

ENVIRONMENTAL SCIENCE

Section I

Time—1 hour and 30 minutes

Part A

Directions: Each set of lettered choices below refers to the numbered questions or statements immediately following it. Select the one lettered choice that best answers each questions or best fits each statement and then fill in the corresponding oval on the answer sheet. A choice may be used once, more than once, or not at all in each set.

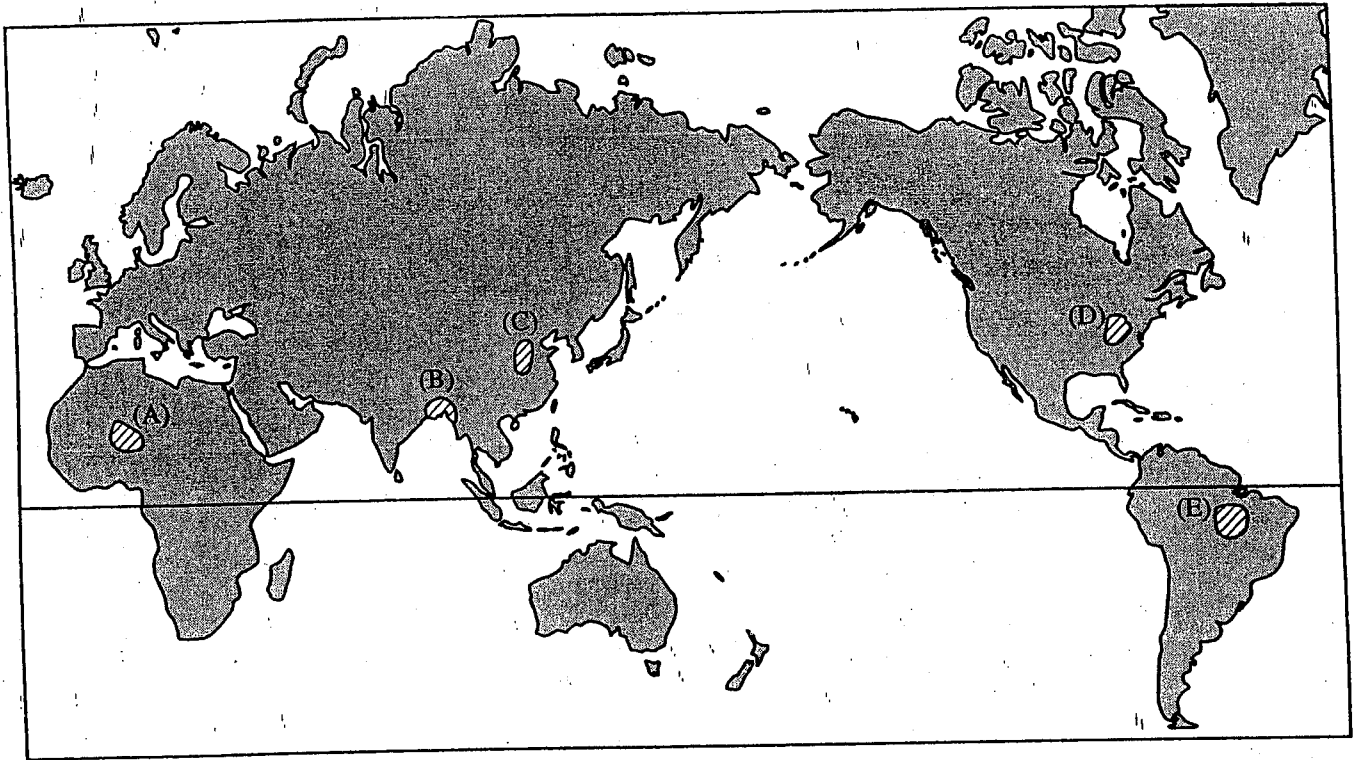
Questions 1-4 refer to the following methods of solid-waste disposal and treatment.

- (A) Sanitary landfill
- (B) Incineration
- (C) Discharge to sewers, streams, and rivers
- (D) Chemical treatment
- (E) Biological treatment

1. Which method reduces the volume of waste but could release toxic emissions into the atmosphere?
2. Which method is used most frequently in the United States today?
3. Which method introduces microorganisms to break down hazardous organic compounds?
4. Which method would be best suited for neutralizing the acidic components of waste?

GO ON TO THE NEXT PAGE 

Questions 5-8 refer to the locations marked by letters in the world map below.



5. The location where the greatest number of people would be directly affected by a rise in ocean level
6. The location of the greatest remaining natural biodiversity
7. The location where desertification is occurring most rapidly
8. The location where the size of the human population is the most stable

GO ON TO THE NEXT PAGE 

Questions 9-12 refer to the following possible relationships between organisms in an ecosystem.

- (A) Commensalism
- (B) Parasitism
- (C) Mutualism
- (D) Predation
- (E) Competition

- 9. Exemplified by ticks feeding on a deer
- 10. Exemplified by starlings displacing bluebirds from nesting sites
- 11. Exemplified by bees consuming nectar and carrying pollen from one flower to another
- 12. Exemplified by moss growing on a tree trunk in a forest

Questions 13-16 refer to the following concepts related to energy.

- (A) Heat flow
- (B) Kinetic energy
- (C) Potential energy
- (D) First law of thermodynamics
- (E) Second law of thermodynamics

- 13. Matter in motion has energy.
- 14. Energy is transferred from one object to another as the result of a temperature difference.
- 15. An energy transformation occurs and results in increased disorder.
- 16. The amount of energy in an isolated system stays constant.

GO ON TO THE NEXT PAGE 

Questions 17-20 refer to the following energy sources.

- (A) Biomass
- (B) Wind
- (C) Tidal energy
- (D) Nuclear fission
- (E) Sunlight

17. The source that produces long-lived hazardous wastes
18. The source that is converted directly into electrical energy by photovoltaic cells
19. The source whose use is a direct cause of deforestation
20. The source that is not renewable

Questions 21-24 refer to the following qualities of water samples.

- (A) Acidity
- (B) Turbidity
- (C) Hardness
- (D) Dissolved oxygen
- (E) Salinity

21. Measured on the pH scale
22. Caused by suspended particulates
23. Decreased by the breakdown of organic waste
24. Measured by the amount of Ca^{2+} and Mg^{2+}

Questions 25-28 refer to the following gases.

- (A) Carbon dioxide
- (B) Carbon monoxide
- (C) Methane
- (D) Radon
- (E) Sulfur dioxide

25. Is an important precursor to acid rain
26. Has a stronger affinity for hemoglobin than oxygen has
27. Has been implicated as the cause of as much as 15 percent of lung cancer cases
28. Is a flammable gas produced by landfills

GO ON TO THE NEXT PAGE 

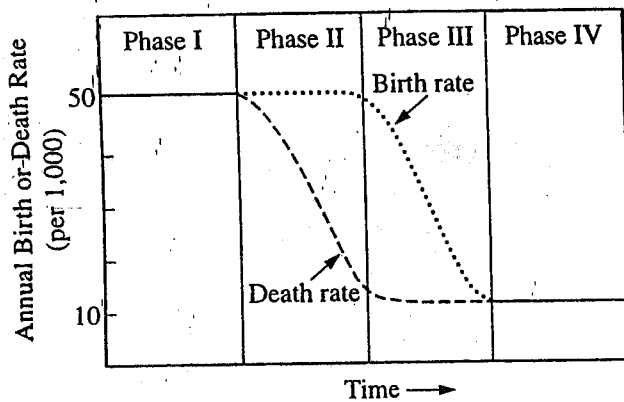
Part B

Directions: Each of the questions or incomplete statements below is followed by five suggested answers or completions. Select the one that is best in each case and then fill in the corresponding oval on the answer sheet.

29. Ozone in the stratosphere is important to organisms at Earth's surface because ozone molecules are very strong absorbers of
- (A) infrared rays
 - (B) ultraviolet rays
 - (C) microwaves
 - (D) visible light rays
 - (E) x-rays
30. Reasons that human populations historically have settled in floodplains include which of the following?
- I. The soil in floodplains is usually fertile.
 - II. The terrain in floodplains tends to be flat.
 - III. Floodplains are close to rivers for transportation.
- (A) I only
 - (B) II only
 - (C) I and II only
 - (D) II and III only
 - (E) I, II, and III
31. The National Environmental Policy Act (NEPA) of 1969 required all agencies responsible for a major federal project that could significantly affect the quality of the environment to file which of the following?
- (A) A mitigated negative declaration
 - (B) A geographic information system report
 - (C) An environmental impact statement
 - (D) An agency review
 - (E) A cost-benefit analysis
32. All of the following are considered toxic metal pollutants EXCEPT
- (A) cadmium
 - (B) chromium
 - (C) lead
 - (D) mercury
 - (E) potassium
33. Which of the following actions would be the most effective in decreasing acid rain and acid deposition problems?
- (A) Using higher smokestacks
 - (B) Reducing use of fossil fuels
 - (C) Developing acid-resistant crops
 - (D) Adding lime to acidified lakes
 - (E) Relocating power plants to areas of lower population density
34. In general, which of the following is the best long-term method of preventing extinctions?
- (A) Breeding endangered species in captivity
 - (B) Protecting the habitats of endangered species
 - (C) Paying people not to kill endangered species
 - (D) Providing food to endangered species in the wild
 - (E) Removing predators from areas that contain endangered species
35. Which of the following is most likely to occur in a forested region that has been recently clear-cut?
- (A) The concentration of nitrates in streams running through the region will increase.
 - (B) The average depth of topsoil will increase.
 - (C) The water temperature in streams running through the region will decrease.
 - (D) Volume of runoff after rains will decrease.
 - (E) The frequency of landslides will decrease.

GO ON TO THE NEXT PAGE 

Questions 36-38 refer to the graph below, which shows different phases related to the birth and death rates for a typical human population over time.

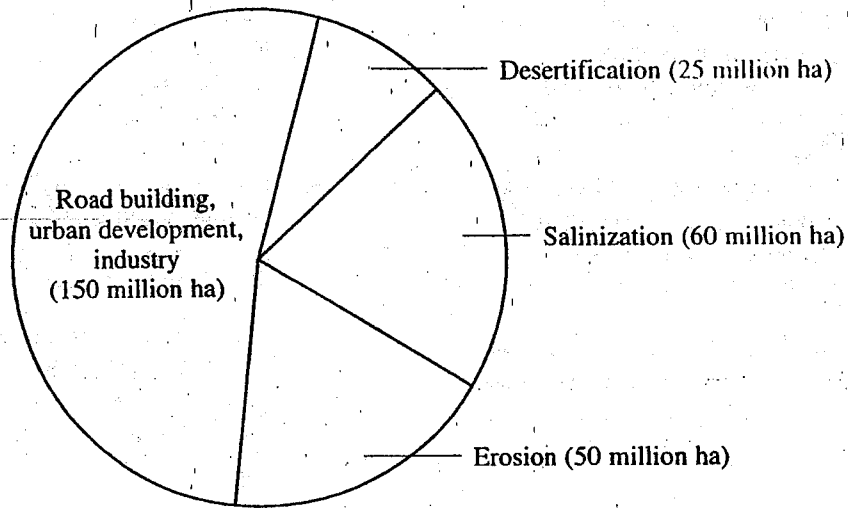


36. Zero population growth is associated with
- phase I only
 - phase II only
 - phase III only
 - phase IV only
 - phases I and IV
37. The rate of population growth starts to slow down at which point?
- The end of phase I
 - The middle of phase II
 - The beginning of phase III
 - The end of phase III
 - The middle of phase IV
38. Which of the following is most likely the primary cause of high death rates in phase I?
- Loss of breeding-age males due to warfare
 - Loss of breeding-age females due to disease
 - Large percentage of elderly individuals in the population
 - Infant and childhood mortality
 - General starvation due to famine

39. Which of the following best shows the process of evolution?
- A lizard's color becomes brown as it sits on a log.
 - A bear goes into hibernation.
 - A plant loses its leaves in a drought.
 - A population of mosquitoes develops resistance to a pesticide.
 - A population of foxes increases as more prey becomes available.
40. Most data indicate that, during the past 100 years, mean global annual temperature has
- decreased by 5°C
 - decreased by 0.5°C
 - stayed the same
 - increased by 0.5°C
 - increased by 5°C

GO ON TO THE NEXT PAGE 

ESTIMATED WORLD ARABLE LAND LOST
BETWEEN 1985 AND 2000



41. According to the information in the graph above, which of the following would most effectively slow the loss of arable land?

- (A) Increasing the efficiency of desalination processes
- (B) Reducing urban development
- (C) Increasing the efficiency of erosion control
- (D) Using more extensive irrigation systems
- (E) Discovering cheaper energy sources

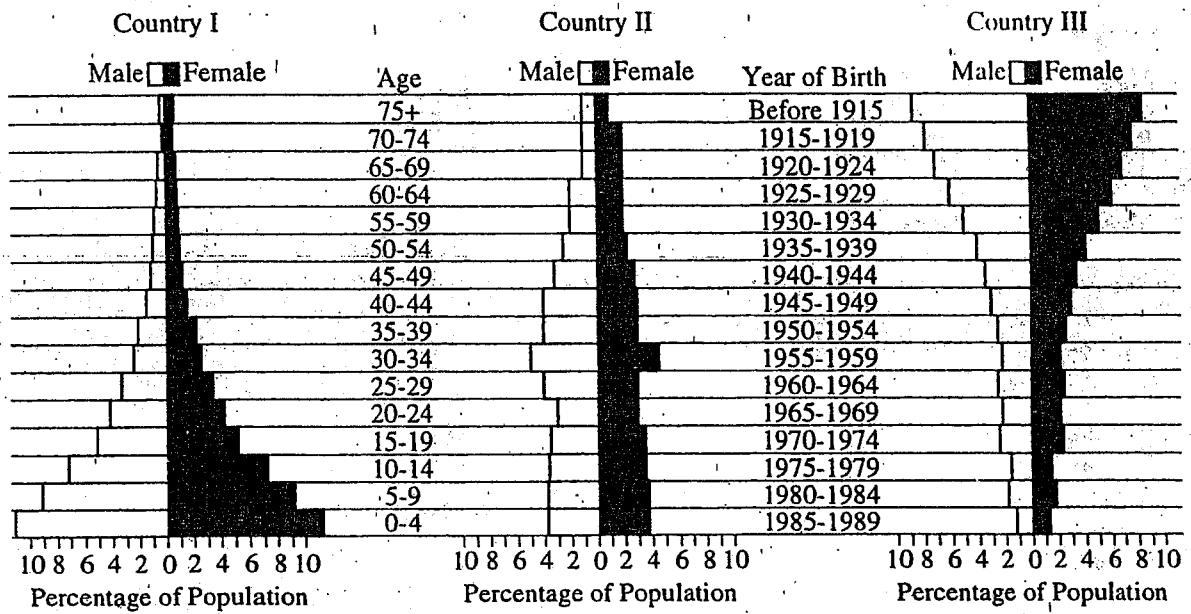
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42. Environmentalists oppose the mining of antarctic mineral resources because
- (A) territorial claims to Antarctica are unresolved
 - (B) the existence of valuable mineral deposits in the antarctic environment is unlikely
 - (C) the antarctic environment is fragile and extremely vulnerable to the disturbance that would accompany development
 - (D) currently known world reserves of important metals and oil are considered inexhaustible
 - (E) the demand for minerals is expected to decline as the world's nations become more industrialized
43. Fragmenting one large park or preserve into many small parks with human habitation in between them is most likely to lead to which of the following?
- (A) Reduction in species diversity
 - (B) Stabilization of microclimates
 - (C) Decrease in the proportion of edge habitat
 - (D) Increase in gene flow within species
 - (E) Increase in population size of top carnivores
44. Which of the following metals is considered an energy resource?
- (A) Uranium
 - (B) Cobalt
 - (C) Mercury
 - (D) Copper
 - (E) Palladium
45. Of the following, which constitutes the greatest percent of domestic use of water in the United States?
- (A) Flushing toilets
 - (B) Drinking
 - (C) Cooking
 - (D) Washing dishes
 - (E) Washing clothes
46. Which of the following best describes soils in many tropical rain forests?
- (A) They lack soil horizons.
 - (B) They are quickly depleted of nutrients when the forest is removed.
 - (C) They are similar to soils in grasslands.
 - (D) They are well suited for growing a wide variety of crops.
 - (E) They are deep and well drained.
47. Which of the following elements constitutes the highest percentage of mass in Earth's crust?
- (A) Oxygen
 - (B) Aluminum
 - (C) Carbon
 - (D) Potassium
 - (E) Nitrogen
48. If an incandescent lightbulb used for lighting has an efficiency rating of 5 percent, then for every 1.00 joule of electrical energy consumed by the bulb, which of the following is produced?
- (A) 1.05 joules of light energy
 - (B) 1.05 joules of heat energy
 - (C) 0.95 joule of light energy
 - (D) 0.05 joule of light energy
 - (E) 0.05 joule of heat energy
49. The ultimate source of energy for terrestrial ecosystems is
- (A) nutrients in soil
 - (B) nutrients in vegetation
 - (C) primary consumers
 - (D) producers
 - (E) the Sun
50. All of the following gases have been implicated in contributing to the increase in global temperatures via the greenhouse effect EXCEPT
- (A) O_2
 - (B) CH_4
 - (C) N_2O
 - (D) CO_2
 - (E) CFC's



GO ON TO THE NEXT PAGE

Questions 51-52 refer to the histograms below, which show age structure expressed as percentage of population for Countries I, II, and III in 1990.



51. Countries undergoing rapid population growth include which of the following?

- (A) I only
- (B) II only
- (C) III only
- (D) II and III only
- (E) I, II, and III

52. Approximately what percent of the population in Country II is under age 15 ?

- (A) 1%
- (B) 5%
- (C) 10%
- (D) 25%
- (E) 50%

GO ON TO THE NEXT PAGE

53. The major reservoirs of nitrogen and sulfur in the biosphere are correctly identified by which of the following?

Nitrogen	Sulfur
(A) Rocks	Rocks
(B) Rocks	Vegetation
(C) Rocks	Atmosphere
(D) Atmosphere	Rocks
(E) Atmosphere	Atmosphere

54. A sample of radioactive waste has a half-life of 10 years and an activity level of 2 curies. After how many years will the activity level of this sample be 0.25 curie?

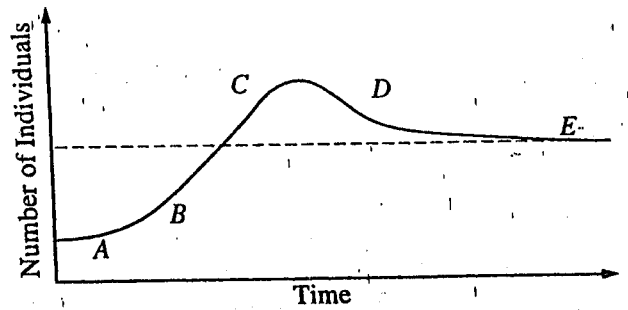
- (A) 10 years
- (B) 20 years
- (C) 30 years
- (D) 40 years
- (E) 80 years

55. The most abundant gas in Earth's atmosphere is

- (A) nitrogen
- (B) oxygen
- (C) water vapor
- (D) carbon dioxide
- (E) hydrogen

56. Which of the following would most likely have the greatest positive impact on the quality of the natural environment worldwide?

- (A) Discovery of new reserves of fossil fuel in coastal areas
- (B) Increased agricultural production on marginal desert lands
- (C) Increased life expectancy in more developed nations
- (D) Increased reliance on food from ocean ecosystems
- (E) Stabilization or reduction of the size of the human population



57. The diagram above illustrates how the number of individuals in a population changed with time as a result of external stresses and resource limitations. Which lettered portion of the curve most likely corresponds to the carrying capacity of the ecosystem?

- (A) A
- (B) B
- (C) C
- (D) D
- (E) E

58. Living organisms must acquire energy from their environment. Examples of adaptations that help organisms acquire this energy include which of the following?

- I. The dark, heat-absorbing coloration of a reptile.
- II. The fangs and claws of a lion
- III. The light coloration of a peppered moth

- (A) I only
- (B) II only
- (C) I and II only
- (D) II and III only
- (E) I, II, and III

59. All of the following substances are derived from petroleum EXCEPT

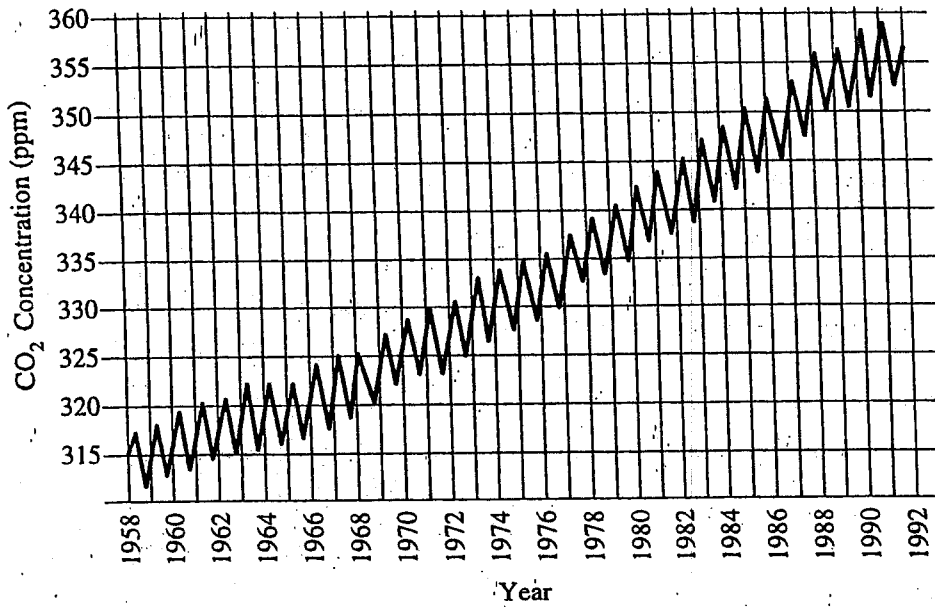
- (A) asphalt
- (B) DDT
- (C) cellulose
- (D) polystyrene
- (E) nylon

GO ON TO THE NEXT PAGE

60. Most volcanism in the world is associated with
- (A) plate boundaries
 - (B) midcontinental hot spots
 - (C) faulting
 - (D) aquifer depletion
 - (E) desertification
61. Compared with people in developing countries, people in industrialized countries are more likely to eat
- (A) beans
 - (B) beef
 - (C) corn
 - (D) rice
 - (E) wheat
62. The current world population is closest to which of the following?
- (A) 1 million
 - (B) 500 million
 - (C) 1 billion
 - (D) 5 billion
 - (E) 20 billion
63. Which of the following is most likely to result from destruction of wetlands surrounding a river?
- (A) A decreased sediment load in the river
 - (B) A decreased level of pollutants such as nitrates in the river
 - (C) An increased diversity of aquatic species in the river
 - (D) An increased level of oxygen in the river
 - (E) An increased frequency of flooding of the river valley
64. The presence of high levels of fecal coliform bacteria in a water source indicates that the water
- (A) is safe to drink
 - (B) is safe to swim in
 - (C) contains too little oxygen to support fish life
 - (D) has been recently chlorinated at a sewage treatment plant
 - (E) has been contaminated by untreated human or animal waste
65. Of the following, which is the most serious immediate problem associated with sanitary landfills?
- (A) Generation of CO_2 gas
 - (B) Leachate contamination of groundwater
 - (C) Release of disease organisms
 - (D) Incomplete degradation of wastes
 - (E) Compaction and settling
66. Of the following organisms, which occupies the lowest trophic level?
- (A) Spider
 - (B) Deer
 - (C) Lion
 - (D) Hawk
 - (E) Snake

GO ON TO THE NEXT PAGE 

Questions 67-69 refer to the graph below, which shows the monthly average CO_2 concentration, in parts per million, as measured at Mauna Loa Observatory in Hawaii.



67. According to the graph, the increase in CO_2 concentration, in parts per million, between 1970 and 1990 is closest to
- (A) 5 ppm
 (B) 30 ppm
 (C) 50 ppm
 (D) 340 ppm
 (E) 355 ppm
68. Which of the following is most likely a significant cause of the general trend indicated by the graph?
- (A) Reduction of ozone concentrations in the upper atmosphere
 (B) Reduction in size of polar ice caps
 (C) Increase in energy output of the Sun
 (D) Increase in evaporation of ocean water
 (E) Increase in consumption of fossil fuels
69. Which of the following most directly explains the periodic fluctuations of the curve?
- (A) Daily variations in air temperature
 (B) Daily variations in sea level
 (C) Seasonal variations in photosynthetic activity
 (D) Seasonal variations in ocean water temperature
 (E) Seasonal variations in human industrial activity

GO ON TO THE NEXT PAGE 

70. Which of the following is most likely to be the direct result of lack of genetic diversity in a food crop such as corn?
- Decreased kernel size
 - Decreased potential yield
 - Decreased dependence on chemical fertilizers
 - Increased susceptibility to plant disease
 - Increased resistance to pests
71. Which of the following substances is released by CFC's and catalyzes a chain reaction that breaks down ozone in the upper atmosphere?
- Carbon monoxide
 - Carbon dioxide
 - Chlorine
 - Sulfur dioxide
 - Methane
72. The major biological source of dissolved oxygen in the ocean comes from
- decomposition of organic sediments on the ocean floor
 - metabolic processes of coral in reefs
 - oxidation of sulfur by bacteria in ocean vent communities
 - photosynthesis by phytoplankton
 - respiration by zooplankton
73. Overgrazing of public land by privately owned livestock is an example of the
- tragedy of the commons
 - right of eminent domain
 - rule of seventy
 - principle of manifest destiny
 - swapping of debt for nature
74. In contrast to low-level radioactive waste, most high-level radioactive waste is currently
- put into steel drums and dumped into the ocean
 - incinerated
 - buried in government landfills
 - recycled
 - stored at reactor sites
75. The main environmental effects of ozone depletion could include all of the following EXCEPT
- lower food-crop production
 - decreased concentration of CO_2 in the atmosphere
 - disruption of marine food chains
 - increased incidence of skin cancer
 - reduction of primary productivity in the oceans
76. The primary cause of Earth's seasons is the
- constant tilt of Earth's rotational axis with respect to the plane of its orbit around the Sun
 - changing distance of Earth from the Sun at different times of the year
 - periodic wobbling of Earth on its axis of rotation
 - changing relative positions of Earth, its Moon, and the Sun
 - periodic changes in solar energy output
77. Elements that cycle in the environment and that also have a gaseous phase at some point in their cycle include which of the following?
- Carbon
 - Phosphorus
 - Sulfur
- I only
 - III only
 - I and II only
 - I and III only
 - I, II, and III
78. There are various stages in the formation of coal as heat and pressure are increased and moisture content is decreased. These stages, in order, are
- bituminous, peat, lignite, anthracite
 - peat, lignite, bituminous, anthracite
 - peat, lignite, anthracite, bituminous
 - lignite, bituminous, anthracite, peat
 - anthracite, bituminous, peat, lignite

GO ON TO THE NEXT PAGE 

79. Which of the following correctly orders the methods of solid-waste management in terms of energy required?

Least Energy → Most Energy

- (A) Reuse Recycle Reduce
- (B) Recycle Reuse Reduce
- (C) Recycle Reduce Reuse
- (D) Reduce Reuse Recycle
- (E) Reduce Recycle Reuse

80. Although ozone in the stratosphere has been decreasing in recent years, ozone near Earth's surface is on the increase. This ozone near the surface is undesirable because it

- (A) absorbs ultraviolet light
- (B) has a different chemical structure than stratospheric ozone
- (C) reacts with hydrocarbons to form CFC's
- (D) is a strong oxidant and a respiratory irritant
- (E) accelerates rates of photosynthesis in plants

81. In models of global warming, the most important factor contributing to an increase in sea level is

- (A) thermal expansion of the oceans
- (B) increased precipitation
- (C) decreased evaporation
- (D) subsurface ocean cooling
- (E) growth of the polar ice caps

82. Which of the following best explains why DDT has been found in penguin eggs in the Antarctic?

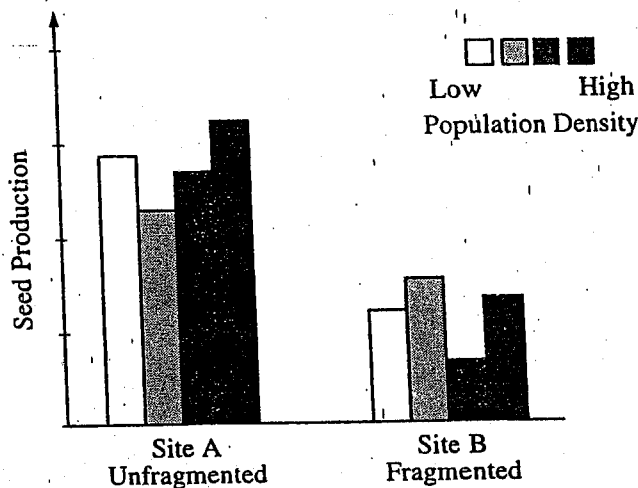
- (A) Chemicals used in one region of Earth can circulate in the biosphere and affect organisms in a distant region.
- (B) The large number of penguins in Antarctica has resulted in a depletion of their preferred foods.
- (C) Although DDT is toxic to adult birds, it has no effect on developing embryos.
- (D) Chemicals like DDT are volatile and eventually make their way to the ozone layer.
- (E) Because penguins incubate their eggs on land, the eggs are exposed to DDT.

83. Of the following, which is the best example of a point source of water pollution?

- (A) Factory effluent
- (B) Storm water
- (C) Acid precipitation
- (D) Agricultural runoff
- (E) Residential pesticide runoff

84. Approximately what percentage of the water on Earth is freshwater (liquid and solid)?

- (A) 75%
- (B) 25%
- (C) 2.5%
- (D) 0.25%
- (E) 0.025%



85. The graph above shows how seed production in a plant species varied with population density in an unfragmented habitat (site A) and in a fragmented habitat (site B). Which of the following conclusions is best supported by the data?

- (A) There is no relationship between seed production and habitat fragmentation.
- (B) Seed production is higher in dense populations.
- (C) Seed production is lower in dense populations.
- (D) Habitat fragmentation has more effect on seed production than does population density.
- (E) Pollinators are either less abundant or less effective in small populations.

GO ON TO THE NEXT PAGE →

86. The land on a 100-acre farm is equally suited for grazing cattle and growing corn. Of the following ways of distributing land use, which would produce the greatest number of calories for human consumption?

	Acres for <u>Grazing Cattle</u>	Acres for <u>Growing Corn</u>
(A)	100	0
(B)	80	20
(C)	50	50
(D)	20	80
(E)	0	100

87. Road construction, logging, and mining are banned in which of the following federal lands?

- (A) National parks
- (B) National wildlife refuges
- (C) National forests
- (D) National wilderness preservation areas
- (E) National resource lands

88. Which of the following best describes the mechanism of the greenhouse effect in Earth's atmosphere?

- (A) Ultraviolet radiation from the Sun is absorbed by ozone gas in the stratosphere.
- (B) Gamma radiation from the Sun is absorbed at ground level by dust particles in the atmosphere.
- (C) Infrared radiation from Earth's surface is absorbed by gases in the atmosphere.
- (D) Cosmic radiation from deep space is absorbed by gases in the atmosphere.
- (E) Alpha radiation from the Sun is absorbed by water vapor in the atmosphere.

89. In a human population undergoing the demographic transition, which of the following generally decreases first?

- (A) Birth rate
- (B) Death rate
- (C) Average family size
- (D) Life expectancy
- (E) Level of education

90. Which of the following not only results from greenhouse warming but also contributes to additional warming of Earth (i.e., is a positive feedback process)?

- (A) Increased emissions of particulates and aerosols from industrial activity
- (B) Increased volcanic activity
- (C) Decreased air temperature and subsequent formation of clouds
- (D) Decreased incidence of sunspot activity
- (E) Decreased size of snowpack

91. Which of the following is an inorganic compound?

- (A) Ethanol
- (B) Benzene
- (C) Table salt
- (D) Sucrose
- (E) Propane

92. High rates of species extinction caused by human activities have taken place at which of the following times in Earth's history?

- I. At the end of the Permian period
- II. At the end of the Cretaceous period
- III. During recent times

- (A) I only
- (B) II only
- (C) III only
- (D) I and II only
- (E) I, II, and III

93. The amount of sediment deposited at the mouth of a river system is likely to be increased by the presence upstream of which of the following?

- I. Artificial levees and embankments
- II. Dams
- III. Extensive natural wetlands

- (A) I only
- (B) II only
- (C) III only
- (D) I and II
- (E) II and III

GO ON TO THE NEXT PAGE 

94. *El Niño*, a periodic warming of ocean surface waters, occurs in which of the following regions?
- (A) Tropical East Pacific
 - (B) Gulf of Mexico
 - (C) Arctic North Pacific
 - (D) Temperate West Atlantic
 - (E) Tropical Indian Ocean
95. In the removal of a pollutant from wastewater, which of the following is true of the cost per unit of pollutant removed?
- (A) It decreases as the toxicity of the pollutant increases.
 - (B) It decreases as the time passed before remediation increases.
 - (C) It increases as the concentration of the pollutant decreases.
 - (D) It increases as the volume of the wastewater decreases.
 - (E) It does not change over time or with concentration of pollutant.
96. In the United States, the largest single component of municipal solid waste is
- (A) glass
 - (B) paper
 - (C) food scraps
 - (D) wood and other construction debris
 - (E) plastic
97. Which of the following countries has the largest coal reserves?
- (A) Saudi Arabia
 - (B) China
 - (C) India
 - (D) France
 - (E) Japan
98. Which of the following will result in accelerated eutrophication when introduced into streams, lakes, and bays?
- (A) Bacteria and viruses
 - (B) Pesticides
 - (C) Herbicides
 - (D) Phosphates
 - (E) Acid wastes and salts
99. The two major processes involved in the carbon cycle are
- (A) weathering and erosion
 - (B) photosynthesis and respiration
 - (C) evaporation and transpiration
 - (D) erosion and deposition
 - (E) fixation and denitrification
100. Which of the following procedures would be best for remediating the effects of soil salinization?
- (A) Application of broad-spectrum biocides to kill microorganisms
 - (B) Application of superphosphate to increase soil fertility
 - (C) Addition of clay to increase soil water-holding capacity
 - (D) Addition of large amounts of water to leach out salts
 - (E) Addition of lime to raise soil pH

END OF SECTION I