

ANSWERS FOR MULTIPLE-CHOICE QUESTIONS

Using the table below, score your test. You will find explanations of the answers on the following pages.

1. E	21. E	41. C	61. C	81. D
2. B	22. C	42. E	62. C	82. C
3. D	23. E	43. C	63. D	83. E
4. A	24. C	44. E	64. B	84. D
5. C	25. A	45. E	65. B	85. A
6. E	26. E	46. D	66. B	86. D
7. B	27. E	47. A	67. A	87. A
8. C	28. D	48. B	68. A	88. D
9. B	29. B	49. B	69. D	89. A
10. B	30. C	50. C	70. E	90. C
11. A	31. A	51. C	71. B	91. C
12. D	32. C	52. D	72. E	92. A
13. E	33. B	53. D	73. C	93. C
14. E	34. D	54. C	74. A	94. D
15. D	35. B	55. A	75. D	95. A
16. A	36. D	56. A	76. E	96. E
17. B	37. B	57. A	77. D	97. D
18. E	38. A	58. C	78. D	98. B
19. E	39. E	59. D	79. D	99. E
20. B	40. D	60. D	80. B	100. C

- ANSWER: E.** New Zealand has regularly been under masses of ozone-depleted air that float northward from over Antarctica. The masses may linger for weeks and they expose all life to damaging levels of UV-B radiation (*Living in the Environment*, 16th ed., page 523 / 17th ed., page 521).
- ANSWER: B.** Iceland is above the mid-Atlantic trench and gets about 75% of its energy and 95% of its electricity from geothermal sources (*Living in the Environment*, 16th ed., page 399 / 17th ed., page 425).
- ANSWER: D.** Japan has the world's tenth-largest population with about 128 million people—far more than any of the other islands labeled (*Living in the Environment*, 16th ed., page 126 / 17th ed., page 138).

4. **ANSWER: A.** Hawaii was formed by a geologic hot spot in the center of the Pacific plate, thousands of miles from any plate boundaries (*Living in the Environment*, 16th ed., not included / 17th ed., not included).
5. **ANSWER: C.** Madagascar is the only developing nation that is labeled (*Living in the Environment*, 16th ed., pages 10–11 / 17th ed., page 12).
6. **ANSWER: E.** Overfishing has severely depleted the North Atlantic cod fishery. In fact, a moratorium has been placed on cod fishing off the northeast coast of North America (*Living in the Environment*, 16th ed., page 254 / 17th ed., page 257).
7. **ANSWER: B.** Some of the natural features that would have weakened Hurricane Katrina were eliminated by the development of wetlands along the Louisiana coast (*Living in the Environment*, 16th ed., pages 177–178 / 17th ed., pages 184–186).
8. **ANSWER: C.** Los Angeles is surrounded on three sides by mountains and the Pacific Ocean on the fourth side. This provides ideal conditions for the formation of an inversion layer that traps photochemical smog over the city (*Living in the Environment*, 16th ed., page 478 / 17th ed., page 476).
9. **ANSWER: B.** The Mississippi River watershed drains nearly two-thirds of the continental U.S. land area into the Gulf of Mexico through the Mississippi River Delta in Louisiana (*Living in the Environment*, 16th ed., page 550 / 17th ed., page 546).
10. **ANSWER: B.** The earth emits infrared radiation, which is trapped in the troposphere by greenhouse gases (*Living in the Environment*, 16th ed., pages 56–57 / 17th ed., page 57).
11. **ANSWER: A.** The stratospheric ozone layer was formed by the reaction between oxygen and ultraviolet radiation (*Living in the Environment*, 16th ed., page 470 / 17th ed., pages 467–468).
12. **ANSWER: D.** X-rays have the highest energy of those listed (*Living in the Environment*, 16th ed., page 42 / 17th ed. pages 44–45).
13. **ANSWER: E.** Microwaves have the lowest energy of those listed (*Living in the Environment*, 16th ed., page 42 / 17th ed. pages 44–45).
14. **ANSWER: E.** The Convention on International Trade of Endangered Species of Flora and Fauna (CITES) treaty restricts trade in products that are manufactured from endangered species (*Living in the Environment*, 16th ed., pages 206–207 / 17th ed., page 209).
15. **ANSWER: D.** Integrated Pest Management (IPM) makes use of a combination of strategies including biological control, crop rotation, and narrow spectrum pesticides to manage pest populations at acceptable levels without using more hazardous broad spectrum pesticides (*Living in the Environment*, 16th ed., page 300 / 17th ed., pages 302–303).
16. **ANSWER: A.** An El Niño Southern Oscillation (ENSO) is a climatic event that occurs every few years and results in, among other things, a decline in the populations of fisheries off the coast of South America (*Living in the Environment*, 16th ed., pages S48–S49 / 17th ed., pages S26–S28).
17. **ANSWER: B.** The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also known as the Superfund Act, created a process by which the U.S. government identifies sites where hazardous materials have contaminated the environment and cleans them up (*Living in the Environment*, 16th ed., pages S48–S49 / 17th ed., page S8).

18. **ANSWER: E.** Species that are slow to recover from environmental change are typically K-strategists and follow a late-loss survivorship curve, which is exemplified by the line labeled “E” above (*Living in the Environment*, 16th ed., not included / 17th ed., not included).
19. **ANSWER: E.** Species that bear few offspring per generation are typically K-strategists and follow a late-loss survivorship curve, which is exemplified by the line labeled “E” above (*Living in the Environment*, 16th ed., not included / 17th ed., not included).
20. **ANSWER: B.** The turbidity of water measures the amount of light that passes through the water. When sediments pollute water the turbidity will immediately change (*Living in the Environment*, 16th ed., page 535 / 17th ed., page 533).
21. **ANSWER: E.** Dissolved oxygen levels decrease as water temperature increases and increase as water temperature decreases. Therefore, water temperature and the dissolved oxygen concentration are inversely proportional (*Living in the Environment*, 16th ed., not included / 17th ed., not included).
22. **ANSWER: C.** Water hardness is a measurement of the concentration of magnesium and calcium in water. As water flows through areas rich in calcium, magnesium or both, the hardness increases (*Living in the Environment*, 16th ed., not included / 17th ed., not included).
23. **ANSWER: E.** Decomposers consume dissolved oxygen, making it difficult for fish and other aquatic species to survive in the same area that decomposition is occurring (*Living in the Environment*, 16th ed., page 536 / 17th ed., page 534).
24. **ANSWER: C.** Palm oil is a commonly used crop to produce biodiesel fuel, and the recent increase in fuel prices has resulted in large areas of tropical rain forest destruction, especially in Southeast Asia (*Living in the Environment*, 16th ed., page 423 / 17th ed., page 421).
25. **ANSWER: A.** Alfalfa is a legume that has nitrogen-fixing *Rhizobium* bacteria living in nodules on its roots. Growing legumes like alfalfa (also, soybeans, peanuts, peas, and clover) in rotation with other crops can restore soil nitrogen without adding inorganic fertilizers (*Living in the Environment*, 16th ed., not included / 17th ed., not included).
26. **ANSWER: E.** Corn is being used to produce ethanol and as a result the price of corn has risen along with energy prices in recent years (*Living in the Environment*, 16th ed., page 425 / 17th ed., pages 419–421).
27. **ANSWER: E.** High-fructose corn syrup is a ubiquitous sweetener that has played a role in the high caloric intake that in turn has led to the obesity epidemic in developed countries (*Living in the Environment*, 16th ed., not included / 17th ed., not included).
28. **ANSWER: D.** Golden rice is genetically modified to produce vitamin A, an essential vitamin to fight off infectious diseases and maintain good eyesight. Children with vitamin A deficiencies are more vulnerable to infectious diseases and can become blind (*Living in the Environment*, 16th ed., page 275 / 17th ed., page 294).
29. **ANSWER: B.** DDT is an endocrine disrupter that is linked to feminization of males, inadequate eggshell production, and several other problems associated with sex hormones. Endocrine disrupters have similar chemical structures to sex hormones (often estrogen), which allow them to mimic hormones in the body and confuse the endocrine system (*Living in the Environment*, 16th ed., page 452 / 17th ed., pages 449–450).

30. **ANSWER: C.** Cool air can hold less moisture than warm air. As an air mass rises in the troposphere it cools, and as a result, water condenses out of the cooler air mass and falls back to earth (*Living in the Environment*, 16th ed., page 143 / 17th ed., page 150).
31. **ANSWER: A.** The release of radioactive gas during the meltdown of the nuclear power plant in Chernobyl, Ukraine, exposed much of the population of northern Europe to enough radiation to result in an increased risk of cancer (*Living in the Environment*, 16th ed., page 390 / 17th ed., page 389).
32. **ANSWER: C.** The bulb's efficiency is a measure of how much of the energy input to the bulb is converted to light energy (the rest is converted to waste heat). Since power is the rate at which the bulb consumes energy, a bulb that is five times more efficient will need five times less energy input to produce the same amount of light and $100 \text{ watts} / 5 = 20 \text{ watts}$ (*Living in the Environment*, 16th ed., page 402 / 17th ed., page 407).
33. **ANSWER: B.** UV-A has the least energy, low potential to harm life, and is not absorbed by the ozone layer. UV-C has the most energy and the most potential to harm life. UV-C has sufficient energy to break down oxygen molecules, and as a result, even with no ozone layer it would still be absorbed by oxygen in the atmosphere. UV-B can do considerable harm to life, and it is strongly absorbed by the ozone layer, and as a result the ozone layer is vital to protect life from UV-B radiation (*Living in the Environment*, 16th ed., pages 525–526 / 17th ed., page 523).
34. **ANSWER: D.** The Zebra mussel was unintentionally introduced to the Great Lakes, probably in the ballast water of a ship (Gypsy moths were intentionally introduced in a failed attempt to improve the U.S. silk industry) (*Living in the Environment*, 16th ed., page 199 / 17th ed., page 200).
35. **ANSWER: B.** The only set of numbers that will balance the equation. You should recognize these reactions as the chain reaction that destroys ozone in the stratosphere (*Living in the Environment*, 16th ed., page 525 / 17th ed., not included).
36. **ANSWER: D.** Methemoglobinemia, or blue baby syndrome, is caused when drinking water is contaminated with excessive nitrates (*Living in the Environment*, 16th ed., page 544 / 17th ed., page 540).
37. **ANSWER: B.** Acid rain falls within 1–2 weeks of the release of the pollutants (SO_2 and NO_x) that cause it (*Living in the Environment*, 16th ed., page 479 / 17th ed., pages 476–477).
38. **ANSWER: A.** A pH difference of 1 unit corresponds to a factor of 10 of the logarithmic pH scale. Normal rain has a pH of about 5.6; therefore the difference is closest to 1 pH unit, which corresponds to a factor of 10 (*Living in the Environment*, 16th ed., pages 479, S41 / 17th ed., pages 477, S13).
39. **ANSWER: E.** Bacteria remove nitrogen from its largest reservoir, the atmosphere, during nitrogen fixation and denitrifying bacteria return nitrogen to the atmosphere (*Living in the Environment*, 16th ed., pages 68–69 / 17th ed., page 71).
40. **ANSWER: D.** The atmosphere is the smallest of the listed reservoirs in the global hydrologic (water) cycle. The water in the atmosphere also has the shortest residence time (1–2 weeks) of the reservoirs in the global hydrologic (water) cycle that are listed (*Living in the Environment*, 16th ed., not included / 17th ed., not included).

41. ANSWER: C. Called terminator seeds, these plants are produced to force farmers to buy new seeds every year (*Living in the Environment*, 16th ed., not included / 17th ed., not included).
42. ANSWER: E. This is an example of positive feedback. The initial change to the system is overgrazing and the system reacts to further the change in the same direction (*Living in the Environment*, 16th ed., page 45 / 17th ed., page 49).
43. ANSWER: C. Reducing energy efficiency will result in more fuel being burned rather than less and will not reduce global warming (*Living in the Environment*, 16th ed., page 515 / 17th ed., page 513).
44. ANSWER: E. Car A uses $12,000/40 = 300$ gal/year $\times 20$ lbs CO₂/gal = 6,000 lbs/year $\times 10$ years = 60,000 lbs. Car B uses $12,000/15 = 800$ gal/year $\times 20$ lbs CO₂/gal = 16,000 lbs/year $\times 10$ years = 160,000 lbs. Car B uses 100,000 pounds or 50 tons of additional CO₂ during the 10 years (*Living in the Environment*, 16th ed., not included / 17th ed., not included).
45. ANSWER: E. Car A uses $12,000/40 = 300$ gal/year $\times 10$ years = 3,000 gallons \times \$3/gal = \$9,000. Car B uses $12,000/15 = 800$ gal/year $\times 10$ years = 8,000 gallons \times \$3/gal = \$24,000. The fuel for Car B costs an additional \$13,000 during the 10 years (*Living in the Environment*, 16th ed., not included / 17th ed., not included).
46. ANSWER: D. Center-pivot irrigation is an irrigation method used in industrialized agriculture in which large pipes on wheels with sprinklers attached are rotated around a central pivot point, creating large circular fields of crops (*Living in the Environment*, 16th ed., pages 334–335 / 17th ed., page 335).
47. ANSWER: A. Soy or soybeans, like other legumes, have a symbiotic relationship with specialized bacteria attached to their roots that fix nitrogen (*Living in the Environment*, 16th ed., page 305 / 17th ed., page 307).
48. ANSWER: B. Honeybees have coevolved with numerous species of flowering plants. Without them pollination would not happen in many of the plant species, which would decimate food supplies (*Living in the Environment*, 16th ed., pages 202–203 / 17th ed., page 204).
49. ANSWER: B. Bromine in halons and methyl bromide depletes stratospheric ozone (*Living in the Environment*, 16th ed., page 525 / 17th ed., page 522).
50. ANSWER: C. In the fall and spring lakes in temperate climates mix, carrying dissolved oxygen from the surface to the bottom of the lake and nutrients from the bottom to the surface of the lake (*Living in the Environment*, 16th ed., not included / 17th ed., not included).
51. ANSWER: C. The calculation of a species diversity index of an ecosystem requires the total number of species and the number of individuals of each species. These data are then manipulated in a statistical formula to determine a diversity index (*Living in the Environment*, 16th ed., not included / 17th ed., not included).
52. ANSWER: D. Only about 0.024% of the water on earth is readily available; the rest is too salty, frozen, or too far underground to reach (*Living in the Environment*, 16th ed., page 315 / 17th ed., page 319).
53. ANSWER: D. The goals of the Resource Conservation and Recovery Act (RCRA) include preventing the unsafe disposal of hazardous wastes on land. The act requires the cradle-to-grave monitoring of hazardous materials, and does not regulate

radioactive materials (*Living in the Environment*, 16th ed., page 582 / 17th ed., page 578).

54. **ANSWER: C.** The dependent variable is the variable that is measured during the experiment. In this case the dependent variable is the corn yield (*Living in the Environment*, 16th ed., not included / 17th ed., not included).
55. **ANSWER: A.** In this situation the loss of the fig trees will lead to the population crash or extinction of numerous species, which defines it as a keystone species (*Living in the Environment*, 16th ed., pages 95–96 / 17th ed., page 99).
56. **ANSWER: A.** The euphotic zone is the upper layer of an aquatic ecosystem through which sunlight can penetrate and where photosynthesis takes place (*Living in the Environment*, 16th ed., page 170 / 17th ed., page 172).
57. **ANSWER: A.** 3 ppm is equivalent to 3,000 ppb (1 ppm = 1,000 ppb = 1,000,000 ppt) (*Living in the Environment*, 16th ed., page G12 / 17th ed., page G11).
58. **ANSWER: C.** Walking to school rather than driving will decrease the use of fossil fuel energy and lower one's ecological footprint (*Living in the Environment*, 16th ed., page 14 / 17th ed., pages 15–16).
59. **ANSWER: D.** Issuing fishing licenses is a way of limiting access to a shared resource, or commons, in an attempt to limit the annual harvest of fish and maintain a sustainable population (*Living in the Environment*, 16th ed., page 13 / 17th ed., page 15).
60. **ANSWER: D.** The sequence fixation, nitrification, assimilation, and ammonification is a feasible sequence. Denitrification does not immediately follow assimilation, and transpiration and respiration are not steps in the nitrogen cycle (*Living in the Environment*, 16th ed., page 69 / 17th ed., pages 71–72).
61. **ANSWER: C.** Photosynthesis emits oxygen, which is not a greenhouse gas; all of the other options release greenhouse gases (*Living in the Environment*, 16th ed., page 59 / 17th ed., page 59).
62. **ANSWER: C.** A large amount of energy is required to desalinate water. The countries in the Middle East have the largest reserves of fossil fuels in the world, and are equipped to essentially trade oil for water by building and operating desalination plants (*Living in the Environment*, 16th ed., pages 332–333 / 17th ed., page 333).
63. **ANSWER: D.** Lead concentration in air has fallen dramatically since lead additives were completely banned from gasoline in 1986. The 1990 Clean Air Act reduced the release of SO₂ and NO₂ but neither has been reduced as effectively as lead (*Living in the Environment*, 16th ed., page 474 / 17th ed., page 472).
64. **ANSWER: B.** Individuals tend to underestimate risk when they feel that they have a large degree of control during the activity; for example, driving an automobile is a high-risk activity (40,000 deaths annually in the United States) that most people think is relatively safe. On the other hand, most people tend to overestimate risk when it gets a large amount of publicity as it does during extensive media coverage or during a political campaign. For example, flying commercial airlines may be perceived as a high-risk activity soon after an accident when it receives extensive media coverage, and the health risk of drinking tap water might be overestimated by individuals during a political campaign in which the candidates disagree on the water quality of the city's water supply (*Living in the Environment*, 16th ed., page 464 / 17th ed., page 461).

65. ANSWER: B. A lack of educational opportunities for women is a strong indicator for rapid population growth (*Living in the Environment*, 16th ed., page 135 / 17th ed., page 132).
66. ANSWER: B. Tuberculosis is transmitted through the air. All the other options are transmitted through untreated water supplies (*Living in the Environment*, 16th ed., page 442 / 17th ed., pages 439–441).
67. ANSWER: A. Begin by extending the clay line horizontally to the right from 15% to meet the silt line coming down from 43% and the sand line coming up from 42%. They meet in the center of the loam region of the triangle (*Living in the Environment*, 16th ed., not included / 17th ed., not included).
68. ANSWER: A. The Ogallala Aquifer is the world's largest aquifer. It lies beneath parts of the U.S. states of South Dakota, Wyoming, Colorado, Nebraska, Kansas, Oklahoma, New Mexico, and Texas (*Living in the Environment*, 16th ed., page 323 / 17th ed., page 326).
69. ANSWER: D. Japan, Iceland, and Norway kill about 1,000 whales each year for scientific purposes, a rationale that critics believe is simply a commercial whaling operation (*Living in the Environment*, 16th ed., page 258 / 17th ed., pages 250, 261).
70. ANSWER: E. Kilowatt-hours and kilocalories are units of energy while the megawatt is a unit of power (*Living in the Environment*, 16th ed., page S2 / 17th ed., page S2).
71. ANSWER: B. Most of the world's freshwater is frozen, but the second largest storage reservoir, and by far the largest on the list, is groundwater (*Living in the Environment*, 16th ed., not included / 17th ed., page 320).
72. ANSWER: E. Sick-building syndrome occurs when living organisms (bacteria, viruses, pollen, dust mites, mildew, mold, and yeast) circulate through a building in the heating, ventilation, and air conditioning systems, making the occupants sick (*Living in the Environment*, 16th ed., pages 484–485 / 17th ed., pages 482–483).
73. ANSWER: C. The littoral zone is the area of a freshwater lake near the shore where most of the plant life grows. There are also high nutrient levels because of runoff from the adjacent land areas (*Living in the Environment*, 16th ed., page 174 / 17th ed., page 181).
74. ANSWER: A. NIMBY (Not In My Back Yard) is a commonly used rallying cry in communities trying to dissuade developers from building near their homes (*Living in the Environment*, 16th ed., page 583 / 17th ed., page 579).
75. ANSWER: D. The National Environmental Policy Act was passed by Congress in 1969 and enacted in 1970. It requires developers to study the environmental impact of projects funded by the federal government and to produce an environmental impact report that describes the results (*Living in the Environment*, 16th ed., pages 646–647 / 17th ed., page 650).
76. ANSWER: E. Requiring electronics manufacturers to take back their products for recycling will build the costs of recycling into the price of a product (also known as a cradle-to-grave approach) (*Living in the Environment*, 16th ed., page 560 / 17th ed., page 557).
77. ANSWER: D. The activity of a radioisotope decays by a factor of 1/2 after one half-life. In order to reduce the activity of a sample from 1 mCi to 1 μ Ci (a factor of 1/1000), one must wait for about ten half-lives ($2^{10} = 1024$). Thus, 80 days or almost 3 months is required (*Living in the Environment*, 16th ed., not included / 17th ed., not included).

78. **ANSWER: D.** Peat is a highly polluting energy source that produces higher quantities of air pollutants per unit of fuel than the coal that it would eventually form if heated under pressure in the earth's crust for millions of years. It is formed in bogs where, despite its hazardous air pollution, it is still used as fuel, often illegally (*Living in the Environment*, 16th ed., page 383 / 17th ed., page 382).
79. **ANSWER: D.** Many types of shellfish including oysters are commonly cultivated in aquaculture (the fish species listed are all large predatory fish that are not farmed) (*Living in the Environment*, 16th ed., page 285 / 17th ed., pages 287–288).
80. **ANSWER: B.** Estimating the extent to the left (the male side) of the right-hand age-structure diagram (developed countries) for the first four age groups, it appears that added together they would extend to approximately the 100-million mark (*Living in the Environment*, 16th ed., pages 130–131 / 17th ed., pages 135–136).
81. **ANSWER: D.** Estimating the extent to the right (the female side) of the left-hand age-structure diagram (developing countries) for the seven age groups, it appears that they average slightly less than 200 million (3 7), which makes the total population estimate approximately 1300 million, or 1.3 billion (*Living in the Environment*, 16th ed., pages 130–131 / 17th ed., pages 135–136).
82. **ANSWER: C.** The growth rate of populations cannot be determined using an age structure diagram. It can only be inferred (fast growth, slow growth, negative growth, etc.) (*Living in the Environment*, 16th ed., pages 130–131 / 17th ed., pages 135–136).
83. **ANSWER: E.** Forests do not construct roads; all of the other options are ecosystem services provided by forests (*Living in the Environment*, 16th ed., pages 217–218 / 17th ed., pages 220–221).
84. **ANSWER: D.** The results show that when nitrate is added to the seawater, algae growth accelerates (A and B), and when phosphate is added (A and C) it accelerates in one case (A) and does not change in one case (C). The conclusion supported by this data is that nitrate is a limiting agent for algae growth in seawater (*Living in the Environment*, 16th ed., not included / 17th ed., not included).
85. **ANSWER: A.** The A horizon is also known as topsoil. It is composed of mineral-containing weathered parent material and humus (*Living in the Environment*, 16th ed., page 281 / 17th ed., page 284).
86. **ANSWER: D.** Energy transfer through food chains typically has an efficiency of only about 10% because of energy that is converted to waste heat, a consequence of the second law of thermodynamics (*Living in the Environment*, 16th ed., page 62 / 17th ed., pages 64–65).
87. **ANSWER: A.** Cap and trade programs place a cap or limit on the total amount of a pollutant that may be emitted. Polluters are then either given or allowed to purchase credits that allow them to emit a given quantity of the pollutant. If a polluter does not need all of its credits, it may trade (sell) them to another polluter who has come up short. By lowering the cap each year, governments can decrease the total amount of the pollutant that is emitted (*Living in the Environment*, 16th ed., page 490 / 17th ed., pages 516–517).
88. **ANSWER: D.** Coal mining by mountaintop removal is practiced in West Virginia, Virginia, Tennessee, Kentucky, and Pennsylvania (*Living in the Environment*, 16th ed., page 358 / 17th ed., page 357).

89. ANSWER: A. During the refining of crude oil, heat is applied and the components of the oil are distilled off one by one. The first components to distill off are those with the lowest boiling points. Compounds like propane that are gases at room temperature are the first to boil away (*Living in the Environment*, 16th ed., page 375 / 17th ed., pages 374–375).
90. ANSWER: C. Canada has 75% of the world's oil sand resources in northeastern Alberta. The mining of oil sands requires a surface mining operation and results in corresponding environmental damage (*Living in the Environment*, 16th ed., page 379 / 17th ed., page 378).
91. ANSWER: C. Mercury pollution that was converted to methylmercury caused a large number of birth defects in the population of Minamata, Japan. The crude oil spill of the tanker Exxon Valdez into Prince William Sound off the coast of Valdez, Alaska, devastated an ecosystem. The leak of methyl isocyanate from a Union Carbide pesticide plant in Bhopal, India, killed thousands of people and injured tens of thousands overnight (*Living in the Environment*, 16th ed., page S37 / 17th ed., not included).
92. ANSWER: A. Mitigation allows the destruction of a wetland if an equal area of the same type of wetland is created (*Living in the Environment*, 16th ed., page 266 / 17th ed., page 268).
93. ANSWER: C. The succession of a lake will result in a flat meadow, usually with a slow-moving stream meandering through it (*Living in the Environment*, 16th ed., not included / 17th ed., not included).
94. ANSWER: D. Setting small contained surface fires, also called prescribed burns, can help to clear away accumulated underbrush and small trees in an attempt to avoid fueling a devastating crown fire (*Living in the Environment*, 16th ed., page 228 / 17th ed., page 231).
95. ANSWER: A. Mercury vapor is the result of burning fuel containing mercury. The only burning that may occur at a sanitary landfill is that of methane, produced during anaerobic respiration, for electricity production (*Living in the Environment*, 16th ed., pages 575–576 / 17th ed., pages 570–572).
96. ANSWER: E. Both methods have been proposed to sequester carbon along with pumping into underground caverns and abandoned mines (*Living in the Environment*, 16th ed., page 516 / 17th ed., pages 513–514).
97. ANSWER: D. This is a depiction of the oxygen-sag curve that typically results when a river flows past a point source of organic waste (*Living in the Environment*, 16th ed., page 536 / 17th ed., page 534).
98. ANSWER: B. The source of the organic waste is point "B" along the river. Following the addition of the organic waste, the dissolved oxygen levels fall dramatically and the biological oxygen demand rises rapidly (*Living in the Environment*, 16th ed., page 536 / 17th ed., page 534).
99. ANSWER: E. The points labeled "A" and "E" are in areas referred to as the clean zone, where normal levels of dissolved oxygen allow the native aquatic ecosystem to exist (*Living in the Environment*, 16th ed., page 536 / 17th ed., page 534).
100. ANSWER: C. The ozone thinning that is sometimes called a "hole" is worsened following the Antarctic winter when polar stratospheric clouds form and allow the ozone-destroying chain reactions to proceed virtually unchecked. Once the sun sufficiently warms the air above Antarctica, the polar stratospheric clouds break up

and ozone depletion slows down to its normal pace (*Living in the Environment*, 16th ed., page 523 / 17th ed., page 521).

SCORING GUIDELINES FOR FREE-RESPONSE QUESTIONS

1.

- (a) The ad makes reference to the golden toads of Monteverde. Explain why this reference is made.

1 point can be earned—Golden toads are extinct

- (b) A large share of the world's ecotourism takes place in developing countries. Describe TWO ways in which ecotourism can help reduce poverty in these countries.

2 points can be earned—1 point for each poverty reduction method with a description

Method	Description
Job creation	Construction jobs building infrastructure Jobs as guides Service industry jobs
Income to provide children with a nutritious diet	Money from jobs can provide a nutritious diet for families.
Income to provide adequate shelter for children	Money from jobs can provide shelter for families.
Revenue to provide clean water	Clean water needed to attract tourists is made available to locals.
Improved health care	Adequate health care needed to treat tourists in emergencies is made available to locals.
Revenue to build schools	State tourism tax revenue can be used to build schools.

- (c) Discuss the conflict between people living in poverty and efforts to conserve biodiversity.

2 points can be earned—1 point for each item discussed

- Bushmeat is harvested for food.
- Habitat is slashed and burned for subsistence agriculture.
- Fuelwood may be gathered unsustainably.
- Illegal hunting (poaching) is practiced to earn money.
- Marginal land is used as pasture or placed under cultivation increasing desertification.

- (d) Other than those listed above, identify a specific endangered species that people might be willing to pay to visit and the location of the species' native habitat.

2 points can be earned—1 point for identifying a species and 1 point for the location of its habitat

For example:

- African lion in Kenya
- Nene in Hawaii

Many other possibilities – *must be on an endangered species list*

- (e) The ad touts the use of biodiesel fuel made from palm oil. Explain why this advertising tactic might have been a mistake.

2 points can be earned—1 point for each item in the explanation

- Palm oil is grown unsustainably.
 - Palm oil is grown on plantations in tropical rain forests.
 - Tropical forests are cleared to create palm oil plantations.
 - Loss of tropical rain forest eliminates it as a carbon storage reservoir.
 - Loss of tropical rain forest eliminates habitat and results in a loss of biodiversity.
- (f) Roundtrip airline travel from the central United States to central Africa will generate about 3 metric tons (3000 kg) of carbon dioxide, and a trip to Southeast Asia will generate about 4 metric tons (4000 kg). Discuss the conflict that this brings about with the ideals of ecotourism.

2 points can be earned—1 point for an item on each side of the conflict

Ideal	Conflict
Ecotourists value biodiversity	CO ₂ causes global warming/climate change which destroys habitat which causes extinction
Ecotourists value nature for aesthetic reasons	CO ₂ causes global warming/climate change which destroys habitat which causes extinction
Ecotourists choose to support the local people	Without air travel, ecotourists cannot visit, and poverty may return

2. (a) Determine the total number of observable droppings in the park for each deer at any time.

1 point can be earned for a correct setup with the correct answer

$$\frac{30 \text{ droppings}}{\text{deer per day}} \times 40 \text{ days} = 1200 \frac{\text{droppings}}{\text{deer}}$$

Units are not required because they are implicit in the prompt.

- (b) Determine the number of deer in the park per hectare.

2 points can be earned—1 point for a correct set up that includes units and 1 point for the correct answer

Area of each quadrat 5 m 3 10 m 5 100 m²

$$\frac{24 \text{ droppings}}{1 \text{ quadrat}} \times \frac{1 \text{ quadrat}}{100 \text{ m}^2} \times \frac{1 \times 10^4 \text{ m}^2}{1 \text{ ha}} \times \frac{1 \text{ deer}}{1200 \text{ droppings}} = 2 \frac{\text{deer}}{\text{ha}}$$

Units are not required on the final answer because they are implicit in the prompt.

- (c) Determine the total number of deer in the park.

1 point can be earned for a correct setup with the correct answer

$$\frac{2 \text{ deer}}{\text{ha}} \times \frac{500 \text{ ha}}{\text{park}} = 1000 \frac{\text{deer}}{\text{park}}$$

- (d) Dr. Beverly's report on the deer population prompts the state park service to issue hunting licenses. Determine the number of hunting licenses that should be issued and explain the rationale for issuing that number of licenses.

3 points can be earned—1 point for a value between 200 and 600, 1 point for calculating the maximum sustainable yield (MSY), and 1 point for an acceptable rationale)

$$\text{MSY} = \frac{\text{Carrying Capacity}}{2} = \frac{800}{2} = 400 \text{ (1 point)}$$

RATIONALE

- With a current population of 1000, issuing 600 licenses will reduce the population to the MSY of 400.
 - A number less than 600 but greater than 200 is acceptable, with acknowledgment of the MSY, and a rationale that the carrying capacity may be overestimated.
 - Issuing a number of licenses that will bring the deer population below 800 will allow the population to remain healthy.
- (e) Describe another way to control the deer population.
- 1 point can be earned** for a description
- Introduce a predator.
 - Trap and relocate deer.
 - Allow the deer to continue on their natural boom and bust population cycle.
- (f) Identify and describe another method to estimate the population size of the deer.
- 2 points can be earned**—1 point for a correct method and 1 point for a correct description

Method	Description
Tag, release, and recapture	Capture, tag, release, and recapture individuals. Estimate the population size based on the rate at which tagged individuals are recaptured.
Sampling	Count the number of individuals in a given area and extrapolate to the entire area. Aerial photography could be used.
Use a different field sign (tracks, feeding signs, remains, etc.)	Use the quadrat sampling method with a different field sign.
Transect Survey	Walk a transect line and count all the individuals seen; extrapolate out to the entire area.

3. (a) Identify and describe the series of energy transformations (conversions) that are used to generate electricity in a hydroelectric power plant.

4 points can be earned—1 point for each correct energy transformation with a correct description

Energy Transformation	Description
Potential energy to kinetic energy	Water flows out of an elevated reservoir (downhill), converting potential energy to kinetic energy.
Kinetic energy of water to kinetic energy of a turbine	The kinetic energy of the water is used to push a turbine, transferring kinetic energy from the water to the turbine.
Kinetic energy to electrical energy	The kinetic energy of the turbine (water is acceptable if the previous transformation was missed) is converted to electricity through a generator connected to the rotating shaft of the turbine (electric potential energy).
Potential and/or kinetic energy to heat	Potential energy and kinetic energy are both converted to heat (waste heat) at each step.

- (b) Explain why the energy provided by existing hydropower dams is virtually free.

1 point can be earned for a correct explanation

- The global water cycle returns water to the elevated reservoir (returns its potential energy) at no cost.
- The ecosystem service is provided by the sun that evaporates the water and returns it to the reservoir.
- No fuel purchases are required.

(Similar explanations are acceptable, but they must include the free return of water to the reservoir by nature.)

- (c) Identify ONE species whose numbers have diminished as the result of a hydropower project and describe how the project led to the decline in their population.

2 points can be earned—1 point for a the identification of a correct species and 1 point for a correct description

Species	Description
Salmon	Migration route is blocked by dams.
Baiai (River) Dolphin	Habitat fragmentation limits food supply.
River Sturgeon	Changes in water temperature, habitat fragmentation.
Steelhead	Migration route blocked by the dam.

- (d) Identify ONE infectious disease that could spread more rapidly among people as a result of a hydropower project and explain how the project could lead to an increase in the spread of the disease.

2 points can be earned—1 point for a correct disease and 1 point for a correct explanation

CORRECT DISEASES

- Typhoid fever
- Cholera
- Dysentery
- Hepatitis B
- Giardiasis
- Cryptosporidium
- Schistosomiasis

EXPLANATION

- The reservoir stops the flow of water and keeps the river from flushing pathogens downstream.
 - Reservoirs have stratified layers and the water does not mix well.
- (e) Hydroelectric dams have a limited lifetime. Identify and describe two natural processes that could lead to the end of the effective lifetime of a hydroelectric dam.

2 points can be earned—1 point for each process with a correct description

Silting – Silt accumulates behind the dam eventually filling the dam.

Flooding – A catastrophic flood could cause the dam to fail.

Earthquake – A massive earthquake could cause the dam to fail.

4. (a) Unsustainable commercial fishing practices for wild species receive much of the blame for the depletion of the world's fisheries. Identify and describe ONE commercial fishing practice that is used to catch wild species and ONE negative environmental consequence of that practice.

3 points can be earned—1 point for a correct identification of a practice, 1 point for a correct description, and 1 point for a correct consequence

Practice	Description	Consequence
Long-line fishing	Miles of fishing line with thousands of baited hooks are let out behind ships and then hauled aboard with their catch.	Bycatch includes turtles, dolphins and other threatened or endangered species. Lines break and continue hooking and killing fish for years.
Drift netting	Huge drifting nets tens of miles long are let out behind a ship and then hauled aboard with their catch.	Bycatch includes turtles, dolphins, sea birds and threatened or endangered species. Nets break loose or are lost and continue catching and killing fish for years.

Practice	Description	Consequence
Purse-seine fishing	A huge net is used to encircle a school of fish and the net is cinched closed like a giant purse capturing everything inside.	Bycatch includes large numbers of dolphins that are actively feeding on the school of fish when it was caught. Nets break loose or are lost and continue catching and killing fish for years.
Trawler fishing or bottom trawling	Huge weighted nets shaped like bags are dragged across the ocean floor to scoop up bottom-dwelling fish and shellfish.	Destruction of most species on the ocean floor including coral reefs. Bycatch includes everything that was on the ocean floor including juvenile fish and shellfish and threatened or endangered bottom-dwelling species.

(b) Identify and describe TWO negative environmental consequences of fish farming.

2 points can be earned—1 point for each consequence

- Excess food enriches nutrient levels in coastal areas, leading to eutrophication/hypoxia.
- Fish wastes enrich nutrient levels in coastal areas, leading to eutrophication/hypoxia.
- The farming of carnivorous species requires fishing for large numbers of prey species as feed.
- Habitat destruction of coastal areas to create fish farms.
- Escaped farmed fish contaminate the genetic diversity of wild species.
- Diseases in farm stock passed to wild species.
- Escape of non-native species occurs when they are farmed outside their native habitat.

(c) Discuss the effect that an El Niño-Southern Oscillation event can have on fisheries.

2 points can be earned—1 point for each item discussed

- The upwelling of nutrient-rich water is stopped.
- Primary productivity is reduced.
- The base of the aquatic food web is diminished.
- Fish species that depend on phytoplankton in these regions decline dramatically.
- Eastern Pacific/west coast of South America is most affected.

(d) Some of the world's fish have high concentrations of mercury in their flesh.

3 points can be earned—1 point can be earned in [i] for a correct source and 2 points can be earned in [ii] for a correct explanation

(i) Identify a major source of the mercury.

1 point can be earned for a correct source

- Emissions from coal-burning power plants
- Emissions from incinerators
- Emissions from volcanoes and other natural sources

(ii) Explain why the concentration of mercury differs from species to species.

2 points can be earned for a correct explanation

- Mercury accumulates or bioaccumulates in tissues throughout the life of an organism; therefore, long-lived species will have higher mercury concentrations as they get older.
- Mercury magnifies or biomagnified in food chains, so organisms feeding at lower trophic levels will have less mercury in their tissues.
- In aquatic ecosystems, mercury can be converted to methylmercury, which is a potent teratogen and very hazardous.
- Species that live in water or eat fish are subject to higher concentrations of mercury.
- Predatory fish and birds have especially high levels of mercury in their tissues.
- Species in the Arctic have especially high levels (polar bears, seals, and toothed [carnivorous] whales).

CALCULATING YOUR SCORE

This scoring worksheet is based on the 2008 AP Environmental Science released exam. While the AP grade conversion chart is NOT the same for each testing year, it gives you an approximate breakdown.

SECTION 1: MULTIPLE CHOICE

$$\frac{\text{Number Correct (out of 100)}}{\text{Number Correct (out of 100)}} \times 0.90 = \frac{\text{Weighted Section I Score}}{\text{Weighted Section I Score}}$$

SECTION II: FREE RESPONSE

$$\text{Document-Based Question} \frac{\text{Score (out of 10)}}{\text{Score (out of 10)}} \times 1.50 = \frac{\text{Weighted Section II Score}}{\text{Weighted Section II Score}} \text{ (Do not round)}$$

$$\text{Data-Set Question} \frac{\text{Score (out of 10)}}{\text{Score (out of 10)}} \times 1.50 = \frac{\text{Weighted Section II Score}}{\text{Weighted Section II Score}} \text{ (Do not round)}$$

$$\text{Synthesis \& Evaluation Question} \frac{\text{Score (out of 10)}}{\text{Score (out of 10)}} \times 1.50 = \frac{\text{Weighted Section II Score}}{\text{Weighted Section II Score}} \text{ (Do not round)}$$

$$\text{Synthesis \& Evaluation Question} \frac{\text{Score (out of 10)}}{\text{Score (out of 10)}} \times 1.50 = \frac{\text{Weighted Section II Score}}{\text{Weighted Section II Score}} \text{ (Do not round)}$$

$$\text{Sum} = \frac{\text{Weighted Section I Score} + \text{Weighted Section II Score}}{\text{Weighted Section I Score} + \text{Weighted Section II Score}}$$

COMPOSITE SCORE

$$\frac{\text{Weighted Section I Score}}{\text{Weighted Section I Score}} + \frac{\text{Weighted Section II Score}}{\text{Weighted Section II Score}} = \frac{\text{Composite Score}}{\text{Composite Score}}$$

AP GRADE CONVERSION CHART

Composite Score Range	AP Grade
107–150	5
87–106	4
75–86	3
62–74	2
0–61	1