2005 AP® ENVIRONMENTAL SCIENCE FREE-RESPONSE QUESTIONS

3. Most of the coal mined in the United States today comes from surface (strip) mines. In surface mining, the vegetation, soil, and rock covering the coal (referred to as overburden) are removed and set aside. After the coal has been hauled away, good conservation practices require that the overburden be replaced and the surface be restored to its original condition. Land restoration may be difficult in some regions, due to factors such as the local climate, the thickness of the coal seam, the extent of the overburden, and the sulfur content of the coal.

(a) Describe the steps that should be taken to restore the land after the overburden has been replaced.

(b) Explain why the restoration of the land would likely be more difficult in an arid climate (less than ten inches of precipitation per year).

(c) Describe one environmental impact that the sulfur content of the remaining coal and the tailings would have on the reclamation process and suggest a possible remedy.

(d) Other than mining and reclamation, describe TWO environmental impacts of using coal for energy.

(e) Explain why per capita coal consumption in the United States is likely to increase.

2008 AP® ENVIRONMENTAL SCIENCE FREE-RESPONSE QUESTIONS

3. For decades, forest fires in the United States have been suppressed. In 2003 legislation was passed under the Healthy Forest Initiative (HFI) in response to the record-breaking wildfires that had occurred in the early 2000s. Some environmental and conservation groups fear that negative impacts could result if timber companies are encouraged to harvest medium- and large-size trees in federally owned forests while clearing away the smaller trees and underbrush.

(a) Identify TWO characteristics of forests that develop when fires are suppressed, and explain why the practice of fire suppression does not reduce, but actually increases, the risk of intense and extensive forest fires.

(b) The effects of the HFI are expected to extend beyond fire reduction. Excluding fire reduction, describe ONE positive and ONE negative effect likely to result from the implementation of the provisions of the HFI.

(c) Describe TWO ecosystem services provided for humans by forests. Explain how clear-cutting would affect each ecosystem service you describe.

(d) Identify a specific type of plant community or biome (other than a forest) that is naturally maintained by fire. Explain how the fire maintains the community or biome.
4. The major issues in modern agriculture include the use of genetically modified (GM) crops and the implementation of sustainable agricultural practices. The following graph shows the increase in the use of GM crops in both developing and industrialized countries from 1995 to 2004.

(a) Reply to the following questions based on the data in the graph above.

(i) Calculate the increase in the area of land used for growing GM crops in developing countries from 1999 to 2003. Express your answer as a percentage of the 1999 value.

(ii) Calculate the annual rate of increase in land area used for growing GM crops in industrialized countries from 1997 to 1999.

(iii) Using the rate you calculated in part (ii), project the area of land that would have been expected to be used for GM crops in industrialized countries in 2004.

(iv) Identify one likely cause for the difference between the projected land area for GM crops in industrialized countries in 2004 and the actual land area for GM crops in industrialized countries in 2004.

(b) Describe one environmental advantage and one environmental disadvantage of using GM crops.

(c) Describe one economic advantage and one economic disadvantage of using GM crops.

(d) A healthy soil ecosystem is of primary importance in sustainable agriculture. Describe TWO viable agricultural practices that farmers can use to maintain or improve soil quality.

(e) Identify and describe one environmental advantage and one economic advantage of consuming locally grown produce.
1. Read the following article from the *Fremont Inquirer* and answer the questions that follow.

**Fremont Inquirer**

*May 1, 2010*

**BEETLES BOOM BUT BEES BUST**

We share our world with millions of insect species that we tend to overlook in our daily lives. Yet once in a while, some insect species do make the front page — sometimes because their populations are exploding and other times because they seem to be performing a disappearing act. Examples of such species are the mountain pine beetle and the European honeybee.

In the western United States, outbreaks of forest destruction caused by mountain pine beetles have been recorded since the late 1880s. But in the past few decades, mountain pine beetles have been killing mature trees (preferred targets of the beetles) at accelerated rates, and now millions of acres of pine forests have been affected. Fire-suppression policies, the practice of clear-cutting, and lowered winter mortality of beetle larvae have all been implicated in causing the epidemic proportions of the beetles’ forest-destroying activities.

While mountain pine beetle populations are booming, European honeybees are in trouble. Many valuable food crops are dependent on pollination by honeybees, yet the number of managed honeybee colonies has dropped significantly since the 1970s due to colony collapse disorder (CCD), which is characterized by the sudden disappearance of all the worker bees in a colony. Recent scientific research suggests that many stress factors of anthropogenic origin are the culprits in CCD. Some farmers are trying to use fewer colonies to pollinate their crops, some are hoping that other natural pollinators (e.g., native wild bees, other insects, bats) will do the job of pollination for them.

(a) As mentioned in the article, there are several possible explanations for the increase in mountain pine beetles.

   (i) Provide one reason why fire-suppression policies lead to increased beetle activity.

   (ii) Reduced winter mortality of beetle larvae is likely a consequence of global climate change. Describe TWO ways that the activities of the beetles might enhance climate change.

(b) The widespread death of trees leads to a series of changes in a forest ecosystem. Identify TWO physical changes that occur in the forest ecosystem as the result of the death of mature trees. For each physical change you identify, describe an impact of that change on the forest ecosystem.

(c) As the article states, the number of managed honeybee colonies has dropped significantly over the past few decades. Describe TWO specific economic consequences of the collapse of the managed honeybee colonies.

(d) Pollination by native insects is considered an ecosystem service. Identify a different ecosystem service and explain how that service benefits human society.
4. As the world’s population increases and availability of new arable land decreases, providing sufficient food for the world’s human population is becoming increasingly difficult. The table below shows the area of land needed to feed the world’s population from 1900 projected to the year 2060.

<table>
<thead>
<tr>
<th>Year</th>
<th>1900</th>
<th>1940</th>
<th>1980</th>
<th>2020</th>
<th>2060</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land Area Needed (billion hectares)</td>
<td>0.40</td>
<td>0.60</td>
<td>1.25</td>
<td>2.50</td>
<td>4.75</td>
</tr>
</tbody>
</table>

(a) On the graph below, plot the data from the table above and draw a smooth curve.

(b) Assume that the maximum arable land area on Earth is 4.00 billion hectares. Using the smooth curve that you created above, determine the year in which the human population is likely to run out of arable land for agriculture.

(c) Soil quality is a critical factor in agriculture. Identify TWO physical and/or chemical properties of soils and describe the role of each property in determining soil quality.

(d) Describe TWO viable strategies for reducing the amount of land needed for agriculture.

(e) One problem that can result from agriculture is soil salinization.
   (i) Describe how salinization occurs.
   (ii) Describe one method to prevent or remediate soil salinization.
3. The active ingredients in many pesticides are chemical compounds that kill organisms such as insects, molds, and weeds. Proponents claim that the use of pesticides improves crop yields and thus protects land and soil by reducing the conversion of forests and wetlands to cropland. Opponents of pesticide use claim that pesticides degrade water and soil quality and that other modern agricultural techniques and practices are responsible for the improved crop yields in recent years.

(a) Design a laboratory experiment to determine whether or not a new pesticide (product X) is toxic to minnows, a type of small fish. For the experiment you design, be sure to do all of the following.

(i) State the hypothesis.
(ii) Describe the method you would use to test your hypothesis.
(iii) Identify the control.
(iv) Identify the dependent variable.

(b) Describe experimental results that would lead you to reject your hypothesis in part (a)(i). (Be specific.)

(c) One strategy for dealing with agricultural pests is integrated pest management (IPM).

(i) Describe IPM. As part of your description, include TWO specific pest-control approaches that are part of IPM.

(ii) Identify one environmental benefit of using IPM.

(d) Describe TWO agricultural practices, other than those involving pest control, that increase crop yields.

2016 AP® ENVIRONMENTAL SCIENCE FREE-RESPONSE QUESTIONS

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.

<table>
<thead>
<tr>
<th>Global Iron and Steel Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.6 billion tons of iron ore are used yearly to make pig iron.</td>
</tr>
<tr>
<td>1.2 billion tons of pig iron are produced each year.</td>
</tr>
<tr>
<td>Iron ore reserves are estimated to be 800 billion tons.</td>
</tr>
<tr>
<td>95% of iron ore that is mined is used in steel production.</td>
</tr>
</tbody>
</table>

(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.