

# AP<sup>®</sup> Environmental Science

## Free-Response Questions

### 2019 AP<sup>®</sup> ENVIRONMENTAL SCIENCE FREE-RESPONSE QUESTIONS

#### ENVIRONMENTAL SCIENCE

#### SECTION II

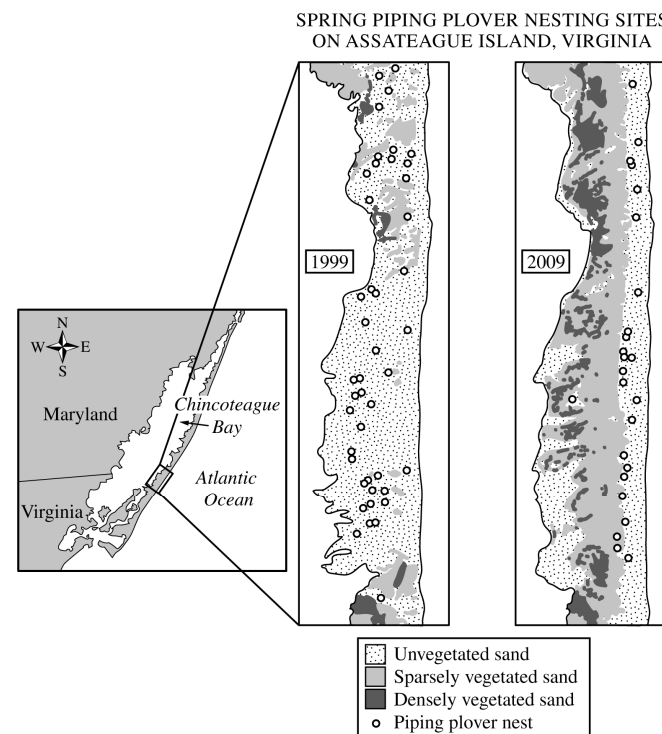
Time—1 hour and 30 minutes

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 book. 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. The piping plover is a globally threatened species, with perhaps as few as 2,000 nesting pairs remaining in the Atlantic population of these migratory shorebirds. Plovers were nearly hunted to extinction in the nineteenth century.

Plovers prefer to nest and search for food on open sandy beaches between sparsely vegetated sand dunes. Washovers, where sand is washed up from the beach and buries vegetated areas during big storms, are also important to plovers because they provide moist and undisturbed habitat for plover adults and their chicks. Ecologists with the Elliott Oceanographic Institute mapped the distribution of plover nests during two seasonal surveys of nesting sites over a ten-year period on Assateague Island. This is a barrier island, a long, narrow island running parallel to the Atlantic coast of Virginia.



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- (a) Use the maps provided to answer the following questions.
- (i) **Identify** the preferred nesting habitat for piping plovers.
  - (ii) **Describe** the change in the number of piping plover nests on Assateague Island between 1999 and 2009.
  - (iii) **Describe** one likely reason for the change in the number of piping plover nests between 1999 and 2009.
- (b) Coastal species are affected by more than just natural events.
- (i) Special beach restrictions can help piping plovers during nesting season. **Describe** one restriction that could reasonably be implemented to help prevent the destruction of plover nests by human actions.
  - (ii) In addition to providing habitat for piping plovers, barrier islands (and closely related landforms) are important for other reasons. **Explain** one way that these features help to preserve and protect the environment in coastal regions.
  - (iii) **Identify** one human action that directly threatens coastal habitats and **describe** one impact on species, other than the piping plover, that use the habitat.

Approximately 40% of the United States population resides in coastal areas, such as areas near Assateague Island, where sea level rise and shoreline erosion is occurring.

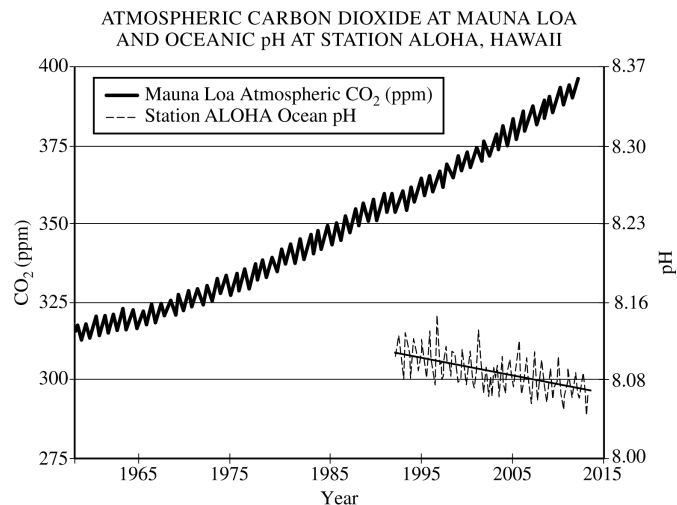
- (c) **Identify** one economic impact on coastal communities that has resulted from rising sea levels.
- (d) **Describe** TWO methods that may be used locally to protect coastal communities from rising sea levels.

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2. As conventional sources of crude oil are depleted, unconventional sources such as oil sands (also known as tar sands) are being utilized. Oils sands contain bitumen, which can be processed into a synthetic crude oil. A region of boreal forest in Alberta, Canada, that covers a deposit of oil sands will be cut and removed during the process of bitumen extraction. It is estimated that the deposit contains 73 billion barrels of recoverable bitumen. The rate of extraction from the deposit will be approximately 1 million barrels of bitumen per day.
- (a) **Identify** one ecological benefit, other than providing habitat, that is provided by forests.
  - (b) **Identify** one economic benefit that is provided by forests.
  - (c) **Describe** TWO environmental consequences, other than those related to the loss of boreal forest habitat, that result from the extraction of bitumen or the transportation of synthetic oil to customers.
  - (d) Assuming the above extraction rate, **calculate** how many days will be needed to extract the recoverable volume of bitumen from the oil sands.
  - (e) **Calculate** how many years will be needed to fully extract the recoverable volume of bitumen from the oil sands.
  - (f) Monthly production of synthetic crude oil is 30 million barrels. Producing one barrel of synthetic crude oil uses two barrels of heated freshwater. **Calculate** the number of barrels of freshwater needed each year to supply this demand.

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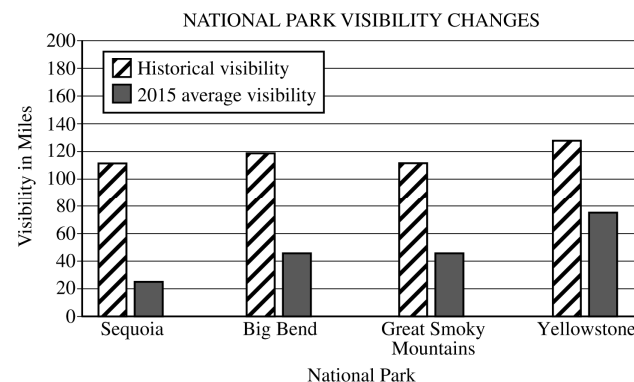
3. The graph shows measurements of atmospheric levels of carbon dioxide ( $\text{CO}_2$ ) at Mauna Loa Observatory, Hawaii, and the measurements of pH levels in the ocean nearby at Station ALOHA. Measurements of pH began in 1992.



- (a) Use the graph above to answer the following questions.
- Determine** the concentration of  $\text{CO}_2$  (in ppm) recorded at Mauna Loa in 2005.
  - Determine** the pH recorded at Station ALOHA in 2005.
- (b) Changes in atmospheric carbon dioxide affect Earth's oceans.
- Predict** the effect of increased concentration of atmospheric  $\text{CO}_2$  on the concentration of  $\text{CO}_2$  in the ocean.
  - Based on the data, **identify** the relationship between the concentration of atmospheric  $\text{CO}_2$  and the pH of ocean water.
  - Provide** the complete chemical equation that represents the reaction between oceanic carbon dioxide ( $\text{CO}_2$ ) and water ( $\text{H}_2\text{O}$ ).
  - Identify** the specific environmental problem that directly results from the decrease in pH of Earth's oceans.
- (c) Changes in pH in the world's oceans pose a risk to many marine organisms.
- Explain** why certain organisms, in particular those with calcium carbonate shells or exoskeletons, are threatened by the decreasing pH levels measured in seawater.
  - Other than threats posed by decreasing pH, **identify** an additional anthropogenic threat to the world's coral reef ecosystems and **describe** how the threat damages the coral reefs and coral reef ecosystems.

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4. One reason that people visit national parks is to view the scenery. Visibility at the four parks in the graph has been reduced over time so that by 2015 the visibility was an average of 70 miles less than the historical visibility. Regional air pollutant sources are commonly located over 100 miles away from national parks.



- (a) Based on the data provided in the graph, **identify** the national park that had the greatest loss of visibility as of 2015 when compared with the historical natural visibility.
- (b) Visibility in national parks can be affected by many different air pollutants.
- Identify** a primary air pollutant.
  - Describe** how a primary air pollutant becomes part of the atmosphere.
  - Identify** a secondary air pollutant.
  - Describe** how a secondary air pollutant is formed within the atmosphere.
- (c) In 1990 Great Smoky Mountains National Park had a visibility of 25 miles. Visibility data for 2015 can be determined from the graph above.
- Calculate** the percentage increase in visibility from 1990 to 2015.
  - Discuss** TWO specific actions that the state or federal government could take or encourage to further improve the visibility in Great Smoky Mountains National Park.
- (d) Excluding air pollution, **discuss** TWO additional ways national park ecosystems are being degraded by high levels of visitor use.

STOP

END OF EXAM