READING TEST

35 Minutes—40 Questions

Directions: The Reading Test includes multiple passages. Each passage includes multiple questions. After reading each passage, choose the best answer and fill in the corresponding bubble on your answer sheet. You may review the passages as often as necessary.

Passage I

PROSE FICTION: This passage is adapted from Nathaniel Hawthorne's short story "Rappaccini's Daughter."

Giovanni still found no better occupation than to look down into the garden beneath his window. From its appearance, he judged it one of those botanic gardens that were of earlier date in Padua than elsewhere in Italy or in the world. Or, not improbably, it might once have been the pleasure-place of an opulent family; for there was the ruin of a marble fountain in the center, sculptured with rare art, but so woefully shattered that it was impossible to trace the original design from the chaos of remaining fragments. The water, however, continued to gush and sparkle into the sunbeams as cheerfully as ever. A little gurgling sound ascended to the young man's window, and made him feel as if the fountain were an immortal spirit that sung its song unceasingly and without heeding the vicissitudes around it, while one century embodied it in marble and another scattered the perishable embellishments on the soil. All about the pool into which the water subsided grew various plants that seemed to require a plentiful supply of moisture for the nourishment of gigantic leaves, and, in some instances, flowers gorgeously magnificent. There was one shrub in particular, set in a marble vase in the midst of the pool, that bore a profusion of purple blossoms, each of which had the luster and richness of a gem; and the whole together made a show so resplendent that it seemed enough to illuminate the garden, even had there been no sunshine. Every portion of the soil was peopled with plants and herbs, which, if less beautiful, still bore tokens of assiduous care, as if all had their individual virtues, known to the scientific mind that fostered them. Some were placed in urns, rich with old carving, and others in common garden pots; some crept serpent-like along the ground or climbed on high, using whatever means of ascent was offered them. One plant had wreathed itself round a statue of Vertumnus, which was thus quite veiled and shrouded in a drapery of hanging foliage, so happily arranged that it might have served a sculptor for a study.

While Giovanni stood at the window he heard a rustling behind a screen of leaves, and became aware that a person was at work in the garden. His figure soon emerged into view, and showed itself to be that of no common laborer, but a tall, emaciated, sallow, and sickly-looking man, dressed in a scholar's garb of black. He was beyond the middle term of life, with gray hair, a thin, gray beard, and a face singularly marked with intellect and cultivation, but which could never, even in his more youthful days, have expressed much warmth of heart.

Nothing could exceed the intentness with which this scientific gardener examined every shrub that grew in his path: it seemed as if he were looking into their inmost nature, making observations in regard to their creative essence, and discovering why one leaf grew in this shape and another in that, and why such and such flowers differed

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among themselves in hue and perfume. Nevertheless, in spite of this deep intelligence on his part, there was no approach to intimacy between himself and these vegetable existences. On the contrary, he avoided their actual touch or the direct inhaling of their odors with a caution that impressed Giovanni most disagreeably; for the man's demeanor was that of one walking among malignant influences, such as savage beasts, or deadly snakes, or evil spirits, which, should he allow them one moment of license, would wreak upon him some terrible fatality. It was strangely frightful to the young man's imagination to see this air of insecurity in a person cultivating a garden, that most simple and innocent of human toils, and which had been alike the joy and labor of the unfallen parents of the race. Was this garden, then, the Eden of the present world? And this man, with such a perception of harm in what his own hands caused to grow—was he the Adam?

The distrustful gardener, while plucking away the dead leaves or pruning the too luxuriant growth of the shrubs, defended his hands with a pair of thick gloves. Nor were these his only armor. When, in his walk through the garden, he came to the magnificent plant that hung its purple gems beside the marble fountain, he placed a kind of mask over his mouth and nostrils, as if all this beauty did but conceal a deadlier malice; but, finding his task still too dangerous, he drew back, removed the mask, and called loudly, but in the infirm voice of a person affected with inward disease.

1. Of the plants mentioned in the passage, which of the following did Giovanni find to be the most exceptional?

   A. The plant wreathed around the statue
   B. The plant that crept along the ground
   C. The plant with the gigantic leaves
   D. The plant with the purple blossoms

2. In order to ensure that he is safe from the plants, the gardener:

   I. handles them only indirectly.
   II. avoids looking directly at them.
   III. avoids breathing their odors.

   F. I and II only
   G. I and III only
   H. II and III only
   J. I, II, and III

3. Given the descriptions in the passage, the author would agree that compared to Giovanni, the gardener is a:

   A. more religious man.
   B. less cautious man.
   C. more cautious man.
   D. less religious man.

4. Which of the following actions performed by the gardener disturbs Giovanni?

   I. Indicating disregard or disapproval of the plants
   II. Avoiding directly inhaling the odors of the plants
   III. Looking at the inmost nature of the plants

   F. I only
   G. II only
   H. III only
   J. I and II only

5. As described in the third paragraph (lines 55–79), the gardener's actions suggest that he is a man who:

   A. is very alert.
   B. knows all there is to know about plants.
   C. loves nature.
   D. resembles Adam.

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6. The narrator suggests that the plant with "a profusion of purple blossoms" (line 26) could:

   F. sprout precious gems.
   G. seemingly produce light.
   H. overrun the garden.
   J. grow very quickly.

7. The narrator takes the point of view of:

   A. a gardener.
   B. Giovanni.
   C. a scientist.
   D. an unknown third party.

8. When Giovanni questions whether the garden is "the Eden of the present world" and whether the gardener is Adam (lines 76–79), he is expressing his belief that the gardener:

   F. goes about his work with great care.
   G. has every reason to be distressed by the plants.
   H. should treat the plants with reverence.
   J. should not appear so afraid of the plants.

9. According to the passage, Giovanni characterizes the area beneath his window as a:

   A. botanic garden.
   B. center for rare art.
   C. place for people with plants.
   D. pleasure-place for the community.

10. In the third paragraph (lines 55–79), the author suggests that the gardener's relationship with the plants was partly characterized by:

    F. the gardener's impatience with the plants.
    G. the gardener's interest in understanding the plants.
    H. the gardener's desire to harm the plants.
    J. the gardener's anger toward the plants.

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Passage II

SOCIAL SCIENCE: This passage is adapted from "Look First to Failure" by Henry Petroski, which appeared in the October 2004 issue of *Harvard Business Review*. It discusses a paradox in the field of engineering.

Engineering is all about improvement, and so it is a science of comparatives. "New, improved" products are ubiquitous, advertised as making teeth whiter, wash fluffier, and meals faster. Larger engineered systems are also promoted for their comparative edge: the taller building with more affordable office space, the longer bridge with a lighter-weight roadway, the slimmer laptop with greater battery life. If everything is a new, improved version of older technology, why do so many products fail, proposals languish, and systems crash?

To reengineer anything—be it a straight pin, a procurement system, or a Las Vegas resort—we first must understand failure. Successes give us confidence that we are doing something right, but they do not necessarily tell us what or why. Failures, on the other hand, provide incontrovertible proof that we have done something wrong. That is invaluable information.

Reengineering anything is fraught with risk. Take paper clips. Hundreds of styles were introduced in the past century, each claiming to be an improvement over the classic Gem design. Yet none displaced it. The Gem maintains its privileged position because, though far from perfect, it strikes an agreeable balance between form and function. Each challenger may improve on one aspect of the Gem but at the expense of another. Thus, a clip that is easier to attach to a pile of papers is also more likely to fall off. Designers often focus so thoroughly on the advantages that they fail to appreciate (or else ignore) the disadvantages of their new design.

Imagine how much more complex is the challenge of reengineering a jumbo jet. The overall external form is more or less dictated by aerodynamics. That form, in turn, constrains the configuration of the interior space, which must accommodate articulated human passengers as well as boxy luggage and freight. As much as shipping clerks might like fuselages with square corners, they must live with whale bellies. It is no wonder that Boeing invited stakeholders, including willing frequent flyers, to participate in designing its Dreamliner—so the users would buy into the inevitable compromises. The resulting jetliner will succeed or fail depending on how convincingly those compromises are rationalized.

Logically speaking, basing a reengineering project—whether of a product or a business process—on successful models should give designers an advantage: They can pick and choose the best features of effective existing designs. Unfortunately, what makes things work is often hard to express and harder to extract from the design as a whole. Things work because they work in a particular configuration, at a particular scale, and in a particular culture. Trying to reverse-engineer and cannibalize a successful system sacrifices the synergy of success. Thus John Roebling, master of the suspension bridge form, looked for inspiration not to successful examples of the state of the art but to historical failures. From those he distilled the features and forces that are the enemies of bridges and designed his own to avoid those features and resist those forces. Such failure-based thinking gave us the Brooklyn Bridge, with its signature diagonal cables, which Roebling included to steady the structure in winds he knew from past example could be its undoing.

But when some bridge builders in the 1930s followed effective models, including Roebling's, they ended up with the Tacoma Narrows Bridge, the third-longest suspension bridge in the world and the largest ever to collapse in the wind. In the process of "improving" on Roebling's design, the

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very cables that he included to obviate failure were left out in the interests of economy and aesthetics.

When a complex system succeeds, that success masks its proximity to failure. Imagine that the *Titanic* had not struck the iceberg on her maiden voyage. The example of that "unsinkable" ship would have emboldened success-based shipbuilders to model larger and larger ocean liners after her. Eventually the *Titanic* or one of those derivative vessels would probably have encountered an iceberg with obvious consequences. Thus, the failure of the *Titanic* contributed much more to the design of safe ocean liners than would have her success. That is the paradox of engineering—and of reengineering.

11. All of the following are mentioned as constraints on the design of a jumbo jet EXCEPT:
    - **A.** the shape of the human body.
    - **B.** fuel consumption.
    - **C.** aerodynamics.
    - **D.** freight handling.

12. When the author states Boeing wants stakeholders to "buy into" the Dreamliner's inevitable compromises (line 46), he means the company hopes that:
    - **F.** passengers will be willing to invest in the company to support Dreamliner development.
    - **G.** engineers will be able to satisfy all the needs of passengers, freight handlers, and pilots.
    - **H.** users will be willing to pay extra to have their specific needs met.
    - **J.** users will understand and accept that the jet will not meet all their needs perfectly.

13. The author believes the sinking of the *Titanic* contributed more to the safety of ocean travel than its success would have because:
    - **A.** engineers realized they could not be so careless.
    - **B.** later ships carried more lifeboats.
    - **C.** shipbuilders were able to learn from mistakes in the *Titanic*'s design before they built more ships with the same weaknesses.
    - **D.** passengers were more likely to take out insurance before a voyage.

14. With which of the following quotes would the author most strongly agree?
    - **F.** "Giving up is the only sure way to fail." (Gena Showalter)
    - **G.** "The definition of insanity is doing something over and over again and expecting a different result." (Albert Einstein)
    - **H.** "Mistakes are the portal to discovery." (James Joyce)
    - **J.** "If everyone is moving forward together, then success takes care of itself." (Henry Ford)

15. According to the passage, which of the following contributed to the failure of the Tacoma Narrows Bridge?
    - **A.** The engineers copied the design for the Brooklyn Bridge too closely.
    - **B.** The wind at Tacoma Narrows was stronger than in Brooklyn.
    - **C.** The engineers ignored the aesthetic aspect of the design.
    - **D.** The final design omitted diagonal cables.

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16. The author inserts the final paragraph (lines 81–92) in order to:

F. emphasize that the designers of the *Titanic* should have studied earlier ships more thoroughly.

G. make the point that all ocean liners will eventually encounter icebergs and sink.

H. illustrate how the failure of a complex design may contribute more to long-term technical development than its success would have.

J. point out that the designs of ocean liners and bridges both involve significant risks.

17. The main purpose of the Gem paper clip example is to show that:

A. paper clips are indispensable to modern business.

B. attempting to redesign a paper clip is a waste of time.

C. engineers should study the effectiveness of the paper clip before beginning a design project.

D. redesigning a successful product risks damaging its effectiveness.

18. According to the passage, the Gem paper clip continues to be the most popular because:

F. it features an excellent compromise between ease of attachment and security.

G. it was invented long before alternative designs.

H. people are familiar with the name and don't want to risk trying new products.

J. it is unlikely to fall off in use.

19. In the context of this passage, "failure-based thinking" (line 68) refers to:

A. a counterproductive habit engineers adopt that inhibits their creativity.

B. the process of taking inspiration from analyzing the causes of past failures.

C. an example of how cannibalizing a successful system can create synergy.

D. an approach to design that was discredited with the collapse of the Tacoma Narrows Bridge.

20. When the author claims engineering is a "science of comparatives" (line 2), he means that:

F. engineers are always compared to other scientists.

G. engineered products are only better if they are bigger or faster than other products.

H. engineers' designs are generally evaluated based on whether they offer improvements over previous designs of the same product.

J. engineering tools are used to compare the discoveries of scientists.

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Passage III

HUMANITIES: The following passages are excerpted from two books that discuss fairy tales. Passage A was written by a specialist in psychology and children's literature and was published in 1965. Passage B was written by a folklore methodologist and was published in 1986.

Passage A

Most of the stories that our society tells have only enjoyed a comparatively short period of popularity in comparison with the sweep of human history, flaming into popular consciousness in books, television, or film for a period reaching anywhere from a few months to a few centuries. Fads come and go as fickle as the weather, and today's hit may be tomorrow's forgotten relic. But one particular kind of story that our society tells, the fairy tale, has a kind of popularity that is uniquely persistent. Literally since time immemorial, fairy tales have been told and retold, refined and adapted across generations of human history. Folk tales that spoke to people in some deeper way, and thus proved popular, endured and were passed down through the ages. Tales that had only temporal and fleeting appeal are long since lost. Since, as we know, it is a truism that time sifts out the literary wheat and discards the chaff, fairy tales can be said to have undergone the longest process of selection and editing of any stories in human history.

Consider, for example, the story of Snow White. Here is reflected the tale of the eternal struggle for supremacy between the generations. The evil mother queen grows jealous of the competition of the young Snow White for supremacy in the realm of youth and beauty, so she contrives to do away with her rival. The innocent Snow White survives by a twist of whim and circumstance, and then retreats into the forest—the traditional symbol of the site of psychological change—where she hides among the Seven Dwarves. Small supernatural spirits or homunculi, often depicted in folk tales as tiny elves, spirit men, trolls, or fairies, represent unconscious forces, and thus Snow White must care for and nurture the Seven Dwarves while she undergoes her psychological transformation. The dwarves' mining activities can be said to symbolize this process of mental delving into the depths in hopes of uncovering the precious materials of the developing psyche.

Yet Snow White's road to her new identity is not without incident. The breaching of the secure space by the disguised queen mother and Snow White's giving in to the temptation of the apple—representative of the same youth and beauty that the queen seeks to deprive her of—causes her to fall into the slumberous mock death. Only the prince can deliver Snow White and metaphorically resurrect her with a kiss, itself a motif that suggests her entry into the identity of a mature person ready to leave the dwarves and forest of the unconscious behind and take on adult responsibilities.

The popularity of this tale, and others like it, across time and in widely scattered societies confirms its power in tapping into unconscious forces and common motifs that all humans share. All humans in all ages experience generational rivalry and the impact that it has on patterns of growth and maturity. The specific symbols used to represent these dynamics are less important than their universality; indeed the very adaptability of the symbolism is what allows tales to remain popular over time. By dramatizing these psychological progressions, the fairy tale helps its audience to process the ill-understood unconscious psychological forces that are a part of human life. Can it be any wonder that such powerful avenues to the cosmic unconscious can be shown to have remained popular across the eons?

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Passage B

The contention that folklore represents a cosmic tale that encapsulates cross-cultural human universalities in narrative form is naive in the extreme. The notion that folk tales somehow embody a symbolically encoded map of human consciousness suffers from a fundamental flaw: It assumes that each tale has a more-or-less consistent form. In fact, the forms of most folk tales that we have today recorded in collections and in the popular media represent nothing more than isolated snapshots of narratives that have countless forms, many of which are so different as to drastically change the interpretations that some critics want to say are universal.

Consider, for example, the story of Little Red Riding Hood. Some psychological interpretations might conjecture, for example, that this is a tale about obedience and parental authority. Straying from the path in the forest, in this context, might represent rebelling against that authority, and the wolf then symbolizes the dangerous unconscious forces from which parents seek to protect Little Red. The red color of the riding hood might be seen as representing the subdued emotions of anger and hostility. Being consumed by the wolf signifies a period of isolation and transformation. Finally, the rescuing huntsman at the end of the story then symbolizes the return of parental authority to deliver the innocent child from being metaphorically consumed by ill-understood emotional states.

It is an apparently consistent analogy, and one that is difficult to dispute, until one investigates the circumstances of the composition and recording of the version of Little Red Riding Hood that we have today. Earlier editions of the story simply don't have many of the components that critics would like to present as so-called "universal symbols." For example, in the vast majority of the older and simpler versions of this tale, the story ends after the wolf eats the girl. So there can be no theme of parental rescue because, in all but a few of the examples of this tale, there is no rescue and no kind huntsman. In some versions the girl even saves herself, completely contradicting the assumption that it is a story about rescue. Story elements such as the path, the hunter, and the happy ending, which are seen as essential symbolic components of our interpretation above, were introduced to this ancient tale by the Brothers Grimm in the 19th century. Even the introduction of the "symbolic" red garment dates only from the seventeenth century, when it was put into the story by Charles Perrault.

In fact, every fairy tale known to the study of folklore has so many different versions that there are encyclopedic reference books to catalog the variations and the differences between them. A creature that is an elf in one country and era might be a troll in another. A magic object represented as a hat in one version of a tale might be a cloak in ten other tellings. If folk tales actually represent universal human truths in symbolic form, the symbols in them would have to reflect universal consistency across time. Any attempt to pinpoint a consistent symbolic meaning or underlying scheme in such a field of moving, blending, and ever-changing targets is doomed to fail before it even begins. Instead, we should embrace all such variations on a theme, searching for insights into the cultural conditions that prompt such divergence.

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Questions 21–23 ask about Passage A.

21. As it is used in line 4, the word *flaming* most nearly means:
    - A. on fire.
    - B. dangerous.
    - C. important.
    - D. prominent.

22. The word *avenues* in line 68 conveys the author's belief that fairy tales offer:
    - F. boulevards for navigating historic cities.
    - G. beginnings of life-changing adventures.
    - H. approaches for understanding common experiences.
    - J. homecomings for people's true feelings toward others.

23. In discussing fairy tales in lines 8–21, the author of Passage A suggests that:
    - A. which stories endure and which are forgotten has nothing to do with the characters featured in the story.
    - B. stories written by a single author and not endlessly retold and edited will not become popular.
    - C. many folk tales that spoke deeply to their audiences have been lost and forgotten over the ages.
    - D. folk tales undergo selection and editing, as do other types of literature.

Questions 24–26 ask about Passage B.

24. The final sentence of Passage B provides information about:
    - F. the author's opinion that only fairy tales written in modern times can be accurately interpreted.
    - G. folklore methodologists who seek out oral versions of folk tales themselves instead of getting them from books.
    - H. the earliest recorded versions of folk tales, which are more accurate and authoritative than later versions.
    - J. the variations among versions of fairy tales, which can tell us something about the cultures in which these versions developed.

25. The author of Passage B specifically disagrees with critics who extract simple symbolic interpretations from fairy tales because of their:
    - A. disregard for the rigorous principles of modern psychology.
    - B. willingness to assume that minor details of a specific version of a folk tale are universal.
    - C. failure to make proper use of reference materials pertaining to folklore methodology.
    - D. naïve view of the complexity of human nature.

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26. The statement that "there can be no theme of parental rescue . . . huntsman" in Passage B (lines 111–114) suggests that fairy tales:

F. cannot be said to have a single authoritative form.

G. are generally not interested in historical accuracy.

H. should make a greater effort to capture universal human themes.

J. are usually not concerned with themes of rescue.

Questions 27–30 ask about both passages.

27. The authors of both passages state that fairy tales are:

A. intuitively meaningful.

B. critically misunderstood.

C. historically changeable.

D. symbolically rich.

28. Which of the following best describes the primary disagreement that the author of Passage B would most likely raise against the statement in Passage A (lines 32–37) that "Small supernatural spirits . . . transformation"?

F. The specific details in different versions of this folk tale show too much variation to make any consistent interpretations based on this particular version.

G. The popularity of this tale is no indication of its value in expressing a psychological truth.

H. This version of the tale is not necessarily the most accurate, because it is recent and may have deviated too much from the true version over time.

J. Small supernatural spirits could represent many things other than unconscious forces.

29. The author of Passage A would probably respond to the statement in lines 78–84 of Passage B with the argument that:

A. many modern folk tales originated relatively recently and haven't been subjected to centuries of editing.

B. the changes in the symbolism of more-recent revisions of folk tales are less important psychologically than the broad themes.

C. there is no evidence that the symbolism of folk tales is related to psychological forces.

D. Snow White is a poor example to use as evidence because it has changed so much over time.

30. With which of the following statements about fairy tales would the authors of both passages most likely agree?

F. The popularity of fairy tales is due to their deeper meanings.

G. Fairy tales speak to all humans in the language of universal psychological symbols.

H. Fairy tales have resulted from a compositional process very different from that of modern literature written by a single author.

J. The study of folklore is undergoing extensive changes because of new information about different versions of particular tales.

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Passage IV

NATURAL SCIENCE: This passage is adapted from an article about particle accelerators. It describes two different devices used to accelerate subatomic particles.

In linear accelerators, particles are accelerated in a straight line, with the target at the end of the line. Low energy accelerators such as cathode ray tubes and X-ray generators use a single pair of electrodes with a DC voltage of a few thousand volts between them. In an X-ray generator, the target is one of the electrodes.

Higher energy accelerators use a linear array of plates to which an alternating high energy field is applied. As the particles approach a plate, they are accelerated toward it by an opposite polarity charge applied to the plate. As they pass through a hole in the plate, the polarity is switched so that the plate now repels the particles, which are now accelerated by it toward the next plate. Normally, a stream bunches particles that are accelerated, so a carefully controlled AC voltage is applied to each plate to repeat this for each bunch continuously.

As the particles approach the speed of light, the switching rate of the electric fields becomes so high as to operate at microwave frequencies, and so microwave cavities are used in higher energy machines instead of simple plates. High energy linear accelerators are often called linacs.

Linear accelerators are very widely used. Every cathode ray tube contains one, and they are also used to provide an initial low-energy kick to particles before they are injected into circular accelerators. They can also produce proton beams, which can produce "proton-heavy" medical or research isotopes, as opposed to the "neutron-heavy" ones made in reactors.

In circular accelerators, the accelerated particles move in a circle until they reach sufficient levels of energy. The particle track is bent into a circle using dipole magnets. The advantage of circular accelerators over linacs is that components can be reused to accelerate the particles further, as the particle passes a given point many times. However, they suffer a disadvantage in that the particles emit synchrotron radiation.

When any charged particle is accelerated, it emits electromagnetic radiation. As a particle travelling in a circle is always accelerating towards the center of the circle, it continuously radiates. This has to be compensated for by some of the energy used to power the accelerating electric fields, which makes circular accelerators less efficient than linear ones. Some circular accelerators have been deliberately built to generate this radiation (called synchrotron light) as X-rays—for example, the Diamond Light Source being built at the Rutherford Appleton Laboratory in England. High energy X-rays are useful for X-ray spectroscopy of proteins, for example.

Synchrotron radiation is more powerfully emitted by lighter particles, so these accelerators are invariably electron accelerators. Consequently, particle physicists are increasingly using heavier particles, such as protons, in their accelerators to achieve higher levels of energy. The downside is that these particles are composites of quarks and gluons, which makes analyzing the results of their interactions much more complicated.

The earliest circular accelerators were cyclotrons, invented in 1929 by Ernest O. Lawrence. Cyclotrons have a single pair of hollow "D"-shaped plates to accelerate the particles and a single dipole magnet to curve the track of the particles. The particles are injected in the center of the circular machine and spiral outwards toward the circumference.

Cyclotrons reach an energy limit because of relativistic effects at high energies, whereby particles gain mass rather than speed. As the Special Theory of Relativity means that nothing can travel faster than the speed of light in a vacuum, the particles in an accelerator normally travel very close to the speed of light. In high energy accelerators, there is a diminishing return in speed as the particle approaches the speed of light. The effect of

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the energy injected using the electric fields is therefore to increase their mass markedly, rather than their speed. Doubling the energy might increase the speed a fraction of a percent closer to that of light, but the main effect is to increase the relativistic mass of the particle.

Cyclotrons no longer accelerate electrons when they have reached an energy for about 10 million electron volts. There are ways of compensating for this to some extent—namely, the synchrocyclotron and the isochronous cyclotron. They are nevertheless useful for lower energy applications.

To push the energies even higher—into billions of electron volts—it is necessary to use a synchrotron. This is an accelerator in which the particles are contained in a doughnut-shaped tube, called a storage ring. The tube has many magnets distributed around it to focus the particles and curve their track around the tube, and microwave cavities similarly distributed to accelerate them. The size of Lawrence's first cyclotron was a mere four inches in diameter. Fermilab now has a ring with a beam path of four miles.

31. The main idea of the passage is that:

A. linear accelerators are more efficient than circular accelerators.

B. particles in accelerators cannot travel at the speed of light.

C. linear and circular accelerators have important, but different, uses.

D. the cyclotron is a useful type of circular accelerator.

32. The passage states that magnets affect particles by:

F. influencing the direction particles travel.

G. creating curved particles.

H. increasing the acceleration of particles.

J. causing an increase in the particles' energy levels.

33. The passage states that which of the following causes an increase in particle mass in high-energy accelerators?

A. A particle reaching the speed of light

B. Acceleration of a particle in a vacuum

C. Using a mixture of different particles

D. Injecting energy using electric fields

34. As it is used in line 62, the word *quarks* most nearly refers to:

F. objects made up of electrons.

G. objects made up of radiation.

H. components of protons.

J. components of gluons.

35. According to the passage, which of the following CANNOT be a result of using a circular accelerator?

A. Particles that emit electromagnetic radiation

B. Reuse of components to accelerate particles

C. Particles that emit synchrotron radiation

D. An initial low kick of energy in particles

36. With which of the following statements would the author most likely agree?

F. Linear accelerators are of limited use.

G. Using particles such as protons in particle acceleration experiments is not possible, since they are composites of quarks and gluons.

H. Circular accelerators have improved little since Lawrence's first cyclotron.

J. Depending on the desired result, both linear and circular accelerators are valuable tools.

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37. According to the passage, what is one effect of particles passing through the hole in the plates and the polarity switching in higher energy accelerators?

A. The mass of the particles increases.
B. The charge of the particles changes.
C. The particles lose energy.
D. The particles are repelled and accelerated toward the next plate.

38. The passage suggests that the greatest difference between a cyclotron and a synchrotron is that:

F. cyclotrons are not useful.
G. synchrotrons accelerate particles in a circle.
H. synchrotrons can overcome limitations that cyclotrons cannot.
J. synchrotrons are capable of causing particles to curve more closely to the edge of the tube.

39. How does the information about the size of Lawrence's first cyclotron and the size of Fermilab's ring function in the passage?

A. It suggests that, over time, there has been progress in improving the size and capabilities of particle accelerators.
B. It proves that cyclotrons are important for particle acceleration because they were invented by Lawrence.
C. It indicates that the inventors at Fermilab were more capable than Lawrence was.
D. It emphasizes the difference between cyclotrons and synchrotrons.

40. The author's approach to the passage is most similar to that of:

F. an interested amateur reporting on an online encyclopedia entry to a group of similarly interested people.
G. a noted scientist working with accelerators and explaining them to other scientists.
H. a professor explaining types and uses of accelerators to a class of aspiring science researchers.
J. a high school student writing a paper for a science class.

IF YOU FINISH BEFORE TIME IS CALLED, YOU MAY CHECK YOUR WORK ON THIS SECTION ONLY. DO NOT TURN TO ANY OTHER SECTION IN THE TEST. STOP