the flow of water to natural areas.
 - (c) Identify another example (other than the Colorado River) of a large-scale water-diversion project. Discuss two environmental problems that have resulted, or might result, from this project.

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3. An experiment is performed to test the toxicity of copper sulfate (CuSO_4) using brine shrimp as a test organism. Six different concentrations of CuSO_4 solution are prepared in separate petri dishes, and 100 brine shrimp are placed in each dish. After 48 hours, the number of brine shrimp that have died is counted and recorded. The results of this experiment are shown in the table below.

CuSO ₄ Concentration (%)	Number of Dead Brine Shrimp
< 0.0001	10
0.001	10
0.01	20
0.1	55
1	90
10	100

- (a) Plot these data on the blank semi-log graph provided below. Draw a smooth curve through the data points to illustrate the overall trend of the data.



- (b) Explain the meaning of the term LD50 (ED50). What is the LD50 concentration of CuSO_4 for brine shrimp?
- (c) Explain the meaning of the term “threshold level of toxicity”. What is the threshold level of toxicity of CuSO_4 for brine shrimp? Label this point on the graph.
- (d) Provide one argument for extending these toxicity results to humans and one argument against doing so.

4. Read the article below and answer the questions that follow.

10
FREMONT DAILY GAZETTE

El Niño Linked to Disease Epidemics

Scientists have long realized the strong linkage between the ocean and atmosphere and the effect of this linkage on global climate patterns. Only recently however, have scientists established a possible link between climate change and health-related epidemics. Every few years a dramatic climate shift known as the El Niño-Southern Oscillation (ENSO) disrupts the normal interaction between ocean and atmosphere and alters the normal pattern of water temperatures and winds. ENSOs occur every 3 to 7 years and typically last from several months to over a year. During an El Niño, normal climatic patterns are severely disrupted and the longer the phenomenon lasts, the more disruptive it can be. When an ENSO lasts 12 months or longer it can also disrupt populations of oceanic and other aquatic organisms and set off a series of environmental problems throughout the world. Recently scientists studying ENSOs established a link between the climate-related changes during an El Niño event and the spread of such diseases as cholera and yellow fever.

The linkage apparently is the result of changing surface temperatures during the event, producing conditions suitable for the rapid spread of various vector-transmitted diseases in affected areas. The same changing conditions are also linked to several other environmental problems.

Recently, scientists at the Max Planck Institute in Germany reported that, based on a computer simulated model, human-induced global warming affects ENSOs. The model predicts more frequent El Niño events with increases in greenhouse gases, and if this model is correct, then we can expect further increases in disease epidemics in various parts of the world.

- (a) Describe what an El Niño is and clearly indicate where it occurs.
- (b) Describe the connection between the climate change associated with an El Niño and the transmission of diseases. Explain whether the article is correct in its reporting of the various disease epidemics that occur in response to an El Niño.
- (c) People in what part of the world would be most likely to be affected by this link between El Niño and disease?
- (d) Clearly describe two other important environmental problems associated with ENSOs.

END OF EXAMINATION