



AP[®] Environmental Science 2016 Free-Response Questions

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2016 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 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. Read the following article from the *Fremont New Tribune*.

Fremont New Tribune

May 2, 2016

As another winter concludes, biologists are alarmed by the continued spread of white nose syndrome (WNS) in bats. WNS is a fungal disease that is decimating bat populations across eastern North American forests, with mortality rates reaching up to 100 percent at many sites. WNS has been found in at least 25 states in the United States and 5 Canadian provinces.

The fungus (*Pseudogymnoascus destructans*) grows well in cool conditions such as those found in caves and has been observed as white patches on the muzzles, noses, ears, and wings of many cave-dwelling bats. WNS has caused significant population declines for several bat species, including once-numerous species such as the little brown bat (*Myotis lucifugus*).

Little brown bats hunt using echolocation by emitting up to 200 high-frequency calls per second when pursuing their prey. When healthy, the little brown bat can live up to ten years and have one or two offspring (called pups) each year.

"Little brown bats provide tremendous value to the United States economy every year by the essential services they provide to farmers and other people. We need to understand how this deadly disease spreads and attempt to help reduce its impact on the little brown bat and other bat species," said Dr. Duke Serach of the Fremont office of the United States Fish and Wildlife Service. Dr. Serach concluded with, "It may yet be possible to save the little brown bats, but the remaining population will be alarmingly small."

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- (a) Diseases can devastate populations; however, most diseases do not drive their host to extinction. **Provide** one explanation for why diseases seldom cause extinction.
- (b) Dr. Serach suggests that even if the impact of WNS on little brown bat populations can be reduced and the extinction of the species avoided, the bat populations are likely to remain alarmingly small.
- (i) **Describe** TWO threats (other than WNS) to the survival of the bat species if the total number of bats becomes very small.
 - (ii) If the little brown bat species does not become extinct and can potentially recover, the rate of recovery is likely to be slow. **Discuss** one aspect of bat biology that might slow the recovery of little brown bat populations to pre-WNS numbers.
- (c) Bats are found in ecosystems around the world. **Describe** TWO ways in which other organisms in an ecosystem could be affected by a decline in a bat population.
- (d) The Eastern deciduous forest in which the little brown bats live is an important ecosystem. **Identify** TWO ecosystem services that forests provide, and **explain** how each service benefits human society.

WNS is an emerging disease in bats. Humans are also subject to emerging diseases, such as Ebola. A recent study suggests that the number of emerging infectious diseases affecting human populations has been steadily increasing in recent decades.

- (e) **Provide** a likely reason for the increase in emerging infectious diseases affecting human populations. Include an explanation for the reason you provided.

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2. Iron ores are rocks from which metallic iron can be extracted for steel production. This process involves several steps. Iron ore is first mined and then turned into pig iron in a blast furnace, and some rock waste such as silicon dioxide is separated out. In the final step, the pig iron is refined into steel using a process that includes reacting the molten pig iron with oxygen to remove impurities.

(a) Use the data below to respond to the following. For each calculation, show all your work.

Global Iron and Steel Data
1.6 billion tons of iron ore are used yearly to make pig iron.
1.2 billion tons of pig iron are produced each year.
Iron ore reserves are estimated to be 800 billion tons.
95% of iron ore that is mined is used in steel production.

- (i) **Calculate** the weight (in tons) of rock waste produced globally each year when iron ore is converted to pig iron.
- (ii) **Calculate** the weight (in tons) of pig iron that could be produced if all of the estimated global iron ore reserves were used for pig iron production.
- (iii) **Calculate** the weight (in tons) of the current global iron ore reserves that would be used to make steel if the current trends continue.

Both iron ore and coal are mined for use in the manufacture of steel. It is estimated that for every ton of steel recycled, 1.25 fewer tons of iron ore and 0.7 fewer tons of coal must be mined. About 80 million tons of steel are recycled each year in North America.

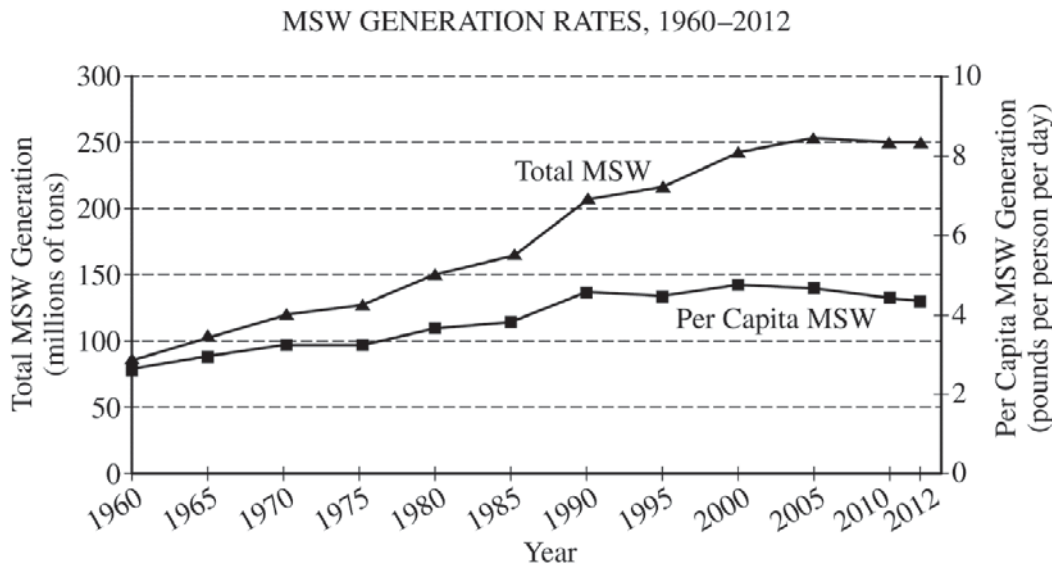
(b) **Calculate** the weight (in tons) of coal that is conserved each year in North America by recycling steel.

Before the year 1900, most mining companies abandoned surface and subsurface coal mine sites once the resource was depleted.

- (c) **Describe** TWO environmental problems that are associated with abandoned coal mine sites.
- (d) **Describe** one method that can be used to mitigate one of the problems you identified in part (c).
- (e) **Discuss** one reason why surface coal mining is generally less expensive than subsurface mining.

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3. Municipal solid waste (MSW) is the trash collected from households and businesses. The graph below shows MSW generation in the United States from 1960 to 2012.



- (a) Use the data provided in the graph above to respond to the following.
- Explain** one probable cause (other than increased composting) for the change in per capita waste generation from 2000 to 2012.
 - Calculate** the percent increase in total MSW generation from 1980 to 2012.
- (b) Two ways of managing MSW are incineration and disposal in landfills.
- Identify** one disadvantage of waste incineration.
 - Identify** one disadvantage of waste disposal in landfills.

Trash incineration is one way to generate electricity from MSW. Electricity can also be generated from waste buried in landfills.

- Describe** the specific steps of a process used to produce electricity from waste buried in a landfill.
- Many landfills do not accept used tires. As a result, the tires are often dumped in poorly regulated piles. **Describe** one human health problem associated with piles of discarded tires.
- Composting is one way to reduce the amount of waste that enters a landfill.
 - Other than reducing the volume of waste, **identify** one advantage of composting.
 - Identify** one disadvantage of composting.

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4. Soil is a complex mixture of living organisms and organic material, along with minerals and other abiotic components. Soils help sustain life and support ecosystem functions.

- (a) **Describe** how TWO climate factors affect the rate of soil formation.
- (b) As soils form, distinct layers known as horizons develop over time. One of these is the A horizon.
 - (i) **Identify** one specific biotic component of the A horizon.
 - (ii) **Identify** one abiotic component of the A horizon.

Resources such as soil and water can be degraded by human activities.

- (c) Nitrate levels exceeding the United States Environmental Protection Agency's primary drinking water standard have been found in the groundwater of areas with intensive agriculture.
 - (i) **Identify** one agricultural practice that can lead to elevated nitrate levels in groundwater.
 - (ii) **Describe** how the practice you identified in (c)(i) leads to elevated nitrate levels in groundwater.
- (d) Acid deposition has affected soil quality in many parts of the northeastern United States.
 - (i) **Explain** one way acid deposition onto soil can affect plant health.
 - (ii) **Describe** one method for remediating soil affected by acid deposition.
- (e) Climate change is causing far-reaching ecosystem changes, including soil degradation in many of the world's biomes. **Describe** TWO ways that climate change can degrade soil.

STOP

END OF EXAM