



AP[®] Environmental Science 2013 Free-Response Questions

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2013 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.

Fremont Examiner

May 1, 2013

GULF OF MEXICO: TROUBLED WATERS

The Mississippi River watershed has been repeatedly altered to improve both navigation and flood control. In addition, human actions in the watershed have harmed coastal wetland ecosystems and the water quality in the Gulf, affecting the regional economy along the Louisiana coast. A group of visiting scientists from Fremont University has released a preliminary report that suggests strategies to address and reverse this

damage. In a recent interview, Dr. Claire James stated, “We urgently need to reconsider our activities in the watershed and have very little time to clean up our mess. Our two biggest priorities have to be restoring the flow of sediment to the Gulf and reducing fertilizer runoff into the River. This will allow us to restore and conserve habitat so that our children and grandchildren will be able to enjoy this precious natural resource.”

1. (a) **Identify** TWO human activities that alter the natural flow of sediments into Gulf Coast ecosystems. Explain how each of the activities alters the flow of sediments.
- (b) Dr. James says that it is important to restore sediments. **Describe** TWO ways that the loss of natural sediment harms Gulf Coast wetland ecosystems.
- (c) Dr. James also indicates that it is necessary to limit fertilizer runoff into the Mississippi River.
 - i. **Describe** TWO environmental impacts on the marine ecosystem that are caused by fertilizer when it flows into the Gulf of Mexico.
 - ii. What are TWO economic consequences that result from the flow of fertilizer into the Gulf of Mexico?
 - iii. **Describe** ONE strategy, other than reducing the use of fertilizer, that can be employed to reduce the flow of nutrients into the Mississippi River.

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2. Battery electric vehicles (BEVs) have been introduced to consumers as an alternative way to reduce the environmental effects caused by use of internal-combustion engine (ICE) vehicles. A comparison of both vehicle types can help determine whether the use of BEVs would be beneficial in the future. Where calculations are required, show your work.
- (a) **Identify** THREE strategies that the federal government could implement to encourage the use of BEVs.
 - (b) Assume that the fuel efficiency of the ICE vehicle is 25 miles per gallon (mpg) and that gasoline costs \$3.75 per gallon (gal). **Calculate** the cost of gasoline per mile.
 - (c) The charger supplies energy to the BEV battery at an average rate of 4.0 kilowatts (kW) and fully charges the BEV battery in 7.0 hours. The car will run for 100 miles on a full charge. The cost of electricity is \$0.11 per kilowatt-hour (kWh).
 - i. **Calculate** the cost of the electricity to fully charge the battery. Assume that the battery is not charged to begin with.
 - ii. **Calculate** the cost of electricity per mile to drive the BEV.

When it is driven 100 miles, the ICE vehicle contributes 72.8 pounds (lb) of CO₂ from the burning of the gasoline. The drilling, refining, and transportation costs of getting the gasoline to the gas station add an additional 17.7 lb of CO₂ per 100 miles. The BEV does not emit any CO₂ itself, but the extraction, transportation, and combustion of the coal that produced the electricity at the power plant add 63.6 lb of CO₂ for the same 100 miles.

- (d) **Calculate** the difference in the amount of CO₂ that would enter the atmosphere if both cars were driven 100 miles.
- (e) **Describe** TWO economic impacts (excluding costs related to climate change resulting from CO₂ emissions or the cost of gasoline at the pump) that result from an increased number of BEVs on the road.

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3. Ozone (O_3) is an atmospheric trace gas that occurs naturally in the stratosphere. It is also formed as a consequence of human activity in the troposphere, immediately above Earth's surface. The location of ozone in the atmosphere determines whether the gas protects or damages the environment.
- (a) **Identify** the type of solar radiation that is absorbed by stratospheric ozone, and **describe** one human health benefit that results from the absorption of this solar energy.
 - (b) The absorption of solar energy by stratospheric ozone causes ozone molecules to undergo chemical decomposition and formation. **Describe** the chemical processes that lead to this natural balance between decomposition and formation of stratospheric ozone (you may use chemical equations in your answer).
 - (c) The Montreal Protocol of 1987 provided a global framework to phase out chlorofluorocarbon (CFC) production and use. Although the Montreal Protocol has led to a dramatic decrease in CFCs released into the atmosphere, stratospheric ozone destruction has decreased only slightly.
 - i. **Explain** the process by which CFCs lead to the destruction of stratospheric ozone. (You may use chemical equations in your answer.)
 - ii. **Explain** why the rapid decrease in CFC emissions has not led to a similarly rapid decrease in the destruction of stratospheric ozone.
 - (d) **Identify** a human activity that leads to the formation of tropospheric ozone as a secondary pollutant and explain why tropospheric ozone levels peak in the daytime.
 - (e) **Identify** one negative ecological impact and one negative human health impact that result from the formation of tropospheric ozone.

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4. Biological diversity, or biodiversity, has become a topic of great concern among conservationists. Biodiversity is often used by scientists and policy makers to help determine the health of ecosystems.
- (a) **Describe** TWO characteristics shared by ecosystems that have high biodiversity.
 - (b) **Identify** TWO specific human activities that result in a loss of biodiversity, and **explain** how each activity lowers biodiversity.
 - (c) For each human activity you discussed in (b), **propose** a practical strategy (other than simply banning the activity) to reduce the loss of biodiversity.
 - (d) **Describe** ONE naturally occurring factor that could lead to a loss of biodiversity.
 - (e) **Describe** TWO ecological benefits that greater biodiversity provides.

STOP

END OF EXAM