

Practice Exam 3

Remove this sheet and use it to mark your answers for the multiple-choice section of Practice Exam 3.

Section I

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

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Section II

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Section I: Multiple-Choice Questions

Time: 90 minutes

100 questions

Directions: Each of the questions or incomplete statements in this section is followed by five answer choices. Select the best answer choice and fill in the corresponding circle on the answer sheet.

Questions 1–3 refer to the following answer choices.

- A. Active volcano
- B. Cinder cone volcano
- C. Dormant volcano
- D. Extinct volcano
- E. Shield volcano

1. A volcano that is considered inactive.
2. A slowly erupting volcano with a broad base.
3. A volcano with a large amount of seismic and thermal activity.
4. Using manual labor, animal labor, and simple tools to grow crops is known as:
 - A. Agriculture
 - B. Conventional agriculture
 - C. Industrialized agriculture
 - D. Subsistence agriculture
 - E. Traditional agriculture
5. The Green Revolution of the 20th century is best characterized by which of the following:
 - I. Development of high-yield crops
 - II. Wide use of pesticides
 - III. Augmentation of an irrigation infrastructure
 - A. I only
 - B. II only
 - C. III only
 - D. I and II only
 - E. I, II, and III

6. Ozone can be beneficial or it can be a pollutant. What is the function of beneficial ozone?

- A. To act as a barrier for heat in the troposphere
- B. To block ultraviolet radiation in the mesopause
- C. To help hold in heat in the thermosphere
- D. To filter ultraviolet radiation in the stratosphere
- E. To filter ultraviolet radiation in the troposphere

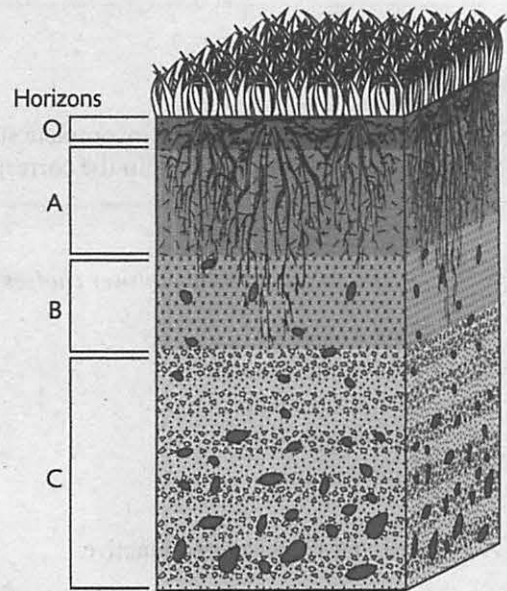
Questions 7–9 refer to the following information.

A CFL bulb using 25 watts of energy is expected to last 10,000 hours. The 100-watt incandescent bulb is expected to last 1,000 hours. Assume electricity costs 10¢/kWh.

7. How much will it cost to operate the CFL over its expected lifetime?
 - A. \$25
 - B. \$250
 - C. \$2,500
 - D. \$25,000
 - E. \$250,000
8. How much will it cost to operate the incandescent bulb over its expected lifetime?
 - A. \$1
 - B. \$10
 - C. \$100
 - D. \$1,000
 - E. \$10,000

9. What is the expected savings in operating costs between the CFL and the incandescent bulb over the expected life of the CFL bulb?
- The incandescent bulb will save \$15 over the CFL bulb.
 - The CFL bulb will save \$15 over the incandescent bulb.
 - The incandescent bulb will save \$75 over the CFL bulb.
 - The CFL bulb will save \$75 over the incandescent bulb.
 - The cost will be the same.
10. The type of treatment for sewage coming from a house is dependent upon the location of the house and its access to a municipal treatment system. If a house in the United States is located far from a treatment system, what form of sewage treatment would it most likely have?
- Primary treatment
 - Secondary treatment
 - Tertiary treatment
 - Septic system
 - No treatment
11. All the following are considered forms of noise pollution EXCEPT:
- Airports
 - Freeways/highways
 - Rock concerts
 - Telephones
 - Lawnmowers
12. Which type of plate boundary is the mid-Atlantic ridge?
- Subduction zone
 - Convergent plate boundary
 - Divergent plate boundary
 - Transform plate boundary
 - Thrust fault

Questions 13–14 refer to the following diagram.



Source: Natural Resources Conservation Service, U.S. Department of Agriculture

13. Which of the following ecosystems best characterizes a thick O horizon?
- Chaparral
 - Desert
 - Grassland
 - Semi-desert
 - Tropical rain forest
14. Parent material is best defined as:
- Loose and partly decayed organic material
 - Bedrock material
 - A light-colored zone of leaching
 - An accumulation of clay and rock
 - Mineral matter mixed with humus
15. Grasslands found in the United States are commonly referred to as:
- Llanos
 - Pampas
 - Prairie
 - Steppes
 - Veld

16. Which of the following is the greatest overall threat to the survival of terrestrial species?

- A. Habitat loss
- B. Resource extraction
- C. Introduction of nonnative species
- D. Overgrazing
- E. Pollution

17. Which of the following is the greatest overall threat to the survival of aquatic species?

- A. Acidification of the water
- B. Global climate change
- C. Habitat loss
- D. Overharvesting
- E. Pollution

18. Every ten years, the United States conducts a census that is the actual count of the population at the given date. All the following are reasons for conducting the census EXCEPT:

- A. To allocate federal funds
- B. To distribute subsidies given to agriculture, mining, forestry, and other businesses
- C. To redistribute the federal House of Representatives
- D. To abide by the U.S. Constitution
- E. To redistrict in states for local, state, and federal elections for elected government officials

19. Which of the following is an argument against genetically modified foods?

- I. Unknown long-term effects on human health
 - II. Built-in resistance to pests
 - III. Destruction of native food sources
- A. I only
 - B. II only
 - C. III only
 - D. I and II only
 - E. I and III only

20. Which method of tree harvesting causes the most damage to an ecosystem?

- A. Strip cutting
- B. Shelter wood harvesting
- C. Selective harvesting
- D. Seed tree harvesting
- E. Clear cutting

Questions 21–23 refer to the following answer choices.

- A. Love Canal
- B. Union Carbide Chemical Co., Bhopal
- C. Cuyahoga River
- D. Lake Erie
- E. Exxon Valdez

21. In upstate New York, chemicals were buried underground. Eventually, the land was sold to a school and houses were built in the area.

22. High concentrations of phosphates, nitrates, and other chemicals from heavy industry led to eutrophication and large fish die-offs.

23. Heavy oil, trash, debris, and other floating chemicals caught fire in 1969. This incident was covered in *Time* magazine.

24. Which of the following best explains why CAFE standards were created?

- A. To establish minimum standards for car mileage per gallon of fuel for all manufactured vehicles
- B. To establish minimum standards for the percentage of a population using public transportation (such as buses and light rail)
- C. To establish minimum standards for car mileage per gallon of fuel only
- D. To establish minimum standards for average fuel usage per weight of cargo for the transportation of goods via large trucks and trains
- E. To establish minimum standards for fuel usage per passenger in air travel

25. Which of the following is considered mainly an indoor air pollutant?
- Carbon dioxide
 - Carbon monoxide
 - Formaldehyde
 - Nitrous oxide
 - Sulfur dioxide
26. *Genetic pollution* is a relatively new term and refers to which of the following?
- The cross-contamination of plant genes into animals
 - Research involving genetically modified organisms in which genes from an animal are crossed with that of an unrelated animal species
 - The cross of genetically modified organisms with other species in a research facility
 - The unintended spread of genes from genetically modified organisms to natural organisms
 - Research involving genetically modified organisms in which genes from a plant are crossed with that of an unrelated plant species
27. Which of the following set of reactions shows the depletion of ozone by chlorofluorocarbons (CFCs)?
- $O_2 + UVC \rightarrow O + O$
 $O + O_2 \rightarrow O_3$
 - $CFC + UV \text{ radiation} \rightarrow CFC + Cl$
 $Cl + O_3 \rightarrow ClO + O_2$
 $ClO + O_3 \rightarrow Cl + 2 O_2$
 - $CO_2 + H_2O + \text{energy} \rightarrow C_6H_{12}O_6 + O_2$
 - $C_6H_{12}O_6 + O_2 \rightarrow CO_2 + H_2O + \text{energy}$
 - $NH_3 + H_2O \rightarrow NO_3^- + H^+$
 $NO_3^- + H^+ \rightarrow N_2O + N_2$
28. In a food chain where krill consumes phytoplankton, penguins and squid consume krill, and orcas consume penguins, which of these organisms is considered the producer?
- Krill
 - Orca
 - Phytoplankton
 - Squid
 - Penguin
29. Which of the following sets of species includes only K-selected species?
- Humans, red ants, and elephants
 - Blue whales, giraffes, and mosquitoes
 - California gray whales, banana slugs, and redwoods
 - Giant sequoias, California condors, and humans
 - Bumble bees, lions, and white rhinoceroses
30. Which of the following best describes how coal is formed?
- Tiny aquatic plants and animals die and sink to the ocean floor, where they are covered in mud and silt. In an anaerobic reaction over time, pressure compresses out the liquid and leaves behind carbon to form short carbon chains.
 - The remains of plants from crops are pressed to remove the liquid and are then heated at high temperatures until coal is formed.
 - Vegetation dies and is covered in mud in an anaerobic environment. Over time, the pressure compresses out the liquid, leaving the carbon matter behind to form complex chains of carbon compounds.
 - Tiny aquatic plants and animals die and sink to the ocean floor, where they are covered in mud and silt. In an anaerobic reaction over time, pressure compresses out the liquid and leaves behind carbon to form long carbon chains.
 - Charcoal forms when wood is heated to high temperatures, causing thermal decomposition. A mixture of gases and water vapors escape, leaving the solid residue called charcoal.
31. All the following are consequences of global climate change EXCEPT:
- Melting of glaciers and polar ice caps
 - Rising sea levels
 - Alteration of worldwide precipitation patterns
 - Little or no impact on the human food supply
 - Increased global temperatures

32. Which of the following terms is used to describe a species that reflects the health of an ecosystem, such as lichen or amphibians?
- Keystone species
 - Indicator species
 - Foundation species
 - Specialist species
 - Generalist species
33. One of the biggest threats to rangeland is overgrazing of vegetation by livestock. All the following are consequences of overgrazing EXCEPT:
- Soil erosion
 - Soil compaction
 - Desertification
 - The proliferation of invasive species
 - An increase in native biodiversity

Question 34 refers to the following table.

Changes in Concentration of Greenhouse Gases

Greenhouse Gas	Preindustrial Levels (ppm)	Current Level (ppm)
Carbon dioxide	280	388
Methane	700	1,745
Nitric oxide	270	314
CFCs	0	533

34. The table shows dramatic increases in greenhouse-gas levels. Combustion of fossil fuels accounts for changes in CO_2 and NO levels. The increasing populations of cattle and other animals for human consumption accounts for the increase in CH_4 . What accounts for the change in CFCs?
- CFCs were not used prior to the Industrial Revolution.
 - CFCs were discovered and manufactured starting in the 1930s.
 - CFCs are a secondary air pollutant, and levels were not significant until concentrations of primary air pollutants were high.
 - CFCs were in the atmosphere prior to the Industrial Revolution, but humans did not have the means to measure the gases until instruments were developed.
 - CFCs are released in the processing of uranium for use as a fuel in nuclear reactors and, therefore, were not produced until the 1950s, when reactors were first developed.
- Questions 35–38 refer to the following answer choices.
- Ammonification
 - Denitrification
 - Nitrification
 - Nitrogen fixation
 - Assimilation
35. NO_3^- is converted to N_2 .
36. NH_4^+ is converted into NO_2^- and then into NO_3^- .
37. Plants take up NH_3 and NH_4^+ .
38. N_2 is combined with H_2 to form NH_3 .
39. In the 1960s, several events occurred as a result of increasing water pollution levels, including the burning of the Cuyahoga River, fish die-offs in Lake Erie, and a crude oil spill off the coast of Santa Barbara, California. Which of the laws below is NOT related to aquatic environments or water quality?
- Safe Drinking Water Act
 - Federal Water Pollution Control Act
 - Ocean Dumping Act
 - Waste Water Reduction Act
 - Clean Water Act

Question 40 refers to the following table.

Power Production in the Top Five Nuclear-Power-Producing Countries	
Country	Megawatt Capacity
United States	100,000
France	63,000
Japan	46,000
Russia	22,000
Germany	20,000
World	370,000

40. Approximately what percent of the world's total nuclear power is produced by the top five nuclear power-producing nations?
- 25
 - 37
 - 55
 - 68
 - 75
41. Managing federal lands is very complex due to the vast ecosystems found in the United States, the physical size of the country, the historical usages of many land areas, the need for recreation, and the use of materials for the production of goods. Which of the following government organizations operates Yellowstone National Park, Gettysburg Battlefield, the Washington Monument, and the Appalachian Trail?
- National Forest Service
 - National Park Service
 - National Resource Lands
 - National Wilderness Preservation System
 - Bureau of Land Management
42. Which of the following best defines *sustainability*?
- The development of methods that use resources wisely
 - The ability to find alternative energy sources for most to the world's energy needs
 - The efforts to find methods to reduce poverty and the effects of poverty on the environment
 - The ability to maintain our current lifestyle and reduce our ecological footprint
 - The ability to meet the needs of the present human population without compromising the ability of future generations to meet their needs
43. Which of the following statements best describes carbon monoxide?
- Carbon monoxide is made up of small particles approximately 10 mm or less in size that can irritate the lungs.
 - At low concentrations, carbon monoxide can cause nausea, impaired vision, confusion, and fatigue.
 - When combined with water in the air, carbon monoxide produces an acid that will fall to the Earth as acid deposition.
 - At ground level, carbon monoxide is a pollutant; in the stratosphere, carbon monoxide blocks UV radiation.
 - Carbon monoxide was a major air pollutant until gasoline was reformulated.

44. Of the following forms of alternative energy, which currently contributes LEAST to the global energy supply?
- Biomass
 - Geothermal
 - Solar energy
 - Wave energy
 - Wind power
45. Which of the following forms of toxins targets the nervous system, affecting motor control and brain function?
- Allergen
 - Carcinogen
 - Mutagen
 - Neurotoxin
 - Teratogen
46. In many developing countries, chronic hunger is an ongoing problem, whereas in developed countries, most of the population has access to food. Which of the following is a major health concern facing the population of the United States?
- Smoking
 - Obesity
 - Lower life expectancy
 - Gang violence
 - High infant mortality

Questions 47–50 refer to the following answer choices.

- Dose
 - Dose-response
 - Persistence
 - Response
 - Toxin
47. The effect of a toxin or drug on an organism.
48. The concentration or amount of a substance experienced by an organism.
49. When a pollutant remains in the environment for a long period of time.
50. A substance that is poisonous to an organism.

51. In which stage of demographic transition do birth rates start to decline?
- Pre-industrial stage
 - Transitional stage
 - Industrial stage
 - Post-industrial stage
 - Urbanization
52. Where did the most severe nuclear accident occur in the United States?
- Chernobyl
 - Yucca Mountain
 - Shoreham
 - Three Mile Island
 - Love Canal
53. Which of the following energy sources produce the least emissions?
- Wind, biomass, and solar
 - Solar, hydroelectric, and wind
 - Wind, biomass, and nuclear
 - Nuclear, solar, and biomass
 - Solar, hydroelectric, and biomass
54. The United States consumes approximately what percentage of the world's oil?
- 10
 - 25
 - 50
 - 80
 - 95
55. Species that can survive in a variety of habitats with a range of resources are considered
- Generalists
 - K-selected
 - Specialists
 - r-selected
 - Survivors
56. Which of the following soil types is most effective at retaining water and nutrients at a neutral pH?
- Silt
 - Loam
 - Sand
 - Clay
 - Sandy clay

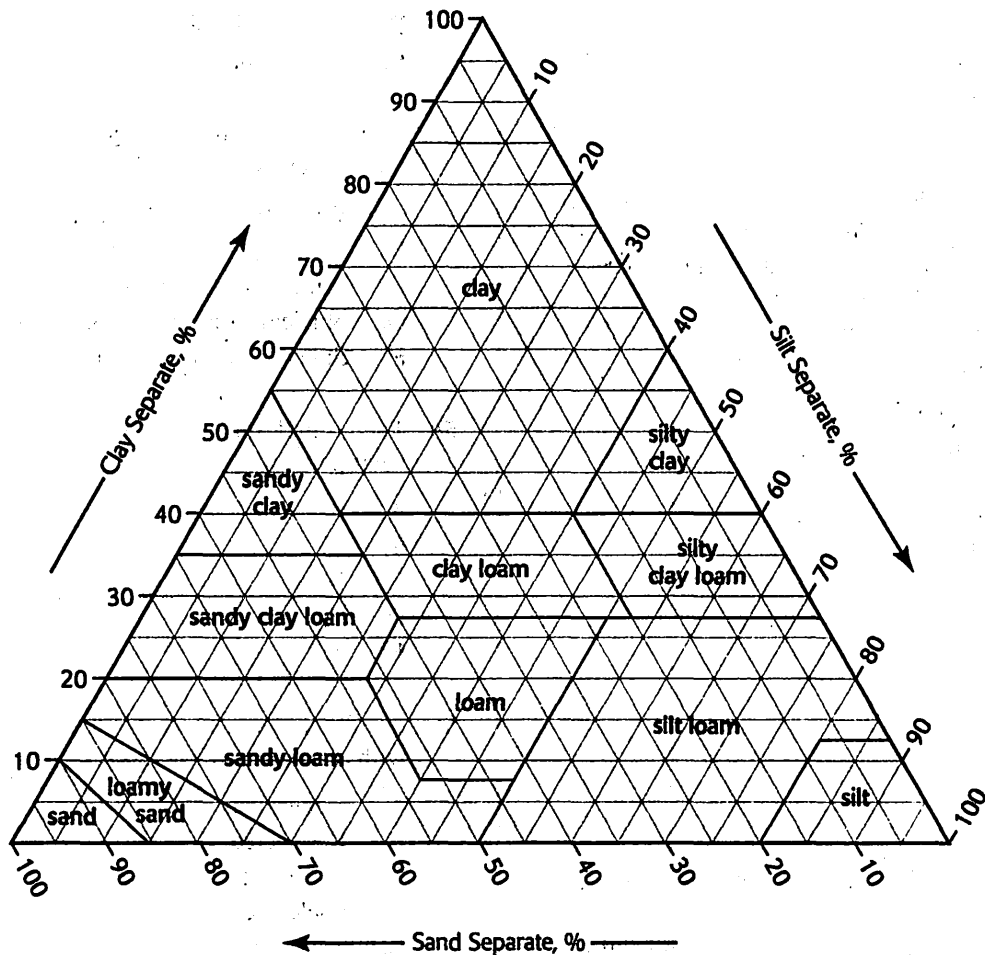
57. Many ocean fisheries are declining in numbers, but often fishing boats are still filling their hulls. How is this possible?

- A. Fishing in shallower depths
- B. Returning to harvesting using traditional methods without the use of technology
- C. Fishing over a longer period of time
- D. Using drift-netting more often
- E. Restocking the oceans with farm-raised fish

58. Which of the following biomes has the most fertile soil?

- A. Tropical rain forest
- B. Tundra
- C. Temperate deciduous forest
- D. Desert
- E. Savanna

Questions 59–60 refer to the following diagram.



Source: U.S. Department of Agriculture

59. Which of the following soil types best describes the soil if it has 30 percent clay and 70 percent sand?
- A. Sandy loam
 - B. Silty loam
 - C. Silty clay
 - D. Sandy clay
 - E. Sandy clay loam
60. Which of the following describes why sandy soils would not be the best soil type for plant growth?
- A. They would hold water and cause water-logging of the soil.
 - B. They would not retain water well.
 - C. They have excessive nutrient content.
 - D. They are excessively basic on the pH scale.
 - E. They are hard to work.
61. Which of the following are the most effective methods for long-term disposal of hazardous waste?
- A. Hazardous waste landfills
 - B. Injection wells
 - C. Surface impoundments
 - D. General landfills
 - E. Incineration
62. A savannah is characterized by:
- A. Minimal rainfall throughout the year
 - B. Large amounts of grasses and tall trees
 - C. Distinct rainy seasons, creating dramatic variations in annual rainfall
 - D. Consistent rainfall throughout the year
 - E. Dry soils
63. Which of the following is a result of overgrazing?
- A. A positive feedback loop where the soil becomes eroded but quickly recovers
 - B. A negative feedback loop where the soil becomes eroded and continues to deteriorate
 - C. A negative feedback loop where the soil becomes eroded but quickly recovers
 - D. A positive feedback loop that turns into a negative feedback loop
 - E. A positive feedback loop where the soil becomes eroded and continues to deteriorate
64. Why is the amount of deforestation higher in tropical rain forests compared to other forest types?
- A. The forests have more secondary growth trees.
 - B. Often, governments in the primarily developing countries that hold tropical rain forests sell the rights to their natural resources as a way of bringing additional money to the country.
 - C. The trees are mainly hardwood trees.
 - D. The forests are made up mainly of fast-growing trees.
 - E. It is more economical to harvest from tropical rain forests than from other types of forest.
65. How can water vapor become a problem in the Earth's atmosphere?
- A. Increasing water vapor in the atmosphere creates a positive feedback loop, intensifying the greenhouse affect.
 - B. Excess water vapor creates more intense storms.
 - C. Decreasing water vapor in the atmosphere creates a positive feedback loop, intensifying the greenhouse effect.
 - D. Increased water vapor can lead to an increase in other greenhouse gases.
 - E. Less water vapor increases cloud production.
66. Which element powers nuclear power plants?
- A. Radon
 - B. Thorium
 - C. Plutonium
 - D. Uranium
 - E. Radium
67. In the oceans, downwellings bring
- A. Oxygen-deprived water to deep waters
 - B. Nutrients to the benthic environment
 - C. Areas of high primary productivity
 - D. Nutrients to the surface
 - E. Oxygen for life in deep waters

68. Biomes are classified based on:
- A. Climate
 - B. Plant type and vegetation pattern
 - C. Temperature and precipitation
 - D. Location
 - E. Latitude
69. If the planet continues in the direction of accelerating climate change and warming, which of the following is a feasible consequence?
- A. Oceans freeze over.
 - B. Atmospheric circulation stops.
 - C. All vegetation dies.
 - D. There is a shift in the location of biomes.
 - E. The Earth's magnetic poles flip.

70. A family lives in a small house with the water heater close to the bedrooms. The heater has a leak. Which of the following might the family be exposed to, potentially leading to sickness or death?
- A. Carbon dioxide
 - B. Methane
 - C. Sulfur dioxide
 - D. Carbon monoxide
 - E. Nitrogen dioxide

Questions 71–72 refer to the following table.

U.S. Methane Emissions by Source (TgCO ₂ Equivalents)							
Source Category	1990	1995	2000	2005	2006	2007	2008
Enteric fermentation	132.4	143.7	136.8	136.7	139.0	141.2	140.8
Landfills	149.3	144.1	120.7	125.6	127.1	126.5	126.3
Natural gas systems	129.5	132.6	130.7	103.6	103.1	99.5	96.4
Coal mining	84.1	67.1	60.4	56.9	58.3	58.1	67.6
Manure management	29.3	33.9	38.6	42.2	42.3	45.9	45.0
Forest land remaining forest land	3.2	4.3	14.3	9.8	21.6	20.0	11.9
Petroleum systems	33.9	32.0	30.2	28.2	28.2	28.8	29.1
Wastewater treatment	23.5	24.8	25.2	24.3	24.5	24.4	24.3
Stationary combustion	7.4	7.1	6.6	6.6	6.2	6.5	6.7
Rice cultivation	7.1	7.6	7.5	6.8	5.9	6.2	7.2
Abandoned underground coal mines	6.0	8.2	7.4	5.6	5.5	5.7	5.9
Mobile combustion	4.7	4.3	3.4	2.5	2.4	2.2	2.0
Composting	0.3	0.7	1.3	1.6	1.6	1.7	1.7
Petrochemical production	0.9	1.1	1.2	1.1	1.0	1.0	0.9
Field burning of agricultural residue	0.8	0.7	0.9	0.9	0.9	1.0	1.0
Iron and steel production and metallurgical coke production	1.0	1.0	0.9	0.7	0.7	0.7	0.6
Ferroalloy production	+	+	+	+	+	+	+
Silicon carbide production and consumption	+	+	+	+	+	+	+
International bunker fuels	+	+	+	+	+	+	+
Total for U.S.	613.4	613.2	586.0	553.2	568.2	569.2	567.6

Source: Environmental Protection Agency

71. What is the percent change in methane emissions from enteric fermentation (digestive processes in organisms) from 1990 to 2008?
- Methane emissions increased by 6.3 percent.
 - Methane emissions decreased by 6.3 percent.
 - Methane emissions increased by 8.4 percent.
 - Methane emissions decreased by 8.4 percent.
 - Methane emissions increased by 6 percent.
72. What is the most likely reason for the decrease in emissions from landfills between 1990 and 2008?
- Decreased disposal of waste in landfills
 - Less decomposition occurring in landfills
 - Fewer methane-producing items disposed of in landfills
 - Increased capture and reuse of the methane produced by landfills
 - Lack of accurate data
73. Which of the following is the main component of acid drainage from mining activities?
- Sulfuric acid
 - Hydrochloric acid
 - Nitrogen dioxide
 - Methane
 - Nitric acid
74. Sand has
- High porosity and low permeability
 - Low porosity and low permeability
 - High porosity and high permeability
 - Equal porosity and permeability
 - Low porosity and high permeability
75. Which of the following explains how a species can become invasive when introduced to an ecosystem?
- Ability to outcompete native species
 - Ability to reproduce quickly
 - Lack of limiting factors
- I only
 - II only
 - III only
 - I and III only
 - I, II, and III
76. All the following are benefits of a kelp forest EXCEPT:
- It provides shelter for fish.
 - It serves as a food supply for many invertebrates.
 - It can provide components of cosmetic products.
 - It reduces the effects of eutrophication.
 - It protects the coastline.
77. Ocean currents transport energy as they move throughout the Earth, with water temperature being a major driver of this circulation. Which of the following statements most accurately describes this phenomenon?
- Surface waters are cooler, less dense, and less saline than deeper waters are.
 - Surface waters are warmer, less dense, more saline than deeper waters are.
 - Surface waters are warmer, less dense, and less saline waters than deeper waters are.
 - Surface and deeper waters are both warm, less dense, and less saline in the equatorial regions and colder, denser, and more saline in the polar regions.
 - Surface waters are warmer, more dense, and more saline waters than deeper waters are.
78. When hosts and parasites develop adaptations in response to each other, it is considered:
- Cooperation
 - Mutualism
 - Co-evolution
 - Symbiosis
 - Dependent evolution

79. The giant panda is one of the most visible endangered species in need of protection. Why is conservation awareness focused on a single flagship species?
- It helps to draw attention to an ecosystem in need of protection by using a species that can capture the public's eye.
 - It helps to protect the species most in need of protection.
 - There is not enough money available to protect all organisms, so efforts are put towards conserving keystone species.
 - Flagship species are the main species contributing to biodiversity of an ecosystem.
 - There is not enough money available to protect all organisms, forcing efforts to focus on conserving the large animals.
80. How is modern population growth different from growth during the Agricultural Revolution?
- Modern growth has high birth and death rates, while during the Agricultural Revolution birth and death rates were both low.
 - Modern growth has a low birth rate and a high death rate, while during the Agricultural Revolution birth and death rates were both high.
 - Modern growth has low birth and death rates, while during the Agricultural Revolution birth and death rates were both high.
 - Modern growth has low birth and death rates, while during the Agricultural Revolution birth rates were low and death rates were high.
 - Modern growth has high birth and death rates, while during the Agricultural Revolution birth rates were high and death rates were low.
81. Which of the following could feasibly explain why hurricanes and tropical storms have increased in intensity in recent decades?
- Increase in tropical sea surface temperatures
 - Rising sea levels
 - Decrease in sea surface temperatures
 - Increasing levels of greenhouse gases in the atmosphere
 - Alteration of ocean circulation patterns

Questions 82–84 refer to the following answer choices.

- Open-pit mining
 - Subsurface mining
 - Bore mining
 - Surface mining
 - Placer mining
82. Which form of mining uses running water to separate heavier minerals from lighter minerals?
83. With this form of mining, quarries are created with terraced sides for access into the mine.
84. Due to the confined nature of this type of mine, particulate matter can accumulate in the air and become a health hazard for miners.
85. Critics point to all the following as potential negative consequences of producing genetically modified foods EXCEPT:
- The increasing need for more powerful pesticides and herbicides due to growing resistance in pests and weeds
 - The destruction of native crops
 - The ability for foods to stay fresh longer, giving them the ability to be transported farther and have a longer shelf-life
 - The possibility of exacerbating allergies in people
 - The potential to create new disease, because bacteria and viruses are sometimes used to create genetically modified foods
86. An evolutionary adaptation in which different species divide a limited resource by specializing in different ways is considered
- Co-evolution
 - Resource partitioning
 - Allotropic speciation
 - Sympatric speciation
 - Natural selection

87. Which of the following statements correctly describes the relationship between altitude and atmospheric pressure?
- With decreasing altitude, atmospheric pressure decreases.
 - With increasing altitude, atmospheric pressure increases.
 - With increasing altitude, atmospheric pressure decreases.
 - With decreasing altitude, atmospheric pressure increases.
 - When altitude increases, atmospheric pressure stabilizes.
88. Which of the following could cause birth rates to increase back to a rate similar to that seen during the pre-industrial stage of demographic transition?
- Increase in disease and death among the young
 - Decrease in disease and death among the young
 - Increase in the elderly population
 - War
 - Female empowerment
89. Who is responsible for the creation of the National Wildlife Refuge System?
- Rachel Carson
 - Gifford Pinchot
 - President Herbert Hoover
 - President Theodore Roosevelt
 - Aldo Leopold
90. Why are wetlands considered an especially valuable ecosystem?
- Wetlands store pollutants so that they do not flow into the oceans.
 - Wetlands help to stop waterlogging and saltwater intrusion.
 - Wetlands help to increase the flow of water into oceans and lakes.
 - Wetlands provide many ecosystem services, such as filtering pollutants.
 - Wetlands provide many raw materials for industry.
91. One benefit of organic agriculture is the:
- Increase in crop yields
 - Use of transgenic seeds
 - Increase in monocultures
 - Use of synthetic chemicals
 - Use of natural as opposed to synthetic inputs
92. Which of the following organizations has created a global tree-planting campaign to encourage the planting of indigenous trees?
- United Nations Environmental Program
 - World Bank
 - European Union
 - World Trade Organization
 - Federal Reserve
93. Which of the following forms of energy do developing nations use the most?
- Coal and natural gas
 - Natural gas and oil
 - Oil and biomass
 - Solar and wind
 - Oil and wind
- Questions 94–96 refer to the following answer choices.*
- Lead
 - PBDEs
 - POPs
 - VOCs
 - Bisphenol-A
94. Commonly used as a fire-retardant in many products but can act as an endocrine disruptor.
95. A group of chemicals that bioaccumulate, persist, and travel long distances.
96. A heavy metal that can have negative effects on the nervous system.
97. Genetic pollution is a result of:
- The unintended spread of altered genetic information from genetically engineered organisms to natural organisms
 - Inbreeding
 - Loss of biodiversity
 - Loss of genetic diversity
 - A decrease in the use of genetically engineered organisms.

98. What is the main reason for the reduction in water volume of the Aral Sea?
- A. A trench opening due to tectonic plate shift
 - B. A dryer climate resulting in excessive evaporation
 - C. Excessive water withdrawal for use in irrigation
 - D. The building of a dam on a river feeding it
 - E. Seepage of the water into underground aquifers
99. If soil and groundwater become contaminated due to a leaking underground tank, what process would need to be conducted in order to clean up the site?
- A. Desalinization
 - B. Deep-well injection
 - C. Drainage of the groundwater
 - D. Composting
 - E. Remediation

100. Why is kudzu considered an invasive species?
- A. It is a specialist.
 - B. It is fast growing, hard to kill, and smothers other types of vegetation.
 - C. It is slow growing but hard to kill.
 - D. It co-evolves with bird species.
 - E. It develops a symbiotic relationship with other organisms.

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS SECTION ONLY. DO NOT WORK ON ANY OTHER SECTION IN THE TEST.



Section II: Free-Response Questions

Time: 90 minutes

4 questions

Directions: Each question is equally weighted. Plan to budget your time and allow yourself approximately 20 minutes per question. Write clearly to show any calculations when computations are necessary. Calculators are not allowed. Where an explanation or discussion is required, support your answers with relevant information, facts, and/or specific examples.

Question 1 refers to the following article from the *Cornell Chronicle Online*.

Rattlesnakes Sound Warning on Biodiversity and Habitat Fragmentation

Like the canary in the coal mine, the timber rattlesnake may be telling us something about the environment we share.

Cornell University researchers—using cutting-edge tools including fine-scale molecular genetics and microsatellite markers—tracked the rattlesnakes to understand how wildlife habitats are affected by even modest human encroachment.

“We used this species as a model to investigate general processes underlying population-level responses to habitat fragmentation,” said the authors, led by Cornell post-doctoral researcher Rulon Clark, in the paper “Roads, Interrupted Dispersal and Genetic Diversity in Timber Rattlesnakes,” currently available online and to be published in the journal *Conservation Biology*.

Researchers discovered that fragmentation of natural habitats . . . has had a significant effect over the past 80 years on genetic structure of timber rattlesnakes in four separate regions of upstate New York.

1. As human population increases, so, too, does habitat fragmentation, negatively impacting many organisms and global biodiversity.
 - A. Discuss how habitat fragmentation can impact the genetic diversity of a species.
 - B. Cite and explain two human activities that have led to habitat fragmentation.
 - C. Explain how the fragmentation of habitats can lead to the loss of biodiversity.
 - D. Discuss two solutions to reduce habitat fragmentation as our global human population continues to grow.
 - E. Explain what is meant by the reference to the “canary in a coal mine.” Relate this idea to this article’s description of the rattlesnake.

2. There are plans to build a new coal-fired power plant near a city in the Midwest. This plant is controversial in the local area and has brought many concerns about potential negative environmental effects on local ecosystems. Efforts are being made, though, by local leaders to show the amount of energy the plant will bring to the area and also ways individuals can lower their own energy usage.
 - A. A large, coal-fired power plant produces 64 million kWh of electricity each day. Assume the following: 10,000 BTUs are required to produce 1 kWh of electricity, 1 pound of coal produces 5,000 BTUs of heat, each coal car can hold 100 tons, and 1 ton is 2,000 pounds.
 - i. How much heat in BTUs is needed to produce the power each day?
 - ii. How many coal cars will be needed to operate the power plant for the day?
 - iii. How many trains will be needed to power the plant for a day if the train pulls 80 coal cars?
 - B. Coal mines in the west tend to be strip mines. Describe how a strip mine is mined to obtain the coal. Explain one impact on aquatic ecosystems from strip mining.
 - C. Discuss one environmental impact related to attaining energy from a coal-fired power plant, aside from the effects of the mining and combustion of the coal.
 - D. Describe two methods to reduce home energy usage.

3. The carbon cycle is one of the major biogeochemical cycles. Biogeochemical cycles are natural processes that recycle nutrients in various chemical forms from the nonliving environment to living organisms and then back to the nonliving environment. These global cycles recycle nutrients through the Earth's air, land, water, and living organisms, connecting past, present, and future life.
- A. Explain how the carbon balance on Earth is shifting from the lithosphere or biosphere to the atmosphere.
 - B. Explain how the carbon cycle contributes to the regulation of the Earth's temperature.
 - C. Describe two natural processes that occur in the carbon cycle.
 - D. Describe two ways in which humans affect the carbon cycle.
 - E. Describe two ways humans impact other biogeochemical cycles.
4. Hydrogen is an emerging alternative energy source, but as with many other energy sources, it is not without drawbacks.
- A. Explain how hydrogen is attained for use as an energy source.
 - B. Discuss two positive aspects of hydrogen as an energy source.
 - C. Discuss three reasons why opponents to hydrogen energy do not see it as a viable alternative to fossil fuels.
 - D. In what ways has hydrogen fuel already been made available to consumers?
 - E. Discuss two reasons why alternative energy is currently an essential component of the world's energy supply and may become more so in the future.

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS SECTION ONLY. DO NOT WORK ON ANY OTHER SECTION IN THE TEST.



Answer Key

Section I: Multiple-Choice Questions

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

Answer Explanations

Section I: Multiple-Choice Questions

1. **D** An extinct volcano is a volcano that is not erupting and most likely will not erupt at any point again.
2. **E** A shield volcano is a slowly erupting volcano with a broad base, gradual slopes, and usually craters at the top.
3. **A** An active volcano is a volcano that is presently erupting or has a large amount of seismic and thermal activity and will eventually erupt.
4. **E** Traditional agriculture uses manual labor, animal labor, and simple tools to grow crops.
5. **E** The Green Revolution of the 20th century was characterized by the development of high-yield crops, the wide use of pesticides, and the augmentation of irrigation infrastructure.
6. **D** Beneficial ozone acts as a protective layer, filtering ultraviolet radiation in the stratosphere including all UVC, 95 percent of UVB, and most all UVA. The majority of UV rays that reach the Earth's surface are UVA.
7. **A** $25 \text{ watts} \times 10,000 \text{ hours} = 250,000 \text{ Wh}$. Then, $250,000 \text{ Wh} \times (1 \text{ k} \div 1,000) = 250 \text{ kWh}$. And $250 \text{ kWh} \times \$0.10/\text{kWh} = \25 .
8. **B** $100 \text{ watts} \times 1,000 \text{ hours} = 100,000 \text{ Wh}$. Then, $100,000 \text{ Wh} \times (1 \text{ k} \div 1,000) = 100 \text{ kWh}$. And $100 \text{ kWh} \times \$0.10/\text{kWh} = \10 .
9. **D** 1 CFL averages 10,000 hours, while an incandescent bulb average 1,000 hours. Therefore, you will need 10 incandescent bulbs to have 10,000 hours ($10,000 \div 1,000 = 10$). The total cost of the energy for the incandescent bulbs is $\$10 \times 10 \text{ bulbs} = \100 , so the savings is $\$100 - \$25 = \$75$.
10. **D** If located a great distance from a municipal treatment center, a house is most likely using a septic system to collect and treat sewage.
11. **D** A telephone ringing is not considered noise pollution because the decibel level from the telephone is below the level considered harmful.
12. **C** The mid-Atlantic ridge is a divergent plate boundary, meaning the plates are moving away from each other.
13. **C** The grassland has a thick O (organic) horizon. Deserts, semi-desert, and chaparral have relatively thin O horizons. The same is true in a tropical rain forest, in which dead plants and animals decay relatively quickly and live plants soon absorb the nutrients, leaving a thin O horizon.
14. **B** The parent material is the lowest level of the soil horizon and is comprised of the bedrock material.
15. **C** The grasslands of the United States are called prairies. The pampas are the grasslands of temperate South America, llanos are the grasslands of tropical South America, steppes are the grasslands of Europe, and veld are the grasslands in Africa.
16. **A** The greatest threat to the survival of terrestrial species is the loss of habitats. The destruction of habitat occurs when land is cleared and altered for homes, businesses, and food production. Notice that each of this question's incorrect answers can *lead* to habitat loss, but habitat loss itself is the most common threat.
17. **D** The greatest threat to aquatic species is overharvesting, which is the overfishing of organisms as a food source for humans or as a food source for other species that are grown for human consumption. Cod, salmon, sole, and tuna are just some of the species that have been overharvested. Notice that this question's incorrect answers are themselves also dire threats.
18. **B** Subsidies are based on the location of agriculture, mining, forestry, and other businesses, not on the location of current population centers.

19. **E** Built-in resistance is an advantage of genetically modified crops. Crops have now been created that contain resistance to disease and pests, reducing or eliminating the need for pesticides. Unknown long-term effects on human health and the destruction of native food sources are arguments against the use of genetically modified crops.
20. **E** Clear-cutting cuts down all the trees in the area, leaving soil bare and subject to erosion. It also reduces habitat and shelter for animals and leaves a minimal basis for the forest to reseed itself and, thus, grow back.
21. **A** Love Canal was a former canal in upstate New York where a large number of steel drums containing toxic chemicals were buried. Eventually the land was covered and sold to a local community for a school and housing. The drums rusted and the chemicals leaked, seeping through the soil and asphalt and contaminating the soil and groundwater. This led to birth defects, cancers, and other human health issues.
22. **D** Lake Erie was one of the most polluted lakes in the United States as a result of polluted rivers such as the Cuyahoga River flowing into the lake, as well as heavy industry along the lake that ultimately led to a large fish die-off in 1969.
23. **C** Oils, trash, debris, and other flammable chemicals were floating on the surface of the Cuyahoga River when it caught fire in 1969. This was not the first river fire, but it brought awareness to the issue because *Time* magazine published an article about the event.
24. **A** CAFE is an acronym for *corporate average fuel economy*, which is a regulation that established the average miles-per-gallon of a manufacturer's fleet of cars. It was also expanded to include light trucks.
25. **C** Formaldehyde is found almost entirely as an indoor air pollutant, coming from pressed woods, carpets, and furniture. Both carbon dioxide and carbon monoxide are found indoors, but they are also found in large quantities outdoors. Nitrous oxide and sulfur dioxide are found mostly outdoors.
26. **D** One concern with GMOs is that the genes from these engineered plants and animals will unintentionally spread to the naturally occurring plants and animals via dispersion and/or interbreeding.
27. **B** Ozone is destroyed by chlorofluorocarbons (CFCs) when CFCs react with UV radiation from the sun to produce more CFCs while releasing a chlorine atom. (Note that the acronym *CFC* is shorthand and not a proper representation of the chemical's atoms, so chemical equations containing "CFC" need not appear balanced.) The chlorine atom then reacts with ozone to form chlorine monoxide and oxygen. The ClO reacts with ozone to form more chlorine molecules and oxygen. This is an ongoing cycle because more chlorine atoms are created in the process.
28. **C** Phytoplankton are the producers in this food web, turning the sun's energy into energy that is usable by the rest of the ocean food chain.
29. **D** Giant sequoias, California condors, and humans are *K*-selected species. They take a long time to reach maturity and generally produce only a few offspring at a time.
30. **C** Coal is formed when vegetation dies and is covered in mud, creating an anaerobic environment. Over millions of years pressure squeezes out the liquid, leaving the carbon matter behind to form complex chains of carbon compounds. These carbon compounds make up coal.
31. **D** Global climate change will have an effect on the human food supply. Crops grown along coastal areas may be flooded by rising seas and, thus, have to be relocated. Changes in precipitation patterns may lead to a need for an increase in crop irrigation or the need to move fields to areas that receive more rainfall. Higher temperatures also may lower crop yields or require a change in selecting where certain crops are grown.
32. **B** An indicator species reflects the quality of the water, soil, or air in a given area. If pollutants are present or the ecosystem is altered, these indicator species that are more sensitive to change will be affected first, likely dying, becoming ill, or moving from one location to another.
33. **E** Overgrazing leads to a reduction in native biodiversity because many native grasses struggle to cultivate and grow after being overgrazed. This could be due to reduced soil quality, soil compaction, or an intrusion of invasive species.

34. **B** CFCs were not developed until the 1930s, when they were manufactured in large quantities for use as refrigerants.
35. **B** Denitrification is the process by which bacteria convert nitrates (NO_3^-) into gaseous nitrogen (N_2), which is released into the atmosphere.
36. **C** Nitrification is the process of converting ammonium (NH_4^+) into both nitrite ions (NO_2^-) and nitrate ions (NO_3^-), both of which can be used by plants.
37. **E** Assimilation is the process of plants taking in the ammonia (NH_3) and ammonium (NH_4^+).
38. **A** Ammonification is the process of combining nitrogen gas (N_2) with hydrogen gas (H_2) to form ammonia (NH_3).
39. **D** The Safe Drinking Water Act sets standards for drinking-water quality in water sources both above and below ground. The Ocean Dumping Act prohibits the dumping of anything into U.S. waters without a permit. The Clean Water Act, also called the Federal Water Pollution Control Act, regulates the discharge of pollutants into waterways and sets quality standards for surface waters, including wastewater standards for industries. Waste Water Reduction Act is a fictitious name.
40. **D** Add the total of the five countries shown: $100,000 + 63,000 + 46,000 + 22,000 + 20,000 = 251,000$. Now divide this total by the world total and multiple by 100 to get the percentage: $(251,000 \text{ MW} \div 370,000 \text{ MW}) \times 100 = 67.8$ percent, which can be rounded to 68 percent.
41. **B** The National Park Service operates national parks, national recreation areas, and areas of historic significance.
42. **E** To live sustainably, we need to meet the needs of the present human population without compromising the ability of future generations to meet their needs. Considerations include sustainable use of land, water, and resources.
43. **B** Exposure to carbon monoxide can cause nausea, impaired vision, confusion, and fatigue at low concentrations. In the bloodstream, CO binds with hemoglobin, displacing oxygen and inhibiting oxygen from binding with the hemoglobin. This can result in suffocation, because oxygen is not circulating in the blood.
44. **D** Wind and solar energy are widely used in many nations and their use continues to grow. Geothermal energy is being used in several countries including the United States and Iceland. Biomass is the oldest form of power and is still used in many areas around the world. Harnessing wave motion is a potential way to capture the ocean's energy. Wave technology is currently under development, but it is mainly experimental in its design and implementation.
45. **D** Neurotoxins affect the nervous system. An allergen stimulates a response in the immune system. A carcinogen is a cancer-causing toxin. A mutagen can cause mutations in the DNA of an organism. A teratogen can affect embryo development.
46. **B** Excess weight and obesity are becoming some of the biggest health issues in the United States, with over 66 percent of the population overweight or obese.
47. **B** A dose-response is the effect of an amount of toxin or drug on an organism or population.
48. **A** A dose is the amount or concentration of a substance experienced by an organism.
49. **C** Persistence refers to a substance remaining in the environment for an extended period of time.
50. **E** A toxin is a substance that is poisonous to an organism.
51. **C** The industrial stage of demographic transition is the point at which birth rates begin to decline due to the decreased need for children to work on farms or as laborers, and an increase in the availability of contraception.
52. **D** Three Mile Island was the site of the most severe nuclear accident in U.S. history. The accident was caused by a loss of reactor coolant. The failure was mechanical in nature in the beginning, followed by

human failure to recognize the problem, and the result was a partial meltdown. In the end, the reactor was brought under control and a total meltdown was avoided.

53. **B** Solar, hydroelectric, and wind energy produce the least amount of direct emissions compared to other sources. Assessment of emissions in this situation does not include emissions from mining, manufacturing, transportation, construction, and disposal aspects of the energy generation processes.
54. **B** The United States consumes close to 25 percent of the world's oil, yet produces about 8 percent of the world's supply. The large population, combined with the economic ability to consume, feeds this consumption. Oil is used in large quantities for transportation, industry, and agriculture.
55. **A** Generalists fulfill a broad niche and can survive in a variety of habitats with a range of resources. This gives them a better chance of survival in times of environmental change.
56. **B** Loam is the most effective soil type at retaining water and nutrients at a neutral pH. Loam is a relatively even combination of sand, silt, and clay, giving it a mixture of pore sizes and even soil porosity and permeability.
57. **C** Even though ocean fisheries are declining in numbers, boats can still come into dock with full hulls because fishermen are spending more time fishing. They are also going farther and fishing in deeper waters. Therefore, fishermen are spending more time and effort to bring in the same numbers of catch as they did in previous years.
58. **C** Temperate deciduous forests have fertile soil due to the organic matter that accumulates on the top of the soil. As leaves are shed from the deciduous trees, they fall to the ground and decompose. The decomposition of leaves and other dead organic matter such as animal waste, grasses, and tree branches, returns nutrients to the soil, making it fertile.
59. **E** Sandy clay loam would describe soil that is 30 percent clay and 70 percent sand. In the soil texture diagram, the percent clay is on the left side and the percent sand is on the bottom. Follow 30 percent from the clay and 70 percent from the sand. The resulting soil is sandy clay loam.
60. **B** Sandy soils are made up of larger particles and have larger pore spaces, so water can flow through sandy soils easily.
61. **A** A hazardous waste landfill is widely considered the most effective choice for long-term disposal of hazardous waste because it is specially designed with a leachate removal system and impermeable liner. However, this type of landfill acts as a storage option as opposed to a place for the hazardous waste to break down. Surface impoundments have a tendency to leak waste, and some waste may be blown away or evaporated. Injection wells can leak into soil and groundwater due to corroded pipes.
62. **C** A savannah has distinct rainy seasons, creating dramatic variations in annual rainfall. This uneven distribution of precipitation throughout the year has given savannahs their unique vegetation pattern of grasses interspersed with patches of trees. In the Northern Hemisphere, most savannah rainfall occurs from November through March.
63. **E** Overgrazing can lead to a positive feedback loop where the soil becomes eroded and continues to deteriorate. In a positive feedback loop, once a system starts moving in a direction, it continues in that direction unless there is an intervention to stop the progression. This ultimately drives a system to an extreme, and in this case the extreme is degraded, unusable land.
64. **B** Deforestation is often higher in tropical rain forests because of the potential economic gain for the country in which the forest is located. Often, governments sell the rights to their natural resources to international buyers as a way to generate additional revenue.
65. **A** Increasing water vapor in the atmosphere creates a positive feedback loop, intensifying the greenhouse effect. As global temperature increases, more water evaporates from the oceans, seas, lakes, and rivers. This puts an increasing amount of water into the atmosphere, which, in turn, continues to warm the climate because water vapor is a greenhouse, heat-trapping gas.
66. **D** Uranium is a radioactive element mined from within the Earth and its isotopes are listed in nuclear power plants. U-235 is used directly and U-238 is converted into a plutonium isotope, Pu-239, to use as an energy source.

67. **E** Downwellings carry oxygen and other gases from surface waters to deeper ocean waters.
68. **B** Biomes are classified based on plant type and vegetation. Each region classified as a specific biome has vegetation similar to other areas also classified as that biome. Note that similarities in vegetation are due to the climate, amount of rainfall, temperatures, and amount of solar radiation.
69. **D** If the climate change continues to accelerate, there could be a shift in the location of biomes. As climate, rainfall, temperatures, and amounts of solar radiation shift due to climate alteration, the locations of biomes will shift as well.
70. **D** Carbon monoxide is produced as part of the incomplete combustion of fossil fuels. If a home appliance such as a hot water heater or clothes dryer has a leak, CO can escape and build up in the home. CO is a colorless and odorless gas that can lead to asphyxiation. If the presence of CO goes undetected, it can lead to illness or death.
71. **A** To calculate percent change, use the following formula:

$$\begin{aligned}\text{Percent Change} &= \frac{V_2 - V_1}{V_1} \cdot 100 \\ &= \frac{140.8 - 132.4}{132.4} \cdot 100 \\ &= \frac{8.4}{132.4} \cdot 100 \\ &= 0.063 \cdot 100 \\ &= 6.3\%\end{aligned}$$

72. **D** The decrease in emissions from landfills between 1990 and 2008 is most likely due to the increased capture and reuse of the methane produced by landfills. New technology, along with awareness of the negative results of methane in the atmosphere, have led to more landfills capturing and reusing the methane produced as a result of the decomposition of the waste.
73. **A** Sulfuric acid is the main component of acid drainage from mining activities. When sulfur contained in rocks is exposed during mining, it reacts with air and water to form sulfuric acid.
74. **C** Sand has high porosity and high permeability. This means that water can flow through easily and the pore spaces between sand particles do not hold water easily.
75. **E** The ability to outcompete native species, the ability to reproduce quickly, and the lack of limiting factors all help to explain how a species can become invasive when introduced to an ecosystem. The ability of an introduced species to thrive when introduced into an environment is dependent upon the ability of a species to survive in that environment.
76. **D** A kelp forest provides shelter for fish, serves as a food supply for many invertebrates, can provide components of cosmetic products, and protects the coastline. Kelp forests do not help to reduce the effects of eutrophication, though, which is caused by an influx of nutrients into an aquatic environment.
77. **C** Ocean currents transport energy as they move, with water temperature being a major driver of this circulation. Surface waters are warm, less dense, and less saline than deeper waters are. Surface waters are warmed by solar radiation in equatorial regions. As the warm waters move away from the equator, they cool and sink. As cold water moves toward warmer regions, the water warms and some of it rises. This constant rising and sinking of ocean water helps to move the water and circulate nutrients and gases.
78. **C** Co-evolution occurs when hosts and parasites develop adaptations in response to one another. As one organism develops an adaptation through the process of natural selection, the other organism may adapt in response to the other organism's adaptation.
79. **A** Focusing conservation on one charismatic species raises awareness of the need to protect an entire ecosystem. Because some species are more appealing to the public, they can be used to help conservation efforts not only for the species itself, but also for other species and the ecosystem as a whole.

80. **C** Modern growth has low birth and death rates. Low death rates are due to efficient medical care and low infant mortality, while low birth rates are due to factors such as increased use of contraception, females joining the workforce, and family planning. During the Agricultural Revolution, birth and death rates were both high because of high infant mortality, poor sanitation and healthcare, and the need for children to help with farming.
81. **A** Tropical storms and hurricanes are believed to be increasing in intensity in recent decades due to warming tropical sea surface temperatures. It is possible that the warming water temperatures are due to global warming, but this point is still being studied and debated.
82. **E** Placer mining uses running water to separate out the heavier minerals from the lighter ones.
83. **A** In open pit mining, quarries are created with terraced sides to allow access into the mine.
84. **B** Subsurface mines often are used in coal mining. Particles are disrupted in this process and become airborne. If not managed properly and without the proper protective gear, this environment can become a health issue affecting the respiratory system.
85. **C** Critics propose that the negative consequences of producing genetically modified foods include the following: the increasing need for more powerful pesticides and herbicides because of the growing resistance of pests and weeds, the destruction of native crops because of genetic contamination from wind-blown and water-carried genetically modified seeds, the possibility of exacerbating allergies in people, and the potential to create new disease because bacteria and viruses are sometimes used to create genetically modified foods. The ability for foods to stay fresh longer, giving them the ability to be transported farther and have a longer shelf life, is considered a benefit of genetically modified crops.
86. **B** An evolutionary adaptation in which different species divide a limited resource by specializing in different ways is considered resource partitioning. This allows similar species to survive within the same habitat by focusing survival efforts in unique ways. Note that this division of habitat occurs over generations through the process of natural selection.
87. **C** With increasing altitude, atmospheric pressure decreases. This is because, at high altitudes, fewer air particles are pushing down from above.
88. **A** The increasing spread of disease and death among the young could cause birth rates to increase and return to a rate similar to that seen in the pre-industrial stage of demographic transition. Historically, if death rates for the young start increasing, parents will start having more children to compensate for the loss.
89. **D** President Theodore Roosevelt was responsible for the creation of the National Wildlife Refuge System in 1903, which aims to preserve wildlife, populations, habitat, and land.
90. **D** Wetlands are valuable ecosystems because they provide many ecosystem services such as filtering pollutants, recharging aquifers, and flood reduction.
91. **E** One benefit of organic agriculture is its use of natural as opposed to synthetic inputs. Natural inputs have less impact on the environment, allowing native ecosystems to continue thriving in the absence of man-made chemicals.
92. **A** The United Nations Environmental Program aims to protect biodiversity and conserve natural resources on a global level, including an initiative to encourage the planting of indigenous trees. The organization helps nations find ways to address and solve environmental issues.
93. **C** Oil and biomass are the most widely-used forms of energy in developing nations. Biomass is widely used because it is relatively easy and inexpensive to attain. Often, people use biomass in the form of crop residue and animal manure from their own property. Oil is becoming more commonly used in developing countries as they become industrialized and not only need but can acquire oil.
94. **B** PBDEs are commonly used as fire retardants in many products. Unfortunately, they can act as endocrine disruptors in humans and other organisms.
95. **C** POPs are a group of chemicals that bioaccumulate, persist, and travel long distances.

96. A Lead is a heavy metal, and heavy metals can have negative effects on the nervous system.
97. A Genetic pollution is the unintended spread of altered genes from genetically modified organisms to natural organisms. Genetic pollution is becoming more common as the use of GMOs is becoming more common.
98. C The main reason for the reduction in water volume of the Aral Sea is excessive water withdrawal for use in irrigation. The region is also hot, dry, and prone to drought, making the replenishment of withdrawn water difficult.
99. E The process of remediation would be used to clean up soil and groundwater contaminated by a leaking underground tank. Possible remediation techniques include excavation, extraction, bioremediation, aeration, phytoremediation, and thermal remediation.
100. B Kudzu is an invasive species because it is fast growing, hard to kill, and smothers other types of vegetation. It is not originally native to North America as it is indigenous to Asia.

Section II: Free-Response Questions

1. This question is worth a maximum of 10 points, as follows:
- A. Discuss how habitat fragmentation can impact the genetic diversity of a species. (2 points maximum)
- 1 point: It limits gene interchange through a population.
 - 1 point: It can lead to inbreeding depression.
 - 1 point: There is increased susceptibility to disease.
- B. Cite and explain two human activities that have led to habitat fragmentation. (2 points maximum)
- 1 point: Development of roads, highways, canals, and irrigation ditches through ecosystems.
 - 1 point: Alteration of the path of a river.
 - 1 point: Development of buildings and communities.
 - 1 point: Creation of parks and other man-made ecosystems.
 - 1 point: Land converted for agricultural purposes.
 - 1 point: Deforestation.
 - 1 point: Timber harvesting.
- C. Explain how the fragmentation of habitats can lead to the loss of biodiversity. (3 points maximum)
- 1 point: Reduction of population immigration and emigration reduces gene flow.
 - 1 point: A decrease in the number of available mates reduces reproduction rates of a species, ultimately decreasing the numbers of a population.
 - 1 point: Species may be cut off from needed resources in other parts of the historic habitat.
 - 1 point: There is a decrease in the range for animals that require a large range.
 - 1 point: Barriers to migration are created for migratory species.
 - 1 point: There is an increase in disease and parasites at the edges of the habitats.
- D. Discuss two solutions to reduce habitat fragmentation as our global human population continues to grow. (2 points maximum)
- 1 point: Conversion of unused agricultural land back to natural habitat.
 - 1 point: Protection of large pieces of land through minimal-use guidelines.
 - 1 point: Protection of large pieces of land through establishment of parks and reserves.
 - 1 point: Use of land trusts to protect pieces of land in their natural state.
 - 1 point: Creation of biosphere reserves, incorporating areas of complete biodiversity preservation with sustainable and limited land use.
 - 1 point: The use of corridors for migrating species.

E. Explain what is meant by the reference to the “canary in a coal mine.” Relate this to rattlesnakes and habitat fragmentation. (1 point maximum)

- 1 point: Historically, mine workers carried canaries with them into subsurface coalmines. If the canary died, it meant there was a problem with air quality, signaling the workers to leave the mine. In examining the genetic diversity of rattlesnakes due to habitat fragmentation, if their diversity is being reduced, then it is likely that the genetic diversity of other organisms may be reduced due to the fragmentation as well.

2. This question is worth a maximum of 10 points, as follows:

A. Calculations

i. How much heat in BTUs is needed to produce the power each day? (2 points maximum—1 point for setting up the problem, 1 point for arriving at the correct answer)

Set up the problem:

$$\frac{64 \text{ million kWh}}{\text{day}} \left| \frac{10,000 \text{ BTU}}{1 \text{ kWh}} \right. =$$

Cancel the units:

$$\frac{64 \text{ million } \cancel{\text{kWh}}}{\text{day}} \left| \frac{10,000 \text{ BTU}}{1 \cancel{\text{kWh}}} \right. =$$

Solve the math:

$$\frac{64 \text{ million}}{\text{day}} \left| \frac{10,000 \text{ BTU}}{1} \right. = \frac{640,000 \text{ million BTU}}{\text{day}}$$

ii. How many coal cars will be needed to operate the power plant for the day? (2 points maximum—1 point for setting up the problem, 1 point for arriving at the correct answer)

$$\frac{640,000 \text{ million BTUs}}{\text{day}} \text{ or simplified } \frac{640 \text{ billion BTUs}}{\text{day}}$$

Set up the problem, cancel the units, and simplify the units:

$$\frac{640,000 \overset{000,000}{\cancel{\text{million BTU}}}}{\text{day}} \left| \frac{1 \cancel{\text{lb coal}}}{5,000 \text{ BTU}} \right| \left| \frac{1 \text{ ton}}{2,000 \cancel{\text{lb coal}}} \right| \left| \frac{1 \text{ coal car}}{100 \text{ tons}} \right. =$$

Solve the math:

$$\frac{6,400}{\text{day}} \left| \frac{1}{5} \right| \left| \frac{1}{2} \right| \left| \frac{1 \text{ coal car}}{1} \right. = \frac{6,400 \text{ coal cars}}{10 \text{ days}} = \frac{640 \text{ coal cars}}{\text{day}}$$

Final answer:

$$\frac{640 \text{ coal cars}}{\text{day}}$$

iii. How many trains will be needed to power the plant for a day if the train pulls 80 coal cars? (1 point maximum)

$$\frac{640 \cancel{\text{ coal cars}}}{\text{day}} \times \frac{\text{trains}}{80 \cancel{\text{ coal cars}}} = \frac{8 \text{ trains}}{\text{day}}$$

- B. Coal mines in the west tend to be strip mines. Describe how a strip mine is mined to obtain the coal. Explain one impact on aquatic ecosystems from strip mining. (2 points maximum)
- 1 point: Strip mining, one form of surface mining, is the removal of soil and rock that are above the coal. Large “earthmover” equipment is needed to remove the soil and rock. Then additional machines (excavators) remove the coal.
 - 1 point: When it rains, the water may wash soil and small rocks down into the stream, increasing turbidity, which can then decrease photosynthesis and alter the entire ecosystem.
 - 1 point: Acid drainage can occur. During mining, when rock is exposed, naturally occurring sulfide minerals also are exposed. When it reacts with oxygen and water, the sulfide turns into sulfuric acid. This can run off into waterways and become toxic to organisms.
- C. Discuss one environmental impact related to attaining energy from a coal-fired power plant, aside from the effects of the mining and combustion of the coal. (1 point maximum)
- 1 point: The transport of the coal from the location of the mine to the power plant requires the use of fossil fuels to operate trains, as do the machinery and vehicles necessary to mine the coal. The combustion of fossil fuels emits carbon dioxide and other greenhouse gases that are contributing to climate change.
 - 1 point: The infrastructure necessary to build and operate the plant has an environmental impact. The building of the power plant as well as roadways and railways all require land. This alters and destroys ecosystems and fragments habitats.
 - 1 point: Infrastructure is necessary to carry the electricity from the plant to homes and businesses. This requires the establishment of underground lines as well as aboveground lines. Ecosystem alteration and habitat fragmentation can result from this.
- D. Describe two methods to reduce home energy usage. (2 points maximum)
- 1 point: Insulation helps prevent warm air from escaping from a building during winter months and keeps cool air inside in the summer months. This makes a building more energy efficient.
 - 1 point: The addition of weather stripping around doorways to the outside reduces drafts coming in at the doorframe.
 - 1 point: Lowering the thermostat in the winter and raising it in the summer uses less energy.
 - 1 point: Replacing single-pane windows with double- or triple-pane windows filled with noble gases cuts down the exchange of hot and cold air on opposite sides of the glass.
 - 1 point: Replace older appliances and equipment with more energy-efficient models. This may include water heaters, washers, dryers, dishwashers, heaters, air conditioners, stoves, and refrigerators.
 - 1 point: Cut down on phantom energy loss by unplugging electrical equipment when it is not in use.
 - 1 point: The addition of ceiling fans can redistribute warm air during the winter months and cool air during the summer months.
 - 1 point: Install electronic switches to turn the heater and air conditioner on and off.
 - 1 point: Install dimmer switches to regulate lighting.
3. This question is worth a maximum of 10 points, as follows:
- A. Explain how the carbon balance on Earth is shifting from the lithosphere or biosphere to the atmosphere. (3 points maximum)
- 1 point: Fossil fuels, which come from the decomposition of dead organic matter, contain carbon and have been sequestered in the lithosphere for millions of years.
 - 1 point: Humans use fossil fuels for energy through combustion processes. This is releasing the carbon into the atmosphere.
 - 1 point: Combustion of biomass releases carbon into the atmosphere.
 - 1 point: Deforestation increases the concentration of carbon in the atmosphere because photosynthesis is not occurring and using carbon from the atmosphere.
 - 1 point: Trees are considered carbon sinks because they store large amounts of carbon. Deforestation releases the stored carbon into the atmosphere.

- B. Describe how the carbon cycle contributes to the regulation of the Earth's temperature. (1 point maximum)
- 1 point: CO_2 is a greenhouse gas that helps trap heat in the atmosphere. An increase in the concentration of CO_2 will lead to an increase in the Earth's temperature over time, and a decrease in the concentration will result in lower temperatures over time.
- C. Describe two natural processes that occur in the carbon cycle. (2 points maximum)
- 1 point: In photosynthesis, energy is used to combine CO_2 with H_2O to form glucose ($\text{C}_6\text{H}_{12}\text{O}_6$) and oxygen.
 - 1 point: In cellular respiration, glucose ($\text{C}_6\text{H}_{12}\text{O}_6$) in the presence of oxygen is burned to release CO_2 and H_2O and energy.
 - 1 point: During the decomposition of dead organisms, CO_2 is released.
 - 1 point: CO_2 exists in equilibrium between the water and atmosphere. Increasing CO_2 in the atmosphere increases CO_2 in aquatic systems.
- D. Describe two ways in which humans affect the carbon cycle. (2 points maximum)
- 1 point: As humans burn fossil fuels and biomass for energy, CO_2 is being released at an increasing rate. This increases the amount of CO_2 in the atmosphere, which causes the concentration of CO_2 in the oceans to increase. Carbon dioxide in the oceans forms carbonic acid, so with an increasing amount of CO_2 in the oceans, more carbonic acid is formed, lowering the pH of the oceans.
 - 1 point: The increase in CO_2 in the atmosphere may be leading to an increase in photosynthesis, increasing plant life and, therefore, the concentration of oxygen in the atmosphere.
 - 1 point: Burning of fossil fuels increases the amount of CO_2 concentrations in the atmosphere. CO_2 is considered a greenhouse gas, and greenhouse gases contribute to climate change.
 - 1 point: Deforestation is causing an increase in CO_2 concentrations in the atmosphere because trees and vegetation hold large amounts of CO_2 . As forests are cleared, CO_2 is released into the atmosphere. CO_2 is considered a greenhouse gas, and greenhouse gases contribute to climate change.
- E. Describe two ways humans impact other biogeochemical cycles. (2 points maximum)
- 1 point: In the phosphorus cycle, an increase in phosphorus into an aquatic system may result in an increase in plant growth. This may lead to algae blooms, eutrophication, and potentially hypoxia.
 - 1 point: Phosphorus can be introduced into an ecosystem through runoff containing detergents, raw sewage, and fertilizers.
 - 1 point: In the oxygen cycle, chlorine-containing compounds may cleave an oxygen molecule from ozone, ultimately depleting the ozone layer. This can increase the amount of UV radiation reaching Earth's surface, harming humans, animals, and plants.
 - 1 point: Humans have altered the nitrogen cycle by artificially fixing nitrogen through the use of fertilizers. This process, called the Haber-Bosch process, has almost doubled the amount of nitrogen fixation that occurs.
 - 1 point: The sulfur cycle has been altered in large part by the burning of coal, which emits SO_2 and H_2SO_4 . When they chemically react with components in the atmosphere, acid rain, pollution, and smog can form.
4. This question is worth a maximum of 10 points, as follows:
- A. Explain how hydrogen is attained for use as an energy source. (2 points maximum)
- 1 point: Hydrogen gas needs to be isolated, as it does not exist on its own naturally.
 - 1 point for one of the following methods:
 - Water is split into oxygen and hydrogen using electricity in a process called electrolysis.
 - Hydrogen can be extracted from hydrocarbons (mainly from natural gas) with extreme heat and pressure.
- B. Discuss two positive aspects of hydrogen as an energy source. (2 points maximum)
- 1 point: Hydrogen can be produced domestically, reducing dependence on foreign energy supplies.
 - 1 point: The only emissions from hydrogen combustion are water and heat.
 - 1 point: Hydrogen has three times the energy per mass of natural gas.
 - 1 point: Hydrogen is the most abundant element in the universe, so it will not be depleted.

- 1 point: Unlike batteries, fuel cells do not need to be recharged by the addition of energy from another source.
 - 1 point: When compressed, hydrogen is not more dangerous than gasoline.
- C. Discuss three reasons why opponents to hydrogen energy do not see it as a viable alternative to fossil fuels. (3 points maximum)
- 1 point: Hydrogen needs to be isolated prior to use.
 - 1 point: Currently, most hydrogen is produced from hydrocarbons in natural gas, a fossil fuel. This does not help to reduce dependency on fossil fuels, and the process also releases carbon dioxide into the atmosphere. This means that the hydrogen economy is dependent upon the price and availability of natural gas.
 - 1 point: Because it has low density, the storage of hydrogen is a challenge. It needs to be compressed into a denser form for storage and transport.
 - 1 point: Hydrogen can make metals brittle, weakening their structure. This creates challenges for storage, transport, and use.
 - 1 point: The process of isolating hydrogen for use may require large energy inputs, which could necessitate greenhouse gas emissions.
 - 1 point: Currently, little infrastructure exists for the transport, storage, and retrieval of hydrogen.
- D. In what ways has hydrogen fuel already been made available to consumers? (1 point maximum)
- 1 point: Currently, vehicles powered by hydrogen fuel cells—including cars, buses, and boats—are available for purchase.
- E. Discuss two reasons why alternative energy is currently an essential component of the world's energy supply and may become more so in the future. (2 points maximum)
- 1 point: It reduces dependency on foreign energy supplies.
 - 1 point: It provides a sustainable and renewable energy supply that will exist indefinitely.
 - 1 point: It reduces harmful greenhouse gas emissions that contribute to climate change.
 - 1 point: It reduces the environmental impact of drilling, mining, and other destructive processes associated with the extraction and refinement of fossil fuels.
 - 1 point: It reduces or eliminates emissions harmful to human health, wildlife, and ecosystems.