Section I

24.

# ENVIRONMENTAL SCIENCE

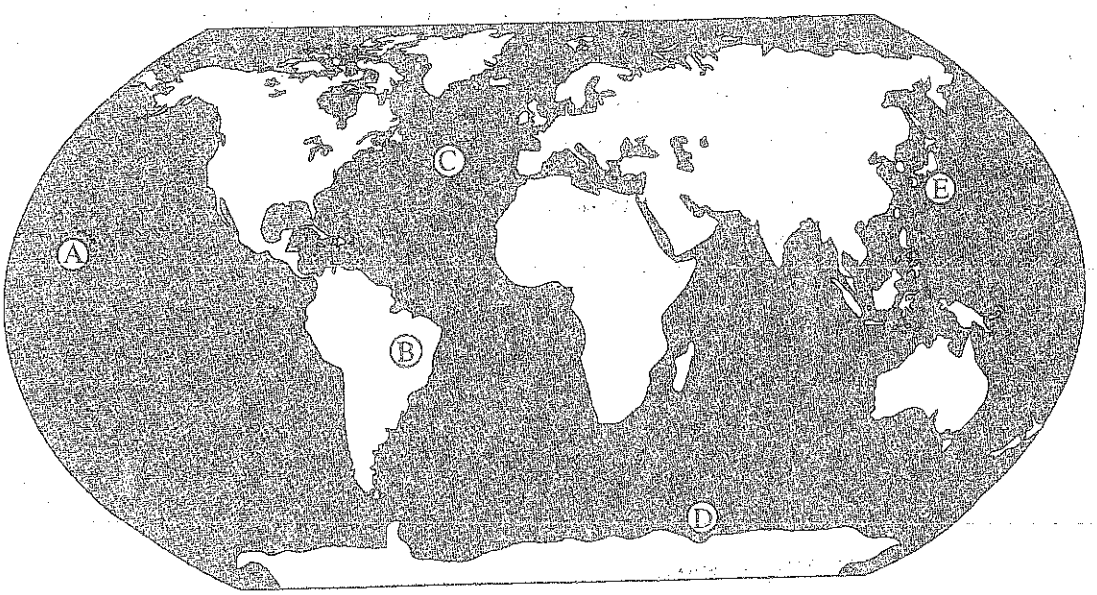
Section I

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 question 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 1-3 refer to the locations marked by letters on the world map below.**




1. The location where new crust is being created at a divergent plate boundary

2. The location where one tectonic plate is being forced beneath another, creating a volcanic arc.

3. The intraplate location where hot-spot volcanism is occurring

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.

14. The greatest amount of fresh water is found in which of the following?

(A) The atmosphere
(B) Estuaries
(C) Lakes
(D) Rivers and streams
(E) Polar ice caps and glaciers

15. Which of the following is true of carbon as it cycles in nature?

(A) Carbon dioxide is released during photosynthesis.
(B) Carbon compounds rarely exist in the gaseous state.
(C) Carbon sinks include forests and oceans.
(D) The carbon dioxide concentration in the atmosphere is reduced by cutting trees.
(E) Carbon is concentrated in igneous rocks.

16. Which three sources supply the majority of commercial energy in the world today?

(A) Coal, oil, and natural gas
(B) Solar, wind, and biomass
(C) Nuclear, hydropower, and photovoltaics
(D) Wood, dung, and charcoal
(E) Fuel cells, geothermal, and tidal power

17. By the year 2050, world population is expected to approach 10 billion. If the current population trends continue, which region of the world will most likely experience the majority of the growth?

(A) North and Central America
(B) Central and South America
(C) Eastern and Western Europe
(D) Africa and Asia
(E) Australia and New Zealand

18. Which of the following human activities is most closely associated with depletion of the stratospheric ozone layer?

(A) Mining of coal
(B) Disposal of refrigerators and air conditioners
(C) Heating of homes and factories
(D) Generation of electricity
(E) Agricultural irrigation

19. Overuse of groundwater in coastal areas would most likely result in which of the following?

(A) Rise in water table
(B) Increase in stream flow
(C) Bacterial contamination of surface water
(D) Saltwater intrusion
(E) Decrease in eutrophication

20. Of the following countries, which has the largest proven reserves of strategic metals such as manganese, chromium, and platinum?

(A) South Africa
(B) Japan
(C) Saudi Arabia
(D) The United States
(E) France

21. In 2007 in the United States there were approximately 480 cars for every 1,000 people. The total number of cars in the United States in 2007 was closest to

(A) 150,000
(B) 30,000,000
(C) 150,000,000
(D) 300,000,000
(E) 3,000,000,000





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30. Of the following cities, which regularly experiences the worst levels of photochemical smog that is enhanced by thermal inversions?

(A) New York City, New York
(B) Los Angeles, California
(C) Portland, Oregon
(D) Atlanta, Georgia
(E) Philadelphia, Pennsylvania

31. Which of the following best describes the first law of thermodynamics?

(A) Energy always changes from a more useful, more concentrated form to a less useful, less concentrated form.
(B) In a closed system of constant mass, the energy involved in any physical or chemical change is neither created nor destroyed, but merely changed from one form to another.
(C) Heat always flows from a hot body to a cold body.
(D) Entropy of a system increases as the state of disorganization in the system increases.
(E) In a reversible process, the entropy of the system is constant, whereas in an irreversible process, the entropy of the system increases.

32. What two main factors would best indicate the quality of life of a country's population?

(A) The total fertility rate and the death rate
(B) The crude birth rate and crude death rate
(C) The birth rate and the infant mortality rate
(D) The replacement-level fertility rate and the total fertility rate
(E) The life expectancy and the infant mortality rate

33. Rachel Carson's contributions to the environmental movement include which of the following?

(A) Alerting the public to the hazardous waste problem at Love Canal
(B) Increasing public awareness of the risks of using pesticides
(C) Starting the first Earth Day in 1970
(D) Discovering the thinning of the ozone layer in polar regions
(E) Being the first female administrator of the EPA

34. In a typical forest ecosystem, dead trees and fallen trees are most important because of their role in which of the following?

(A) Providing a valuable source of timber
(B) Providing habitats for wildlife
(C) Contributing to soil erosion
(D) Increasing water runoff
(E) Removing carbon dioxide from the air

35. Possible effects of a warmer atmosphere include which of the following?

I. Expanded ranges of tropical diseases
II. More intense hurricanes and typhoons
III. Increased crop damage from pests and diseases

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

36. When a rain forest is slashed and burned, the local concentration of carbon dioxide in the atmosphere increases. This is primarily due to

(A) changes in the local climate
(B) oxidation of carbon compounds
(C) cellular respiration of rain-forest plants
(D) erosion of exposed soil
(E) carbon dioxide being released by anaerobic organisms

37. Pollution is considered an external cost when

(A) it has harmful effects borne only by the people who purchase the products that cause the pollution
(B) the cost to the environment is not reflected in the price of the products that produce the pollution
(C) it has a significant impact on the consumer's decision to buy a product that pollutes
(D) it is a hidden cost that would result in a greater demand for the product if the consumer were aware of the hidden cost
(E) it is produced in the external environment by a malfunction in the operation of the product

43. Which of the following is most typically associated with the transition from a rural to an urbanized society?

(A) Reduced birth rates
(B) Reduced need for sewage-treatment facilities
(C) Increased rates of population growth
(D) Increased air quality in urban areas
(E) Increased stabilization of microclimate in urban areas

44. Five islands, *A*, *B*, *C*, *D*, and *E*, differ only in distance from the mainland, area, and species diversity. Which island would be predicted to have the highest species diversity?

| Island | Distance from Mainland (kilometers) | Area (hectares) |
|---|---|---|
| (A) *A* | 50 | $1 \times 10^2$ |
| (B) *B* | 50 | $1 \times 10^6$ |
| (C) *C* | 500 | $1 \times 10^2$ |
| (D) *D* | 1,000 | $1 \times 10^2$ |
| (E) *E* | 1,000 | $1 \times 10^6$ |

45. Which of the following best illustrates point-source pollution?

(A) Toxic sediments in the delta of a major river
(B) Increase in $NO_x$ in a traffic-clogged city
(C) Dust blowing off unpaved roads
(D) Smoke emitted from forest fires
(E) Smokestack emissions from a large smelting company

46. The net annual primary productivity of a particular wetland ecosystem is found to be 8,000 kcal/m$^2$ per year. If respiration by the aquatic producers is 12,000 kcal/m$^2$ per year, what is the gross annual primary productivity for this ecosystem, in kcal/m$^2$ per year?

(A) 4,000
(B) 8,000
(C) 12,000
(D) 20,000
(E) 96,000

47. The three main anthropogenic sources of gaseous air pollutants in the United States are

(A) soil erosion, volcanoes, and forest fires
(B) soil erosion, volcanoes, and energy production
(C) industry, construction, and agriculture
(D) industry, transportation, and energy production
(E) industry, transportation, and agriculture

54. If Earth had no atmosphere, the mean surface temperature would be approximately −15°C. With our present atmosphere, Earth's mean surface temperature is approximately +15°C. Which of the following is the best explanation for this difference?

(A) Reflection of incident solar radiation by clouds
(B) Scattering of visible radiation by aerosols
(C) Absorption of ultraviolet radiation by the ozone layer
(D) Absorption of infrared radiation by atmospheric gases
(E) The breakdown of oxygen molecules in the thermosphere

55. Which of the following can be used to assess the biological diversity of an area?

(A) Population size of each species and area occupied by each population
(B) Minimum population area and minimum viable population size
(C) Ratio of *r*-strategists to *K*-strategists and life expectancy of *K*-strategists
(D) Number of individuals under fifteen years old and number of individuals over sixty-five years old
(E) Genetic variation within each species and number of species present

56. Which of the following is a way for the government to encourage efficient energy use?

(A) Requiring higher fuel economy standards for new cars
(B) Implementing government subsidies to keep gasoline prices low
(C) Raising the speed limit from 55 to 70 miles per hour
(D) Limiting the development of public transportation systems
(E) Removing all taxes from gasoline at the fuel pump

57. Ground-level ozone in most major United States cities results primarily from

(A) burning coal
(B) burning fuel for cooking
(C) producing electric power
(D) industrial emissions
(E) motor-vehicle exhaust

63. Which of the following is a true statement about passive solar heating?

(A) It is effective only during the summer months.
(B) It is based in part on the principle of the greenhouse effect.
(C) It is not used to heat commercial buildings.
(D) It is not efficient because it cannot produce high-quality energy.
(E) It produces more pollution than heating with an electric heat pump.

64. Which of the following is a common characteristic of lakes undergoing cultural eutrophication?

(A) Decreased rates of sediment accumulation
(B) Decreased amounts of green and blue-green algae
(C) Increased levels of oxygen throughout the water column
(D) Increased water clarity in the epilimnion
(E) Increased levels of plant nutrients

65. An advantage of using natural gas, rather than oil, as a fuel is that natural gas is

(A) less of a contributor to global warming because it does not release $CO_2$ when it burns
(B) less expensive because most reserves are in the United States
(C) more abundant because it is a by-product of photosynthesis
(D) cleaner because it burns more completely
(E) safer to store because it is a gas

66. Which of the following best explains why the maximum sustainable yield for ocean fisheries has been exceeded?

(A) Populations of fish-eating birds such as the albatross have increased.
(B) Too many fish of reproductive age are harvested.
(C) Too many marine fish farms have been created.
(D) Everything trapped by large bottom trawl nets is used for food.
(E) For every calorie of fish caught, a ship uses only about 0.5 calorie of fuel energy.

67. Although the fertility rate for women in the United States has declined in recent years to a value below replacement level, the United States population is still increasing because of

(A) lower average age at first marriage
(B) lower infant death rates
(C) increased longevity
(D) improved health care
(E) immigration

**Item 68 was not scored.**

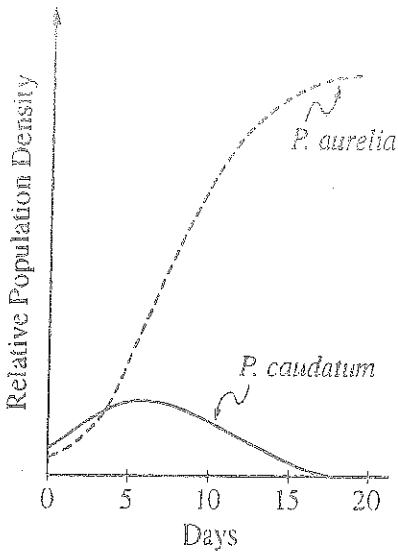
69. Which of the following is an important contributor to both global warming and ozone depletion?

(A) An increase in the concentration of carbon dioxide to higher-than-preindustrial levels
(B) A buildup of methane in the stratosphere to higher-than-preindustrial levels
(C) An increase in the levels of ultraviolet radiation reaching Earth's surface
(D) An increase in the amount of infrared solar radiation absorbed in the troposphere
(E) A release of chlorofluorocarbons to the atmosphere

70. The most populous countries in the world are China, India, and

(A) Indonesia
(B) Russia
(C) the United States
(D) Japan
(E) Mexico

78. The graph below shows the results obtained when two species of *Paramecium* were grown together in the same medium.




The graph above best exemplifies

(A) the demographic transition
(B) sustained logarithmic growth
(C) the edge effect
(D) competitive exclusion
(E) the normal distribution

79. In a cost-benefit analysis of the risks associated with an environmental hazard involving human health and safety, which of the following concerns is NOT typically taken into account?

(A) Lower worker productivity resulting from health-related time lost on the job
(B) Higher production costs resulting from the installation of expensive pollution-control devices
(C) The long-term value and peace of mind to society resulting from a cleaner, healthier environment
(D) The initial capital investment required to purchase pollution-control devices
(E) The need to remove pollutants from factory effluents

80. Three common methods employed in the cleanup of oil spills are

(A) aeration of water, skimmer boats, and genetically engineered bacteria
(B) aeration of water, phytoremediation, and genetically engineered bacteria
(C) skimmer boats, high temperature incineration, and phytoremediation
(D) large floating booms, high temperature incineration, and phytoremediation
(E) large floating booms, skimmer boats, and genetically engineered bacteria

81. Ticks are vectors for various diseases. The ticks acquire the disease-causing organisms from

(A) polluted water
(B) feeding on host animals
(C) contact with other ticks
(D) trees and plants in a forest
(E) gene changes as they go through metamorphosis

82. Which of the following is most likely to increase both the nutrient levels and the bacterial content of lake water?

(A) Runoff from a nearby hog farm
(B) Thermal pollution from a nearby power plant
(C) Increased aeration of the lake water
(D) Percolation of the water through soil to groundwater
(E) Acidification of the lake water by acid deposition

83. Which of the following is a major goal of the program begun in 1995 to reintroduce the gray wolf into Yellowstone National Park?

(A) Decrease the number of grizzly bears, because they were becoming a nuisance
(B) Enable the removal of the gray wolf from the endangered species list
(C) Increase the dwindling numbers of tourists that visit the park each year
(D) Upset the natural predator-prey balance between coyotes and elk
(E) Decrease the number of sheep and cattle that wander into the park and overgraze the vegetation





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88. Which of the following is a true statement concerning the production of electricity in conventional nuclear power plants using fission reactors?

(A) New nuclear power plants will be built without containment structures, due to the increased insulation in the reactor core.
(B) Thermal energy is converted into mechanical energy and then to electrical energy, as in coal-burning power plants.
(C) Regularly scheduled releases of radioactive gases during production are well below the maximum contamination levels set by the EPA (Environmental Protection Agency).
(D) Nuclear production of electricity is much less expensive per kilowatt-hour than production of electricity at a coal-burning or natural-gas-fueled power plant.
(E) Storage of nuclear waste is no longer an issue, because power plants are now storing all wastes on-site in specialized containment units.

89. Alligators in a Florida lake polluted by high levels of dioxins (chlorinated hydrocarbons) had low testosterone levels and failed to reproduce. Scientists came to the conclusion that the dioxins were acting as which of the following?

(A) Endocrine disrupters
(B) Growth hormones
(C) Carcinogens
(D) Immune-system suppressors
(E) Mutagens

90. Factors that affect the total fertility rate of a human population include which of the following?

I. Cultural traditions
II. Government policies and economic incentives
III. Education level and economic opportunities for females

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

91. Sustainable use of forests in the United States would likely be encouraged by

(A) cutting small groups of medium- and large-sized trees in uneven-aged forests
(B) clear-cutting old-growth forests to allow for secondary succession
(C) allowing road building in wilderness areas so that older, clear-cut forests have time to regenerate
(D) logging on steep slopes in designated wilderness areas
(E) enforcing all provisions of the Resource Conservation and Recovery Act (RCRA)

92. The use of which of the following to control agricultural insect pests is most likely to have a negative and persistent impact on an ecosystem?

(A) *Bacillus thuringiensis*, a soil organism that kills insect larvae
(B) *Braconid sp.*, a parasitic wasp
(C) Insecticidal soap, a surfactant that kills through suffocation
(D) Lindane, a chlorinated hydrocarbon
(E) Rotenone, a toxic plant derivative

94. Overgrazing of grasslands can lead to reduced range quality. Two of the major effects of overgrazing are

(A) erosion and desertification
(B) higher fire potential and increased productivity
(C) eutrophication and increased methane production
(D) higher primary productivity and ammonification
(E) soil compaction and subsidence

95. Which of the following describes the heat-island effect?

(A) Urban areas trap more heat than rural areas do.
(B) Tropical islands reflect heat back into the atmosphere.
(C) Warm water in the Pacific causes excessive evaporation into the atmosphere.
(D) Lakes retain heat and provide warmth for landmasses nearby.
(E) Rapid decomposition in swamps releases a large amount of heat.

96. Losses of usable energy between successive trophic levels in an ecosystem are best accounted for by which of the following?

(A) The first law of thermodynamics
(B) The second law of thermodynamics
(C) The law of conservation of matter
(D) The process of ecological succession
(E) Limiting factors in the ecosystem

97. Which of the following actions would reduce global greenhouse emissions?

(A) Increasing the use of automobiles
(B) Decreasing the number of nuclear power plants
(C) Replacing coal-burning power plants with wind farms
(D) Converting tropical forests to rice paddies
(E) Switching from hydroelectric power generation to power generation using natural gas as the primary fuel

98. A home uses ten 100-watt lightbulbs for five hours per day. Approximately how many kilowatt-hours of electrical energy are consumed in one year by using the lightbulbs?

(A) 365
(B) 1,825
(C) 5,000
(D) 10,500
(E) 365,000