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## PASSAGE IV

**NATURAL SCIENCE:** *This passage discusses some of the controversy surrounding the existence of dark matter in the universe.*

Dark matter in the universe is believed by some scientists to be a substance that is not readily observable because it does not directly refract light or energy. Its existence can only be deduced because of the effect that it has on surrounding matter. In fact, some members of the scientific community have argued that dark matter does not actually exist. Others, however, believe in its existence, in part because the scientific community does not have a complete understanding of gravitational science. On the other hand, some would argue that it is the understanding of gravitational science that leads most scientists to believe in the existence of dark matter, because without dark matter, there are many cosmological phenomena that are difficult to explain.

For example, dark matter in the universe may have a peculiar effect on the Milky Way galaxy. Some scientists believe that the interaction between dark matter and other smaller, nearby galaxies is causing the Milky Way galaxy to take on a warped profile. It has been asserted that not only does dark matter exist, it may also be responsible for the Milky Way's unusual shape. The interaction referenced involves two smaller galaxies near the Milky Way, called Magellanic clouds, moving through an enormous amount of dark matter, which, in effect, enhances the gravitational pull that the two Magellanic clouds could have on the Milky Way and other surrounding bodies. Without the existence of the dark matter, the Magellanic clouds would not have sufficient mass to have such a strong effect on the bend of the Milky Way galaxy.

The strongest evidence for the validity of this hypothesis rests in Newtonian physics, and the hypothesis that anything with mass will exert a gravitational pull. The Milky Way and other galaxies with peculiar warped shapes are being molded by a gravitational force. However, there is nothing readily observable with sufficient mass that could cause such a high level of distortion via gravitational pull in the vicinity of the Milky Way. Therefore, something that is not easily observed must be exerting the necessary force to create the warped shape of the galaxy.

Aaron Romanowsky and several colleagues have questioned the effect that dark matter might have on galaxies. They point to the existence of several elliptical galaxies surrounded by very little dark matter as evidence that dark matter is not, in fact, the cause of the warped galaxies. While they do not claim that their findings should be interpreted to conclude that dark matter does not exist, they apparently believe that the results of their studies cast doubt on some of the conventional theories of galaxy formation and manipulation.

Several models constructed by researchers from the University of California at Berkeley, however, point to the idea that dark matter is the most likely explanation for the distorted shape of the Milky Way and other galaxies. Using computer models, they have

mapped the likely interactions between certain galaxies and the surrounding dark matter, and those models have shown not only the possibility that dark matter is responsible for the warped shape of the Milky Way, but that the relationship between the dark matter and the Magellanic clouds is dynamic; the movement of the clouds through the dark matter seems to create a wake that enhances their gravitational influence on the Milky Way.

31. As it is used in line 14, the term *phenomena* most nearly means:
- A. occurrences.
  - B. problems.
  - C. attitudes.
  - D. surprises.
32. The passage states that some members of the scientific community are reluctant to believe in the existence of dark matter because:
- F. there is absolutely no evidence for the existence of dark matter.
  - G. no one understands how to apply gravitational science.
  - H. dark matter cannot be directly observed.
  - J. dark matter has little effect on surrounding matter.
33. What does the passage offer as evidence for the existence of dark matter?
- A. A complete understanding of gravitational science.
  - B. The enormous mass of Magellanic clouds.
  - C. The shape of the Milky Way galaxy.
  - D. A photograph taken with the aid of a refracting telescope.
34. According to the passage, what is Aaron Romanowsky's theory regarding dark matter?
- F. It cannot be conclusively proven that dark matter affects the shape and formation of galaxies.
  - G. The discovery of certain galaxies disproves the theory that dark matter exists in the universe.
  - H. Computer models suggest that dark matter is responsible for warped galaxies.
  - J. Dark matter has not effect at all on the shape of a galaxy.

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35. The last paragraph supports the general hypothesis provided earlier in the passage that:
- A. the effect of Magellanic clouds on galaxies is enhanced by dark matter.
  - B. computer models are necessary for an understanding of gravitational science.
  - C. dark matter has little to no effect on the formation of certain cosmological phenomena.
  - D. the shape of the Milky Way galaxy can be deduced by observing the matter surrounding it.
36. The main purpose of the third paragraph is to point out that:
- F. dark matter was first discovered by applying Newtonian physics.
  - G. different viewpoints exist regarding gravitational science.
  - H. galaxies with peculiar shapes could not exist in the presence of dark matter.
  - J. scientific theories provide support for the existence of dark matter in the universe.
37. The word *conventional* in line 51 most nearly means:
- A. easily understood.
  - B. formally disputed.
  - C. strictly interpreted.
  - D. generally accepted.
38. Which one of the following is NOT mentioned in the passage as a scientific theory regarding dark matter?
- F. The existence of dark matter cannot be proved by direct observation.
  - G. Dark matter may be responsible for the shape of the Milky Way.
  - H. It is certain that dark matter has no influence on surrounding celestial bodies.
  - J. Magellanic clouds require the presence of dark matter in order to influence the shape of galaxies.
39. According to the passage, dark matter cannot be readily detected because:
- A. dark matter does not actually exist.
  - B. most of the dark matter in the universe is hidden behind galaxies.
  - C. it does not directly interact with light or energy.
  - D. it has no effect on the surrounding matter.
40. The passage supports which of the following statements about dark matter?
- F. Its existence is inferred by some researchers based on observations of cosmological bodies composed of ordinary matter.
  - G. Its existence has been conclusively proven by computer models.
  - H. If it does not exist, the universe is largely empty.
  - J. Its presence is readily observable to researchers who completely understand how to apply gravitational science.

END OF THE READING TEST.  
STOP! IF YOU HAVE TIME LEFT OVER, CHECK YOUR WORK ON THIS SECTION ONLY.

TLC Stamp

