



AP[®] Environmental Science 2004 Scoring Commentary

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**AP[®] ENVIRONMENTAL SCIENCE
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Question 1

**Sample: 1A
Score: 10**

Part (a) earns one point for coal burning as the source of mercury mentioned in the document, one point for saying how mercury is transported after “incorporation into rain clouds,” and one point for the description of rain as the way mercury enters aquatic systems. Part (b) earns two points, one for a description of strategies that would reduce the amount of fossil fuel burned, and one for the description of how subsidies to promote alternative energy use would reduce the amount of mercury released. In part (c), one point is earned for the general description of mercury in food chains, and one elaboration point is earned for an in-depth discussion of biomagnification. Part (d) earns one point for naming lead as a toxic metal, one for identifying paint as a way of introducing it into the environment, and one for identifying brain “retardation” as a sublethal effect.

**Sample: 1B
Score: 8**

In part (a), one point is earned for identifying the burning of coal as a human activity that releases mercury into the environment. One point is earned for atmospheric transport by incorporation into the water cycle, and one point is earned for the explanation that rain brings the mercury into aquatic ecosystems. In part (b), one point is earned for describing and giving examples of how mercury could be reduced by switching to a cleaner energy source. No point can be earned for the scrubber explanation without additional information about how the process could be modified to take out gaseous mercury. Part (c) earns one point for its explanation of the behavior of mercury in a food chain. In part (d), one point is earned for identifying lead as a toxic metal, one point for describing how it enters the environment in leaded gasoline, and one point for identifying shortened attention span as a sublethal effect.

**Sample: 1C
Score: 6**

In part (a), one point is earned for the description of wind transport of mercury in the atmosphere, and one point for introduction of mercury into water by rain. A specific reference to coal burning is not present in the part of the answer labeled (a), (the student used the term “fossil fuel,” which is not acceptable). Nevertheless, that point is earned for part (a) because the student makes it clear in part (b) that the fossil fuel in question is coal. In part (b), one point is earned for a description of alternative fuel use as a way to reduce the release of mercury. Part (c) earns one point by connecting the amount of mercury in fish with their diet. In part (d), a point is earned for lead, but not for the vague reference to dumping waste, or for the generic “lead poisoning” as a health effect.

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Question 2

Sample: 2A

Score: 10

Two points are earned in part (a) for correctly showing the set-up of the calculation (1 point), and for the correct calculation and answer (1 point). Two points are earned in part (b) for correctly showing the set-up of the calculation (1 point), and for the correct calculation and answer (1 point). One point is earned in part (c) for an explanation of why the power plant produces more electricity than is consumed. Two points are earned in part (d) for correctly showing the set-up of the calculation (1 point), and for the correct calculation and answer (1 point). This is a good example of the student using an alternate method to arrive at the correct answer. In part (e), the student earns two points for identifying and describing two environmental benefits of switching from coal to wind power generation. The student might have also earned two points for identifying and describing two environmental costs, for a total of 11 points, but the maximum number of points is ten.

Sample: 2B

Score: 8

Two points are earned in part (a) for correctly showing the set-up of the calculation (1 point), and for the correct calculation and answer (1 point). Two points are earned in part (b) for correctly showing the set-up of the calculation (1 point), and for the correct calculation and answer (1 point). One point is earned in part (c) for an explanation of why the power plant produces more electricity than is consumed. No points are earned in part (d). In part (e), the student earns two points for describing two benefits: the reduction of sulfur dioxide emissions and hence acid rain, and the reduction of coal mining and hence acid mine drainage. The student also earns one point for identifying and describing the environmental cost of bird death and population decline as a result of the turbine blades. No point is earned for the second cost as it is linked to an economic value (agriculture), rather than an environmental one.

Sample: 2C

Score: 6

Two points are earned in part (a) for correctly showing the set-up of the calculation (1 point), and for the correct calculation and answer (1 point). Two points are earned in part (b) for correctly showing the set-up of the calculation (1 point), and for the correct calculation and answer (1 point). One point is earned in part (c) for an explanation of why the power plant produces more electricity than is consumed. No points are earned in part (d) because no calculations are shown. One point is earned in part (e) for identifying the role of sulfur dioxide as a component in acid deposition. The suggestions of increased land use and noise pollution are not explained and do not earn points.

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Question 3

Sample: 3A

Score: 10

Three points are earned in part (a): one point is earned for indicating that low-level radioactive waste becomes “safe” in a shorter amount of time than high-level waste; one point is earned for indicating the low-level waste needs to be safely stored for 100-500 years while high-level waste must be stored for thousands of years; one point is earned for indicating that uranium-235 is present in radioactive waste and that humans generate the waste by using nuclear power plants. Three points are earned in part (b): one point is earned by indicating that an ideal deep underground storage site for high-level radioactive waste should not be located in an area prone to earthquakes; one point is earned by indicating that an ideal deep underground storage site for high-level radioactive waste should not be located in an area prone to volcanic activity; one point is earned by indicating that an ideal deep underground storage site for high-level radioactive waste should be located far away from groundwater. A fourth characteristic cannot earn a point. Three points are earned in part (c): one point is earned by indicating that dumping high-level radioactive waste into the ocean and burying it in deep ocean vents have been suggested as options for the long-term management of the waste; one point is earned by indicating that ocean dumping is not feasible due to the potential for ecosystem damage; one point is earned by indicating that burying in deep ocean vents is not feasible because undersea volcanic activity could cause the release of the waste into the ocean. A third management option cannot earn a point. One point is earned in part (d) by indicating that ionizing radiation damages living tissue by causing mutations in DNA.

Sample: 3B

Score: 8

One point is earned in part (a) by indicating that uranium-235 is present in radioactive waste and that humans generate the waste by using nuclear power plants. Three points are earned in part (b): one point is earned by indicating that an ideal deep underground storage site for high-level radioactive waste should not be located in an area prone to earthquakes; one point is earned by indicating that an ideal deep underground storage site for high-level radioactive waste should not be located in an area prone to volcanic activity; one point is earned by indicating that an ideal deep underground storage site for high-level radioactive waste should be located in an area with a very low water table. A fourth characteristic cannot earn a point. Three points are earned in part (c): one point is earned by indicating that launching into space and converting the waste into less harmless isotopes have been suggested as options for the long-term management of high-level radioactive waste; one point is earned by indicating that launching into space is nearly impossible due to the threat of leaks; one point is earned by indicating that turning the waste into less harmless isotopes remains scientifically impossible. One point is earned in part (d) by indicating that cancer is caused by radiation mutating or altering genes.

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Question 3 (cont'd.)

Sample: 3C

Score: 6

Two points are earned in part (a): one point is earned by indicating that low-level waste has a shorter half-life than high-level waste; one point is earned by indicating that low-level waste does not need to be stored as long as high-level waste. Three points are earned in part (b): one point is earned by indicating that a deep underground storage site for high-level radioactive waste should not be located near a fault line; one point is earned by indicating that a deep underground storage site for high-level radioactive waste should not be located near any groundwater deposits; one point is earned by indicating that a deep underground storage site for high-level radioactive waste should not be located near any volcanic activity. No points are earned in part (c). One point is earned in part (d) by indicating that cancer is caused by radiation causing cells to mutate.

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Question 4

Sample: 4A

Score: 10

In part (a), three points are earned: one point for correctly identifying that a chemical test for nitrogen will be performed, one point for recommending planting legumes with nitrogen-fixing bacteria, and one point for correctly identifying a physical test as finding the “composition”, i.e., how much sand, silt, and clay are in the soil. In part (b), one point is earned for stating that an advantage in using inorganic fertilizers is that they are easy to transport and acquire, and one point for identifying the disadvantage that nutrients enter runoff and cause “cultural eutrophication.” In part (c), one point is earned for correctly describing the planting of windbreaks and one point for correctly describing no-till farming. In part (d), one point is earned for identifying a correct biome, the temperate deciduous forest, and one point for explaining that the decomposing leaf litter causes humus to form. A final point is earned for saying that humus is rich in nutrients. Part (d) has a maximum of three points, so no additional point is earned by explaining that humus increases water-holding capacity.

Sample: 4B

Score: 8

In part (a), one point is earned for correctly describing pH as a chemical test for acidity. One point is earned for recommending neutralizing with sulfur or lime. The student does not sufficiently describe a physical test. In part (b), two points are earned: one point for indicating that an advantage of inorganic fertilizer is that it increases land productivity, and one point for indicating that inorganic fertilizers add no humus to the soil. In part (c), one point is earned for describing no-till agriculture. An incorrect description of alley cropping does not earn a point. In part (d), one point is earned for identifying the biome as temperate grasslands and one point for explaining how the humus forms (from decaying grass). A third point is earned in part (d) for explaining that humus supplies nutrients.

Sample: 4C

Score: 6

In part (a), one point is earned for describing the pH test as chemically measuring soil acidity. One point is earned for the physical test of measuring “particle size” (sand, silt, or clay). The student does not earn a third point, as there is no recommendation for sustainable agriculture. In part (b), one point is earned for stating that the advantage of using inorganic fertilizers is that they speed up the growing process and one point for stating that the disadvantage is that fertilizer runoff can end up in surface water, killing fish. In part (c), no points are earned. If the student were more specific in explaining the planting of grasses and relating it to cover crops, a point could be earned. No points are earned for the suggestion of installing a drainage system, as this is not a proper description. In part (d), the student does not list a correct humus-rich biome; therefore no point is earned for how humus is formed. One point is earned for saying that humus is rich in nutrients and one point for saying that it provides for optimal root growth.