1

Reading Test 2

65 MINUTES, 52 QUESTIONS

Turn to Section 1 of your answer sheet to answer the questions in this section.

DIRECTIONS

Each passage or pair of passages is accompanied by 10 or 11 questions. Read each passage or pair of passages, and then select the most appropriate answer to each question. Some passages may include tables or graphs that require additional analysis.

Refer to the passage below to answer questions 1 – 10.

This passage is adapted from Mark Twain, *Tom Sawyer*, originally published in 1884.

line

Saturday morning was come, and all the summer world was bright and fresh, and brimming with life. Tom appeared on the sidewalk with a bucket of whitewash and a long-handled brush. He surveyed the fence, and all gladness left him and a deep melancholy settled down upon his spirit. Thirty yards of board fence nine feet high. Life to him seemed hollow, and existence but a burden. Sighing, he dipped his brush and passed it along the topmost plank; repeated the operation; did it again; compared the insignificant whitewashed streak with the far-reaching continent of unwhitewashed fence, and sat down on a tree-box discouraged.

He began to think of the fun he had planned for this day, and his sorrows multiplied. Soon the free boys would come tripping along on all sorts of delicious expeditions, and they would make a world of fun of him for having to work—the very thought of it burnt him like fire. …At this dark and hopeless moment an inspiration burst upon him! Nothing less than a great, magnificent inspiration.

He took up his brush and went tranquilly to work. Ben Rogers hove in sight presently—the very boy, of all boys, whose ridicule he had been dreading. Ben's gait was the hop-skip-and-jump—proof enough that his heart was light and his anticipations high. He was eating an apple, and giving a long, melodious whoop, at intervals, followed by a deep-toned ding-dong-dong, ding-dong-dong, for he was personating a steamboat.

Tom went on whitewashing—paid no attention to the steamboat. Ben stared a moment and then said: "*Hi-Yi! You're* up a stump, ain't you!"

No answer. Tom surveyed his last touch with the eye of an artist, then he gave his brush another gentle sweep and surveyed the result, as before. Ben ranged up alongside of him. Tom's mouth watered for the apple, but he stuck to his work. Ben said:

"Hello, old chap, you got to work, hey?"

Tom wheeled suddenly and said:

"Why, it's you, Ben! I warn't noticing."

"Say—I'm going in a-swimming, I am. Don't you wish you could? But of course you'd druther *work*—wouldn't you? Course you would!"

Tom contemplated the boy a bit, and said:

"What do you call work?"

"Why, ain't *that* work?"

Tom resumed his whitewashing, and answered carelessly:

"Well, maybe it is, and maybe it ain't. All I know, is, it suits Tom Sawyer."

"Oh come, now, you don't mean to let on that you *like* it?"

The brush continued to move.

"Like it? Well, I don't see why I oughtn't to like it. Does a boy get a chance to whitewash a fence every day?"

That put the thing in a new light. Ben stopped nibbling his apple. Tom swept his brush daintily back and forth—stepped back to note the effect—added a touch here and there—criticized the effect again—Ben watching every move and getting more and more interested, more and more absorbed. Presently he said:

"Say, Tom, let *me* whitewash a little."

Tom considered, was about to consent; but he altered his mind:

"No—no—I reckon it wouldn't hardly do, Ben. You see, Aunt Polly's awful particular about this fence—right here on the street, you know—but if it was the back fence I wouldn't mind and *she* wouldn't. Yes, she's awful particular about this fence; it's got to be done very careful; I reckon there ain't one boy in a thousand, maybe two thousand, that can do it the way it's got to be done."

"No—is that so? Oh come, now—lemme just try. Only just a little—I'd let *you*, if you was me, Tom."

"Ben, I'd like to, honest injun; but Aunt Polly—well, Jim wanted to do it, but she wouldn't let him; Sid wanted to do it, and she wouldn't let Sid. Now don't you see how I'm fixed? If you was to tackle this fence and anything was to happen to it—"

"Oh, shucks, I'll be just as careful. Now lemme try. Say—I'll give you the core of my apple."

"Well, here—No, Ben, now don't. I'm afeard—"

"I'll give you *all* of it!"

Tom gave up the brush with reluctance in his face, but alacrity in his heart. And while the late steamer Big Missouri worked and sweated in the sun, the retired artist sat on a barrel in the shade close by, dangled his legs, munched his apple, and planned the slaughter of more innocents.

1. As used in line 11, "operation" most nearly means

   (A) venture.
   (B) maneuver.
   (C) performance.
   (D) process.

2. In paragraph 1 (lines 1 – 14), the narrator conveys Tom's attitude toward whitewashing the fence by

   (A) suggesting that Tom was unknowingly tricked into whitewashing the fence.
   (B) using hyperbole to highlight Tom's despair at the seeming enormity of the fence.
   (C) contrasting the simplicity of the task with Tom's relentlessly negative outlook.
   (D) comparing Tom to a reluctant hero embarking on a long journey.

3. Which choice provides the best evidence for the answer to the previous question?

   (A) Lines 1 –3 ("Saturday morning...with life")
   (B) Lines 3 – 5 ("Tom appeared...a long-handled brush")
   (C) Lines 7 – 9 ("Thirty yards...but a burden")
   (D) Lines 9 – 11 ("Sighing, he dipped...did it again")

4. In context of the passage, paragraph 2 serves to

   (A) contrast Tom's generosity with the other boys' cruelty.
   (B) convey Tom's transformation from despondent to hopeful.
   (C) explain the origins of Tom's mental acuity.
   (D) provide justification for Tom's sorrow.

5. In context of the passage, the author's statement, "Tom surveyed... as before," (lines 37 – 39) is meant to convey

   (A) the idea that Tom's artistic inclinations bleed into all aspects of his daily life.
   (B) Tom's earnest desire to impress Ben with his whitewashing skills.
   (C) Tom's enthusiasm for undertaking tasks with diligence and care.
   (D) Tom's level of commitment in his attempt to deceive Ben.

6. Tom first interests Ben in whitewashing by

   (A) comparing whitewashing to an activity that Ben enjoys.
   (B) offering Ben an apple in exchange for his help.
   (C) pointing out the novelty of the activity.
   (D) claiming that the activity is more fun than swimming.

7. Tom mentions Aunt Polly (lines 71 – 89) primarily to

   (A) explain to Ben why he has so little time to play.
   (B) contrast her laziness with his diligence and determination.
   (C) suggest that meeting her expectations is extremely challenging.
   (D) imply that she will berate Ben if he does not help whitewash the fence.

8. The relationship between Tom and Ben most closely resembles that between

   (A) a con man and his unsuspecting victim.
   (B) an artist and his wealthy patron.
   (C) a child and his disapproving father.
   (D) a detective and a criminal suspect.

9. As used in line 97, "late" most nearly means

   (A) overdue.
   (B) recent.
   (C) tardy.
   (D) deceased.

10. Ben's impersonation of a steamboat and Tom's impersonation of an artist differ in that

    (A) Ben's act is skillful while Tom's is unconvincing.
    (B) Ben's act is playful while Tom's is manipulative.
    (C) Ben's act is harmless while Tom's is hurtful.
    (D) Ben's act is offensive while Tom's is flattering.

1

Refer to the passage below to answer questions 11 – 21.

This passage is adapted from John Malone, "The Importance of Geothermal Energy," published by The Moderate Voice in 2009.

line

In the world of renewables, most of the attention is on the wind and the sun. Geothermal power just hasn't gotten the same respect. That could be changing, as both the Obama Administration and Silicon Valley are considering the heat under the ground as a potentially huge source of clean, domestic U.S. energy, but recent setbacks are calling into question how much geothermal can contribute. Given the potential benefits, we should be doubling our efforts to make geothermal a viable power source for the U.S.

Some background: All thermal power plants use the same basic process. A heat source (burning coal or gas, uranium, concentrated solar energy) is used to turn water into steam, and the energy released turns a turbine that produces electricity. What sets geothermal apart is that the steam comes directly from the ground. Water percolates down through cracks in the ground and is heated to the boiling point by hot rocks underground (in some cases coming back up as a geyser — think Old Faithful), and the resulting steam is drawn up via a well to a turbine.

This makes for, in principle, the ideal alternative energy source. Geothermal power releases virtually no carbon dioxide or pollutants. Crucially, geothermal provides baseload power—wind and solar power are better suited as peaking technologies, as they are dependent on energy sources that wax and wane over the course of a day. Geothermal power is on 24 hours a day, 365 days a year (geothermal power plants can have utilization rates up to 98 percent). And from a national security angle, the promise of geothermal is obvious: There is no more domestic source of energy than the actual ground underneath us.

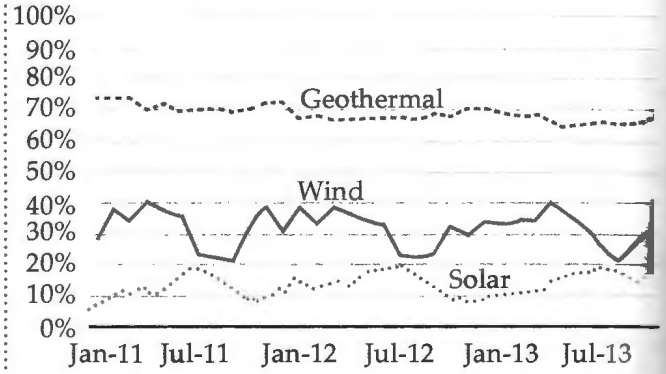
There's one problem, though. There are only a few places in the U.S. where you can find shallow groundwater hot enough to get steam directly from the ground. Engineers and geologists are therefore looking at a new way to tap underground heat. Enhanced Geothermal Systems (EGS) make use of the fact that, if you drill deep enough, any bedrock in the world gets hot enough to boil water. Basically, EGS involves drilling a well into deep, hot, dry rock; drilling a second well nearby to the same depth; fracturing the rock between those two wells enough to allow water to pass between them; and then pumping water down the first well and allowing it to percolate through the hot fractured area to the second well, where it will come back to the surface as superheated steam. The potential for EGS in the U.S. is enormous. A 2006 Massachusetts Institute of Technology report concluded it could provide 100,000 megawatts of power by 2050.

EGS is not without its drawbacks. Cost is the main hurdle. Oil and gas companies now measure well depths in miles, but these are wells drilled through relatively soft rock, not the hard granites that are best suited for EGS. If not managed properly, rocks could lose their heat — eventually, pumping water through a hot rock system could bring the heat gradient down to the point that new wells need to be drilled. There has also been some concern about earthquakes. In 2006, an EGS pilot project in Switzerland set off a 3.4 magnitude quake.

That said, these hurdles are all surmountable, and given the huge benefits it could bring, there is already a surge in investment — both public and private — in EGS. Google laid down an $11 million investment for early-stage research. Perhaps most encouraging is the interest shown in EGS by our Nobel Laureate Secretary of Energy, Steven Chu. Obama's stimulus plan set aside $400 million for pure geothermal research and development. And it's looking like EGS wouldn't need too much more of an investment. A recent New York University study found that as little as $3 billion in R&D development could make EGS cost-competitive with fossil fuel plants.

The widespread application of EGS is still a ways off. But geothermal, whether traditional or EGS, should be used alongside technologies like wind and solar to diversify our renewable base. There is no silver bullet in renewable energy. It's better to think in terms of silver buckshot, where a collection of solutions add up to a big impact. We should do our best to make sure that one of those solutions is the one right under our feet.

Monthly capacity factors for select fuels and technologies (January 2011 - October 2013)



The net capacity factor of a power plant is the ratio of its actual output over a period of time, to its potential output if it were possible for it to operate at full nameplate capacity continuously over the same period of time.

11. The primary purpose of the passage is to

(A) describe the potential costs and benefits of an emerging technology.
(B) compare the effectiveness of EGS to other forms of renewable energy.
(C) advocate for a viable source of renewable energy.
(D) challenge the assumption that fossil fuels are the most effective source of energy.

12. According to paragraph 2 (lines 13 – 24), the heat sources for geothermal energy are

(A) coal and natural gases.
(B) subterranean rocks.
(C) underground water reservoirs.
(D) steam-powered turbines.

13. Based on the passage, it is reasonable to infer that the production of geothermal energy requires

(A) access to drills owned by gas and oil companies.
(B) the use of poorly understood technologies.
(C) global cooperation.
(D) large reserves of water.

14. As used in line 35, "angle" most nearly means

(A) perspective.
(B) gradient.
(C) direction.
(D) point.

15. The author indicates that Enhanced Geothermal Systems are beneficial because they

(A) provide more energy than other methods of geothermal energy production.
(B) can be effective in places that lack easily accessible heated underground water.
(C) require less drilling and maintenance than other forms of renewable energy.
(D) can completely replace wind and solar energy while still proving cost effective.

16. As used in line 87, "silver bullet" most nearly refers to

(A) a surprising revelation.
(B) a clear set of instructions
(C) a short-term plan.
(D) an all-encompassing solution.

17. In line 91, the phrase "right under our feet" primarily serves to

(A) underscore the accessibility of geothermal energy.
(B) suggest that the U.S. should exploit its huge stores of hot underground water.
(C) reiterate the need to begin producing geothermal energy immediately in the U.S.
(D) imply that the most effective uses for geothermal energy should be obvious to readers.

18. The author's attitude toward the production of geothermal energy in the U.S. is one of

(A) anxiety.
(B) hope.
(C) surprise.
(D) criticism.

19. Which choice provides the best evidence for the answer to the previous question?

(A) Line 9 – 12 ("Given...U.S.")
(B) Line 34 – 37 ("And from...us")
(C) Line 38 – 41 ("There's...ground")
(D) Line 84 – 87 ("But geothermal...energy")

20. Which statement about geothermal energy is best supported by the graph?

(A) Certain environmental factors affect wind and solar energy production more than they do geothermal energy production.
(B) The development of solar and wind energies has largely overshadowed that of geothermal energy.
(C) More energy was produced from geothermal sources than from wind of solar sources during the period described in the graph.
(D) Geothermal energy production may never be affordable enough to compete with the production of wind and solar energies.

21. Data from the graph provide most direct support for which claim in the passage?

(A) Lines 9 – 12 ("Given...U.S.")
(B) Lines 27 – 32 ("Crucially...day")
(C) Lines 55 – 57 ("A 2006...2050")
(D) Lines 87 – 89 ("It's better...impact")

1

Refer to the passage below to answer questions 22 – 31.

This passage is adapted from Charles Darwin, *On the Origin of Species*, originally published 1859. The book laid the foundation for the study of evolutionary biology.

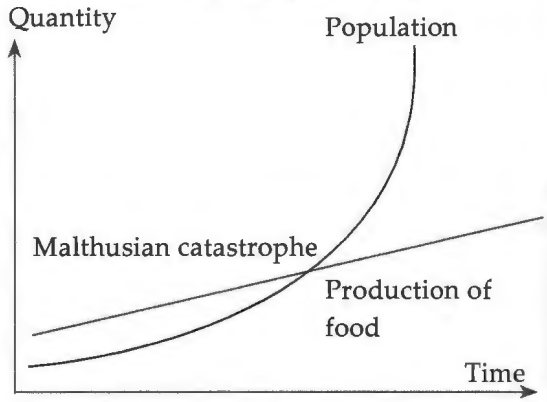
line

I should premise that I use the term Struggle for Existence in a large and metaphorical sense, including dependence of one being on another, and including (which is more important) not only the life of the individual, but success in leaving progeny. Two canine animals in a time of dearth, may be truly said to struggle with each other which shall get food and live. But a plant on the edge of a desert is said to struggle for life against the drought, though more properly it should be said to be dependent on the moisture. A plant which annually produces a thousand seeds, of which on an average only one comes to maturity, may be more truly said to struggle with the plants of the same and other kinds which already clothe the ground. The mistletoe is dependent on the apple and a few other trees, but can only in a far-fetched sense be said to struggle with these trees, for if too many of these parasites grow on the same tree, it will languish and die. But several seedling mistletoes, growing close together on the same branch, may more truly be said to struggle with each other. As the mistletoe is disseminated by birds, its existence depends on birds; and it may metaphorically be said to struggle with other fruit-bearing plants, in order to tempt birds to devour and thus disseminate its seeds rather than those of other plants. In these several senses, which pass into each other, I use for convenience' sake the general term of struggle for existence.

A struggle for existence inevitably follows from the high rate at which all organic beings tend to increase. Every being, which during its natural lifetime produces several eggs or seeds, must suffer destruction during some period of its life, and during some season or occasional year, otherwise, on the principle of geometrical increase, its numbers would quickly become so inordinately great that no country could support the product. Hence, as more individuals are produced than can possibly survive, there must in every case be a struggle for existence, either one individual with another of the same species, or with the individuals of distinct species, or with the physical conditions of life. It is the doctrine of Malthus applied with manifold force to the whole animal and vegetable kingdoms; for in this case there can be no artificial increase of food, and no prudential restraint from marriage. Although some species may be now increasing, more or less rapidly, in numbers, all cannot do so, for the world would not hold them.

It is good thus to try in our imagination to give any form some advantage over another. Probably in no single instance should we know what to do, so as to succeed. It will convince us of our ignorance on the mutual relations of all organic beings; a conviction as necessary, as it seems to be difficult to acquire. All that we can do, is to keep steadily in mind that each organic being is striving to increase at a geometrical ratio; that each at some period of its life, during some season of the year, during each generation or at intervals, has to struggle for life, and to suffer great destruction. When we reflect on this struggle, we may console ourselves with the full belief, that the war of nature is not incessant, that no fear is felt, that death is generally prompt, and that the vigorous, the healthy, and the happy survive and multiply.

Theory of Human Population Growth by Thomas Robert Malthus (1766 – 1834)



22. The statement in lines 6 – 8 ("Two canine… live") sets up a contrast in the remainder of the paragraph between

(A) competing for food and depending on other species.
(B) struggling for individual existence and struggling for the success of one's offspring.
(C) struggling against environmental factors and struggling against other organisms.
(D) actually fighting over food and a wider definition of the struggle for existence.

23. As used in line 2, the word "sense" most nearly means

(A) feeling.
(B) wisdom.
(C) meaning.
(D) perception.

24. Darwin's central claim in the passage is that

(A) every living organism is engaged in a struggle for existence.
(B) understanding an organism's struggle for existence is impossible.
(C) all organisms are part of a web of dependence.
(D) people should be careful to reproduce only in accordance with the food supply.

25. Which choice provides the best evidence for the answer to the previous question?

(A) Lines 11 – 16 ("A plant which…ground")
(B) Lines 23 – 28 ("As the mistletoe…plants")
(C) Lines 40 – 45 ("Hence, as more…life")
(D) Lines 45 – 49 ("It is the…marriage")

26. Which statement about the struggle for existence is best supported by the graph?

(A) Lines 1 – 6 ("I should premise…progeny")
(B) Lines 6 – 8 ("Two canine…live")
(C) Lines 28 – 30 ("In these several…existence")
(D) Lines 33 – 40 ("Every being…product")

27. Darwin mentions Malthus primarily to

(A) argue that Malthus was wrong about animals and plants.
(B) adapt Malthus's theory to non-human organisms.
(C) persuade the reader to accept Malthus's conclusions.
(D) claim that increased food production would benefit all species.

28. As used in line 48, "artificial" most nearly means

(A) fake.
(B) cultivated.
(C) imitation.
(D) dishonest.

29. In paragraph 3 (lines 52 – 70), Darwin's stance could best be described as

(A) an advocate seeking supporters for a policy.
(B) an expert attempting to simplify sophisticated concepts.
(C) a teacher advising persistence and humility.
(D) an environmentalist encouraging like-minded readers.

30. What is Darwin's main point about mutual relations of organic beings?

(A) We can comprehend them, but not fully.
(B) We must respect and protect them.
(C) We should think of ourselves as part of the system of mutual relations.
(D) We ought to double our efforts to study them.

31. The three-part structure of the passage most closely resembles which of the following?

(A) Thesis-Evidence-Consequence
(B) Question-Answer-Discussion
(C) Argument-Counterargument-Synthesis
(D) Definition-Explanation-Commentary

1

Refer to the passage below to answer questions 32 – 42.

Passage 1 is adapted from Patrick Henry's speech to the Second Virginia Convention in 1775. Virginia was one of 13 British colonies in America; its leaders were debating whether to join the fight against the British. Passage 2 is adapted from an 1811 speech by Tecumseh, a Shawnee Indian leader from the Northeast. After seeing his own territory overtaken by American colonists, he tried to unite all Native Americans in armed resistance. The following is from a speech he gave in Mississippi to members of the Choctaw and Chickasaw tribes.

Passage 1

line Mr. President,

...Sir, we have done everything that could be done, to avert the storm which is now coming on. We have petitioned; we have remonstrated; we have supplicated... In vain, after these things, may we indulge the fond hope of peace and reconciliation. There is no longer any room for hope. If we wish to be free, if we mean to preserve inviolate those inestimable privileges for which we have been so long contending, if we mean not basely to abandon the noble struggle in which we have been so long engaged, and which we have pledged ourselves never to abandon until the glorious object of our contest shall be obtained, we must fight! I repeat it, sir, we must fight! An appeal to arms and to the God of Hosts is all that is left us!

They tell us, sir, that we are weak; unable to cope with so formidable an adversary. But when shall we be stronger? Will it be the next week, or the next year? Will it be when we are totally disarmed, and when a British guard shall be stationed in every house?...The battle, sir, is not to the strong alone; it is to the vigilant, the active, the brave....There is no retreat but in submission and slavery! Our chains are forged! Their clanking may be heard on the plains of Boston! The war is inevitable and let it come! I repeat it, sir, let it come.

It is in vain, sir, to extenuate the matter. Gentlemen may cry, Peace, Peace but there is no peace. The war is actually begun! The next gale that sweeps from the north will bring to our ears the clash of resounding arms! Our brethren are already in the field! Why stand we here idle? What is it that gentlemen wish? What would they have? Is life so dear, or peace so sweet, as to be purchased at the price of chains and slavery? Forbid it, Almighty God! I know not what course others may take; but as for me, give me liberty or give me death.

Passage 2

...The whites are already nearly a match for us all united, and too strong for any one tribe alone to resist; so that unless we support one another with our collective and united forces; unless every tribe unanimously combines to give check to the ambition and avarice of the whites, they will soon conquer us apart and disunited, and we will be driven away from our native country and scattered as autumnal leaves before the wind.

But have we not courage enough remaining to defend our country and maintain our ancient independence? Will we calmly suffer the white intruders and tyrants to enslave us?...The annihilation of our race is at hand unless we unite in one common cause against the common foe. Think not, brave Choctaws and Chickasaws, that you can remain passive and indifferent to the common danger, and thus escape the common fate. Your people, too, will soon be as falling leaves and scattering clouds before their blighting breath. You, too, will be driven away from your native land and ancient domains as leaves are driven before the wintry storms.

Sleep not longer, O Choctaws and Chickasaws, in false security and delusive hopes. Our broad domains are fast escaping from our grasp. Every year our white intruders become more greedy, exacting, oppressive and overbearing.... Before the palefaces* came among us, we enjoyed the happiness of unbounded freedom, and were acquainted with neither riches, wants, nor oppression. How is it now? Wants and oppression are our lot; for are we not controlled in everything, and dare we move without asking, by your leave*? Are we not being stripped day by day of the little that remains of our ancient liberty? Do they not even kick and strike us as they do their blackfaces*? How long will it be before they will tie us to a post and whip us, and make us work for them in their cornfields as they do them? Shall we wait for that moment or shall we die fighting before submitting to such ignominy?

* *palefaces: people of European ancestry*
* *by your leave: with your permission*
* *blackfaces: people of African ancestry*

32. Passage 1 strongly suggests that, given circumstances in the American colonies at the time,

(A) expecting a peaceful solution would be wishful thinking.
(B) a standoff might be possible unless Americans are disarmed.
(C) the British governors are probably ready to negotiate seriously.
(D) Virginians should focus on the goal of building a strong Virginia.

33. Which choice provides the best evidence for the answer to the previous question?

(A) Lines 4 – 5, ("We have...supplicated")
(B) Lines 5 – 7 ("In vain...reconciliation")
(C) Lines 8 – 10 ("If we wish...contending")
(D) Lines 21 – 23 ("Will it be...house?")

34. As used in line 14, "object" most nearly means

(A) recipient.
(B) item.
(C) goal.
(D) protest.

35. In line 26, Henry uses the phrase "Our chains are forged!" primarily to

(A) allude to the work of making weapons to fight the British.
(B) argue that the colonists are already doomed.
(C) encourage a debate in Virginia about whether to own slaves.
(D) suggest that complete political oppression is imminent.

36. Tecumseh's metaphor of autumn leaves blown by wind (lines 49 – 51) primarily conveys the idea that

(A) European people will destroy vital plants and animals.
(B) native people will be forcibly detached from communities.
(C) his listeners' dreams for a better life will be crushed.
(D) everyone involved will be unable to exercise self-restraint.

37. Tecumseh strongly suggests in Passage 2 that, for native tribes,

(A) preparing to defend their own territories is paramount.
(B) a natural strategy would be identifying with African American slaves.
(C) retaining each tribe's unique culture is a major concern.
(D) overcoming their differences is crucial for their survival.

38. Which choice provides the best evidence for the answer to the previous question?

(A) Lines 55 – 57 ("The annihilation...foe")
(B) Lines 58 – 61 ("Think not...fate")
(C) Lines 68 – 69 ("Our broad...grasp")
(D) Lines 79 – 80 ("Do they not...blackfaces?")

39. As used in line 74, the word "wants" most nearly means

(A) wishes.
(B) privations.
(C) interests.
(D) objectives.

40. In Passage 2, does Tecumseh base his pro-war argument on the same premise as Patrick Henry does in Passage 1?

(A) Yes, because both refer to their frustration with ineffective written and verbal protests.
(B) Yes, because both predict that courage and vigilance can overcome a stronger enemy.
(C) No, because unlike Henry, Tecumseh claims that the war has already begun.
(D) No, because unlike Henry, Tecumseh warns of the complete loss of communities.

41. One difference between the two speakers' arguments in the passages is that

(A) Tecumseh describes his own experiences in battle.
(B) Henry claims he is ready to die for the cause.
(C) Henry supports unifying the rebels.
(D) Tecumseh warns about literal slavery.

42. Passages 1 and 2 both feature which component?

(A) Evidence in terms of facts and figures
(B) A rhetorical question about dying
(C) A reference to past heroes who prevailed against all odds
(D) A narrative account of a person's suffering

1

Refer to the passage below to answer questions 43 – 52.

This passage is adapted from Monte Basgall, "A smashing success," 2014 by the Krell Institute. The passage primarily discusses the acquisition and analysis of data from particle colliders, which guide groups of particles into near-light-speed collisions. These collisions can reveal even smaller particles, many of which can only be observed during particle collisions.

line

In 2012, as a worldwide collaboration of physicists labored to assemble findings that would spawn global headlines, 33 computational scientists at Brookhaven National Laboratory were working equally long and tense hours to keep many of those particle hunters supplied with constantly updated information.

"Those were probably the most exciting moments of my professional career, and this was true for many other people working in computing," recalls Michael Ernst about his group's role in the discovery of the Higgs boson. Ernst directs the RHIC and ATLAS Computing Facility (RACF) at Brookhaven, which has served as a key data hub for two massive particle accelerators making landmark findings in physics.

"It was essential for everybody directly involved in the analysis to have immediate access to the data. Everybody was committed to resolving problems, regardless of what the hour. Whenever something was not going as projected there were automatic alarms, and people got out of their beds to solve these problems immediately."

Since 2000, RHIC – for Relativistic Heavy Ion Collider – has pushed gold ions to near-light speeds around a 2.4-mile racetrack at Brookhaven, colliding them at energies of up to 500 billion electron volts (GeV). That high-energy crash is thought to free an optimal number of quarks from their normal bondage to gluons, something theoreticians say last happened 100 millionths of a second after the Big Bang.

Researchers anticipated the collisions would result in intensely hot gaseous plasmas of quarks and gluons. But RHIC experiments are instead showing these extreme conditions create a perfect liquid – a substance that flows with virtually no viscosity.

The RHIC, in essence, is a time machine. So is the Large Hadron Collider (LHC), a 17-mile track at the French-Swiss border. At intervals since 2008, the LHC has smashed together beams of protons at energy levels of up to 8 trillion electron volts (TeV). Theoretically, that can recreate other kinds of physics from just after the Big Bang.

The LHC's most notable finding to date is the apparent discovery of the last major fundamental particle needed to complete the Standard Model dictated by quantum mechanics. Theoreticians say the Higgs boson begat the mass in most states of matter.

The Tevatron, a 4-mile, 1 TeV proton-and-antiproton smasher at the Fermi National Accelerator Laboratory (Fermilab) near Batavia, Illinois, narrowed down the Higgs search before closing in 2011. That quest then refocused at the higher-energy LHC. Meanwhile, both Fermilab and Brookhaven took on major roles in the European-based mission.

Seeking particles and states of matter that don't exist in today's world are needles-in-haystacks challenges that demand careful sifting through the many fragments from ferocious matter smashing.

The Higgs challenge has confronted about 6,000 scientists from 38 nations with byproducts from 600 million proton-proton collisions per second, reports CERN, the laboratory that hosts the LHC. Only one of each trillion such bust-ups would likely create a Higgs, Brookhaven experts say. Caught outside its time zone, each candidate Higgs would instantly decay, in as many as a dozen ways, into other detectable particles.

RHIC's gold-gold ion smashups, meanwhile, occur thousands of times a second to generate many more fragments for more than 1,000 other investigators in the U.S. and abroad to analyze.

These two divergent experiments pose another set of challenges for the information scientists at Ernst's RACF. Besides managing megadata for all RHIC collaborators, Brookhaven and Fermilab also agreed to split the more imposing information management duties for all U.S. collaborators in the LHC.

That means RACF serves about 600 Americans who analyze fragments logged by the LHC's huge ATLAS particle detector. Fermilab supplies an equal number using LHC's other detector, called CMS.

RACF is among about 140 data centers sharing the LHC's information-handling duties via a high-speed global fiber optic data grid. PanDA, a special workload management system for ATLAS that draws on disk storage, processors and enabling software, ensures that all of that detector's researchers receive whatever data they need, regardless of where they're working.

"I think it's fair to say that all these resources combined form a worldwide distributed supercomputer," Ernst says.

43. Over the course of the passage, the focus of the article shifts from

(A) the benefits of experimentation to the costs of experimentation.
(B) the production of data to the analysis of data.
(C) developments in the United States to developments in Europe.
(D) historic notions of the genesis of the universe to contemporary developments.

44. As used in line 16, "landmark" most nearly means

(A) geographic.
(B) visible.
(C) inspiring.
(D) seminal.

45. Based on Ernst's description in lines 18 – 25, the atmosphere at the RACF facility is best described as

(A) pressing and collaborative.
(B) frantic and competitive.
(C) frustrated and aggressive.
(D) open and forgiving.

46. In paragraph 4 (lines 26 – 34), the author mentions "near-light speeds," "energies of up to 500 billion electron volts," and "100 millionths of a second" primarily to

(A) provide the reader with the sense of the magnitude of the endeavor.
(B) convince the reader of the wastefulness of the experimental procedures.
(C) intimidate the reader with difficult concepts.
(D) encourage the reader to reach out to laboratories and get involved.

47. In paragraph 6 (lines 41 – 47), the author refers to the RHIC and the LHC as time machines primarily to convey the idea that

(A) they challenge traditional concepts of time and space.
(B) they were first envisioned by science-fiction writers.
(C) they allow us to study the origins of the universe.
(D) they provide glimpses of processes that have not yet occurred.

48. Which choice provides the best evidence for the answer to the previous question?

(A) Lines 30 – 34 ("That high-energy crash…Big Bang")
(B) Lines 37 – 40 ("But RHIC experiments…no viscosity")
(C) Lines 62 – 66 ("Seeking particles and… matter smashing")
(D) Lines 67 – 71 ("The Higgs challenge…the LHC")

49. According to the passage, the RHIC and LHC produce collisions of

(A) ions and protons, respectively.
(B) gluons and quarks, respectively.
(C) antiprotons and protons, respectively.
(D) ions and neutral atoms, respectively.

50. In the context of the passage, the author's use of the phrase "needles-in-haystacks" (lines 63 – 64) is primarily meant to convey the

(A) difficulty and laboriousness of the scientists' task.
(B) mathematical impossibility of the search.
(C) necessity of collaboration in science.
(D) smallness of the Higg's boson compared to an atom or ion.

51. The passage most strongly suggests which of the following about the Higgs boson?

(A) It does not actually exist.
(B) It has sparked much controversy among scientists.
(C) Its existence has been suspected since antiquity.
(D) It can only be identified indirectly.

52. Which choice provides the best evidence for the answer to the previous question?

(A) Lines 8 – 12 ("Those were…Higgs boson")
(B) Lines 46 – 47 ("Theoretically, that…Big Bang")
(C) Lines 47 – 50 ("The LHC's most…quantum mechanics")
(D) Lines 61 – 65 ("Seeking particles and… matter smashing")