Practice Test 1

AP® Environmental Science Exam

SECTION I: Multiple-Choice Questions

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

At a Glance

Total Time
1 hour and 30 minutes
Number of Questions
80
Percent of Total Grade
60%
Writing Instrument
Pencil required

Instructions

Section I of this examination contains 80 multiple-choice questions. Fill in only the ovals for numbers 1 through 80 on your answer sheet.

Indicate all of your answers to the multiple-choice questions on the answer sheet. No credit will be given for anything written in this exam booklet, but you may use the booklet for notes or scratch work. 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. Here is a sample question and answer.

Sample Question	Sample Answer
Chicago is a	Ⓐ ● Ⓒ Ⓓ

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

Use your time effectively, working as quickly as you can without losing accuracy. Do not spend too much time on any one question. Go on to other questions and come back to the ones you have not answered if you have time. It is not expected that everyone will know the answers to all the multiple-choice questions.

About Guessing

Many candidates wonder whether or not to guess the answers to questions about which they are not certain. Multiple-choice scores are based on the number of questions answered correctly. Points are not deducted for incorrect answers, and no points are awarded for unanswered questions. Because points are not deducted for incorrect answers, you are encouraged to answer all multiple-choice questions. On any questions you do not know the answer to, you should eliminate as many choices as you can, and then select the best answer among the remaining choices.

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ENVIRONMENTAL SCIENCE
Section I
Time—1 hour and 30 minutes
80 Questions

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

1. Which of the following best explains how clearcutting contributes to climate change on a global scale?

   (A) Clearcutting requires prescribed burning, or setting controlled forest fires to reduce the occurrence of natural fires.

   (B) Clearcutting results in a loss of biodiversity and adds to the problems of endangered species and extinctions.

   (C) Clearcutting involves the burning of cut trees, which releases the greenhouse gas carbon dioxide.

   (D) Clearcutting removes plants and their root systems, leading to soil erosion and flooding.

2. Which of the following does NOT result from the melting of polar icecaps?

   (A) Increase in ocean acidification

   (B) Loss of habitat for ice-dwelling species

   (C) Release of the greenhouse gas methane

   (D) Decrease in albedo causing more warming

3. The release of stored energy when stress overcomes a locked fault results in which of the following?

   (A) Earthquake

   (B) Volcanic eruption

   (C) Mountain creation

   (D) Hot spot formation

4. The table below shows the four categories of ecosystem services.

Type	What is provided
Provisioning services	water, food, medicinal resources, raw materials, energy, ornaments
Regulating services	waste decomposition and detoxification, purification of water and air, pest and disease control and regulation of prey populations through predation, carbon sequestration
Cultural services	use of nature for science and education, therapeutic and recreational uses, spiritual and cultural uses
Supporting services	primary production, nutrient recycling, soil formation, pollination

Based on the information in the table, which of the following gives an example of the possible human consequences of the disruption of a provisioning service?

(A) Agricultural use of former parklands resulting in fewer recreational areas

(B) Rainforest destruction resulting in the loss of potential medicinal plant species

(C) Decline in wild bee populations resulting in less pollination and decreased crop yields

(D) Destruction of wetland habitats for real estate resulting in decreased carbon sequestration

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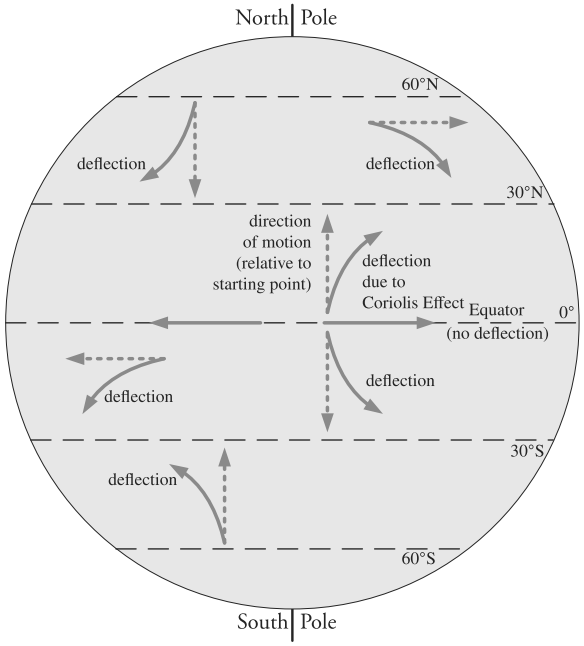


5. Which of the following phenomena are NOT influenced by the Coriolis effect shown in the diagram above?

   (A) Cyclones

   (B) Hadley cells

   (C) Tradewinds

   (D) El Niño–Southern Oscillation

6. Which of the following is the name for the land area that drains into a particular stream?

   (A) Delta

   (B) Estuary

   (C) Watershed

   (D) Headwaters

7. Which of the following factors limiting human population growth is density-independent?

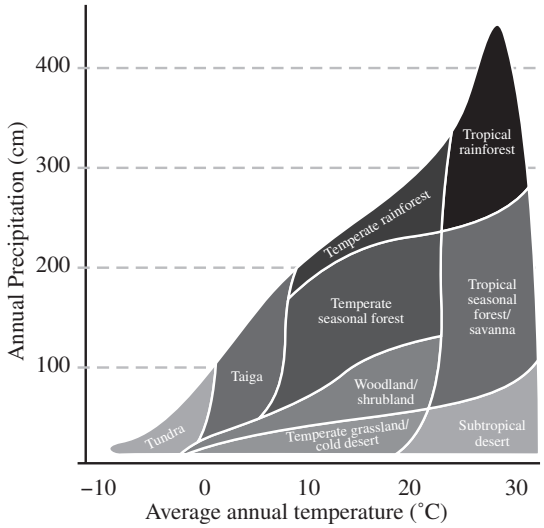
   (A) Access to clean air and water

   (B) Natural disaster frequency

   (C) Disease transmission

   (D) Food availability

Questions 8–10 refer to the following graph.



8. According to the graph, which biome would likely be found in a location with an average annual temperature above 20°C and average annual precipitation below 50 cm?

   (A) Tundra

   (B) Savanna

   (C) Subtropical desert

   (D) Temperate grassland

9. Which of the following does NOT help explain the relationship between temperature, precipitation, and biome shown in the graph?

   (A) Some vegetation types thrive only in very wet conditions.

   (B) The coldest and hottest temperatures both restrict plant life.

   (C) Drier regions cannot support as great a variety of vegetation as wetter ones can.

   (D) There are temperature extremes in which even the hardiest species cannot grow.

10. Which of the following types of vegetation would likely be found in a location with an average annual temperature below 10°C and average annual precipitation above 100 cm?

    (A) Conifer trees, fungi, mosses, lichens

    (B) Shrubs, grasses, herbs, tubers

    (C) Mosses, heath, lichens, algae

    (D) Cacti, succulents, grasses

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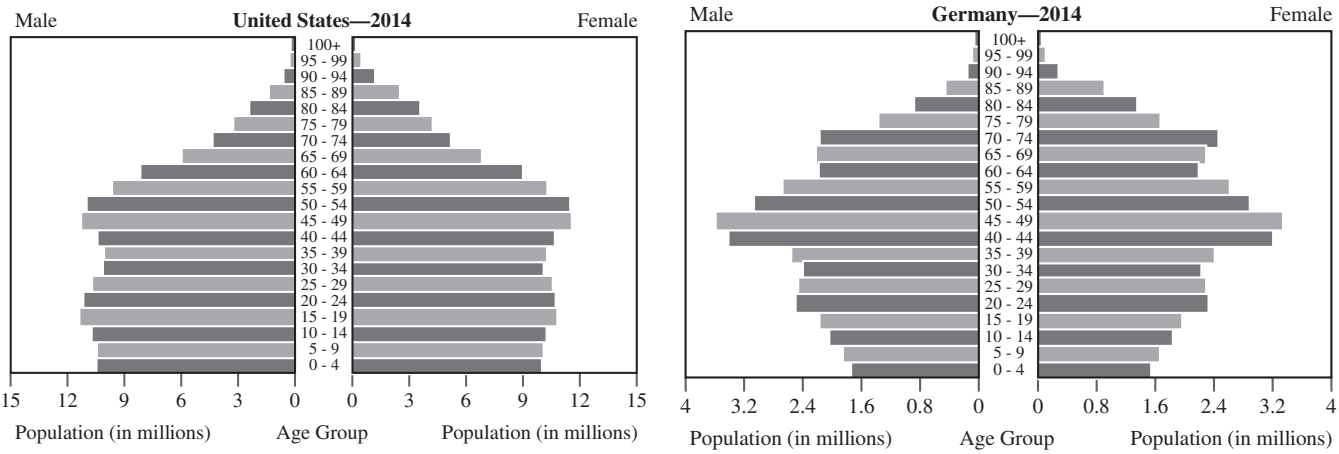
Questions 11–13 refer to the following diagrams.



11. Which comparison is valid according to the age-structure diagrams above?

    (A) In 2014 the U.S. had a slower-growing population than Germany did.

    (B) In 2014 Germany had a higher proportion of its population under 45 than the U.S. did.

    (C) In 2014 Germany's population included more people in the 45–49 age range than did the U.S. population.

    (D) In 2014 Germany's population showed negative growth while that of the U.S. showed close to zero growth.

12. Based on the information in the diagram above, where is it likely that Germany falls in the Demographic Transition Model?

    (A) Preindustrial State (Phase I)

    (B) Transitional State (Phase II)

    (C) Industrial State (Phase III)

    (D) Postindustrial State (Phase IV)

13. Based on the information in the diagram above, which of the following was likely true about the U.S. population in 2014?

    (A) The total fertility rate was between 1 and 2.

    (B) The total fertility rate was between 2 and 3.

    (C) The total fertility rate was between 3 and 4.

    (D) The total fertility rate was between 4 and 5.

14. Catalytic converters on automobiles use chemical reactions to convert pollutants from exhaust into less harmful substances. In order for a catalytic converter to function optimally when regular gasoline is used, a ratio of 14.7 air to 1 fuel is needed. However, certain kinds of fuel require different ratios. For example, E85, an ethanol fuel blend, requires 34% more fuel to balance the reaction. What is the approximate optimal ratio of air to E85 fuel?

    (A) 0.09 to 1

    (B) 1.34 to 1

    (C) 10.97 to 1

    (D) 14.7 to 1

15. Which of the following is NOT an aspect of the phosphorous cycle?

    (A) Precipitation returning atmospheric phosphorous to land and water

    (B) Geological uplift pushing phosphorous-containing rock to the ocean surface

    (C) Phosphorous from the soil and farming reaching the ocean via leaching and runoff

    (D) Decomposers breaking down phosphorous-containing plant and animal matter into soil

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Questions 16–17 refer to the following diagram.

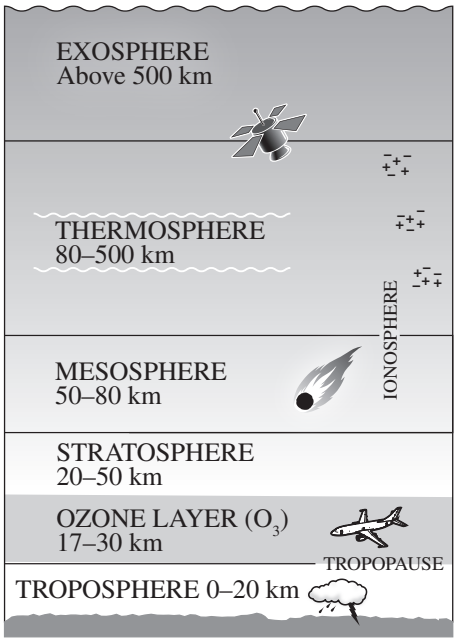


Diagram not to scale

16. Which of the following can be found in the tropopause?

    (A) The jet streams

    (B) The ozone layer

    (C) Aurora borealis and australis

    (D) The gases responsible for the greenhouse effect

17. Which of the following is the most common gas in the troposphere?

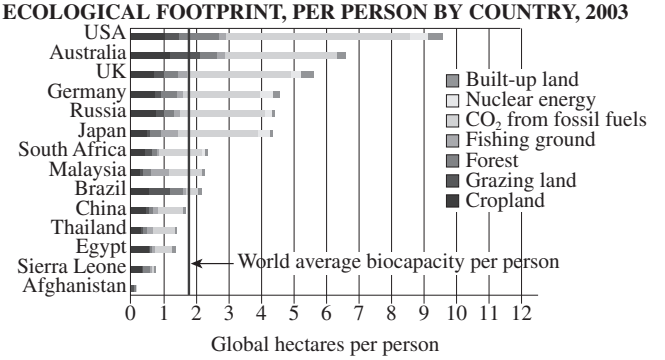
    (A) Oxygen

    (B) Nitrogen

    (C) Water vapor

    (D) Carbon dioxide

ECOLOGICAL FOOTPRINT, PER PERSON BY COUNTRY, 2003



18. According to the graph above, which of the following countries' ecological footprints lay below the world average biocapacity per person in 2003?

    (A) Afghanistan, Sierra Leone, and South Africa

    (B) United States, Australia, and the UK

    (C) China, Egypt, and Thailand

    (D) Brazil, Malaysia, and Japan

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Questions 19–21 refer to the following information.

Because soil conservation is of major interest in sustainable agriculture, methods of farming that slow erosion and help preserve soil are an integral part of sustainable farming technique. One such method, strip cropping, involves the partitioning of a farmed field into long, narrow strips and using a crop rotation system by alternating what is planted in them. The strips can be contoured to follow the landscape, and the strips are planted alternately with cover crops and row crops. The strips of cover crop serve to slow the flow of water off the other strips and thus prevent erosion on a large scale. If some areas are particularly eroded, permanent protective vegetation can be grown there. In addition, the crop rotation helps improve soil fertility by periodically changing which nutrients are being leached from the soil and which returned.

19. Which of the following is a potential benefit of strip cropping?

(A) Minimizing runoff

(B) Providing shelter from wind erosion

(C) Lessening the damage of overgrazing

(D) Reducing the erosion caused by tillage

20. A small farmer has purchased a new plot of land that she intends to cultivate using sustainable practices. The major issues she wishes to address on the plot include excessive wind erosion, low soil fertility after long-term monoculture, and soil loss due to runoff. Would using strip cropping help her address these issues?

(A) Yes, because strip cropping protects against wind erosion.

(B) No, because strip cropping is mainly used to slow soil erosion.

(C) No, because strip cropping will damage the soil fertility further.

(D) Yes, because strip cropping will slow runoff and improve soil fertility.

21. Which of the following sustainable agricultural practices has benefits similar to those of strip cropping?

(A) Terracing

(B) Windbreaks

(C) No-till farming

(D) Rotational grazing

22. Which of the following best explains the outcome in the scenario below?

A wildfire damages a forest habitat and kills the majority of several animal populations living there. All populations begin to recover, but a generalist animal species outcompetes a few specialist species in overlapping niches, and recovers much more quickly, changing the balance of the local ecosystem permanently.

(A) The specialist species have a disadvantage because there are several of them, and thus they recovered more slowly.

(B) The specialist species have an advantage in changing conditions that allowed them to recover more quickly.

(C) The generalist species has an advantage in changing conditions that allowed it to recover more quickly.

(D) The generalist species has the advantage of being invasive, which allowed it to recover more quickly.

23. Which of the following is NOT a reason why the Earth's Northern Hemisphere is hotter during its summer months?

(A) More direct light from the sun means the light has to pass through less atmosphere before it reaches the Earth's surface.

(B) More direct light from the sun means a given amount of light is concentrated into a smaller area.

(C) Shorter distance from the sun means less heat lost before it reaches the Earth.

(D) Longer daylight hours mean more sunlight for a given area per day.

24. Which of the following best describes the type of symbiotic relationship labeled "Type I" in the table below?

Interaction	Species A	Species B
Type I	receives benefit	receives benefit
Type II	receives benefit	not affected
Type III	receives benefit	harmed

(A) Commensalism

(B) Mutualism

(C) Parasitism

(D) Predation

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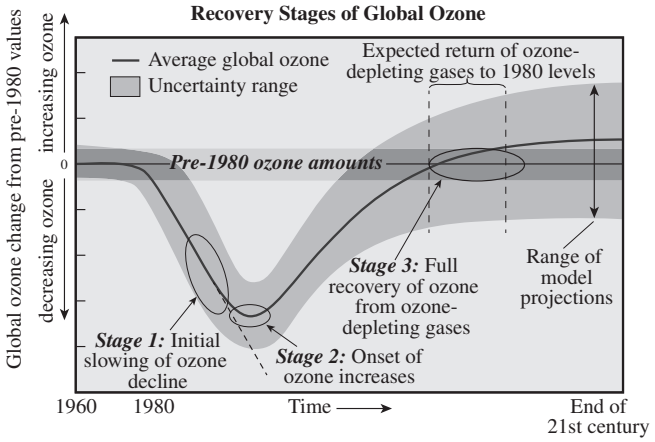
25. The diagram below shows the projected recovery of stratospheric ozone levels over the course of the current century according to several models.



What stage of this model is happening currently, according to the diagram?

(A) Stage 0: Rapid ozone decrease

(B) Stage 1: Initial slowing of ozone decline

(C) Stage 2: Onset of ozone increases

(D) Stage 3: Full recovery of ozone from ozone-depleting gases

26. A number of sheep are introduced to an island with plenty of grazing available, and the population increases rapidly. When the sheep population reaches its carrying capacity, which of the following is likely to occur?

(A) The population growth will continue to accelerate.

(B) The population growth will slow until it becomes constant.

(C) The population growth will stop as sheep choose not to reproduce until more resources are available.

(D) The population growth will overshoot the carrying capacity and some dieoff will occur until the resources available are adequate to sustain the population.

27. Which of the following is a source of atmospheric CO_2 for which humans are almost entirely responsible?

(A) Volcanism

(B) Respiration

(C) Combustion

(D) Decomposition

28. One major effect of global climate change is a rise in sea levels. This can cause several negative effects; which of the following is a possible positive effect of this change?

(A) Loss of estuary and shoreline habitats due to flooding

(B) Newly created marine habitats on flooded continental shelves

(C) Change in photic level, causing a lack of sunlight in ocean layers that were previously sunlit

(D) Loss of the protection from storm surge, tidal waves, and tsunamis afforded by mangroves and tidal marshes

29. Which of the following explains why biomagnification is a bigger problem in ocean life than in land animals?

(A) Marine food chains are longer.

(B) Marine ecosystems are more complex.

(C) Land animals encounter fewer pollutants.

(D) Land animals are less likely to ingest pollutants they encounter.

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30. The west Texas region known as the Permian Basin is rich in oil, natural gas, and potash reserves. Which of the following could explain why this region has such a wealth of petroleum resources compared to surrounding areas?

    (A) The basin is in a geographic region of long-term subsidence, the pressure of which has been brought to bear on large deposits of ancient sediment.

    (B) The basin is too far south to be subject to glaciation, which means that surface layers of rock have not been scraped away.

    (C) The basin is in a region of high tectonic activity, the pressure of which accounts for a large amount of metamorphic rock.

    (D) The basin was once the seabed of an ancient ocean, but geologic processes have lifted it up above sea level.

31. Which of the following is an advantage of concentrated animal feeding operations over free-range grazing?

    (A) More animals can be raised for meat in a smaller space, which is more cost-effective for producers and therefore less costly to consumers.

    (B) Less crowding means animals are less susceptible to disease and there is less need for antibiotics to treat livestock.

    (C) Organic waste from the animals can be used as fertilizer and tends to be free of contaminants.

    (D) Animals are fed grains or feed, which are not as suitable as grass and can contribute to disease.

32. Which of the following explains how soil protects water quality?

    (A) Soils are formed when rock is weathered, transported, and deposited by wind and water.

    (B) Soil with greater water holding capacity is more productive and fertile.

    (C) Water can erode soil, removing fertile layers and exposing bare rock.

    (D) Soils effectively filter and clean water that moves through them.

33. Which of the following approximates the amount of energy lost through two trophic levels?

    (A) 1%

    (B) 10%

    (C) 90%

    (D) 99%

34. Because of impervious surfaces such as roads, sidewalks, parking areas, and rooftops, an acre of city land generates about 5 times as much runoff as an acre of forest. Which of the following represents a method to help reduce urban runoff?

    (A) Solar panels

    (B) Carbon offsets

    (C) Contour plowing

    (D) Permeable pavement

35. Which of the following characteristics is most likely to protect a given species against becoming endangered or extinct?

    (A) Mobility

    (B) Limited diet

    (C) High number of competitors

    (D) Specific habitat requirements

36. Which of the following correctly describes the shift in pH involved in global ocean acidification?

    (A) A change from slightly acidic to slightly basic

    (B) A change from slightly basic to slightly acidic

    (C) A change from slightly basic toward pH-neutral

    (D) A change from pH-neutral toward slightly acidic

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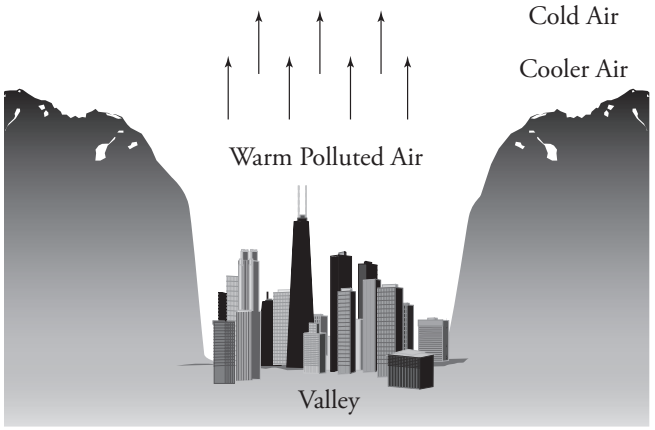
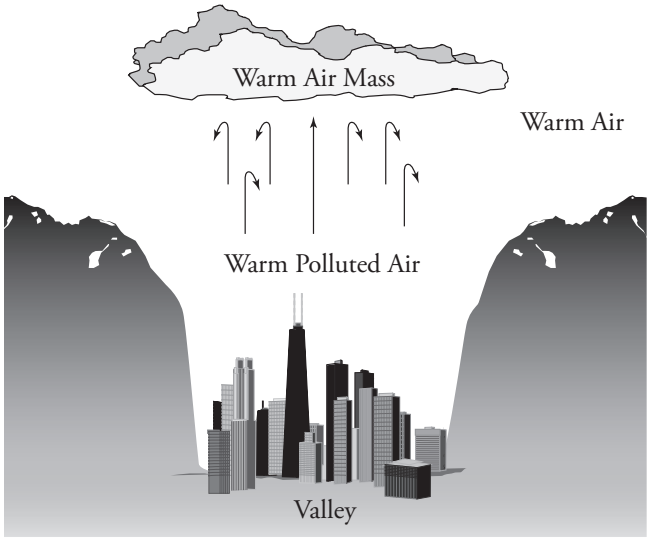
37. The drawings below show how temperature inversion works in cities surrounded by mountains.



Normal Conditions



A Temperature Inversion

An environmental scientist wants to measure the effects of her city's temperature inversion on the yearly average levels of certain pollutants in the city's air. Which of the following is a variable she will need to control for when gathering her data?

(A) Regulations affecting the pollutants she's interested in

(B) Output levels for the pollutants she's interested in

(C) Seasonal temperature variations

(D) Number of cars in the city

38. Each of the following is a drawback of aquaculture EXCEPT

(A) Contamination of wastewater

(B) Density can increase the incidence of disease

(C) Fish that escape may compete or breed with wild fish

(D) Small requirements in terms of growing space and fuel

39. Which of the following does NOT constitute a natural disruption to an ecosystem?

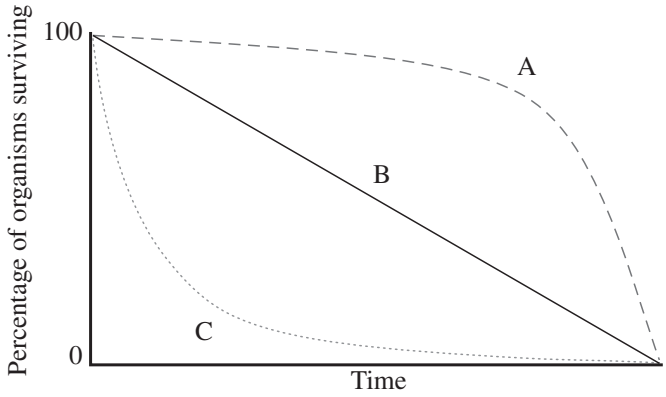
(A) Seasonal flooding due to monsoons, high tides, or snowmelts

(B) Periodic sea level changes due to increased glaciation during ice ages

(C) Local climate change resulting from atmospheric interference of volcanic ash

(D) Forest fires used as part of forest management strategies leading to ecological succession

40. Which of the following species has a survivorship curve most similar to the one labeled A in the model below?



(A) Moose

(B) Squirrel

(C) Sparrow

(D) Tree frog

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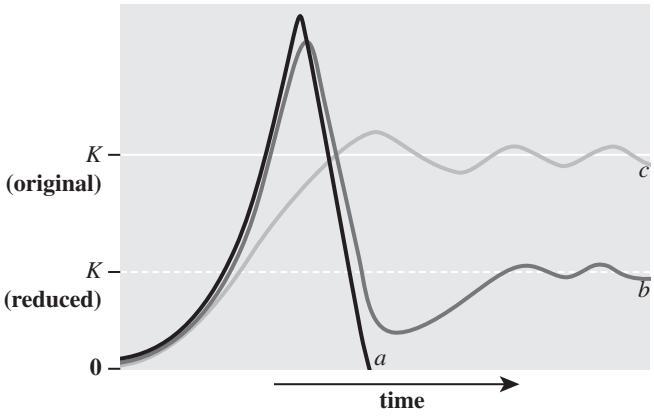
41. Which of the following describes Population *b* in the graph below?



(A) Its population growth continues accelerating because the resources it needs are unlimited.

(B) Its population growth overshoots its carrying capacity; its environment is extremely damaged and the population dies out.

(C) Its population growth overshoots its carrying capacity; its environment is damaged and the carrying capacity is permanently lowered.

(D) Its population growth overshoots its carrying capacity; its environment is only lightly damaged and the resources recover, along with the population.

42. Geothermal energy is used for heating and electricity generation. Which of the following uses of geothermal energy can function without any infrastructure being built?

(A) Geothermal district heating

(B) Geothermal hot spring baths

(C) Enhanced geothermal systems

(D) Binary cycle geothermal power plants

43. Which of the following energy sources produces variable renewable energy?

(A) Biomass

(B) Wind power

(C) Geothermal energy

(D) Dammed hydroelectricity

44. Which fossil fuel burns the cleanest in terms of CO_2 and particulate emissions?

(A) Coal

(B) Crude oil

(C) Petroleum

(D) Natural gas

45. An area of protected wetland is under environmental threat because runoff from nearby agriculture is polluting water faster than the wetland ecology can purify it, and some activists in the area are calling for a ban on pesticides and fertilizers in soil that drains into the area. Which of the following is a potential disadvantage to this plan?

(A) Wetland animal populations may suffer health effects from the pollutants.

(B) An increase in the health of the wetland ecosystem may provide niches for more species to succeed.

(C) Floods may increase if the wetland area, which likely provides a buffer zone against them, decreases.

(D) Other types of development may move in, bringing new sources of pollution, if farms' financial stability is harmed.

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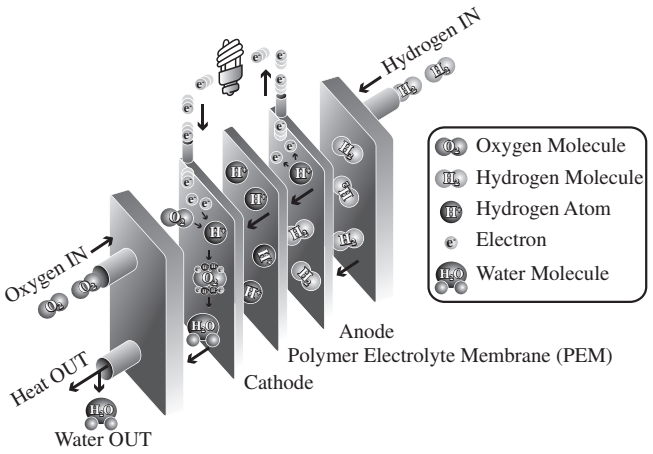
46. The diagram below shows how a hydrogen fuel cell functions.



Which of the following is a drawback of hydrogen fuel cells as a fuel source?

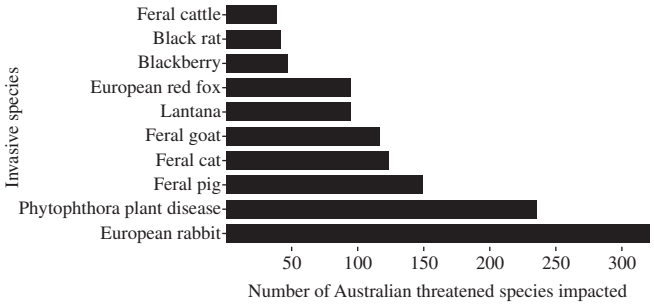
(A) Water is used as an input.

(B) Carbon dioxide, a greenhouse gas, is released.

(C) Energy is still needed to create the hydrogen gas used as input.

(D) Energy production from hydrogen fuel cells is highly inefficient.

47. The graph below shows the invasive species in Australia that have the greatest impact against native species there. Which of the following helps explain why the European rabbit has such an advantage in competing against native species?



(A) Rabbits are an *r*-selected, specialist mammal species; they reproduce rapidly and fit into a particular niche that tends to be rich in resources.

(B) Rabbits are an *r*-selected, generalist mammal species; they reproduce rapidly and use available resources at a faster rate than the varied native species with whom they compete.

(C) Rabbits are a *K*-selected, specialist mammal species; the greater investment of parents into offspring allows them to survive at a greater rate than the native species with whom they share a niche.

(D) Rabbits are a *K*-selected, generalist mammal species; the greater investment of parents into offspring allows them to survive at a greater rate than the varied native species with whom they compete.

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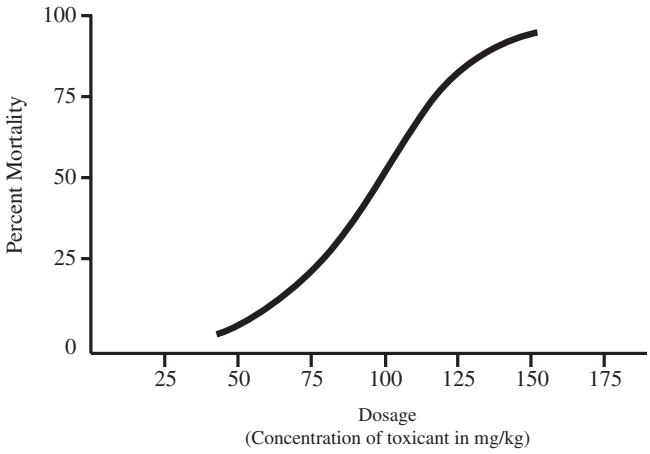
Questions 48–50 refer to the following information and graph.

Some researchers tested the effects of an unknown substance on a population of mice. The graph below shows the percent mortality of the mouse population against the concentration of the substance.



48. According to the graph, what is the approximate LD_{50} of the substance on this population?

(A) 5 mg/kg

(B) 80 mg/kg

(C) 100 mg/kg

(D) 120 mg/kg

49. Would the unknown substance in this experiment be considered a poison to the mouse population?

(A) No, because the mice may be able to detoxify the substance.

(B) No, because the LD_{50} of this substance is not 50 mg or less per kg of body weight.

(C) Yes, because the LD_{50} of this substance is 100 mg per kg of body weight.

(D) Yes, because the threshold dose of this substance is below 50 mg per kg of body weight.

50. In a second phase of the experiment, the researchers introduced a second, known substance along with the unknown substance, and then measured the effect of the two substances combined on the mouse population. Assuming that the new substance served to decrease toxicity, what can be said about the LD_{50} of the two-substance combination?

(A) It is less than 100 mg/kg.

(B) It is more than 100 mg/kg.

(C) It is now high enough that the substance will be considered a poison.

(D) It is low enough that the two-substance combination is considered non-toxic.

51. Which of the following is a natural factor that contributes to stratospheric ozone depletion?

(A) The El Niño–Southern Oscillation

(B) Upwelling of cold water in the Arctic and Antarctic zones

(C) An increase in the amount of UV rays that reach the Earth's surface

(D) Melting of ice crystals in the atmosphere at the beginning of the Antarctic spring

52. Which of the following explains why a population bottleneck may weaken the likelihood of a species' long-term survival?

(A) Bottleneck events reduce species richness in a given area.

(B) Fewer individuals left after a bottleneck event means that the population will never reach its former numbers.

(C) Bottleneck events reduce genetic diversity, which makes a species less likely to recover from further disruptions.

(D) Reduced genetic diversity after a bottleneck event means that the population will experience more genetic drift.

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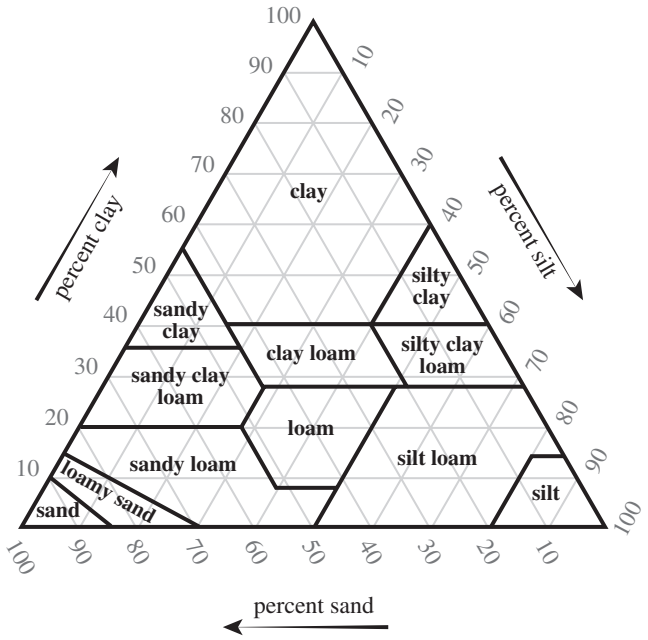
53. According to the soil texture triangle below, which type of soil is made up of 40% sand, 35% clay, and 25% silt?



(A) Clay

(B) Clay loam

(C) Sandy loam

(D) Silty clay loam

54. Which of the following describes the range of conditions (such as salinity, temperature, sunlight, etc.) in which an organism can live, and outside of which death or injury might occur?

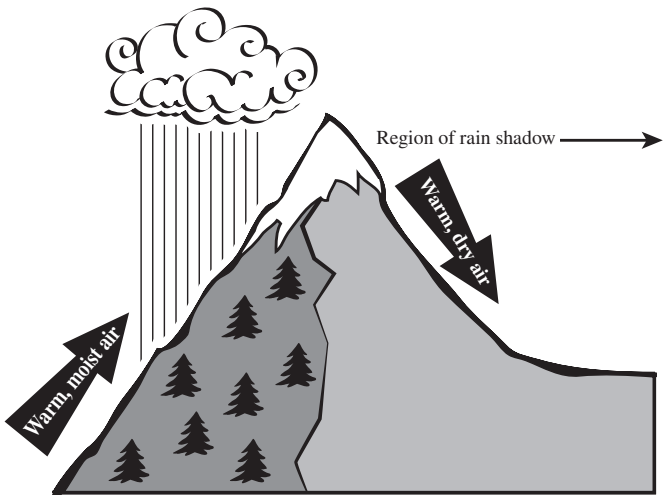
(A) Ecological succession

(B) Ecological tolerance

(C) Species distribution

(D) Biodiversity

55. Which of the following gives the correct order of events leading to the rainshadow effect shown below?



(A) Warm, moisture-laden air from over a body of water moves toward the mountain—as the air rises it cools and water vapor condenses—precipitation removes water vapor from the air—dry air remains on the other side of the mountain, creating a desert climate

(B) Cool, moisture-laden air from over a body of water moves toward the mountain—as the air rises it warms and water vapor condenses—precipitation removes water vapor from the air—dry air remains on the other side of the mountain, creating a desert climate

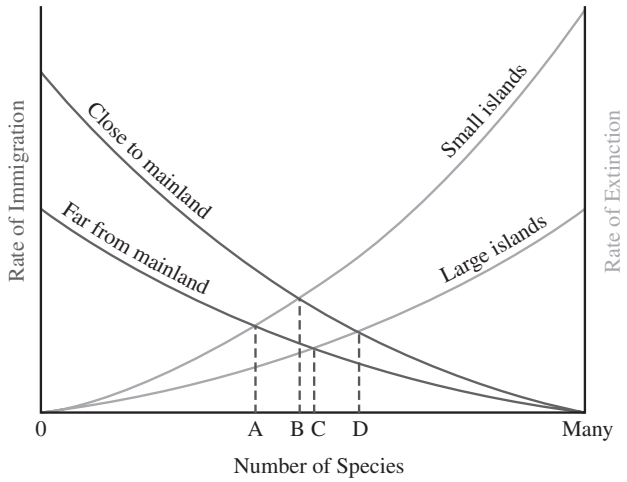
(C) Warm, moisture-laden air from over a body of water moves toward the mountain—as the air rises it cools and water vapor condenses, but since it does not fall a desert climate is produced—precipitation falls on the other side of the mountain

(D) Cool, moisture-laden air from over a body of water moves toward the mountain—as the air rises it warms and water vapor condenses, but since it does not fall a desert climate is produced—precipitation falls on the other side of the mountain

GO ON TO THE NEXT PAGE.

Questions 56–57 refer to the following passage and graph.

The theory of island biogeography describes the number of species found on an undisturbed island or other isolated area in terms of two factors: immigration and extinction.



56. According to the graph, which of the following characterizes islands with the greatest species richness?

(A) Large islands close to the mainland

(B) Small islands close to the mainland

(C) Large islands far from the mainland

(D) Small islands far from the mainland

57. Which of the following could explain why invasive species tend to outcompete native ones when introduced to islands or isolated areas?

(A) Since limited resources on islands push local species to evolve to be generalists, more specialist mainland species have a short-term advantage in competition.

(B) Since limited resources on islands push local species to evolve to be specialists, more generalist mainland species have a short-term advantage in competition.

(C) Both island and mainland species tend to evolve to be specialists, but the greater distance traveled by mainland species leads island species to outcompete them.

(D) Both island and mainland species tend to evolve to be generalists, but the greater number of mainland species outcompetes the fewer island species.

58. One major source of noise pollution in urban environments is yard maintenance tools, especially the leaf blower. All of the following are more environmentally friendly alternatives to the use of this device EXCEPT

(A) Using lawn care services rather than individual homeowners being responsible

(B) Leaving leaves and other debris in place as mulch

(C) Using lawn space for gardens rather than grass

(D) Using a rake

59. Which of the following is associated with the cooler "La Niña" portion of the El Niño–Southern Oscillation?

(A) Air pressure high in the western Pacific and low in the eastern Pacific

(B) Air pressure high in the eastern Pacific and low in the western Pacific

(C) Air pressure high in the northern Pacific and low in the southern Pacific

(D) Air pressure high in the southern Pacific and low in the northern Pacific

60. Which of the following is an assumption made in the passage below?

Bisphenol A (BPA) is a known endocrine disruptor that is found in the linings of metal food cans, in plastic containers and bottles, and in the coating found on most receipt paper. Animal studies have shown that low levels of BPA are correlated with higher rates of mammary and prostate cancers, diabetes, low sperm count, early puberty, neurological problems, and obesity. Its effects seem to be greatest during early developmental stages, such as the prenatal stage. Therefore, BPA should be more actively banned from household and everyday products, especially baby formula packaging.

(A) BPA causes cancers after exposure during any stage of life.

(B) BPA's effects on animals are not similar to its effects on humans.

(C) Most obesity is caused by either BPA exposure or lifestyle factors.

(D) BPA has not recently been banned from use in household products and on receipt paper.

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61. Which of the following greenhouse gases has the LEAST impact on global climate change?

(A) CO_2

(B) CFCs

(C) Methane

(D) Water vapor

62. The acronym HIPPCO describes the main factors leading to a decrease in biodiversity. Which of the following gives four of these factors?

(A) Habitat destruction, invasive species, population movements, and coastal displacement

(B) Habitat destruction, increase in greenhouse gases, pollution, and ocean acidification

(C) Invasive species, polar warming, climate change, and ozone depletion

(D) Invasive species, population growth, pollution, and climate change

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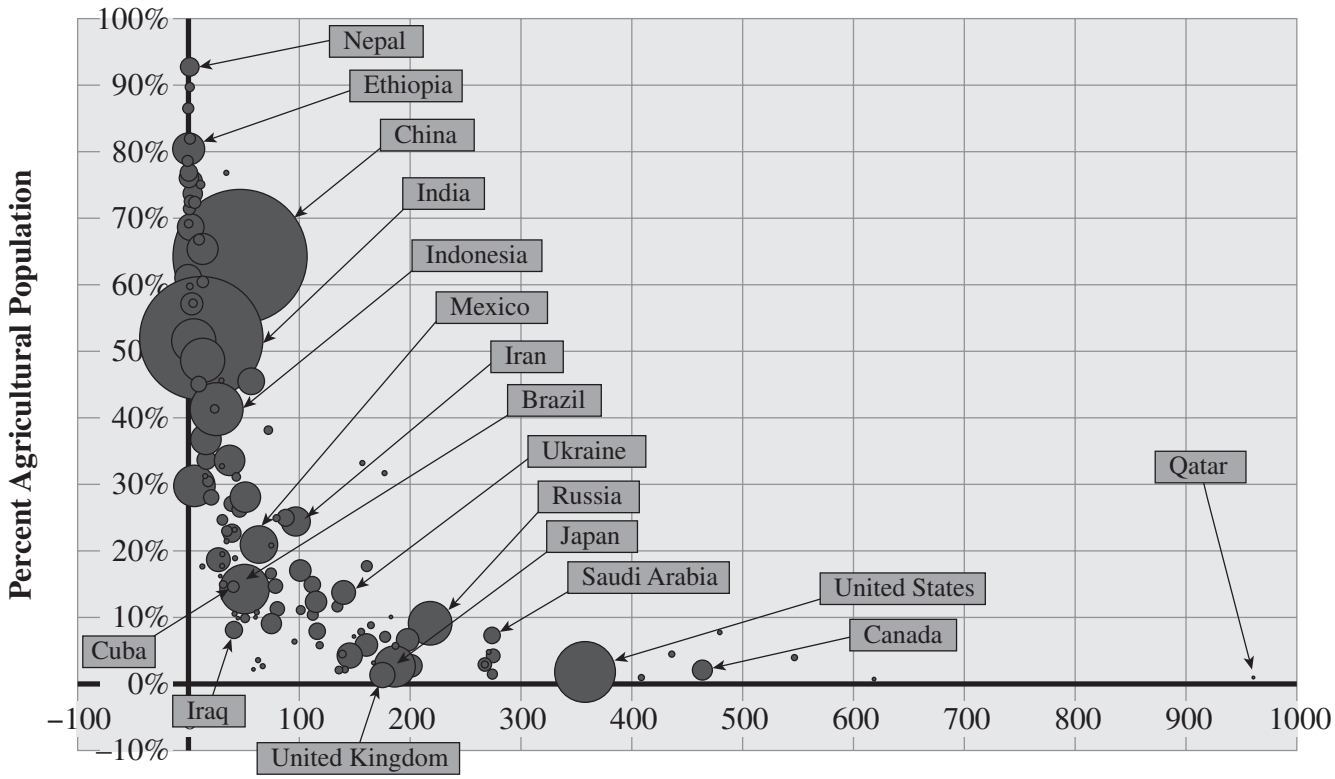
Question 63 refers to the following graph.

Energy Consumption and Agricultural Population for 205 countries, 2004



63. Which of the following best explains the trend in the graph above?

(A) Countries with higher population use more energy.

(B) Countries with lower population tend to use more energy per person.

(C) Countries with lower agricultural populations are more industrialized and have higher energy demands.

(D) Countries with higher agricultural populations are more mechanized and have higher energy demands.

64. Which of the following gives both an advantage and a disadvantage of the mechanization of farming practices that took place during the Green Revolution?

(A) Mechanization increased profits but required reliance on genetically modified organisms.

(B) Mechanization greatly increased efficiency on farms and also increased reliance on fossil fuels.

(C) Mechanization increased the use of pesticides and the overuse of water resources for irrigation.

(D) Mechanization made it easier to grow whole fields of the same crop, leaving farmers susceptible to disaster if pests or disease affected a specific crop too much.

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Questions 65–67 refer to the following information.

Sick Building Syndrome (SBS) refers to a medical condition in which people who live or work in a given building develop shared symptoms that are unexpected and ultimately trace back to the building itself. Usually the main culprit is poor indoor air quality due to the presence of pollutants, including gases (such as radon, carbon monoxide, and VOCs), particulates (from sources such as tobacco smoke, indoor fires, and asbestos), and microbial contaminants (such as mold or bacteria). Ways to alleviate symptoms and prevent continued sickness include thorough cleaning; fixing problems in ventilation, heating, and air conditioning systems; eliminating sources of pollutants; and using indoor plants to improve air quality.

65. Which of the following is NOT usually a component of indoor air pollution, according to the information above?

(A) VOCs

(B) Hydrocarbons

(C) Mold and bacteria

(D) Particulates from smoke

66. A building manager suspects that a certain number of sicknesses in employees in the building are due to Sick Building Syndrome and takes certain measures to reduce the problem. She arranges for an expert diagnosis and repair of the building's HVAC system and also has the carpets and walls professionally cleaned. Which of the following needs to be true for her plan to be successful?

(A) The indoor air quality in the building is being adversely affected by pollutants.

(B) The employees all spend a minimum of 8 hours in the building per workday.

(C) Mold is the factor responsible for a majority of the sickness.

(D) The carpet is releasing VOCs through off-gassing.

67. Which of the following proposed solutions to the problems of indoor air pollution and Sick Building Syndrome would have the most far-reaching effects?

(A) An initiative providing low-cost cleaning for affected buildings

(B) A safety requirement for radon detectors to be installed in all office buildings

(C) A tax leveraged against businesses that do not provide employees suspected to have SBS with paid sick leave

(D) Building codes addressing multiple sources of indoor air pollution and requiring their prevention in all new construction

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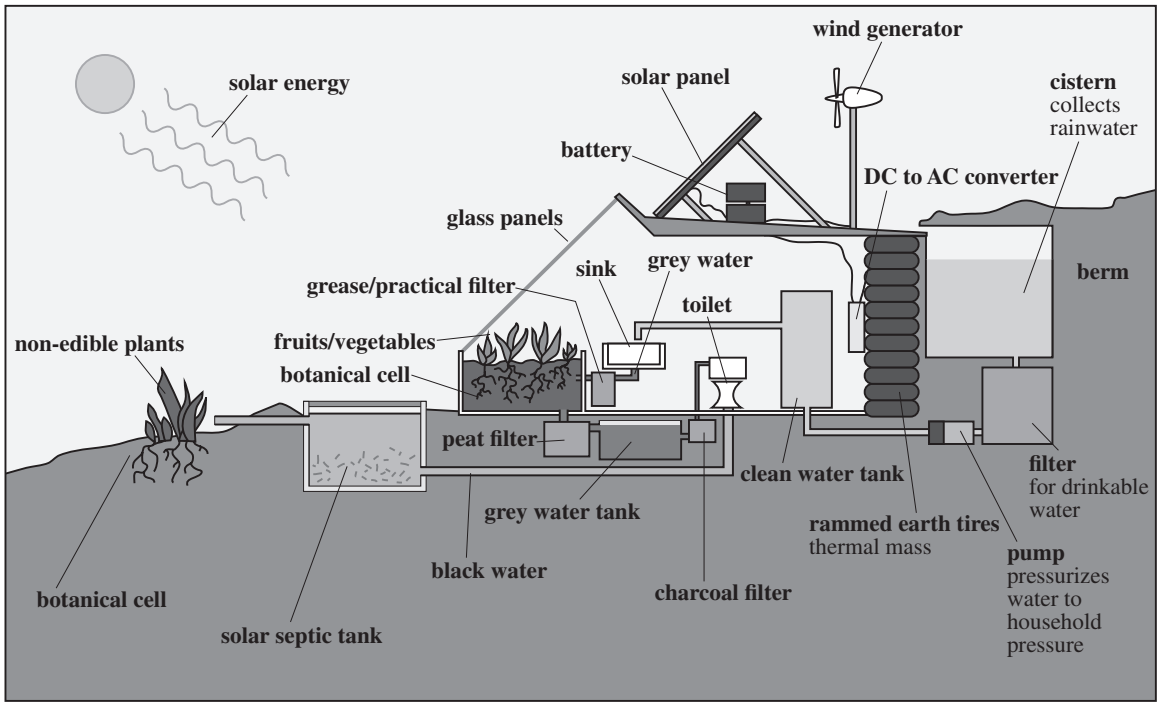
Questions 68–70 refer to the diagram below of the workings of an "earthship" passive house.



68. Which type(s) of solar energy does the house employ?

I. Passive solar energy system(s)
II. Active solar energy system(s)
III. Photovoltaic solar cells

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

69. The house uses each of the following methods to conserve energy and resources EXCEPT

(A) Hydroelectric power
(B) Rainwater collection
(C) Wind energy
(D) Solar energy

70. At the right side of the diagram, to the left of the labeled cistern, is a wall made of rammed earth tires labeled "thermal mass." With which of the following types of energy conservation does this feature help?

(A) Greywater reuse
(B) Rainwater collection
(C) Passive solar heating
(D) Solar and wind energy collection

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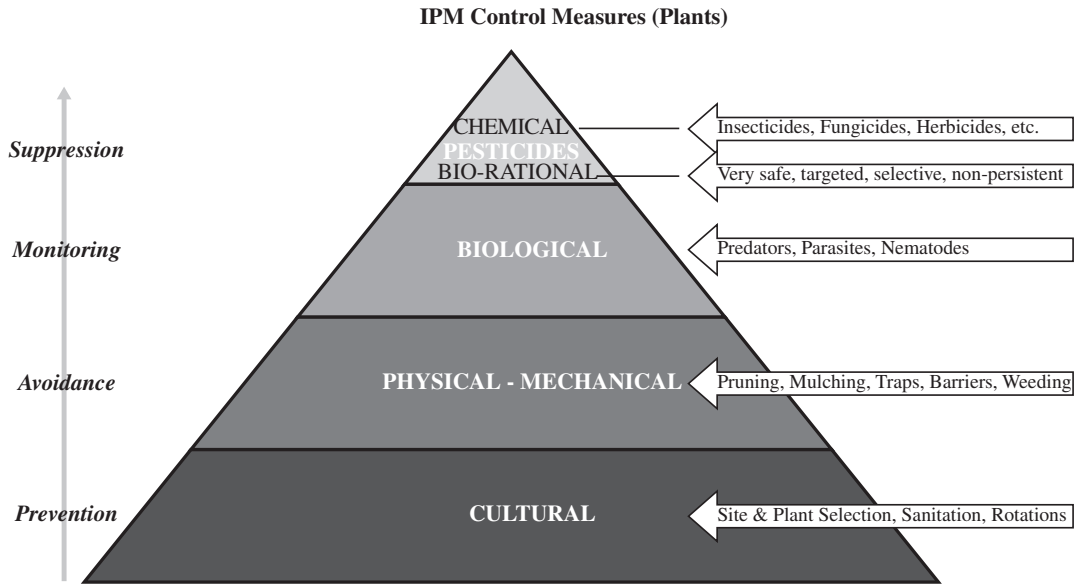
71. The diagram below shows the hierarchy of steps involved in Integrated Pest Management, and some examples for each step.



Which of the following are potential disadvantages of Integrated Pest Management?

(A) It can be rigid and might be inadequate for certain environments.

(B) It can be complex and expensive to implement.

(C) It can lessen disruptions to the local biome.

(D) It can minimize threats to human health.

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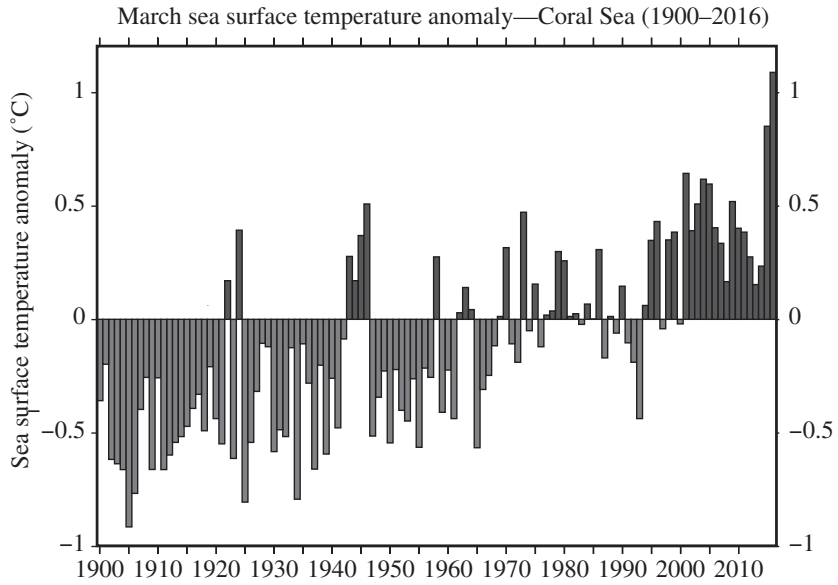
72. The graph below shows a trend in sea surface temperatures at the Great Barrier Reef over a period of 116 years.



Given that temperatures 1°C above average can cause bleaching, in which year did a mass bleaching event last long enough to still be occurring in March?

(A) 1942

(B) 1966

(C) 2008

(D) 2016

73. All of the following are ways global climate change can cause widespread habitat destruction EXCEPT

(A) Rise in sea level

(B) Increase in pollution

(C) Temperature changes

(D) Change in amounts of precipitation

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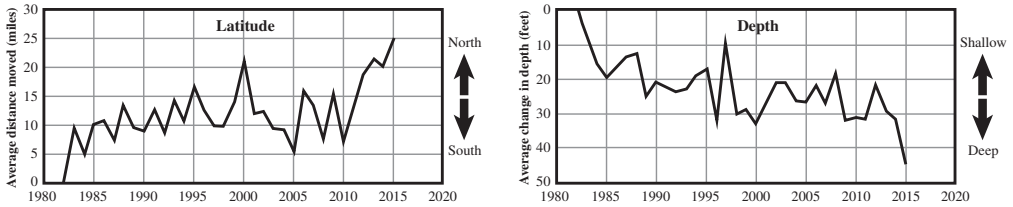
Questions 74–76 refer to the following graphs.

Two graphs, showing the movement of the mean latitude and mean depth of a single given marine species over time, are shown below.

Change in Latitude and Depth of Marine Species, 1982–2015



Data source: NOAA (National Oceanic and Atmospheric Administration) and Rutgers University. 2016. OceanAdapt. http://oceanadapt.rutgers.edu.

74. According to the graphs, which of the following characterizes the average movement of the given species between 1999 and 2000?

(A) Small amount of drift southward and small decrease in depth

(B) Small amount of drift northward and small decrease in depth

(C) Significant drift northward and small increase in depth

(D) Significant drift southward and small increase in depth

75. Which of the following could explain the trends shown in the graphs—the species moving both northward and deeper over time?

(A) Ocean warming has caused the species to move toward areas that were once warmer than the temperature range to which it is adapted.

(B) Ocean cooling has caused the species to move toward areas that were once warmer than the temperature range to which it is adapted.

(C) Ocean warming has caused the species to move toward areas that were once cooler than the temperature range to which it is adapted.

(D) Ocean cooling has caused the species to move toward areas that were once cooler than the temperature range to which it is adapted.

76. Which of the following gives the approximate total net change in distance and depth of this species for the years measured?

(A) 17 miles north and 44 feet deeper

(B) 25 miles north and 23 feet deeper

(C) 25 miles north and 44 feet deeper

(D) 17 miles north and 23 feet deeper

77. Burning biomass releases CO_2. How can some biomass energy generation still be considered carbon-negative?

(A) Photosynthesis cycles the CO_2 back into new crops.

(B) Some biomass use falls below the allowable threshold for CO_2 emissions.

(C) Some plant and animal material used as biomass grows quickly enough to replace what's used.

(D) Biomass burning produces air pollution in the form of carbon monoxide and volatile organic compounds.

78. Which of the following is NOT a characteristic of a population in the transitional state of the Demographic Transition Model?

(A) High birth rate

(B) Lowered death rate

(C) High infant mortality

(D) High level of education for women

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79. Malaria is a widespread disease, particularly in the tropical and subtropical regions, that claims hundreds of thousands of lives each year worldwide. Which of the following is a factor that may cause an increase in malaria cases?

    (A) Climate change

    (B) Drug resistance

    (C) Development of a malaria vaccine

    (D) More widespread use of mosquito netting

80. Which of the following is NOT likely to be true about an *r*-selected species?

    (A) They tend to have small body size.

    (B) Their life expectancy tends to be long.

    (C) They may reproduce only once in their lifespans.

    (D) Competition for resources in their habitat is relatively low.

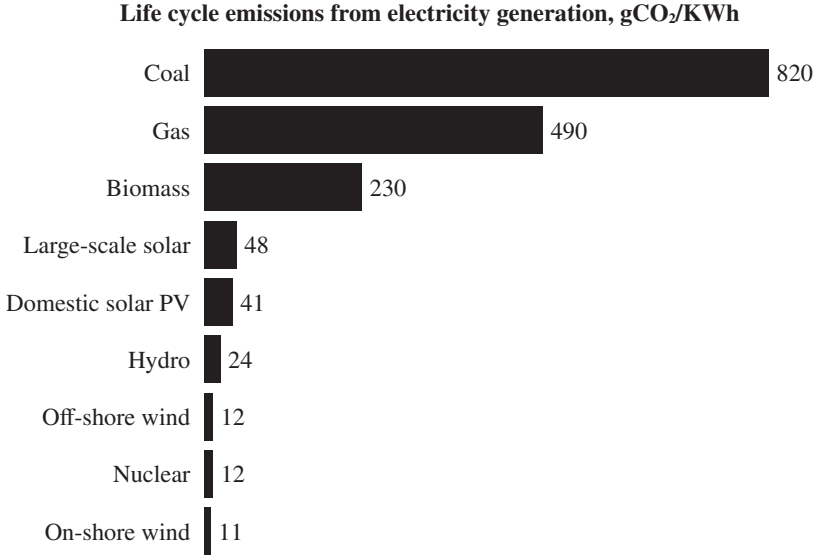
END OF SECTION I

ENVIRONMENTAL SCIENCE

SECTION II
Time—1 hour and 10 minutes
3 Questions

Directions: Answer all three questions, which are weighted equally; the suggested time is about 23 minutes for answering each question. 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. A state has a 10-year plan to reduce its CO_2 emissions by half, which involves the construction of wind farms. The graph below shows a comparison of several energy sources in terms of their CO_2 emissions.



(a) Using the graph, **identify** the three energy sources with the least CO_2 emissions and **explain** why the construction of wind farms is a good choice for the state in terms of meeting its goal.

(b) **Explain** how wind farms convert the kinetic energy of wind into electricity.

(c) The energy commission has tasked a team with predicting the success of the 10-year plan based on a preliminary trial of two years after the construction of the first wind farm. The team plans to monitor energy generation at the plant over the course of the two years and make predictions based on that and the data they already have about the amount of energy used and emissions generated while building the farm.

i. **Describe** TWO other pieces of data the team must have in order for the commission to be able to accurately predict what difference each comparable wind farm will make in terms of the goal of reduction of CO_2 emissions.

ii. If the majority (assume 100%) of the state's energy production prior to this trial was based on coal, **calculate** the approximate difference in CO_2 emissions per kilowatt-hour it will see if the new (on-shore) wind farms are able to supply 60% of the state's energy budget. **Show** your work.

iii. The commission claims that if the new wind farms are able to supply 60% of the state's energy budget, then the goal of 50% CO_2 emissions reduction will have been met. **Justify** this claim using the calculation above.

iv. **Identify** ONE real-world reason why a given wind farm might produce less energy than expected.

(d) The state's plan to reduce CO_2 emissions is focused solely on energy production. **Identify** TWO ways to reduce CO_2 emissions that are based instead in conservation (reducing energy use).

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2. Below is a chart showing the stages of sewage treatment at a typical city water treatment facility.

Stage	Process	Byproduct	Filtered out
Physical Treatment	Filtering through screens		Larger debris
Primary Treatment	Chemical treatment and settling	Sludge	Suspended solids: 60% Organic waste: 30%
Secondary Treatment	Treatment with aerobic bacteria and settling	Sludge	Suspended solids: 97% Organic waste: 96% Toxic metals: 70% Organic chemicals: 70% Nitrogen: 50% Dissolved salts: 5%
Chlorination	Treatment with chlorine to remove any remaining living cells		

(a) **Identify** ONE pollutant that is NOT removed by this process.

(b) **Explain** how secondary treatment works to remove the wastes and pollutants it does.

(c) Sewage treatment of this type has byproducts that can be used.
   i. **Identify** TWO possible byproducts that are usable.
   ii. **Explain** how each can be used beneficially.

(d) The final stage identified in the table above, chlorination, sometimes causes the formation of trihalomethanes.
   i. **Explain** why this byproduct is undesirable.
   ii. **Propose** an alternate method that might reduce or avoid this negative effect, and **give one reason** this method has not been preferred to chlorination.

(e) Normally, after the final stage above, treated water is discharged into a city's streams, the ocean, or the city's gray water supply. Some cities prefer to discharge back into the groundwater. **Describe** what additional steps are necessary to make this acceptable under U.S. regulations.

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3. Emeka wants to use the roof of the small house he built to collect rain. He intends to use it to irrigate his garden, and to supplement the municipal water source he is hooked up to for household use. He installs a rain collection barrel in his yard, and a downspout from the roof to fill it. Over the course of the following spring, his area gets about 25 centimeters of rain. The dimensions of the roof are 2.5 meters by 8 meters.

   (a) **Describe** ONE environmental benefit of urban rainwater collection.

   (b) Emeka's collection system is in operation without any changes for the length of one spring.
      i. **Calculate** the volume of rain he collects over that whole season, in cubic meters, by finding the volume of an imaginary rectangular prism with the dimensions of his roof as length and width, and the amount of rainfall as height (remember that the volume of a rectangular prism is length × width × height). Assume that he is using the water at a rate that assures his collection barrel does not overflow and no water is wasted. **Show** your work.
      ii. **Calculate** the amount of rainwater collected in liters. Convert the total volume of water Emeka collects into liters using the fact that a cube of side length 10 cm has a volume of 1 liter (remember that the volume of a cube is its side length cubed). Then convert the total volume to gallons (recalling that a gallon is about 3.785 liters), rounding to the nearest gallon. **Show** your work.
      iii. **Calculate** the average rate of his water collection to the nearest tenth in gallons per week if the spring lasts 13 weeks. **Show** your work.

   (c) Rainwater is a relatively clean water source, but using a roof to collect it can introduce pollutants from the air (as well as bird droppings, moss, lichens, and dust) and make it non-potable. **Identify** TWO human-made pollutants likely to be found in rainwater collected this way in an urban setting.

   (d) In order to use the water for dishes, bathing, and drinking, Emeka installs a filter system to remove contaminants and make it potable. Before he installed his rainwater collection system, his normal water use (for only himself in his small house) averaged 175 gallons per week. He pays for his municipal water use at a flat rate of 0.75¢ per gallon. At this rate, **calculate** how much money will he save per week now that he is supplementing with rainwater at the rate you found in part (b) (iii). **Show** your work.

   (e) Emeka's longer-term goal is to collect enough water to be able to disconnect himself from the municipal water supply. To do this, he plans to install another rainwater collection barrel on the roof of his garden patio, which is 3 meters wide by 5 meters long. He claims this will meet his goal by making up for what he's been using from the municipal supply. **Calculate** the amount of water he'll collect per week (assuming the same average amount of rainfall) in this barrel as you did in part (b). **Show** your work. Then use it to **justify** Emeka's claim.

STOP

END OF EXAM

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Completely darken bubbles with a No. 2 pencil. If you make a mistake, be sure to erase mark completely. Erase all stray marks.

1. YOUR NAME: _____
(Print) Last First M.I.

SIGNATURE: _____ **DATE:** ___/___/___

HOME ADDRESS: _____
(Print) Number and Street

_____
City State Zip Code

PHONE NO. : _____
(Print)

IMPORTANT: Please fill in these boxes exactly as shown on the back cover of your test book.

2. TEST FORM

3. TEST CODE

0	A
1	B
2	C
3	D
4	E
5	F
6	G
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4. REGISTRATION NUMBER

0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
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6	6	6	6	6	6
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5. YOUR NAME

First 4 letters of last name					FIRST INIT	MID INIT
A	A	A	A		A	A
B	B	B	B		B	B
C	C	C	C		C	C
D	D	D	D		D	D
E	E	E	E		E	E
F	F	F	F		F	F
G	G	G	G		G	G
H	H	H	H		H	H
I	I	I	I		I	I
J	J	J	J		J	J
K	K	K	K		K	K
L	L	L	L		L	L
M	M	M	M		M	M
N	N	N	N		N	N
O	O	O	O		O	O
P	P	P	P		P	P
Q	Q	Q	Q		Q	Q
R	R	R	R		R	R
S	S	S	S		S	S
T	T	T	T		T	T
U	U	U	U		U	U
V	V	V	V		V	V
W	W	W	W		W	W
X	X	X	X		X	X
Y	Y	Y	Y		Y	Y
Z	Z	Z	Z		Z	Z

6. DATE OF BIRTH

Month	Day		Year	
JAN				
FEB				
MAR	0	0	0	0
APR	1	1	1	1
MAY	2	2	2	2
JUN	3	3	3	3
JUL		4	4	4
AUG		5	5	5
SEP		6	6	6
OCT		7	7	7
NOV		8	8	8
DEC		9	9	9

7. SEX
- MALE
- FEMALE

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Section I

Start with number 1 for each new section.
If a section has fewer questions than answer spaces, leave the extra answer spaces blank.

1. A B C D	21. A B C D	41. A B C D	61. A B C D
2. A B C D	22. A B C D	42. A B C D	62. A B C D
3. A B C D	23. A B C D	43. A B C D	63. A B C D
4. A B C D	24. A B C D	44. A B C D	64. A B C D
5. A B C D	25. A B C D	45. A B C D	65. A B C D
6. A B C D	26. A B C D	46. A B C D	66. A B C D
7. A B C D	27. A B C D	47. A B C D	67. A B C D
8. A B C D	28. A B C D	48. A B C D	68. A B C D
9. A B C D	29. A B C D	49. A B C D	69. A B C D
10. A B C D	30. A B C D	50. A B C D	70. A B C D
11. A B C D	31. A B C D	51. A B C D	71. A B C D
12. A B C D	32. A B C D	52. A B C D	72. A B C D
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16. A B C D	36. A B C D	56. A B C D	76. A B C D
17. A B C D	37. A B C D	57. A B C D	77. A B C D
18. A B C D	38. A B C D	58. A B C D	78. A B C D
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20. A B C D	40. A B C D	60. A B C D	80. A B C D