Questions 1–10 refer to the following passage.

This passage describes the varying and changing scientific theories surrounding sunspots.

Astronomers noted more than 150 years ago that sunspots wax and wane in number in an 11-year cycle. Ever since, people have speculated that the solar cycle might exert some influence on the Earth's weather. In this century, for example, scientists have linked the solar cycle to droughts in the American Midwest. Until recently, however, none of these correlations has held up under close scrutiny.

One problem is that sunspots themselves have been poorly understood. Observation revealed that the swirly smudges represent areas of intense magnetic activity where the sun's radiative energy has been blocked and that they are considerably cooler than bright regions of the sun. Scientists had not been able, however, to determine just how sunspots are created or what effect they have on the solar constant (a misnomer that refers to the sun's total radiance at any instant).

The latter question, at least, seems to have been resolved by data from the *Solar Maximum Mission* satellite, which has monitored the solar constant since 1980, which was the peak of a solar cycle. As the number of sunspots decreased through 1986, the satellite recorded a gradual dimming of the sun. Over the next year, as sunspots proliferated, the sun brightened. These data suggest that the sun is 0.1 percent more luminous at the peak of the solar cycle, when the number of sunspots is greatest, than at its nadir, according to Richard C. Willson of the Jet Propulsion Laboratory and Hugh S. Hudson of the University of California at San Diego.

The data show that sunspots do not themselves make the sun shine brighter. Quite the contrary. When a sunspot appears, it initially causes the sun to dim slightly, but then after a period of weeks or months islands of brilliance called faculas usually emerge near the sunspot and more than compensate for its dimming effect. Willson says faculas may represent regions where energy that initially was blocked beneath a sunspot has finally breached the surface.

Does the subtle fluctuation in the solar constant manifest itself in the Earth's weather? Meteorological reports offer statistical evidence that it does, albeit rather indirectly. The link seems to be mediated by a phenomenon known as the quasi-biennial oscillation (QBO), a 180-degree shift in the direction of stratospheric winds above the Tropics that occurs about every two years.

Karin Labitzke of the Free University of Berlin and Harry van Loon of the National Center for Atmospheric Research in Boulder, Colorado, were the first to uncover the QBO link. They gathered temperature and air-pressure readings from various latitudes and altitudes over the past three solar cycles. They found no correlation between the solar cycle and their data until they sorted the data into two categories: those gathered during the QBO's west phase (when the stratospheric winds blow west) and those gathered during its east phase. A remarkable correlation appeared: temperatures and pressures coincident with the QBO's west phase rose and fell in accordance with the solar cycle.

Building on this finding, Brian A. Tinsley of the National Science Foundation discovered a statistical correlation between the solar cycle and the position of storms in the North Atlantic. The latitude of storms during the west phase of the QBO, Tinsley found, varied with the solar cycle: storms occurring toward the peak of a solar cycle traveled at latitudes about six degrees nearer the Equator than storms during the cycle's nadir.

Labitzke, van Loon, and Tinsley acknowledge that their findings are still rather mysterious. Why does the solar cycle seem to exert more of an influence during the west phase of the QBO than it does during the east phase? How does the 0.1 percent variance in solar radiation trigger the much larger changes—up to six degrees Celsius in polar regions—observed by Labitzke and van Loon? Van Loon says simply, "We can't explain it."

John A. Eddy of the National Center for Atmospheric Research, nonetheless, thinks these QBO findings as well as the *Solar Maximum*

Mission data "look like breakthroughs" in the search for a link between the solar cycle and weather. With further research into how the oceans damp the effects of solar flux, for example, these findings may lead to models that have some predictive value. The next few years may be particularly rich in solar flux.

1. Which one of the following best describes the main idea of the passage?

   A) The scientific advances provided by the research of Labitzke and van Loon have finally cleared up some of the mysteries that long plagued the study of sunspots.

   B) Recent research combining astronomical and climate data provides a promising foundation for better understanding the relationship between sunspots and Earth's weather.

   C) Despite recent breakthroughs, scientists are unlikely to ever fully explain correlations between sunspot activity and Earth's weather patterns.

   D) Scientists have used data from the *Solar Maximum Mission* satellite to explain how sunspots affect Earth's climate during the quasi-biennial oscillation's west phase.

2. The author's point of view can best be described as that of

   A) a meteorologist voicing optimism that the findings of recent solar research will improve weather forecasting.

   B) an astronomer presenting a digest of current findings to a review board of other astronomers.

   C) a science writer explaining the possible influence of a solar phenomenon on terrestrial weather patterns.

   D) a historian listing the contributions to climate science made by the *Solar Maximum Mission*.

3. The passage indicates which of the following about the sun's luminosity and the solar cycle?

   A) Scientists have found no correlation between the sun's brightness and the solar cycle.

   B) The sun is brightest at the nadir of the solar cycle.

   C) The sun is brightest at the peak and again at the nadir of the solar cycle.

   D) The sun is brightest at the peak of the solar cycle.

4. Which one of the following provides the best evidence for the answer to the previous question?

   A) Lines 10–11 ("One problem . . . understood")
   B) Lines 15–18 ("Scientists had . . . constant")
   C) Lines 20–24 ("The latter . . . cycle")
   D) Lines 27–31 ("These data . . . nadir")

5. Based on information in the passage, it can most reasonably be inferred that faculas

   A) are directly responsible for increased temperatures on Earth.
   B) have a dimming effect on the sun's luminescence during sunspot activity.
   C) are mostly likely to appear at the peak of the solar cycle.
   D) grow in number as the number of sunspots decreases.

6. Which one of the following provides the best evidence for the answer to the previous question?

   A) Lines 20–24 ("The latter . . . cycle")
   B) Lines 34–35 ("The data . . . brighter")
   C) Lines 36–41 ("When a . . . effect")
   D) Lines 46–47 ("Meteorological . . . indirectly")

7. As used in line 45, "manifest" most nearly means

   A) impact.
   B) disguise.
   C) itemize.
   D) reveal.

8. According to the passage, Labitzke and van Loon's research on the quasi-biennial oscillation (QBO) shows that

   A) the QBO's west phase correlates to the solar cycle.
   B) the QBO's west phase has a longer duration than that of its east phase.
   C) the QBO shows no correlation with the solar cycle.
   D) the reasons for the QBO's correlation to the solar cycle are now well understood.

9. The main purpose of the questions in the second-to-last paragraph (lines 76–84) is to

   A) emphasize how little scientists know about the solar constant.
   B) explain more fully the mysterious nature of the scientists' findings.
   C) question the basis upon which these scientists built their hypotheses.
   D) express doubts about the scientists' interpretations of their findings.

10. The use of the quoted phrase "look like breakthroughs" in line 88 is primarily meant to convey the idea that

    A) information about the solar cycle has allowed scientists to predict changes in Earth's complex climate system.
    B) additional analysis of the link between the solar cycle and Earth's weather may yield useful models.
    C) despite the associated costs, space missions can lead to important discoveries.
    D) an alternative interpretation of the data may contradict the initial findings.