2025

AP®

AP® Environmental Science

Free-Response Questions
Set 1

ENVIRONMENTAL SCIENCE

SECTION II

TIME – 1 HOUR AND 10 MINUTES

Directions:

Section II has 3 free-response questions and lasts 1 hour and 10 minutes.

If you are asked to explain, describe, or justify, respond in complete sentences and support your answers with relevant information and/or specific examples. Do not spend time restating the questions or providing more than the number of examples called for.

A calculator is available in this application and can be accessed throughout the exam.

For the parts of question 3 where calculations are required, clearly show how you arrived at your answer. You do not need to include units unless indicated. Use your keyboard for the following math expressions and symbols:

- Multiplication: use an "x" or asterisk (*)
  Example: 4 x 5 or 4 * 5

- Division and Fractions: use a forward slash (/)
  Example: 17 / 5

- Degrees: write "degrees"
  Example: 25 degrees C

- Grouping: use parentheses
  Example: (2+3) / (7-5)

Within the application, you can enter subscript or superscript, but the following methods are also acceptable:

- Subscript: use an underscore (_)
  Example: CO_2

- Superscript: use a caret (^)
  Example: 10^12

You may pace yourself as you answer the questions in this section, or you may use these optional timing recommendations:

The suggested time is about 22 minutes for each question.

You may use the available paper for scratch work, but credit will only be given for responses entered in this application. Text you enter as an annotation will **not** be included as part of your answer. For questions that have sub-parts, be sure to label those clearly in your answer.

You can go back and forth between questions in this section until time expires. The clock will turn red when 5 minutes remain—**the proctor will not give you any time updates or warnings.**

Note: This exam was originally administered digitally. It is presented here in a format optimized for teacher and student use in the classroom.

Chickadees are a K-selected species of bird that eat insects and spiders. Spiders consume insects, and many insects consume plants as shown in the following food chain.

Plants → Insects → Spiders

Chickadee habitat includes forests and residential yards. Residential yards often contain nonnative plants, which do not naturally exist in an area, but were introduced by humans.

Scientists measured the average number of insects and spiders as related to the percentage of nonnative plants (Figure 1). The scientists also measured the chickadees' average population growth rate (Figure 2) to determine the impact of nonnative plants on chickadee populations.

Figure 1. Percentage of Nonnative Plants and Average Number of Individual Spiders and Insects
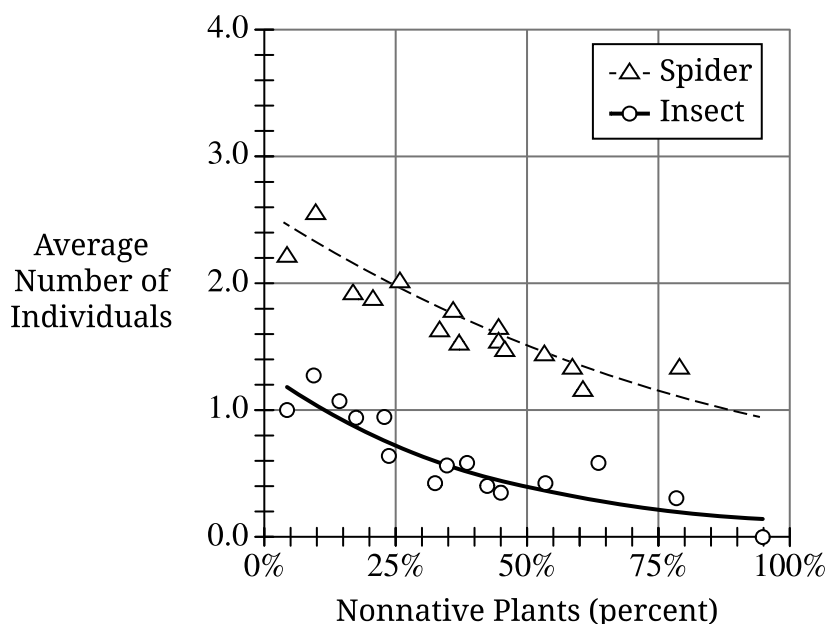
Figure 2. Chickadee Population Average Growth Rate and Percentage of Nonnative
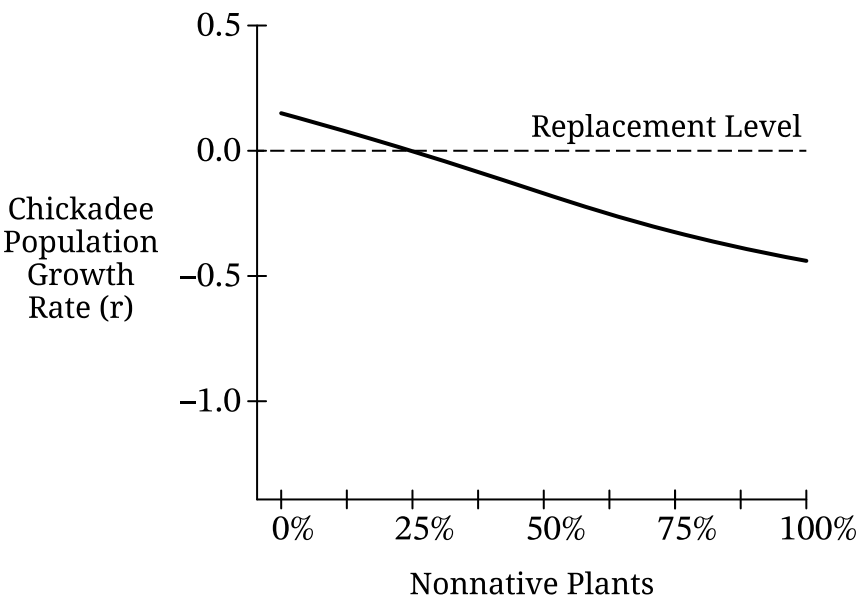
1. Respond to parts A, B, C, D, E, F, G, and H, and all subparts.

   A. **Describe** one reproductive strategy used by a K-selected species such as the chickadee.

   B. Based on the information provided, **explain** how a decrease in spider populations could affect a lower trophic level.

   C. Based on the data in Figure 1, **identify** the number of spiders per sample at 25% nonnative plants.

   D. Based on the data in Figure 1, **describe** the trend in the number of insects per sample in relation to the percentage of nonnative plants.

   E. Scientists hypothesized that the population of chickadees would be stable or growing with fewer than 25% nonnative plants. **Describe** one way that the data in Figure 2 support this hypothesis.

   F. Insect biodiversity is important to maintain ecosystem health. A group of students was interested in learning about factors that affect ant biodiversity. They located two study sites near their school: a frequently mowed urban park and an unmowed grassland. The students used traps designed to collect ants. They loaded 10 of these traps with the same food and placed them randomly at different locations within each site. Students collected the traps after 24 hours and counted the number of different ant species in each trap to determine species richness.

      i. **Identify** a likely scientific question for the students' investigation of ant diversity.

      ii. **Identify** the dependent variable in the students' investigation.

   G. The data from the student investigation of ant diversity are shown in the following table. An "X" in the table indicates that the species was present at that site.

   Ant Species Present in an Urban Park and Unmowed Grassland

Site	Species A	Species B	Species C	Species D	Species E	Species F
Urban park	X			X	X	
Grassland	X	X	X	X		X

      i. **Explain** why the ant community of the unmowed grassland would be more likely to recover from a disturbance, such as a flood or fire, than the ant community in the mowed urban park would.

      ii. **Explain** how the results of the investigation could have been altered if students had measured ant biodiversity at a paved playground rather than in the grassland.

   H. Habitat fragmentation has impacts on a variety of species. Paved roads can lead to habitat fragmentation.

   Describe one effect that a paved road in a forest can have on animal species such as deer or bears.

There is a natural climate phenomenon that occurs in the equatorial Pacific Ocean because of periodic fluctuations in sea surface conditions and atmospheric circulation. This phenomenon happens every few years, resulting in shifts in temperature and precipitation in many parts of the world.

Figure 1 shows temperature and precipitation patterns associated with one phase of this phenomenon in the equatorial Pacific Ocean. Figure 2 shows the associated temperature and precipitation patterns that occur over North America.

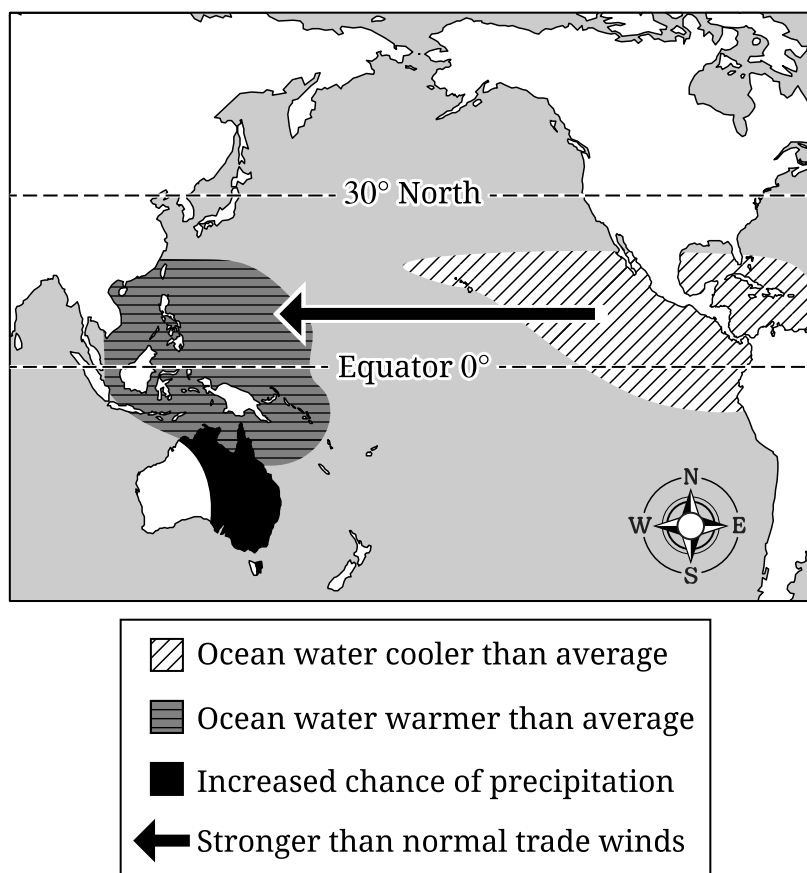**Figure 1. Effects of Changes in Sea Surface Conditions in Equatorial Pacific Ocean**
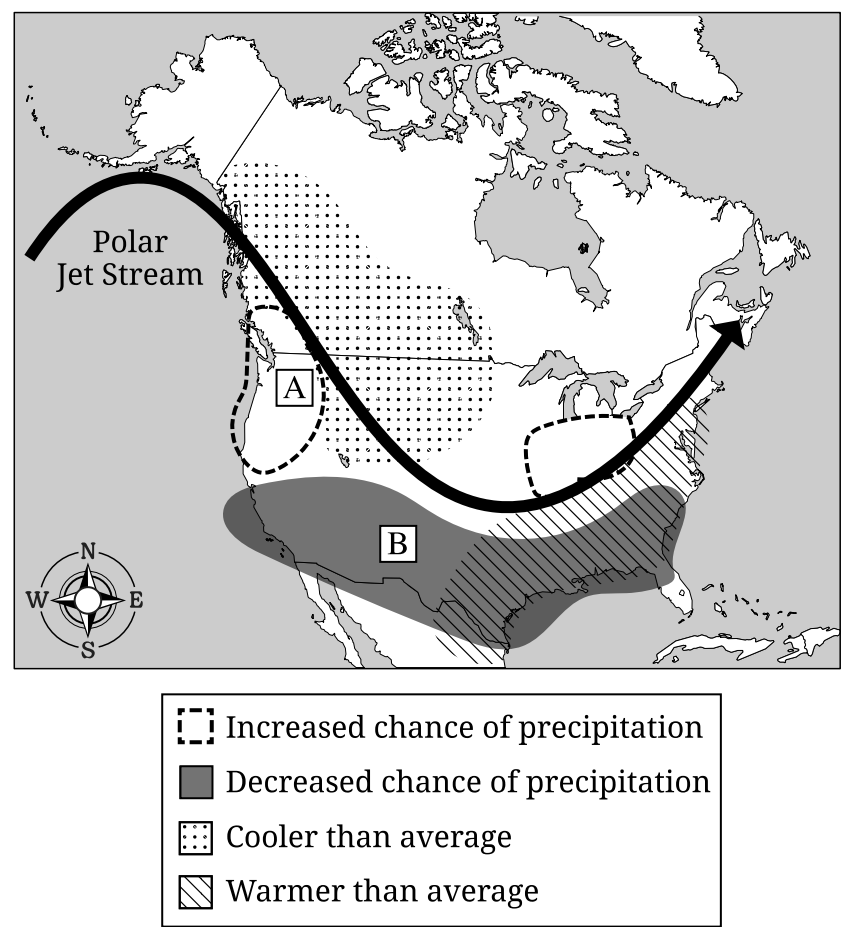
Figure 2. Polar Jet Stream and Climate Conditions in North America

Legend:
- ⬚ Increased chance of precipitation
- ◼ Decreased chance of precipitation
- ⬚ Cooler than average
- ⬚ Warmer than average

2. Respond to parts A, B, C, D, E, F, G, H, I, and J.

A. Identify the sea surface condition for the eastern equatorial area of the Pacific Ocean illustrated in Figure 1.

B. Based on the information in Figure 1, **identify** the climate phenomenon associated with the sea surface conditions shown in the equatorial area of the Pacific Ocean.

C. Based on the information in Figure 2, **describe** a difference in climate patterns between the regions A and B.

D. Increases in regional precipitation can lead to increased flooding in certain locations. **Describe** one reason why there is an increased risk of flooding in urban areas during extended periods of precipitation.

E. Propose a realistic solution a city could implement to decrease the risk of flooding in urban areas.

F. Justify the solution proposed in part E by providing an additional advantage other than a reduction in the risk of flooding.

G. Terrestrial biomes are primarily determined by temperature and precipitation patterns. **Describe** one difference between the climate of a temperate seasonal forest and that of a savanna.

H. Droughts are one environmental problem that can affect the frequency and severity of forest fires. **Identify** the ecological process that occurs following a forest fire that leaves the soil intact.

I. Describe one way burning forests contribute to atmospheric pollution.

J. Describe one sustainable forestry practice that could be used to reduce the occurrence or severity of forest fires.

3. Respond to parts A, B, C, D, E, F, and G.

A. One major environmental problem is air pollution. Air pollution can come from natural or anthropogenic sources. Motor vehicles can be a source of particulate matter (PM) and other pollutants.

Identify an anthropogenic source of particulate matter, other than from motor vehicles.

B. One way to reduce pollutants associated with motor vehicles is to use a vapor recovery nozzle. **Describe** one way a vapor recovery nozzle is used to reduce atmospheric pollution.

C. Acid rain is another air pollutant linked to motor vehicles. Over the past few years, there has been an increase in the number of people working from home, so fewer people are commuting to work in their personal vehicles.

Explain how a decrease in the number of people commuting to work in their personal vehicles could lead to a reduction in acid rain.

D. The average gas mileage for a small gasoline-powered sport utility vehicle (SUV) is 22 miles per gallon (mpg) in the city. The average gas mileage for a small hybrid SUV is 36 mpg in the city. One commuter sells their gasoline-powered SUV and replaces it with a hybrid SUV.

Calculate the percent change in gas mileage between the gasoline-powered SUV and the hybrid SUV based on the data provided. **Show** your work.

E. Both the gasoline-powered SUV and the hybrid SUV have 14-gallon gas tanks. As stated in part D, the average gas mileage for a small gasoline-powered sport utility vehicle (SUV) is 22 miles per gallon (mpg) in the city. The average gas mileage for a small hybrid SUV is 36 mpg in the city.

Calculate how many more miles the owner can drive in the hybrid SUV in the city than they could have driven in the gasoline-powered SUV. **Show** your work.

F. In addition to vehicles, buildings such as schools often have high energy consumption. The primary sources of energy use in many buildings are heating, cooling, and lighting.

Propose a realistic solution that schools could implement to decrease energy use for heating and cooling, other than a reduction in the amount of time the school building is occupied.

G. The school plans to upgrade its lighting to save money and reduce both its electricity use and its ecological footprint. The sustainability committee proposes that the school reduce its electricity use by switching to energy-efficient light-emitting diode (LED) bulbs. The school building uses 2.8×10^4 bulbs. The LED bulbs would each use 0.0085 kilowatts per hour. Each bulb would be used for an average of 2,340 hours per year.

Calculate the energy use in the school building in kilowatts per year using LED light bulbs. **Show** your work.

STOP

END OF EXAM