



## AP<sup>®</sup> Environmental Science 2003 Free-Response Questions

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# 2003 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. Read the following article from the *Fremont Examiner*.

FREMONT EXAMINER

## Worm Invasion

A researcher studying the ecology of the deciduous forest outside of Fremont has made an alarming discovery. While taking an inventory of the species present on the forest floor, Professor Peter Tate discovered many earthworms of an Asian species not previously known to live in this area. The Asian worms, unlike native worms, have voracious appetites. The forest floor is home to a myriad of species that live in the leaf litter, which is composed of several years' accumulation

of slowly decomposing leaves. Dr. Tate explained that “the leaf litter is critical to the survival of local species of forest plants.” Dr. Tate has found the Asian worms, unlike their indigenous cousins, consume the entire layer of leaf litter in a single season. He said, “This sets the stage for the takeover by invasive exotics such as Japanese stilt grass.” Dr. Tate and other scientists are exploring strategies for the control of the Asian worms.

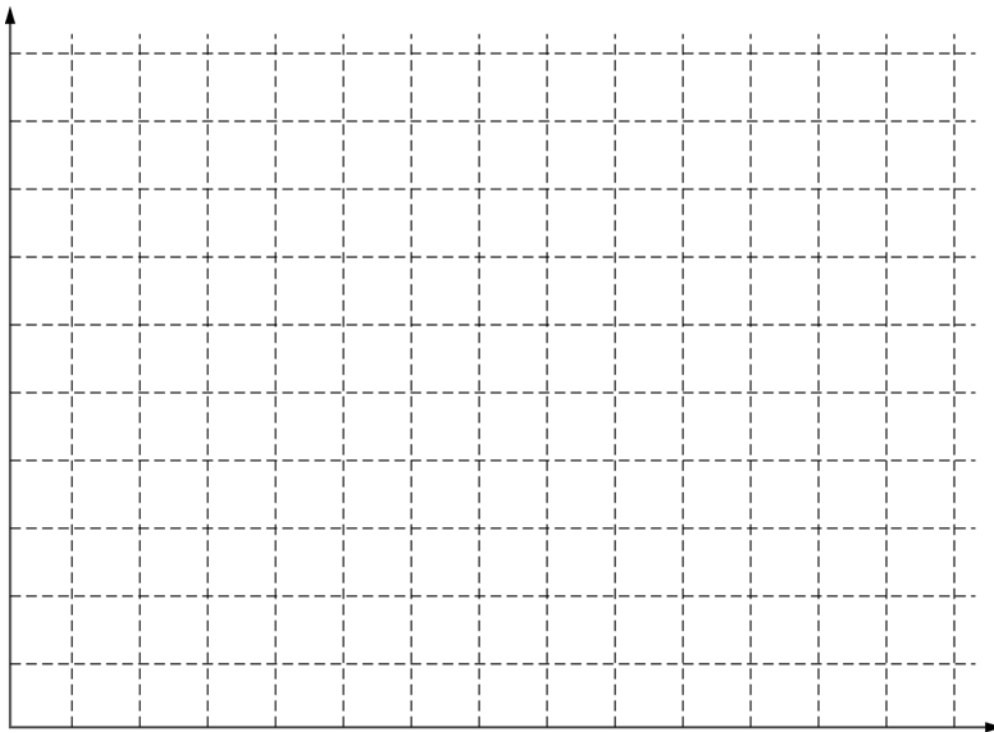
- (a) Support Dr. Tate’s assertion that “the leaf litter is critical to the survival of local species of forest plants.” Include in your discussion the roles of leaf litter in a deciduous forest ecosystem.
- (b) Describe THREE abiotic changes that would be likely to result if the exotic worms consumed all the leaf litter in a single year.
- (c) For one of the changes you identified in part (b), explain how the change could set the stage for the takeover of Japanese stilt grass or other exotic species.
- (d) Design a controlled experiment to determine whether the worms, in fact, do change the forest ecosystem. Identify the environmental factor you will measure, and include the specific hypothesis you will test and the data you will collect.

## 2003 AP<sup>®</sup> ENVIRONMENTAL SCIENCE FREE-RESPONSE QUESTIONS

2. A certain fictional country called Industria is tracking its population data. In 1855, the first year vital statistics were reported for the country, the population was 1.6 million, with a crude birth rate of 43 per 1,000. At that time the population of Industria was growing quite slowly, because of the high death rate of 41 per 1,000. In 1875 the population began to grow very rapidly as the birth rate remained at its 1855 level, while the crude death rate dropped dramatically to 20 per 1,000. Population growth continued to increase in the small country into the late 1800's, even though birth rates began to decline slowly.

In 1895 the crude birth rate had dropped to 37, and the death rate to 12 per 1,000. In that year (1895) a complete census revealed that the population of Industria had grown to 2.5 million. By 1950 population growth gradually began to decline as the death rate remained at its 1895 level, while the birth rate continued to decline to 22 per 1,000. In 1977 vital statistics revealed that the death rate was 10 per 1,000, and that population growth had slowed even more to an annual rate of 0.4%. By 1990 Industria had reduced its birth rate to that of its now constant, low death rate, and the population transition was complete.

- (a) On the axes below, plot the crude birth-rate data from 1855 to 1990. Now plot the crude death-rate data on the same axes. Clearly label the axes and the curves.



- (b) What was the annual growth rate of Industria in 1950? What was the birth rate in Industria in 1977?
- (c) Indicate TWO factors that might have accounted for the rapid decline in the death rate in Industria between 1855 and 1895. Indicate one specific reason why the birth rate might have been so high in 1855 and was so slow to decrease between 1855 and 1950.
- (d) Determine what the population size of Industria would have been in 1951 if the population had continued to grow at the annual rate of growth recorded for Industria in 1895.

## 2003 AP<sup>®</sup> ENVIRONMENTAL SCIENCE FREE-RESPONSE QUESTIONS

3. Environmental conditions in coastal estuaries vary hourly and seasonally.
- (a) Discuss TWO important causes for the variation in the temperature and/or salinity of an estuary. Be sure to include the connection between each cause and temperature and/or salinity.
  - (b) Discuss TWO roles that coastal wetlands play that are ecologically important, and TWO roles that wetlands play that are economically important.
  - (c) Identify and explain THREE ways in which humans have had a negative impact on or have degraded coastal wetlands.
  - (d) Choose one of the negative human impacts you identified in part (c), and explain one environmental policy and one economic incentive that could have prevented it.
4. The American whooping crane and the California condor are two of North America's largest birds. Although both are rare and endangered, they are protected, and large preserves are available for them. The two species, however, seem to be responding differently to these conservation efforts.

In 1937, the whooping crane population was reduced to 14 individuals. It has since recovered; currently more than 200 birds live and breed in the wild. In the preservation of endangered species, the whooping crane is a success story. On the other hand, the California condor population declined rapidly so that no birds remained in the wild between 1987 and 1992. Condors were reintroduced into the wild after 1992 and approximately 50 condors currently live in the wild in California and Arizona. However, the recovery program cannot yet be considered a success.

- (a) Identify and describe TWO major causes for the original decline of these species. (You may describe one cause for each species or two causes for one species.)
- (b) Describe TWO measures that have been taken to protect these species. (Specify which of the species benefited from each measure.)
- (c) Describe TWO important characteristics of an endangered species that would cause it to be slow to recover.
- (d) Make one economic or ecological argument for protecting the condor, the whooping crane, or another endangered species that you identify and make one economic or ecological argument against protecting it.

### END OF EXAMINATION