ENVIRONMENTAL SCIENCE

A total of three hours is allotted for this examination; 90 minutes for Section I, which consists of 100 multiple-choice questions, and 90 minutes for Section II, which consists of 4 free-response questions. Section I is printed in this examination booklet. Section II is printed in a separate booklet.

NO CALCULATORS MAY BE USED IN THIS SECTION OR IN SECTION II OF THE EXAMINATION.

SECTION I

Time — 1 hour and 30 minutes

Number of questions — 100

Percent of total grade — 60

This section of the examination contains 100 multiple-choice questions, followed by 9 multiple-choice questions regarding your preparation for this examination. Therefore, please be careful to fill in only the ovals that are preceded by numbers 1 through 109 on your answer sheet. NO CALCULATORS ARE ALLOWED.

General Instructions

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE INSTRUCTED TO DO SO.

INDICATE ALL YOUR ANSWERS TO QUESTIONS IN SECTION I ON THE SEPARATE ANSWER SHEET. No credit will be given for anything written in this examination booklet, but you may use the booklet for notes or scratchwork. After you have decided which of the suggested answers is best, COMPLETELY fill in the corresponding oval on the answer sheet. Give only one answer to each question. If you change an answer, be sure that the previous mark is erased completely.

Example:

Chicago is a

(A) state
(B) city
(C) country
(D) continent
(E) village

Sample Answer



Many candidates wonder whether or not to guess the answers to questions about which they are not certain. In this section of the examination, as a correction for haphazard guessing, one-fourth of the number of questions you answer incorrectly will be subtracted from the number of questions you answer correctly. It is improbable, therefore, that mere guessing will improve your score significantly; it may even lower your score, and it does take time. If, however, you are not sure of the correct answer but have some knowledge of the question and are able to eliminate one or more of the answer choices as wrong, your chance of getting the right answer is improved, and it may be to your advantage to answer such a question.

Use your time effectively, working as rapidly as you can without losing accuracy. Do not spend too much time on questions that are too difficult. Go on to other questions and come back to the difficult ones later if you have time. It is not expected that everyone will be able to answer all the multiple-choice questions.

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?

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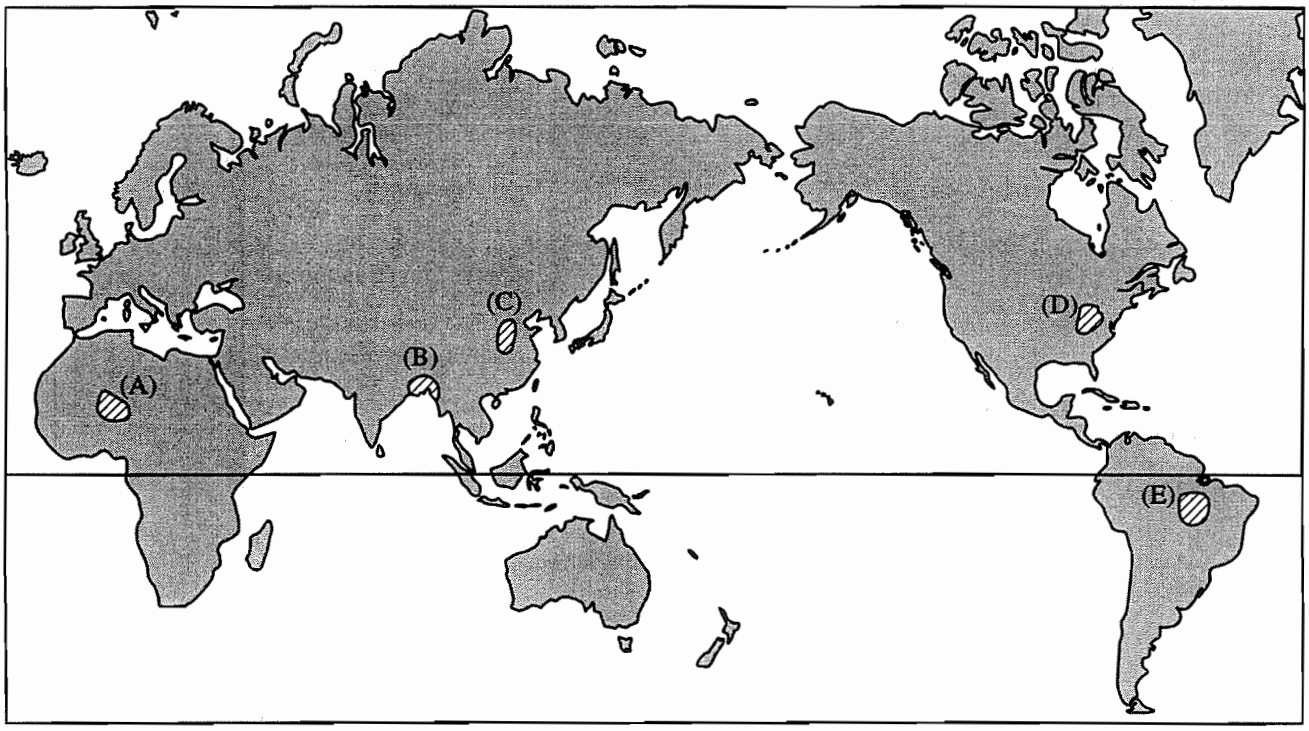
Questions 5-8 refer to the locations marked by letters in the world map below.



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

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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.

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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

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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.

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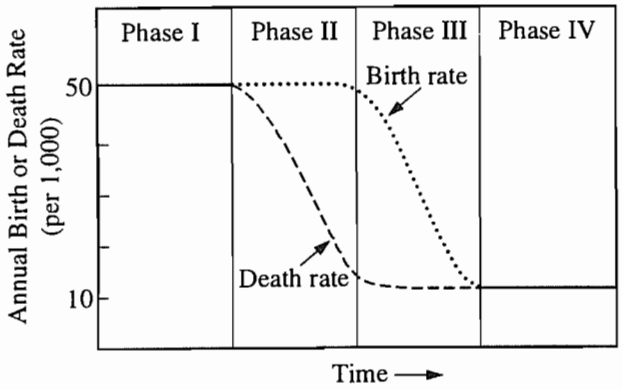
Questions 36-38 refer to the graph below, which shows different phases related to the birth and death rates for a typical human population over time.



36. Zero population growth is associated with

(A) phase I only
(B) phase II only
(C) phase III only
(D) phase IV only
(E) phases I and IV

37. The rate of population growth starts to slow down at which point?

(A) The end of phase I
(B) The middle of phase II
(C) The beginning of phase III
(D) The end of phase III
(E) The middle of phase IV

38. Which of the following is most likely the primary cause of high death rates in phase I ?

(A) Loss of breeding-age males due to warfare
(B) Loss of breeding-age females due to disease
(C) Large percentage of elderly individuals in the population
(D) Infant and childhood mortality
(E) General starvation due to famine

39. Which of the following best shows the process of evolution?

(A) A lizard's color becomes brown as it sits on a log.
(B) A bear goes into hibernation.
(C) A plant loses its leaves in a drought.
(D) A population of mosquitoes develops resistance to a pesticide.
(E) 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

(A) decreased by 5°C
(B) decreased by 0.5°C
(C) stayed the same
(D) increased by 0.5°C
(E) increased by 5°C

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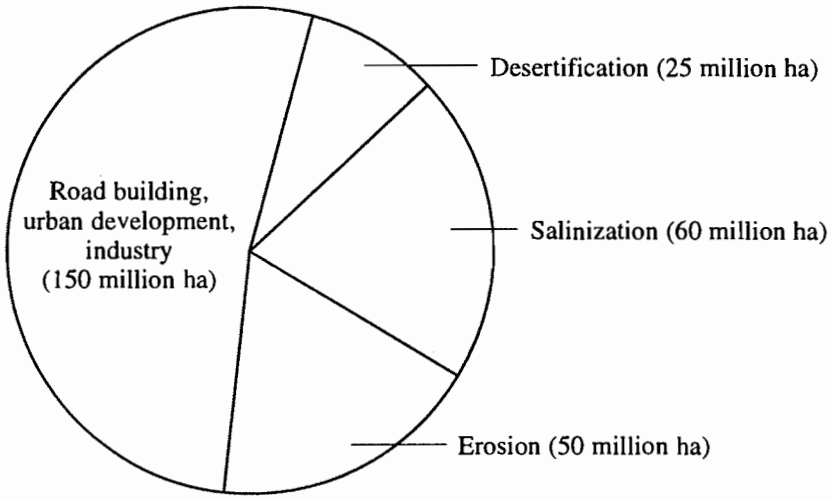
ESTIMATED WORLD ARABLE LAND LOST
BETWEEN 1985 AND 2000



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

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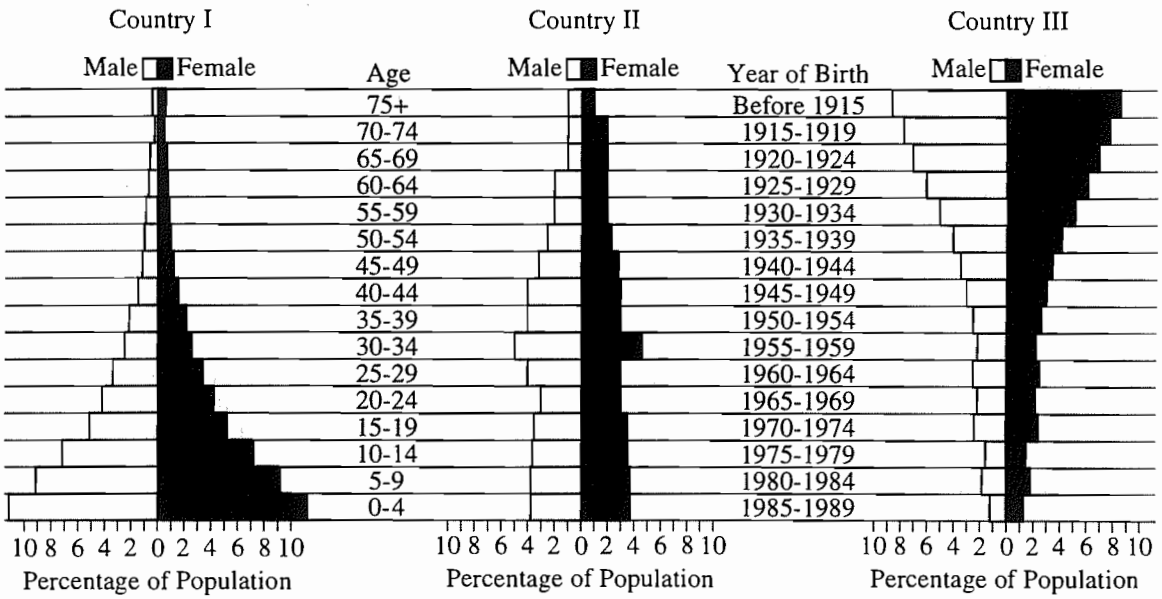
Questions 51-52 refer to the histograms below, which show age structure expressed as percentage of population for Countries I, II, and III in 1990.



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%

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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?

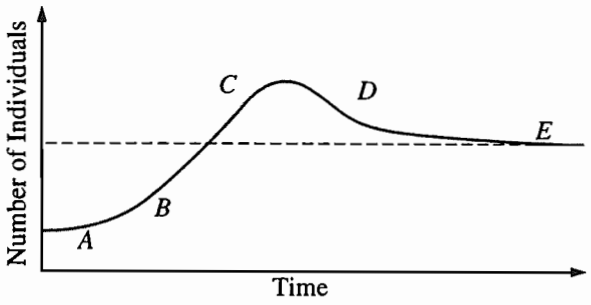
(A) 10 years
(B) 20 years
(C) 30 years
(D) 40 years
(E) 80 years

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

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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

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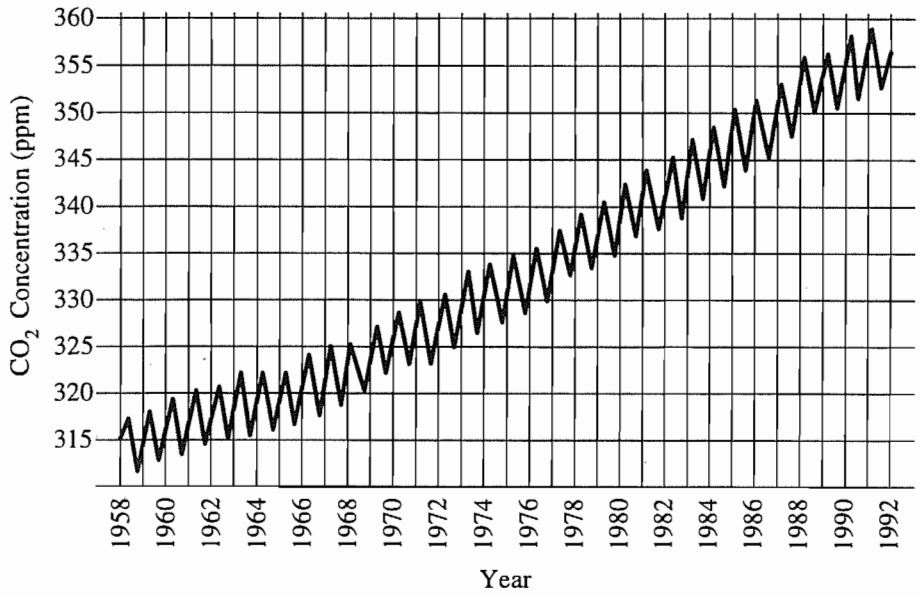
Questions 67-69 refer to the graph below, which shows the monthly average CO_2 concentration, in parts per million, as measured at Mauna Loa Observatory in Hawaii.



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

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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?

(A) Decreased kernel size
(B) Decreased potential yield
(C) Decreased dependence on chemical fertilizers
(D) Increased susceptibility to plant disease
(E) 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?

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

72. The major biological source of dissolved oxygen in the ocean comes from

(A) decomposition of organic sediments on the ocean floor
(B) metabolic processes of coral in reefs
(C) oxidation of sulfur by bacteria in ocean vent communities
(D) photosynthesis by phytoplankton
(E) respiration by zooplankton

73. Overgrazing of public land by privately owned livestock is an example of the

(A) tragedy of the commons
(B) right of eminent domain
(C) rule of seventy
(D) principle of manifest destiny
(E) swapping of debt for nature

74. In contrast to low-level radioactive waste, most high-level radioactive waste is currently

(A) put into steel drums and dumped into the ocean
(B) incinerated
(C) buried in government landfills
(D) recycled
(E) stored at reactor sites

75. The main environmental effects of ozone depletion could include all of the following EXCEPT

(A) lower food-crop production
(B) decreased concentration of CO_2 in the atmosphere
(C) disruption of marine food chains
(D) increased incidence of skin cancer
(E) reduction of primary productivity in the oceans

76. The primary cause of Earth's seasons is the

(A) constant tilt of Earth's rotational axis with respect to the plane of its orbit around the Sun
(B) changing distance of Earth from the Sun at different times of the year
(C) periodic wobbling of Earth on its axis of rotation
(D) changing relative positions of Earth, its Moon, and the Sun
(E) 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?

I. Carbon
II. Phosphorus
III. Sulfur

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

(A) bituminous, peat, lignite, anthracite
(B) peat, lignite, bituminous, anthracite
(C) peat, lignite, anthracite, bituminous
(D) lignite, bituminous, anthracite, peat
(E) anthracite, bituminous, peat, lignite

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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?

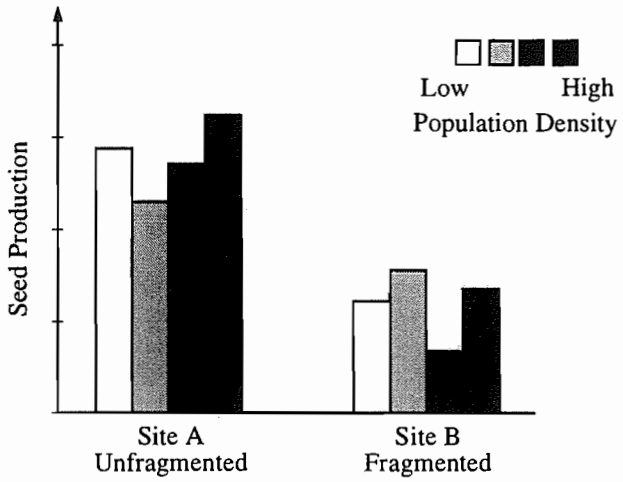
(A) Chemicals used in one region of Earth can circulate in the biosphere and affect organisms in a distant region.
(B) The large number of penguins in Antarctica has resulted in a depletion of their preferred foods.
(C) Although DDT is toxic to adult birds, it has no effect on developing embryos.
(D) 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.

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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 Grazing Cattle	Acres for Growing Corn
(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

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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

ENVIRONMENTAL SCIENCE
SECTION II
Time —90 minutes
Number of questions—4
Percent of total grade—40

Suggested writing time per question—approximately 22 minutes

Because each question will be weighted equally, you are advised to divide your time equally among them without spending too much time on any one question. You are expected to answer all four questions in this section. Suggested times will not be announced; you may proceed freely from one question to the next.

Each answer should be organized, well balanced, and as comprehensive as time permits. Answers must be in organized, well-written prose form; outline form is NOT acceptable. Do not spend time restating the questions. If a specific number of examples are called for, no credit will be given for additional examples. For instance, if a question calls for two examples, you will receive credit only for the first two examples you provide.

The questions in the green insert are duplicates of those in this booklet. Use the green insert to organize your answers and for scratchwork, but write your answers in the pink booklet. NO CREDIT WILL BE GIVEN FOR ANYTHING WRITTEN IN THE GREEN INSERT.

You are to write your answers with a pen only, preferably in black or dark blue ink. Be sure to write CLEARLY and LEGIBLY. If you make an error, you may save time by crossing it out rather than trying to erase it.

ENVIRONMENTAL SCIENCE

SECTION II

Time—90 minutes

4 Questions

Directions: Answer all four questions, which are weighted equally; the suggested time is about 22 minutes for answering each question. Write all your answers on the pages following the questions in the pink booklet, NOT on the green insert. Where calculations are required, clearly show how you arrived at your answer. Where explanation or discussion is required, support your answers with relevant information and/or specific examples.

1. The environmental impact of washing a load of dirty dishes in an electric dishwasher differs from that of washing them by hand in a sink. Use the information and data below to answer the questions that follow. Show your calculations.

   Assume the following:

   1. The dishes all fit in one load.
   2. The water coming into the water heater for the sink and into the water heater in the dishwasher is at 50°F.
   3. The water heaters for the sink and the dishwasher are both 100 percent efficient.
   4. In one complete cycle, the electric dishwasher uses 10 gallons of water heated to 140°F and the dishwasher also uses 0.500 kilowatt-hour of electrical energy for its mechanical operation.
   5. Washing the dishes by hand requires 20 gallons of water heated to 110°F.

   Other Information:

   1 gallon of water = 8 pounds of water
   1 BTU = the amount of energy needed to raise the temperature of 1 pound of water by 1°F
   1 kilowatt-hour = 3,400 BTU's

   (a) Calculate the total energy (in BTU's) used to both heat the water and run the electric dishwasher to wash a load of dishes.

   (b) Calculate the energy (in BTU's) used to heat the water for washing the load of dishes by hand.

   (c) Discuss the economic and environmental costs and benefits of
      i) using the electric dishwasher (including its manufacture and disposal)
      ii) washing the dishes by hand

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2. Refer to the article and diagram below when answering the questions that follow.

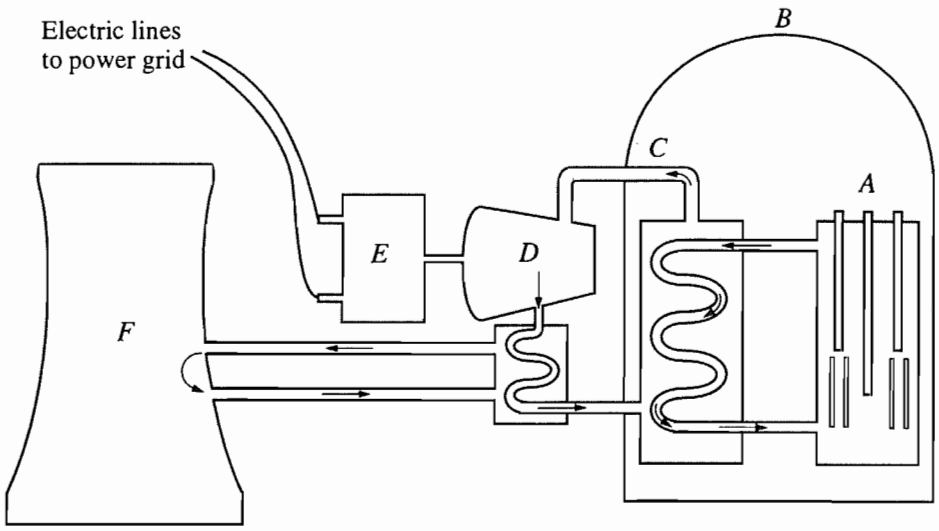
FUTURE OF NUCLEAR POWER IN DOUBT

A long decline for nuclear power in the United States began in the late 1970's when predictions that the price of oil would rise to $100 per barrel did not materialize. In 1979, the near-meltdown at the Three Mile Island nuclear plant in Pennsylvania alarmed the public over the potential hazards of nuclear power. These concerns were further exacerbated by the events at Chernobyl in 1986.

Societal concerns about nuclear power and increased costs associated with the construction and operation of nuclear generating plants have led to a virtual moratorium on new plant construction. In the United States, no new orders for nuclear power plants have been placed since 1979. Even Energy Department officials are now reluctant to predict that another nuclear reactor will ever be built in this country.

Nuclear power plants currently generate 21 percent of United States electricity and the 110 nuclear power plants across the nation are operating more efficiently and safely now than ever before. Some officials believe that if we do not continue research on nuclear energy, then we will not have a viable economy in 30 years.

DIAGRAM OF NUCLEAR POWER PLANT



(a) Identify and describe the function of any three parts labeled on the diagram of a water-cooled nuclear power plant shown above.

(b) Describe and discuss two environmental problems associated with the use of nuclear power for generating electricity.

(c) On the basis of the article and other information, what options do you foresee for the future production and use of electricity in the United States?

(d) Describe briefly the environmental implications of your answer in part (c).

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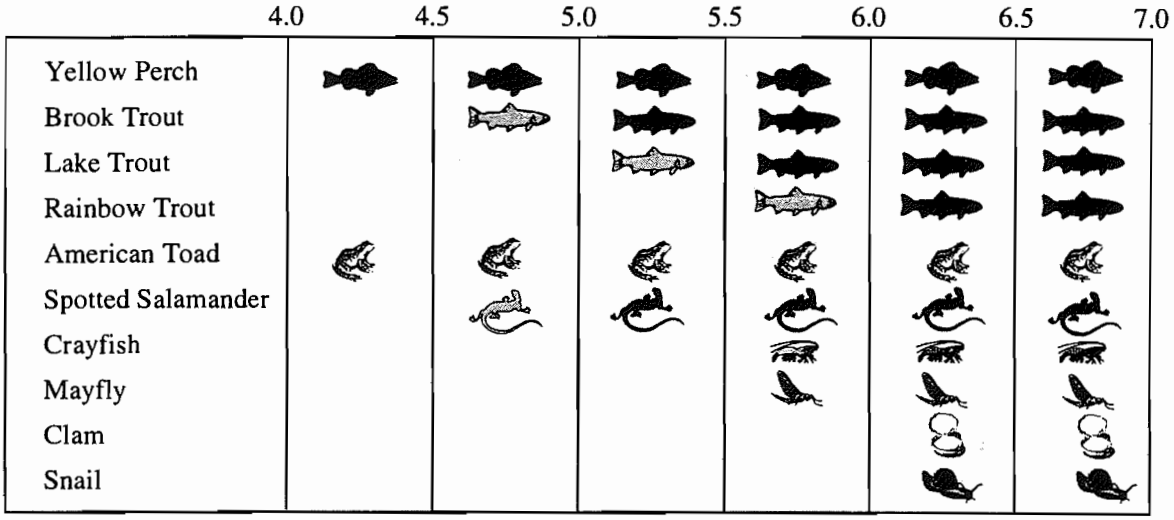
3. The diagram below represents the pH ranges in which selected aquatic organisms exist. The solid figures represent pH ranges in which the organism thrives. Shaded figures represent pH ranges in which conditions are less favorable, but in which the organism survives. No symbol is placed in a pH range in which that organism cannot survive. Using the diagram and your understanding of environmental principles, answer the following questions.

pH TOLERANCE



(a) Determine the pH range in which brook trout thrive. To what range of hydrogen-ion concentration, [H^+], does this pH range correspond?

(b) Which organism(s) might best provide an indication that a lake has changed from pH 5.8 to pH 5.2 ? Explain.

(c) Discuss how pH affects biodiversity in a freshwater community. Consider chemical, physiological, and ecological factors in your answer.

(d) Discuss the cause of lake acidification and describe potential ways to avoid or remediate it.

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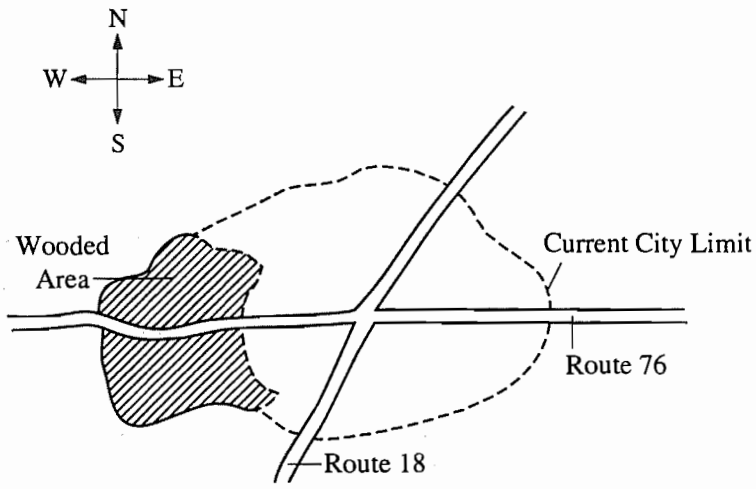
4.



Fremont

The map above shows the town of Fremont, where biologists have noted that the population of a certain species of bird has been declining over the past several years. This bird species is now found only in the wooded area on the western edge of the city. Developers view this wooded area as prime real estate and have recommended to the Fremont City Council that the area be zoned for single-family housing. A group of citizens concerned about the bird species and its habitat recommended to the council that future urban expansion be directed toward the eastern portion of the city and that the wooded area be preserved.

(a) Identify and briefly describe two federal laws or regulations that might apply to this situation.

(b) Assume that the Fremont City Council votes to preserve the wooded area. Explain the positive and negative consequences of this action. Include long- and short- term effects on the environmental, economic, and recreational needs of the citizens of Fremont.

(c) Assume that the Fremont City Council votes against preserving the wooded area. Propose and defend an alternative plan that both protects the bird species and provides for urban expansion.

END OF EXAMINATION