TJ Admissions Prep / Test #5 Instructions

Date: _____

mm/dd/yyyy

First Name: _____ Last Name: _____

Email: _____ Phone: _____

Instructions for TJ Test Administration

Please do the following:

- Make sure your name is on the test and on each separate sheet of the answer form "bubble" sheets.
- Write on the test as much as you want.
- Mark a "T" on the test beside questions that eat up your time.
- Mark a "?" on the test beside questions you guess on.
- Circle your answer choices (or write answer where indicated) on the test.
- Transfer your answers to the answer form/bubble sheet (don't write notes on the answer form/bubble sheet
- There is no guessing penalty, so answer all questions!

Environment:

- Find a room where you will not be distracted by family members.
- You must sit in a regular chair at a table.
- Turn off any music or TV in the background.
- Get a timer or use your timer on your phone.
- Put your phone on airplane mode so you aren't distracted.
- No eating or drinking during the test. You may take breaks in between sections if you need to eat, drink, etc.
- If you are being proctored via Zoom, take your test in front of your computer. You will receive log in information in the email that say "New Appointment" and you can find the credentials by clicking the link that says "view appointment details".

If you self-proctor, the timing is as follows:

- ACT Math – 28 Questions / 50 Minutes, then 5 minute break
- ACT Reading – 40 Questions / 65 Minutes, then 5 minute break
- ACT Science – 40 Questions / 60 Minutes

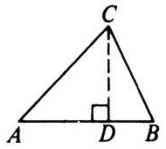
SECTION 1	Time—50 minutes 28 Questions	In this section solve each problem, using any available space on the page for scratchwork. Then decide which is the best of the choices given and fill in the corresponding oval on the answer sheet.

The following information is for your reference in solving some of the problems.

Circle of radius r: Area $= \pi r^2$; Circumference $= 2\pi r$
The number of degrees of arc in a circle is 360.
The measure in degrees of a straight angle is 180.

Definition of symbols:

$=$ is equal to	$\leqq$ is less than or equal to
$\neq$ is unequal to	$\geqq$ is greater than or equal to
$<$ is less than	$\parallel$ is parallel to
$>$ is greater than	$\perp$ is perpendicular to



Triangle: The sum of the measures in degrees of the angles of a triangle is 180.

If $\angle CDA$ is a right angle, then

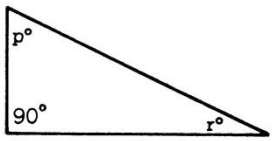
(1) area of $\triangle ABC = \frac{AB \times CD}{2}$

(2) $AC^2 = AD^2 + DC^2$

Note: Figures that accompany problems in this test are intended to provide information useful in solving the problems. They are drawn as accurately as possible EXCEPT when it is stated in a specific problem that its figure is not drawn to scale. All figures lie in a plane unless otherwise indicated. All numbers used are real numbers.

1. If $x + 1 = 7$, then $(x + 2)^2 =$

(A) 25 (B) 36 (C) 49 (D) 64 (E) 81



2. In the triangle above, $p + r =$

(A) 30
(B) 45
(C) 60
(D) 90
(E) 180

3. A farmer has completed fencing all but one side of a square field. If he has already used $3x$ meters of fencing, how many meters will he need for the last side?

(A) $\frac{3x}{4}$ (B) x (C) $\frac{4x}{3}$ (D) $3x$ (E) $4x$

4. If $0 < x < \frac{1}{2}$, which of the following could NOT be x ?

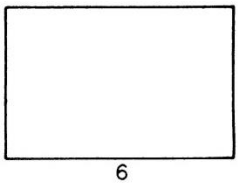
(A) $\frac{1}{4}$ (B) $\frac{3}{10}$ (C) $\frac{5}{8}$ (D) $\frac{7}{16}$ (E) $\frac{9}{32}$

5. There are 3 roads from Town A to Town B and 4 other roads from Town B to Town C. Mrs. Smith must drive from Town A to Town C through Town B every day to her job. How many times could Mrs. Smith make the trip from A to B to C without taking exactly the same route twice?

(A) 15 (B) 12 (C) 7 (D) 4 (E) 3

6. In a mythical country, 1 tong equals 5 sooks and 10 sooks equal 1 kant. How many tongs equal 6 kants?

(A) $1\frac{1}{5}$ (B) $8\frac{1}{3}$ (C) 12 (D) 60 (E) $83\frac{1}{3}$



7. If the rectangle above has perimeter 20 and length 6, what is its area?

(A) 24 (B) 42 (C) 48 (D) 120
(E) It cannot be determined from the information given.

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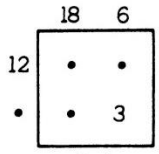


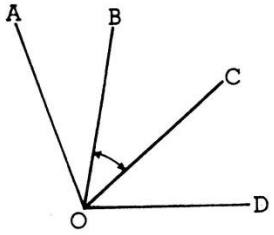
8. In the figure above, each dot represents a missing number. The product of numbers in any row or column inside the square must be equal to the number in the corresponding position outside the square. If the table is completed, which number would go below 12 ?

(A) 3 (B) 6 (C) 9 (D) 18 (E) 27

Expression 1: $6 + 2 + 1 + 3 + 4 + y$
Expression 2: $5 + 7 + 8 + y$

9. A positive number x is added to one of the two expressions above and subtracted from the other. If the resulting expressions are equal, then x =

(A) 2
(B) 3
(C) 4
(D) 5
(E) 6



10. In the figure above, $\angle AOC = 70°$, $\angle BOD = 80°$, and $\angle AOD = 110°$. What is the degree measure of $\angle BOC$?

(A) 10 (B) 20 (C) 30 (D) 40 (E) 50

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11. If $x^2 - 5x + 6 > x^2 + 5x + 6$, which of the following describes x ?

(A) $x < 0$
(B) $x = 0$
(C) $x = 2$
(D) $x = 3$
(E) $x > 3$

12. In a certain school system a child must be at least five years old on March 1 to start school on September 1 of that year. The youngest possible age, in months, on September 1, of a child starting school in this school system would be

(A) 55 (B) 56 (C) 57 (D) 65 (E) 66

13. If $\frac{4}{N}$ is an odd integer, which of the following could be a value of N ?

(A) $\frac{4}{3}$
(B) $\frac{5}{4}$
(C) $\frac{3}{4}$
(D) $\frac{2}{3}$
(E) $\frac{1}{3}$

TRI-SCHOOL MEET

	Event I	Event II	Event III
First Place (5 points)	C	A	
Second Place (3 points)	A		
Third Place (1 point)	B		

14. In a three-school meet, schools A, B, and C each entered one team for each of 3 events. If the score card above is completed and shows no ties in any event, what is the greatest possible number of points by which B's total score could exceed A's total score?

(A) 0
(B) 2
(C) 4
(D) 8
(E) 9

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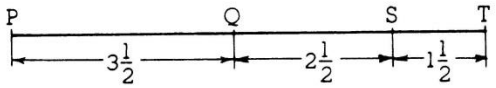
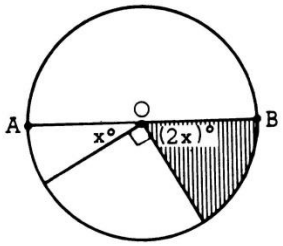
15. If $2a + 3b = 17$ and $a + 2b = 7$, then $\frac{3a + 5b}{2} =$

(A) 10
(B) 12
(C) 18
(D) 20
(E) 24



16. On the straight line in the figure above, if M, not shown, is the midpoint of QS and if N, not shown, is the midpoint of PT, what is the length of MN ?

(A) 1 (B) $1\frac{1}{2}$ (C) 2 (D) $2\frac{1}{2}$ (E) $3\frac{3}{4}$



17. In the figure above, if the radius of the circle with diameter AB and center O is 1, then the area of the shaded region is

(A) $\frac{\pi}{12}$ (B) $\frac{\pi}{8}$ (C) $\frac{\pi}{6}$ (D) $\frac{\pi}{4}$ (E) $\frac{\pi}{3}$

18. If the average of p, q, and r equals the average of p and q, what is r in terms of p and q ?

(A) $\frac{p + q}{3}$ (B) $\frac{p + q}{2}$ (C) $p + q$

(D) $2(p + q)$ (E) $3(p + q)$

19. If $\frac{x + 100}{y + 200} = 1$, then y is what per cent of x ?

(A) 50% (B) 100% (C) 150% (D) 200%
(E) It cannot be determined from the information given.

20. Containers P, Q, and R have capacities in the ratio 2 to 1 to 3, respectively; P is $\frac{3}{4}$ full and Q and R are both empty. If Q is filled to capacity by pouring from P and if the remaining contents of P are poured into R, what part of R is filled?

(A) $\frac{1}{8}$

(B) $\frac{1}{6}$

(C) $\frac{1}{4}$

(D) $\frac{1}{3}$

(E) $\frac{1}{2}$

21. Five contestants competed for two days in a sports event in which there were no ties in standings. At the end of each day, the standings were recorded. Which of the following could NOT be the total number of contestants whose standings changed on the second day?

(A) One (B) Two (C) Three
(D) Four (E) Five

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22. The dimensions of two boxes are p, q, and r and s, t, and u, respectively. If $s < q$, $t < p$, $u < t$, $t < r$, and $q < u$, what is the diameter of the largest ball that will fit into both boxes?

(A) q
(B) r
(C) u
(D) t
(E) s

23. If X, Y, and Z are the hundreds', tens', and units' digits, respectively, of a number, how many hundreds are equal to that number?

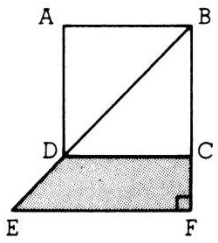
(A) $X + \frac{Y + Z}{100}$

(B) $X + \frac{10Y + Z}{100}$

(C) $\frac{X}{100} + 10Y + Z$

(D) $\frac{ZYX}{100}$

(E) $100X + 10Y + Z$



24. In the figure above, isosceles right triangle BEF overlaps square ABCD as shown. If AB = 1 and EB = 2, what is the area of the shaded region CDEF ?

(A) 2

(B) $\sqrt{2}$

(C) 1

(D) $\frac{\sqrt{2}}{2}$

(E) $\frac{1}{2}$

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25. A watch loses x minutes every y hours. At this rate, how many hours will the watch lose in 1 week

(A) 7xy (B) $\frac{7y}{x}$ (C) $\frac{x}{7y}$ (D) $\frac{14y}{5x}$ (E) $\frac{14x}{5y}$

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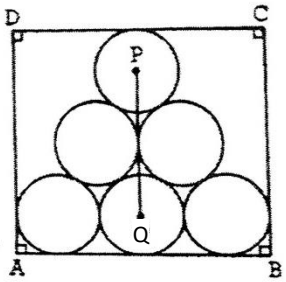
26. **A kindergarten class wants to buy a $77 tropical tree for the school. If the teacher agrees to pay twice as much as the class and the administration promises to pay 4 times as much as the class, how much should the teacher pay?**

27. Starting at A, Julia traveled $\frac{2}{5}$ of the distance from A to B by bus, then traveled 15 miles by car, and then walked 3 miles to reach B. For what fractional part of her trip from A to B was Julia traveling by bus or by car?

28.



If the area of each circle in the figure above is $\frac{\pi}{4}$ and the distance between the centers of circles P and Q is $\sqrt{3}$, what is the area of rectangle ABCD ?

End of Section 1 - Math

READING TEST

65 Minutes—40 Questions

DIRECTIONS: There are four passages in this test. Each passage is followed by several questions. After reading a passage, choose the best answer to each question and fill in the corresponding oval on your answer document. You may refer to the passages as often as necessary.

Passage I

PROSE FICTION: This passage is adapted from the novel *The Alchemist: A Fable About Following Your Dreams* by Paulo Coehlo (©1993 by Paulo Coehlo).

Dusk was falling as Santiago arrived with his herd at an abandoned church.

He decided to spend the night there. He saw to it that all the sheep entered through the ruined gate, and then laid some planks across it to prevent the flock from wandering away during the night.

He swept the floor with his jacket and lay down, using the book he had just finished reading as a pillow.

It was still dark when he awoke, and, looking up, he could see the stars through the half-destroyed roof.

He arose and, taking up his staff, began to awaken the sheep that still slept. He had noticed that, as soon as he awoke, most of his animals also began to stir. It was as if some mysterious energy bound his life to that of the sheep, with whom he had spent the past two years, leading them through the countryside in search of food and water. "They are so used to me that they know my schedule," he muttered. Thinking about that for a moment, he realized that it could be the other way around: that it was he who had become accustomed to *their* schedule.

He had always believed that the sheep were able to understand what he said. So there were times when he read them parts of his books that had made an impression on him, or when he would tell them of the loneliness or the happiness of a shepherd in the fields.

But for the past few days he had spoken to them about only one thing: the girl, the daughter of a merchant who lived in the village they would reach in about four days. The merchant owned a dry goods shop, and he always demanded that the sheep be sheared in his presence. The boy had taken his sheep there the year before.

"I need to sell some wool," the boy told the merchant. The shop was busy, and the man asked the shepherd to wait until the afternoon. So the boy sat on the steps of the shop and took a book from his bag.

"I didn't know shepherds knew how to read," said a girl's voice behind him.

"Well, usually I learn more from my sheep than from books," he answered. During the two hours that they talked, she told him she was the merchant's daughter, and spoke of life in the village, where each day was like all the others. The shepherd told her of the Andalusian countryside, and related the news from the other towns where he had stopped. It was a pleasant change from talking to his sheep.

"How did you learn to read?" the girl asked at one point.

"Like everybody learns," he said. "In school."

And now it was only four days before he would be back in that same village. He was excited, and at the same time uneasy: maybe the girl had already forgotten him. Lots of shepherds passed through, selling their wool.

"It doesn't matter," he said to his sheep. "I know other girls in other places."

But in his heart he knew that it did matter. And he knew that shepherds, like sailors and like traveling salespeople, always found a town where there was someone who could make them forget the joys of carefree wandering.

The day was dawning, and the shepherd urged his sheep in the direction of the sun. He drank a bit, and he gathered his jacket closer to his body.

The jacket had a purpose, and so did the boy. His purpose in life was to travel, and, after two years of walking the Andalusian terrain, he knew all the cities of the region. He was planning, on this visit, to explain to the girl how it was that a shepherd knew how to read. His parents had wanted him to become a priest, and thereby a source of pride for a simple farm family. They worked hard just to have food and water. He had studied Latin, Spanish, and theology. But ever since he had been a child, he had wanted to know the world. One afternoon, he had summoned up the courage to tell his father that he didn't want to become a priest. That he wanted to travel.

"People from all over the world have passed through this village, son," said his father. "They come in search of new things, but when they leave they are basically the same people they were when they arrived. They climb the mountain to see the castle, and they

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wind up thinking that the past was better than what we have now."

"But I'd like to see the castles in the towns where they live," the boy explained.

"Amongst us, the only ones who travel are the shepherds," his father said.

"Well, then I'll be a shepherd!"

His father said no more. The next day, he gave his son three ancient Spanish coins.

"I found these one day in the fields. I wanted them to be a part of your inheritance. But use them to buy your flock. Take to the fields, and someday you'll learn that our countryside is the best."

1. The first seven paragraphs (lines 1–33) establish all of the following about Santiago EXCEPT that he:
   - A. has often watched his sheep wander away during the night.
   - B. has learned to be resourceful as a shepherd.
   - C. draws comfort from talking to his sheep.
   - D. spends some of his time reading books.

2. The time sequence of the passage indicates that Santiago's conversation with the merchant's daughter takes place:
   - F. before he arrives at the abandoned church with his sheep.
   - G. before his father gives him the three ancient coins.
   - H. after he realizes it was he who had become accustomed to the sheep's schedule.
   - J. after he has sold some wool to the merchant.

3. Compared to Santiago's views about traveling, his father's views are best described as:
   - A. contrasting; the father is certain traveling is an unfulfilling pastime.
   - B. contrasting; the father thinks staying home is financially more profitable than traveling.
   - C. similar; the father thinks traveling is rewarding.
   - D. similar; the father wants to know about other cities.

4. Which of the following statements best describes the reaction of Santiago's father to Santiago's wish to travel?
   - F. He is angry at Santiago for dashing his family's hopes by abandoning the path to the priesthood and tells him to leave the village permanently.
   - G. He lectures Santiago at length about the agonizing complications that can befall a shepherd and his flock but ultimately wishes him well.
   - H. He has a brief conversation with Santiago during which he expresses his regret for not realizing sooner what his son's life goals were.
   - J. He questions the wisdom of Santiago's intentions but after a brief discussion offers him support to start his new career.

5. According to the passage, prior to Santiago's arrival, the abandoned church features all of the following EXCEPT:
   - A. a broken gate.
   - B. an old, torn book.
   - C. a dilapidated roof.
   - D. a dirty floor.

6. Which of the following statements about the start of the conversation between Santiago and the girl is supported by the passage?
   - F. Before he noticed her, she saw him reading on the steps of her father's shop and spoke to him.
   - G. When he first saw her in the merchant's shop, he wanted to start a conversation but was too shy.
   - H. He talked to the girl for the first time on his second visit to the shop, because on the first visit he had been too preoccupied with business.
   - J. The first words she spoke to him so surprised him that he was unable to reply until after she had spoken at length.

7. It is most reasonable to infer from the passage that the merchant's daughter would agree with which of the following statements about her village?
   - A. Life there is so exciting because every day different people from around the world come to visit.
   - B. It is painful to witness visitors who discover that what they had hoped to find in the village does not exist.
   - C. Life there is the same day after day, year after year, even though it is a busy place.
   - D. It is a charming place where people support each other in business and family matters.

8. As it is used in the thirteenth paragraph (lines 51–55), the statement "Lots of shepherds passed through, selling their wool" primarily supports which of the following points implied by the passage?
   - F. Santiago is excited about coming to a bustling village after a boring stretch of time in the fields.
   - G. The merchant asked Santiago to wait to conduct business because the merchant had more wool than he could sell that day.
   - H. Santiago fears that the merchant's daughter will not be as excited to see him as he is to see her.
   - J. The merchant's daughter hoped to run her father's business one day because it was so successful.

9. The passage states that Santiago sees a clear similarity between himself and:
   - A. the merchant.
   - B. sailors and traveling salespeople.
   - C. others who have left the priesthood.
   - D. his father when he was young.

10. As it is used in line 65, the word *gathered* most nearly means:
    - F. attached.
    - G. lifted.
    - H. assembled.
    - J. pulled.

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Passage II

SOCIAL SCIENCE: This passage is adapted from the article "A Proverb Each Day Keeps This Scholar at Play" by Richard Wolkomir (©1992 by Smithsonian Institution).

Ever since emigrating to the United States from Germany at age 16, Wolfgang Mieder has left no proverbial stone unturned. Besides teaching about proverbs at the University of Vermont, he has published more than 50 books on his favorite subject, including the massive Oxford University Press *Dictionary of American Proverbs.*

Mieder can tell you the origin of the proverb "One picture is worth a thousand words." Its structure, he says, is one of the universal types: "One of something is worth vast numbers of something else." He can spin off examples, such as "One good head is better than a hundred strong hands" (English), "A friend is better than a thousand silver pieces" (Greek), "A moment is worth a thousand gold pieces" (Korean), "A single penny fairly got is worth a thousand that are not" (German), and "Silence is worth a thousand pieces of silver" (Burmese).

The structure of "One picture is worth a thousand words" may derive from a familiar type, but the actual proverb was dreamed up in 1921 by Fred R. Barnard of the Street Railways Advertising Company. He used it in a piece he wrote for an advertising journal, advocating pictures in advertisements.

"One picture" hit on something about how the mind works—at least, the American mind in the nascent media age—and became part of the national psychic genome. That is one way to look at proverbs: as bits of mental DNA passed on from generation to generation. Some persist, others mutate and evolve. Some disappear. But proverbs are slippery things, and defining them precisely has eluded proverb scholars, or paroemiologists.

"Proverbs are crystallized bits of wisdom," says Mieder, adding that they average seven words, tend to have several levels of meaning and apply to various situations. That is why they are not necessarily true. If "Absence makes the heart grow fonder," why do we say "Out of sight, out of mind"? And if "He who hesitates is lost," how come you have to "Look before you leap"? Mix and match, says Mieder. "We pick the proverb that fits the situation." He has his own favorite definition: "A proverb is a concise statement of an *apparent* truth that has currency."

Folklorists note that proverbs' meanings depend on the situations in which they are used. And many proverbs do not fit our changed society. A city youth who has never met a Rhode Island Red chicken might have trouble deciphering "Never cackle unless you lay." Nationality also can affect interpretations. The Scots, for instance, tend to read "A rolling stone gathers no moss" as extolling the virtues of action as opposed to the more sedentary life. The English, however, tend to equate it with the beautiful growth of moss on a stone in a stream, a metaphor for tradition and stability.

These examples suggest that proverbs reveal "national character." But paroemiologists following that road have hit a dead end. "I could put together a bunch of proverbs that show Americans are materialistic, and I could put together another collection showing that Americans really value friendship and love," says Mieder. "If I know the 300 most common American proverbs, the ones we really use, then *maybe* I can say something."

In fact, that is one of Mieder's projects, although aimed at a different goal than determining national character. The idea of establishing a country's "proverbial minimum" began in Russia in the 1970s, when scholars identified about 300 proverbs that every Russian knows. In the former Soviet Union, people of many nationalities often found themselves struggling to learn Russian, a proverb-rich language, and mastering the proverbial minimum was vital. Now efforts are under way to establish proverbial minimums for other nations, too.

Mieder is pushing the project in the United States: "I've already done statistical analyses, figuring out which proverbs are particularly frequent in 20th-century U.S. writing." Mieder cautions, however, "we would have to distribute about 10,000 questionnaires around the United States to see what proverbs people actually use." Establishing a U.S. proverbial minimum will ease the path for immigrants learning English, he adds.

Meanwhile, linguists are taking a whack at the world's millions of extant proverbs, trying to reduce them to a small number of basic structures. On one level, they reduce proverbs to simple formulas, like "Where there's X, there's Y." But on a deeper level, where they use symbolic logic, their results are pages full of pluses, minuses, equal signs and does-not-equal signs.

11. Which of the following groups is NOT mentioned in the passage as being associated with the study of proverbs?

A. Linguists
B. Anthropologists
C. Paroemiologists
D. Folklorists

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12. The main idea of the first paragraph is that Mieder:
    - F. emigrated to the United States to study the origin of proverbs at the University of Vermont.
    - G. has published a few books on proverbs since coming to the United States at age 16.
    - H. has spent his career studying proverbs and sharing his knowledge through teaching and writing.
    - J. considers his massive proverb dictionary to be the most important work of his career.

13. As it is used in line 10, the word *types* most nearly means:
    - A. situations.
    - B. meanings.
    - C. models.
    - D. letters.

14. Based on the passage, Mieder most likely includes the word *apparent* in his "favorite definition" of a proverb (lines 42–44) to indicate that a proverb doesn't have to be:
    - F. true.
    - G. concise.
    - H. meaningful.
    - J. popular.

15. The italicizing of the word *maybe* in line 64 primarily serves to:
    - A. point to the general lack of scholarly research on proverbs worldwide.
    - B. emphasize that even knowing the most common American proverbs will not necessarily reveal the "national character."
    - C. suggest that Mieder is unsure about whether he could put together a collection of proverbs about friendship and love.
    - D. reveal Mieder's doubts about his ability to determine which proverbs Americans really use.

16. The passage indicates that the movement behind establishing a proverbial minimum began as an effort to:
    - F. pinpoint when it is most appropriate to use a proverb in conversation.
    - G. determine the national character of a population.
    - H. respond to the rapid changes in a language.
    - J. lessen nonnative speakers' struggle to learn a new language.

17. The passage suggests that of the following, which one poses the greatest difficulty in establishing a U.S. proverbial minimum?
    - A. Mieder's lack of interest in the project
    - B. Competing efforts underway in other nations
    - C. Figuring out which proverbs occur most frequently in twentieth-century U.S. writing
    - D. Distributing enough questionnaires around the United States to determine what proverbs people actually use

18. The author includes the information in the last paragraph primarily to:
    - F. criticize Mieder for excluding too many proverbs from his research on the proverbial minimum.
    - G. emphasize the complexity of trying to reduce millions of proverbs to meaningful patterns.
    - H. describe how the use of surveys has assisted researchers in the advanced study of proverbs.
    - J. argue that the world's millions of proverbs should be reduced to a small number of basic structures.

19. The author's reference to proverbs as *slippery things* in line 31 most nearly means that they are:
    - A. innumerable.
    - B. memorable.
    - C. untrue.
    - D. inconstant.

20. According to the passage, the Scots tend to view the proverb "a rolling stone gathers no moss" as endorsing the value of:
    - F. sedentary living.
    - G. tradition and stability.
    - H. action.
    - J. growth.

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Passage III

HUMANITIES: This passage is adapted from the article "The Ascent of Glass" by Jeffrey Hogrefe (©2001 by the Smithsonian Institution).

One of the most striking of the transparent glass buildings that are appearing like ghostly apparitions in cities around the world, the Rose Center for Earth and Space at the American Museum of Natural History in Manhattan marks a new age in glass architecture. Not since the early 1950s, when sleek, green-tinted glass buildings like New York City's Lever House rose amid the stone canyons of countless major cities, has glass elicited so much attention. There are so many glass buildings currently on the drawing boards or under construction, in fact, that it is hard to keep track of them all. "Glass is back," says Kenneth Frampton, professor of architecture at Columbia University and author of *Modern Architecture: A Critical History.* And now it's taking center stage.

Like the Rose Center, many of the new glass edifices are signature buildings. That is to say, the structure itself is used to communicate a message to the public about the occupants' underlying philosophies. "We wanted to build a structure that would say science," says Rose Center lead designer James Polshek. In the year since the Rose Center opened to the public, it drew crowds beyond the wildest expectations of the museum's directors. Many people go just to see the pristine glass cube, which houses the spherical aluminum Hayden Planetarium as if it were a ship in a giant glass bottle. The museum's directors were initially reluctant to give the green light to such an experimental system of glass construction because nothing like it had been used here in the United States. Although many of the icons of early glass architecture rose in U.S. cities during the years after World War II, since the energy crisis of 1973 most of the advances in glass architecture have taken place in Europe. The directors approved the design only after a trip to France to see the building's prototype, the Cité de Sciences & l'Industrie, in Paris. Completed in 1986, the museum used an innovative structural device designed by the Paris-based firm of Rice Francis Ritchie. The system suspended the glass wall in front of a series of metal trusses and braces that held the glass panels in a state of tension.

Glass has many virtues. It lets in light, and brings the outside in and the inside out. Glass is also impervious to the effects of most harsh chemicals and thus is less susceptible to damage from acid rain, which eats away at masonry buildings. Furthermore, advancements in glass production since the 1973 energy crisis have resulted in revolutionary changes in its performance.

Kenneth Frampton sees the return to glass buildings as a symbol of progress. "We do see glass coming back, and with the comeback it has to be effective environmentally," he says. "The early glass curtain wall was only slightly more efficient than no wall." The new glass is not only spectacular to look at and through, it is also more efficient and much safer than the old glass. Stringent energy codes have led to many innovations. Glass is now being manufactured with special coatings that adjust the thermal intake for all four directions of the compass and even allow for the increased intensity of the sun at certain latitudes. For the new LVMH (Louis Vuitton Moët Hennessy) building, which opened in midtown Manhattan in 1999, more than 30 different types of glass were used in the curtain wall in order to meet New York City's energy codes and create an arresting facade of contrasting textures and colors.

Old glass buildings, too, are benefiting from the improvements in glass. Completed in 1952, Park Avenue's Lever House was one of the first glass-walled buildings in Manhattan. Construction was recently finished on a two-year renovation, undertaken because the original glass had begun to crack. The structure has now been completely reclad with a new, stronger version of the glass originally used in the building.

"Glass is being argued as a new material," notes architect Robert A. M. Stern, dean of the School of Architecture at Yale University. "It's being rediscovered after a generation of architects who rejected it."

Glass can serve as a lens, revealing and bringing into focus the interior of buildings—as in the Rose Center, and in the award-winning Hillier Group design for the power plant that supplies electricity to New York's John F. Kennedy International Airport. The inner workings of the plant are exposed to view through the building's transparent glass walls. Unlike traditional power plants, which disguise themselves as other types of buildings, the JFK design is as honest as it is bold. "The underlying point of the design was that power is beautiful," says project architect David Finci.

21. It can most reasonably be inferred from the passage that the author views the statement by Frampton in line 12 as:

- **A.** an exaggeration of the role of glass in architecture today.
- **B.** a gross oversimplification of a complicated issue regarding glass.
- **C.** a suggestion about glass that will hopefully be true someday.
- **D.** an accurate comment about the use of glass in contemporary architecture.

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22. Based on information in the passage, during which of the following periods were architects LEAST likely to design innovative glass buildings for construction in the United States?

F. 1945–1955
G. 1955–1965
H. 1965–1975
J. 1975–1985

23. The passage's author indicates that compared to most other transparent glass buildings, the Rose Center is:

A. more impressive in terms of appearance and design.
B. less impressive in terms of structural soundness.
C. more likely to be a part of ongoing research about the shortcomings of glass as a building material.
D. less likely to influence future designs of buildings in the United States.

24. The main purpose of the fourth paragraph (lines 50–66) is to make clear that the glass used to build walls today has to be:

F. layered to create walls thick enough to insulate the building adequately.
G. made of a type of glass that has been used in several energy-efficient older buildings.
H. much more environmentally effective than the glass used in past buildings.
J. coated with a special material that allows for the increased intensity of the Sun at certain latitudes.

25. As it is used in line 86, the word *disguise* could reasonably be said to mean any of the following EXCEPT:

A. vary.
B. mask.
C. conceal.
D. misrepresent.

26. As it is used in line 31, the word *icons* most nearly means:

F. likenesses.
G. substitutes.
H. landmarks.
J. reflections.

27. The passage suggests that since the early 1970s, compared to architectural firms in the United States, architectural firms in Europe have been:

A. more in favor of designing stone buildings.
B. more focused on advancing glass architecture.
C. less interested in designing signature buildings.
D. less focused on experimenting with new types of glass.

28. According to the passage, an important factor in the Rose Center directors' decision to approve a proposed experimental glass construction for the center was:

F. the approval and support of the construction by the Paris-based firm of Rice Francis Ritchie.
G. their visit to the Cité de Sciences & l'Industrie.
H. their belief that a more traditional glass construction would be less energy efficient.
J. the public excitement over the proposed design.

29. It can most reasonably be inferred from the passage that one aspect of glass that has continued to satisfy architects and builders since the first glass buildings were constructed in the United States is the ability of glass to:

A. withstand the damaging effects of strong winds.
B. insulate a building as well as more traditional building materials.
C. let in light and blur the distinction between the outside and the inside.
D. adjust how it performs as an insulator depending on environmental conditions.

30. It can most reasonably be inferred from Stern's comments that architects today:

F. are reconsidering and redefining how glass is used in architecture.
G. believe that glass must be further improved before it can be considered a truly "new material."
H. are not able to keep their designs up to date with the continuing advances in glass.
J. wonder why the past generation of architects had rejected glass.

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Passage IV

NATURAL SCIENCE: This passage is adapted from the article "Is There Life on Other Planets?" by Victoria Pope (©2002 by U.S. News and World Report, Inc.).

The search for life on other planets is a quest of vast intrinsic interest but of extreme difficulty in practice. Its root logic, though, is simple enough: If life was brewed on the planet Earth in a primordial soup of chemicals 4 billion to 4.5 billion years ago, why shouldn't it have happened on at least one other planet in the universe, too? Astronomers calculate that hundreds of millions of Earth-like planets must exist throughout the universe.

Early space exploration didn't turn up life. When NASA's Viking landers examined Mars two decades ago, they found a dry, sterile environment. Venus was a blazing inferno. It was only the images from the Galileo spacecraft that raised a slight hope of finding suitable conditions for life elsewhere in our solar system: Jupiter's moon Europa appeared to have an ocean of liquid water covered with pack ice.

Scientists who are skeptical about life's having arisen elsewhere have had a strong case, given the precise conditions that seemed essential for life to develop and survive. Planets that are too small cannot retain an atmosphere at all. Those too large turn into gas balls, like Jupiter. Those that are too hot or too cold have no liquid water. And without water, the chemical process of photosynthesis, which converts sunlight into chemical energy, is impossible. Without an atmosphere of oxygen, the chemical reactions that allow a cell to extract energy from other chemicals cannot normally run, either.

But recent findings from our own planet have led scientists to wonder if they've taken too parochial a view of life. Microbes have been discovered thriving under circumstances once thought impossible: in volcanic vents, in hot springs, in geysers. Antarctica's rocks, the cold waters deep beneath the surface of its frozen lakes, and the subterranean ground water below the basalt flows of Washington State's Columbia River Basin may harbor terrestrial models for the rise of life on Mars and other planets. And some tantalizing, if still highly controversial, evidence from Mars at least hints that some similar forms of life may indeed have arisen there, even if they subsequently died out. A Martian meteorite found in Antarctica contains microscopic wormlike structures, dating from at least 3.6 billion years ago, that resemble fossilized bacterial forms found on Earth.

The earthly microbes that seem to defy the odds are members of a category loosely called "extremophiles." Among their hardy ranks are the thermophiles, which thrive in searing heat; the halophiles, which love salt; and the barophiles, bacteria often found in the deep sea that live under high pressure.

Evidence of life in inhospitable environments began to pile up in recent years as highly sensitive gene-sequencing techniques made it possible to identify microorganisms that wouldn't grow in petri dishes in the lab. Before these techniques were available, scientists were able to examine only about 1 percent of the real microbial population. New exploration technologies have helped, too. Deep-diving submarines found "cryptoendolithic" ("hiding within rock") organisms whose metabolism is driven by heat from a geothermal source.

Although the issue is highly contentious, some researchers argue that many of these microbes belong to a distinct and previously unrecognized branch of life. Supporters of this idea say that these one-cell throwbacks, now dubbed "archaea," are genetically different from bacteria and appear to be the oldest life forms on Earth. If that's so, it means that life did not necessarily need some warm, hospitable primordial soup to form but could have originated in a far greater range of environments—including some downright hostile ones.

One of the first Martian rocks to be analyzed by the rover from NASA's Pathfinder spacecraft appears to be andesite, a type of lava found in the Columbia Basin, an area some view as an apt geological analog to Mars. Scientists are especially on the lookout for any rocks that show signs of water deposits that could have supported life. And microbiologists are hoping to find direct traces of archaealike microbes under the surface of Mars to support the idea that Martian life could have existed on the surface and then retreated underground—just like earthly microorganisms found in the volcanic vents, salt mines, and other hard-to-take environments. Guided by what they know from our planet, researchers now have their eyes set on a costly and complex mission: drilling into the Martian permafrost, which could yield the firmest answers yet about the origins of life.

31. With regard to the possibility of finding life on other planets, information presented in the passage makes it clear that the author is:

- **A.** intrigued but cynical.
- **B.** frustrated but determined.
- **C.** optimistic but practical.
- **D.** hopeful but impatient.

32. Which of the following statements most accurately summarizes how the passage characterizes the current state of scientific knowledge about the origins of life?

- **F.** New evidence is misunderstood because today's technology is inadequate.
- **G.** Long-held assumptions are being challenged by new evidence.
- **H.** Once-competing theories are now merging due to conclusive evidence found on other planets.
- **J.** Recent findings are providing concrete support for scientists who are skeptical of the possibility of life on other planets.

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33. Based on the passage, recent discoveries made on which two planets have led some scientists to broaden theories about where life could have originated?

A. Jupiter and Venus
B. Venus and Mars
C. Mars and Earth
D. Earth and Jupiter

34. The main point of the second paragraph (lines 10–17) is that:

F. space technology has progressed greatly in two decades.
G. images from space are difficult for scientists to interpret.
H. space exploration for finding life should be expanded beyond our solar system.
J. early exploration of other planets had offered little hope for finding life.

35. The passage indicates that if scientists can show that archaea are different from all other forms of life, it will prove that life:

A. arose when bacteria first developed in a primordial soup.
B. arose when photosynthesis first occurred in microorganisms.
C. could only have emerged under one set of precise conditions.
D. could have emerged under a fairly broad range of conditions.

36. According to the passage, some early evidence of conditions suitable for life on other planets was found when:

F. Galileo sent back images of Europa.
G. Viking landers examined the surface of Mars.
H. Columbia took pictures of Jupiter.
J. Pathfinder took atmospheric readings of Venus.

37. As it is used in line 31, the word *parochial* most nearly means:

A. private.
B. religious.
C. narrow.
D. spiritual.

38. According to the passage, extremophiles include microbes that:

F. live in very hot, salty, or highly pressurized environments.
G. have life spans twice as long as average microorganisms.
H. live in very dry, sterile environments without oxygen or liquid water.
J. have been thriving recently due to changes in Earth's atmosphere.

39. It can reasonably be inferred that as it is used in line 77, the term *geological analog* directly refers to an area on Earth where:

A. fossilized microorganisms are found in rocks, as if frozen in time.
B. NASA installs and tests equipment before moving it to other planets.
C. rock and mineral layers contain bits of meteorites from other planets.
D. rock and mineral layers are similar to those on another planet.

40. According to the passage, scientists studying Mars to determine the planet's potential for supporting life are especially looking for:

F. signs of water deposits.
G. traces of a geothermal heat source.
H. chemical readings showing high oxygen levels.
J. proof that the planet is between 4 and 4.5 billion years old.

End of Section 2 - Reading

SCIENCE TEST

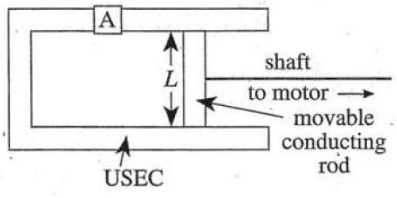
60 Minutes—40 Questions

DIRECTIONS: There are seven passages in this test. Each passage is followed by several questions. After reading a passage, choose the best answer to each question and fill in the corresponding oval on your answer document. You may refer to the passages as often as necessary.

You are NOT permitted to use a calculator on this test.

Passage I

Some students conducted 4 studies using *slidewire generators* of various sizes. Each slidewire generator contained a U-shaped electrical conductor (USEC), a movable conducting rod of length L that connected the sides of the USEC, and an ammeter (A). All conductors were made of the same metal. Using a motor-driven shaft attached to the conducting rod, the students could move the rod either to the left or to the right at speed v (see Figure 1).



top view

Figure 1

In each trial, the slidewire generator was placed perpendicular to a magnetic field of strength B that pointed vertically toward the ceiling. The field was constant in strength and direction. When the rod was moved, an amount of electrical current, I, was generated in the circuit made by the USEC and the conducting rod (see Figure 2).

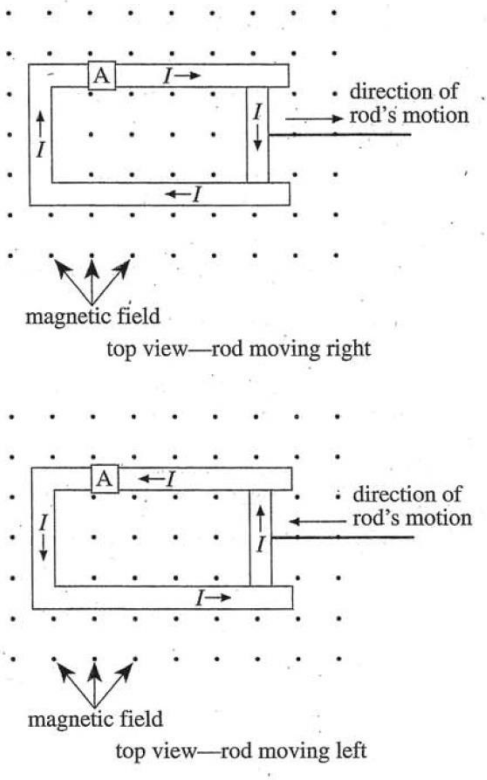


Figure 2

I was positive when the current moved clockwise through the circuit and negative when the current moved counterclockwise through the circuit.

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Study 1

The students moved a rod of length $L = 0.20$ m to the right at various v and measured I in milliamps (mA) for each v (see Table 1). B was the same across the 3 trials.

Table 1

Trial	v (m/sec)	I (mA)
1	0.10	+1.6
2	0.20	+3.2
3	0.30	+4.8

Study 2

The students moved rods of various L to the right at $v = 0.20$ m/sec and found I for each rod (see Table 2). For each trial, $B = 0.40$ tesla (T).

Table 2

Trial	L (m)	I (mA)
4	0.10	+1.6
5	0.40	+6.4
6	0.60	+9.6

Study 3

The students moved a rod of $L = 0.20$ m to the right at $v = 0.20$ m/sec in fields of various B and found I for each B (see Table 3).

Table 3

Trial	B (T)	I (mA)
7	0.60	+4.8
8	0.80	+6.4
9	1.00	+8.0

Study 4

The students moved a rod of $L = 0.20$ m to the left at various v and found I for each v (see Table 4). In each trial, B was the same as in Study 1.

Table 4

Trial	v (m/sec)	I (mA)
10	0.10	−1.6
11	0.20	−3.2
12	0.30	−4.8

1. In Study 1, I would most likely have equaled +8.0 mA if v had been:
   - **A.** 0.05 m/sec.
   - **B.** 0.25 m/sec.
   - **C.** 0.40 m/sec.
   - **D.** 0.50 m/sec.

2. In Study 2, as the length of the conducting rod increased, the amount of electrical current through the loop:
   - **F.** increased only.
   - **G.** decreased only.
   - **H.** remained constant.
   - **J.** varied, but with no general trend.

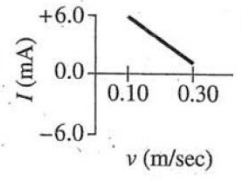
3. In Study 3, I would most likely have equaled +5.6 mA if B had equaled which of the following?
   - **A.** 0.50 T
   - **B.** 0.70 T
   - **C.** 0.90 T
   - **D.** 1.10 T

4. During each trial, an electrical current flowed through the circuit because the motion of the conducting rod in the magnetic field produced a nonzero voltage in the circuit. Assuming that the electrical resistance in the circuit was the same across Trials 2, 7, 8, and 9, during which of these trials was the voltage greatest?
   - **F.** Trial 2
   - **G.** Trial 7
   - **H.** Trial 8
   - **J.** Trial 9

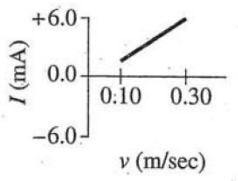
5. In which of the studies, if any, did the electrical current move counterclockwise?
   - **A.** Study 1 only
   - **B.** Study 4 only
   - **C.** Studies 1, 2, and 3 only
   - **D.** None of the studies

6. The results of Study 4 are best represented by which of the following graphs?

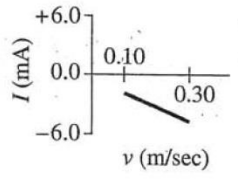
F.



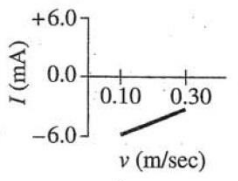
H.



G.



J.



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Passage II

The order Anura includes frogs and toads. Table 1 is a key for identifying some anurans in national forests in California.

Table 1

Step	Trait	Appearance	Result
1	pupils	horizontally aligned	*Ascaphus truei*
		vertically aligned	go to Step 2
2	large parotid glands*	present	go to Step 3
		not present	go to Step 4
3	throat and chest	white without markings	*Bufo microscaphus*
		white with dark markings	*Bufo boreas*
4	toes	padded	go to Step 5
		unpadded	go to Step 6
5	black eye stripe	present	*Hyla regilla*
		not present	*Hyla cadaverina*
6	skin folds on back	present	go to Step 7
		not present	*Rana catesbeiana*
7	groin color	white	*Rana pipiens*
		red	go to Step 8
		yellow or orange	go to Step 9
8	eyes	tilt upward	*Rana pretiosa*
		look outward	*Rana aurora*
9	black spots on back, neck, and head	present	*Rana cascadae*
		not present	go to Step 10
10	light stripe across snout	present	*Rana boylii*
		not present	*Rana muscosa*

*The parotid gland is a gland found behind each eye.

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Table 2 describes 4 anurans that were seen in national forests in California.

Table 2

Anuran	Traits
W	• 8 cm in length • large parotid glands • brown back • white throat and chest with black markings • unpadded toes • vertically aligned pupils
X	• 9 cm in length • no large parotid glands • eyes look outward • skin folds on back • unpadded toes • vertically aligned pupils
Y	• 4 cm in length • brown back with black spots • eyes look outward • no large parotid glands • horizontally aligned pupils
Z	• 3 cm in length • black eye stripe present • unpadded toes • vertically aligned pupils • no large parotid glands • no skin folds on back

Tables 1 and 2 adapted from U.S. Department of Agriculture and Forest Service, *R-5 Fish Habitat Relationship Technical Bulletin, Number 4, Monitoring Frogs and Toads in Region 5 National Forests.* 1991.

7. Table 1 is used to identify animals that belong to which of the following groups?

   A. Mammals
   B. Birds
   C. Reptiles
   D. Amphibians

8. Based on the information provided, the anuran listed in Table 1 that is most closely related to *Bufo boreas* most likely has which of the following characteristics?

   F. Horizontally aligned pupils
   G. A white throat and chest
   H. Padded toes
   J. A light stripe across its snout

9. Based on Table 1, which of the following traits of Anuran X indicates it is NOT a *Hyla regilla* ?

   A. No large parotid glands
   B. Eyes look outward
   C. Skin folds on back
   D. Unpadded toes

10. The results from Table 1 for Anuran Y and Anuran Z first diverge at which of the following steps?

    F. Step 1
    G. Step 2
    H. Step 3
    J. Step 4

11. According to Table 1, *Rana cascadae* and *Rana muscosa* both have which of the following traits?

    A. Padded toes
    B. Skin folds on their backs
    C. Red groin color
    D. A light stripe across their snouts

Passage III

A mercury thermometer, at an initial temperature of 20°C, was placed in 30°C water, and the temperature registered by the thermometer was recorded over time. This procedure was repeated using water samples at 40°C and 50°C (see Figure 1). Next, the same thermometer, at an initial temperature of 50°C, was placed in an air sample at 20°C, and the temperature registered by the thermometer was recorded over time. This procedure was repeated using air samples at 30°C and 40°C (see Figure 2).

(Note: Assume that the designated temperatures of the water samples and air samples did not change during the measurements.)

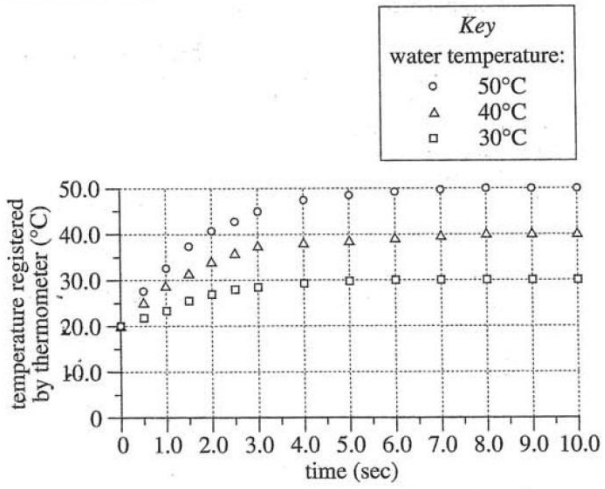

Figure 1

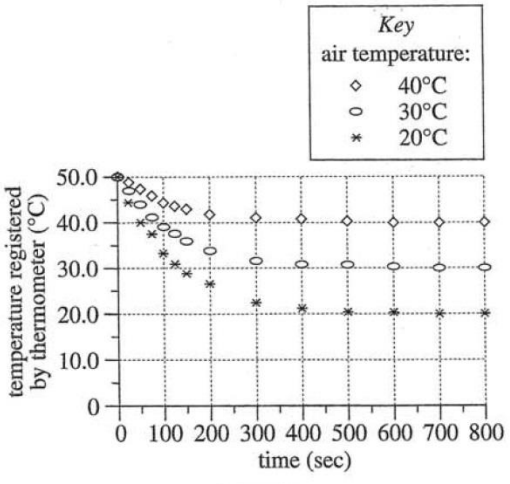

Figure 2

Figures 1 and 2 adapted from Volker Thomsen, "Response Time of a Thermometer."[1] ©1998 by American Association of Physics Teachers.

12. Based on Figure 2, at 250 sec, the thermometer reading in the 40°C air most likely was closest to which of the following?

F. 24°C
G. 32°C
H. 41°C
J. 53°C

13. When the thermometer was in the 50°C water, in the time interval between 2 sec and 3 sec, approximately how rapidly, in °C/sec, was the temperature registered by the thermometer changing?

A. 1°C/sec
B. 4°C/sec
C. 40°C/sec
D. 45°C/sec

14. According to Figure 2, for an air temperature of 20°C, over which of the following time intervals was the thermometer reading changing most rapidly?

F. 0–100 sec
G. 100–200 sec
H. 200–300 sec
J. 300–400 sec

15. Based on Figure 2, for the thermometer placed in 30°C air, the average kinetic energy of the mercury atoms in the thermometer was greatest at which of the following times?

A. 100 sec
B. 300 sec
C. 500 sec
D. 700 sec

16. Based on Figure 2, if the thermometer, at an initial temperature of 50°C, had been placed in an air sample at 10°C, how long would it most likely have taken the thermometer reading to reach 10°C ?

F. Less than 5 sec
G. Between 5 sec and 15 sec
H. Between 100 sec and 300 sec
J. Greater than 300 sec

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Passage IV

Amylase is an enzyme that speeds up the breakdown of starch into smaller carbohydrates (such as maltose).

A starch solution, an amylase solution, and several *buffer solutions* (solutions that maintain a constant pH) were prepared. Two experiments were done using these solutions and the following tests:

- Iodine test: 3 drops of a brown KI_3 solution is added to a sample solution. If starch is present in the sample solution, the solution will turn from brown to black.
- Benedict's test: 1 mL of a blue solution containing $CuSO_4$ is added to a sample solution. The solution is then heated in a boiling water bath for 3 min. If maltose is present in the sample solution, the solution will turn from blue to orange.

Experiment 1

Each of 7 test tubes was filled with 5 mL of pH 7.0 buffer solution. Different amounts of starch solution and/or amylase solution were added to each tube. The solution in each tube was then diluted to 10 mL with the buffer solution (so the final pH was 7.0 in each tube). Each tube was then incubated at a constant temperature for 10 min. The iodine and Benedict's tests were then each done with 2 mL samples drawn from each tube (see Table 1).

Table 1

Tube	Starch (mL)	Amylase (mL)	Temperature (°C)	Iodine test	Benedict's test
1	1	1	30	black	blue
2	1	1	35	black	orange
3	1	1	40	brown	orange
4	1	1	45	black	orange
5	1	1	50	black	blue
6	1	0	50	black	blue
7	0	1	50	brown	blue

Experiment 2

Seven test tubes were filled and tested according to the procedure used for Tube 3, except that for each tube, a different buffer solution was used (see Table 2).

Table 2

Tube	pH	Iodine test	Benedict's test
8	5.0	black	blue
9	6.0	black	blue
10	6.5	black	blue
11	7.0	brown	orange
12	7.5	brown	orange
13	8.0	black	orange
14	9.0	black	blue

17. Based on the passage, amylase in humans is most directly associated with which of the following systems?

A. Nervous
B. Respiratory
C. Digestive
D. Circulatory

18. Suppose an additional trial had been done in Experiment 2 using a buffer solution with a pH of 7.3. What would be the most likely results of the iodine and Benedict's tests?

	Iodine test	Benedict's test
F.	brown	blue
G.	brown	orange
H.	black	blue
J.	black	orange

19. Suppose an additional trial had been performed in Experiment 2 using a buffer solution with a pH of 4.3. What would be the most likely results of the iodine and Benedict's tests?

	Iodine test	Benedict's test
A.	brown	blue
B.	brown	orange
C.	black	blue
D.	black	orange

20. According to the results of the iodine and Benedict's tests, which of Tubes 1–4 in Experiment 1 contained both starch and maltose?

F. Tube 1 only
G. Tube 3 only
H. Tubes 2 and 4 only
J. Tubes 1, 2, 3, and 4

21. All of the experimental factors were identical for which of the following tubes?

A. Tubes 1 and 8
B. Tubes 3 and 11
C. Tubes 5 and 6
D. Tubes 10 and 14

22. Which of the following best describes the relationship between the starch concentration and the maltose concentration during the incubation of Tube 3 ? As the starch concentration:

F. decreased, the maltose concentration increased.
G. decreased, the maltose concentration remained constant.
H. increased, the maltose concentration decreased.
J. increased, the maltose concentration remained constant.

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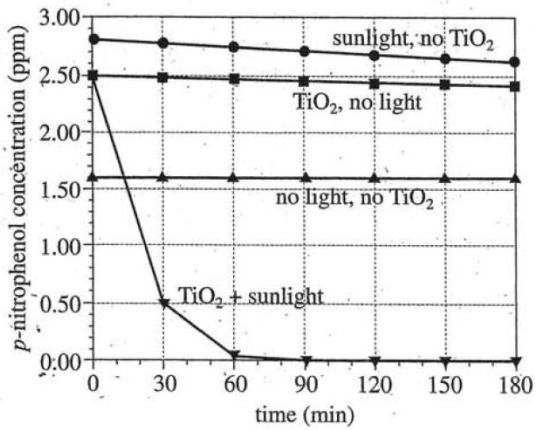
Passage V

Students studied the *photodecomposition* (breakdown by light) of *p*-nitrophenol (a toxic pollutant) in wastewater. They measured the concentration of *p*-nitrophenol (in parts per million, ppm) in wastewater samples during exposure to various lighting conditions. Titanium dioxide (TiO_2) and/or hydrogen peroxide (H_2O_2) were added to some samples at the start of exposure (time = 0 min). TiO_2 and H_2O_2 speed up some photodecomposition reactions. The results of 3 sets of experiments are shown in Figures 1–3.



Note: For the 2 samples exposed to sunlight, the intensity of the sunlight was the same.

Figure 1

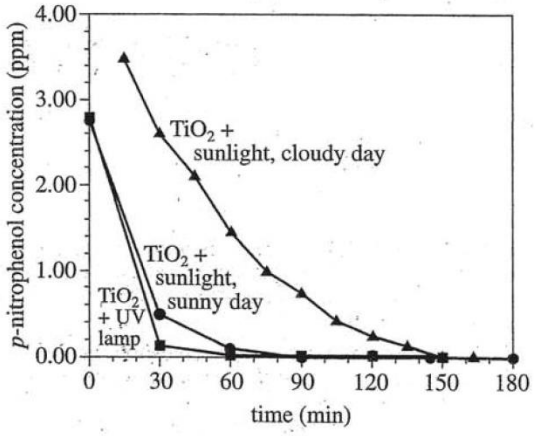
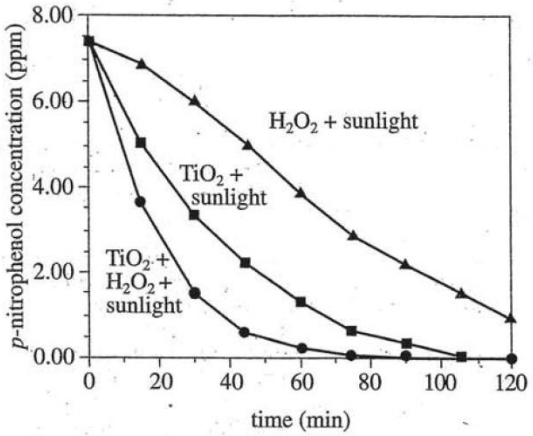


Figure 2



Note: All 3 samples were exposed to the same intensity of sunlight.

Figure 3

Figures adapted from J. A. Herrera-Melián et al., "Solar Photocatalytic Destruction of *p*-Nitrophenol: A Pedagogical Use of Lab Wastes." ©2001 by Division of Chemical Education, Inc., American Chemical Society.

23. According to Figure 1, 60 min after TiO_2 was added to the wastewater sample that was NOT exposed to sunlight, the concentration of *p*-nitrophenol was closest to which of the following?

A. 0.00 ppm
B. 0.20 ppm
C. 2.50 ppm
D. 2.70 ppm

24. According to Figure 1, for the sample that contained TiO_2 and was exposed to sunlight, the greatest amount of *p*-nitrophenol decomposed during which of the following time intervals?

F. From 0 min to 30 min
G. From 30 min to 90 min
H. From 90 min to 150 min
J. From 150 min to 180 min

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25. For which of the 3 figures did all of the wastewater samples studied have the same initial *p*-nitrophenol concentration?

A. Figure 1 only
B. Figure 2 only
C. Figure 3 only
D. Figures 1, 2, and 3

26. Based on the information in the passage, which of the following best describes and explains the results shown in Figure 2 ? As time increased from 0 min to 180 min, the concentration of *p*-nitrophenol in the 3 samples:

F. decreased, because the *p*-nitrophenol changed from a liquid to a gas.
G. decreased, because the *p*-nitrophenol molecules broke down to form other substances.
H. increased, because the *p*-nitrophenol changed from a liquid to a gas.
J. increased, because the *p*-nitrophenol molecules broke down to form other substances.

27. A chemist claimed that adding H_2O_2 to wastewater containing *p*-nitrophenol will cause the *p*-nitrophenol to decompose in the absence of light. Do the results from any of the figures confirm her claim?

A. Yes; according to Figure 1, the *p*-nitrophenol concentration only decreased in the sample containing H_2O_2 tested in the absence of light.
B. Yes; according to Figure 3, the *p*-nitrophenol concentration only decreased in the sample containing H_2O_2.
C. No; according to Figure 1, the *p*-nitrophenol concentration only decreased in the sample containing H_2O_2 tested in the absence of light.
D. No; according to Figures 1–3, no samples containing H_2O_2 were tested in the absence of light.

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Passage VI

Water flowing over the sediment in a river channel creates *bedforms* (3-dimensional structures formed in the sediment). The processes that produce bedforms in present-day river channels produced the same types of bedforms in ancient river channels. Ancient bedforms are often found preserved in sedimentary rock layers. Figure 1 shows a longitudinal cross section of 3 types of bedforms: ripples, dunes, and flat beds.

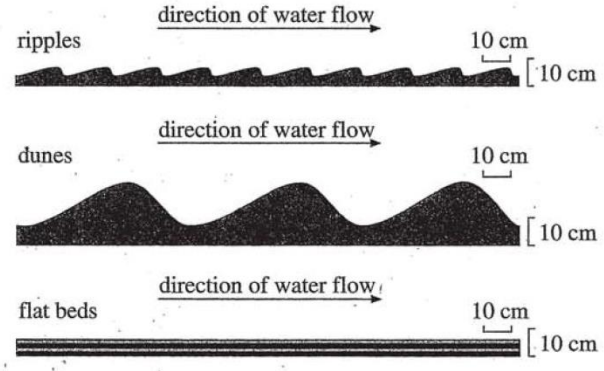

Figure 1

A geologist conducted 3 studies using an artificial river channel 15 m long, 1 m wide, and 0.6 m deep. Water velocity through the channel and water flow depth could be controlled. At the start of each study, a flat, 15 cm thick layer of sand particles of uniform diameter was placed in the bottom of the channel. Various combinations of water velocity, from 0.2 m/sec to 2.0 m/sec, and of water flow depth, from 0.1 m to 0.4 m, were tested in each of the 3 studies.

Study 1

The bottom of the channel was covered with fine sand particles, all having a diameter of 0.19 mm. Water was passed over the sediment bed. The resulting *bedform stability fields* (water velocities and water flow depths at which various types of bedforms were present) are shown in Figure 2.

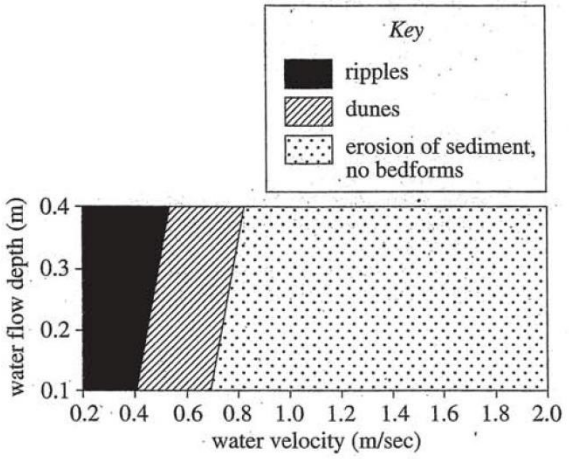

Figure 2

Study 2

Study 1 was repeated using medium sand particles, all having a diameter of 0.45 mm. The resulting bedform stability fields are shown in Figure 3.

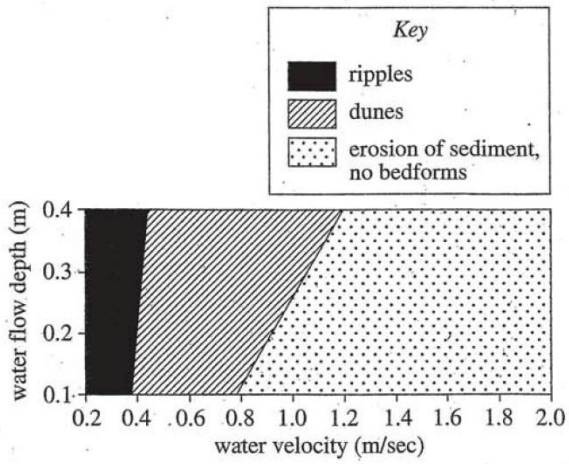

Figure 3

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Study 3

Study 1 was repeated using coarse sand particles, all having a diameter of 0.93 mm. The resulting bedform stability fields are shown in Figure 4.

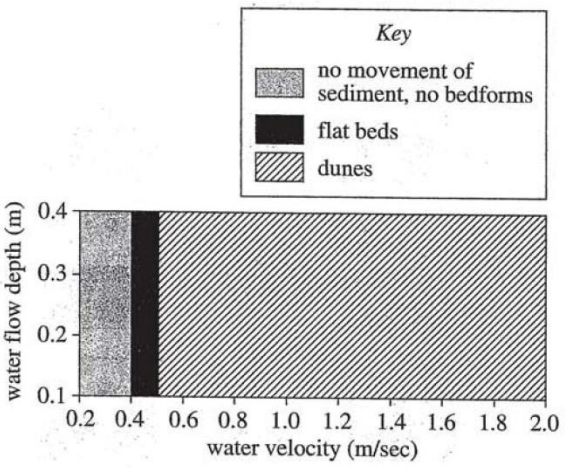

Figure 4

Figures 2–4 adapted from Gerald Middleton and John Southard, *Mechanics of Sediment Movement*. ©1984 by the Society of Economic Paleontologists and Mineralogists.

28. Which of the following factors was NOT directly controlled by the geologist during the studies?

F. Water velocity
G. Water flow depth
H. Bedform type
J. Sediment particle diameter

29. Suppose Study 1 were repeated using sand particles all having a diameter of 0.30 mm. The resulting bedform stability fields would include which of the 3 types of bedforms referred to in the passage?

A. Ripples only
B. Flat beds only
C. Ripples and dunes only
D. Dunes and flat beds only

30. A sedimentary rock layer containing preserved ripples was composed entirely of sediment particles with diameters between 0.4 mm and 0.5 mm. The water flow depth in the river at the time the ripples were forming was between 0.1 m and 0.4 m. Based on the information presented, the velocity of the river water was most likely:

F. less than 0.5 m/sec.
G. between 0.5 m/sec and 0.6 m/sec.
H. between 0.6 m/sec and 0.7 m/sec.
J. greater than 0.7 m/sec.

31. According to the results of Studies 1 and 2, which of the following statements comparing the maximum water velocity at which ripples were present and the maximum water velocity at which dunes were present is true?

A. For all water flow depths, the maximum water velocity at which ripples were present was higher than the corresponding maximum water velocity at which dunes were present.
B. For all water flow depths, the maximum water velocity at which ripples were present was lower than the corresponding maximum water velocity at which dunes were present.
C. For only some of the water flow depths, the maximum water velocity at which ripples were present was higher than the corresponding maximum water velocity at which dunes were present.
D. For only some of the water flow depths, the maximum water velocity at which ripples were present was lower than the corresponding maximum water velocity at which dunes were present.

32. According to the results of Study 3, for a given water velocity, as the water flow depth increased, the type of bedform present:

F. changed from ripples to dunes.
G. changed from dunes to flat beds.
H. changed from flat beds to dunes.
J. did not change.

33. Consider the average wavelength of a ripple bedform and the average wavelength of a dune bedform, as shown in Figure 1. Which, if either, is(are) greater than 10 cm ?

A. The average wavelength of a ripple bedform only
B. The average wavelength of a dune bedform only
C. Both the average wavelength of a ripple bedform and the average wavelength of a dune bedform
D. Neither the average wavelength of a ripple bedform nor the average wavelength of a dune bedform

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Passage VII

Vapor pressure is the pressure exerted by the vapor above a liquid in a closed container at a given temperature and at *equilibrium*. At equilibrium, the rate of evaporation equals the rate of condensation.

Two students observed that the vapor pressure of H_2O *decreased* when NaCl was dissolved in the H_2O. The students then offered explanations for why this decrease occurred.

Student 1

Solvent molecules are attracted to charged solute particles. This causes solvent molecules to surround solute particles, forming clusters. Additional energy is needed to break solvent molecules free from these clusters. Thus, at a given temperature, the vapor pressure of the solution is lower than that of the pure liquid. The vapor pressure decreases as the concentration of charged solute particles increases and as the magnitude of the charge on each solute particle increases. Neutral solute particles do not affect the vapor pressure of a liquid.

Student 2

Vapor pressure decreases because some of the solvent particles that have sufficient energy to escape the solution's surface collide with the solute particles and lose energy. Thus, at a given temperature, the vapor pressure of the solution is lower than that of the pure liquid. The size of the decrease in vapor pressure is directly proportional to the concentration of solute particles. A neutral solute particle decreases the vapor pressure of a liquid by the same amount as does a charged solute particle. The concentration of solute particles is the only factor that affects the vapor pressure of a liquid.

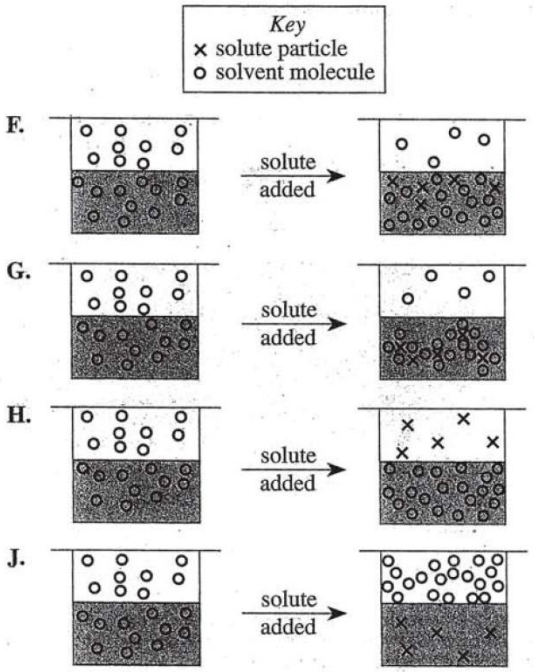
Experiment

Three 1 kg solutions were made by dissolving 1.0 *mole* (6×10^{23} units or molecules) of glucose, NaCl, or $CaCl_2$, respectively, in distilled H_2O. Thus, the concentration of each solution was 1.0 mole/kg. Table 1 shows the solute particle(s) resulting from each unit (or molecule) of each substance dissolved in H_2O. The students then measured the vapor pressure of distilled H_2O and of each solution at 25°C.

Table 1

Solution	Solute	Resulting solute particle(s)
1	glucose	1 particle (1 neutral glucose molecule)
2	NaCl	2 particles (1 Na^+ and 1 Cl^-)
3	$CaCl_2$	3 particles (1 Ca^{2+} and 2 Cl^-)

34. Which of the following diagrams best illustrates how Student 1 would describe the change that occurs when NaCl is dissolved in H_2O ?



35. Do the 2 students differ in their descriptions of how solvent molecules interact with solute particles in a solution?

- **A.** Yes; Student 1 claims solvent molecules are attracted to charged solute particles and Student 2 does not.
- **B.** Yes; Student 2 claims solvent molecules are attracted to charged solute particles and Student 1 does not.
- **C.** No; both students claim that the solvent molecules surround charged solute particles.
- **D.** No; neither student discusses the interactions of solvent molecules with solute particles.

36. Based on Table 1, how did the concentration of solute particles in Solution 3 compare to the concentration of solute particles in Solution 1 ? The concentration of solute particles in Solution 3 was:

- **F.** lower, because each $CaCl_2$ unit dissolves into fewer solute particles than does each glucose molecule.
- **G.** lower, because each $CaCl_2$ unit dissolves into more solute particles than does each glucose molecule.
- **H.** higher, because each $CaCl_2$ unit dissolves into fewer solute particles than does each glucose molecule.
- **J.** higher, because each $CaCl_2$ unit dissolves into more solute particles than does each glucose molecule.

GO ON TO THE NEXT PAGE

37. Suppose an experiment showed that each Na^+ in a salt-water solution exists in a cluster with 3 H_2O molecules. This finding would support the explanation(s) of which of the students, if either?

A. Student 1 only
B. Student 2 only
C. Both students
D. Neither student

38. When table sugar is dissolved in pure H_2O at 25°C, the vapor pressure at equilibrium is lower than that of pure H_2O at 25°C. Because dissolved table sugar molecules are neutral, this observation *contradicts* the explanation of:

F. Student 1, because Student 1 claims that only charged solute particles can cause the vapor pressure to decrease.
G. Student 2, because Student 2 claims that only charged solute particles can cause the vapor pressure to decrease.
H. Student 1, because Student 1 claims that only uncharged solute particles can cause the vapor pressure to decrease.
J. Student 2, because Student 2 claims that only uncharged solute particles can cause the vapor pressure to decrease.

39. With which of the following statements about solutes would both students agree? Adding to a liquid a substance that dissolves:

A. and dissociates into ions will decrease the liquid's vapor pressure.
B. and dissociates into ions will increase the liquid's vapor pressure.
C. but does not dissociate into ions will decrease the liquid's vapor pressure.
D. but does not dissociate into ions will increase the liquid's vapor pressure.

40. Assume the following for the addition of a substance to a pure liquid:

ΔP = the decrease in vapor pressure
C = the concentration of solute particles
k = a constant

Which of the following equations is most consistent with Student 2's explanation?

F. $\Delta P = \frac{k}{C^2}$

G. $\Delta P = k \times C^2$

H. $\Delta P = \frac{k}{C}$

J. $\Delta P = k \times C$

End of Section 3 - Science

COMPLETE MARK ● EXAMPLES OF INCOMPLETE MARKS 

You must use a No. 2 pencil and marks must be complete. Do not use a mechanical pencil. It is very important that you fill in the entire circle darkly and completely. If you change your response, erase as completely as possible. Incomplete marks or erasures may affect your score.

First Name: _____ Last Name: _____

SECTION 1

Math

1	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
2	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
3	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
4	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
5	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
6	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
7	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
8	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
9	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
10	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
11	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
12	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
13	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
14	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
15	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
16	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
17	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
18	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
19	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
20	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
21	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
22	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
23	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
24	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
25	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ

Student-Produced Responses:

26 _____

27 _____

28 _____

COMPLETE MARK ● EXAMPLES OF INCOMPLETE MARKS 

You must use a No. 2 pencil and marks must be complete. Do not use a mechanical pencil. *It is very important that you fill in the entire circle darkly and completely. If you change your response, erase as completely as possible. Incomplete marks or erasures may affect your score.*

First Name: _____ Last Name: _____

SECTION 2

Reading

1	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**21**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
2	Ⓕ	Ⓖ	Ⓗ	Ⓙ	**22**	Ⓕ	Ⓖ	Ⓗ	Ⓙ
3	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**23**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
4	Ⓕ	Ⓖ	Ⓗ	Ⓙ	**24**	Ⓕ	Ⓖ	Ⓗ	Ⓙ
5	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**25**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
6	Ⓕ	Ⓖ	Ⓗ	Ⓙ	**26**	Ⓕ	Ⓖ	Ⓗ	Ⓙ
7	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**27**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
8	Ⓕ	Ⓖ	Ⓗ	Ⓙ	**28**	Ⓕ	Ⓖ	Ⓗ	Ⓙ
9	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**29**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
10	Ⓕ	Ⓖ	Ⓗ	Ⓙ	**30**	Ⓕ	Ⓖ	Ⓗ	Ⓙ
11	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**31**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
12	Ⓕ	Ⓖ	Ⓗ	Ⓙ	**32**	Ⓕ	Ⓖ	Ⓗ	Ⓙ
13	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**33**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
14	Ⓕ	Ⓖ	Ⓗ	Ⓙ	**34**	Ⓕ	Ⓖ	Ⓗ	Ⓙ
15	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**35**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
16	Ⓕ	Ⓖ	Ⓗ	Ⓙ	**36**	Ⓕ	Ⓖ	Ⓗ	Ⓙ
17	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**37**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
18	Ⓕ	Ⓖ	Ⓗ	Ⓙ	**38**	Ⓕ	Ⓖ	Ⓗ	Ⓙ
19	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**39**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
20	Ⓕ	Ⓖ	Ⓗ	Ⓙ	**40**	Ⓕ	Ⓖ	Ⓗ	Ⓙ

COMPLETE MARK ● EXAMPLES OF INCOMPLETE MARKS

You must use a No. 2 pencil and marks must be complete. Do not use a mechanical pencil. *It is very important that you fill in the entire circle darkly and completely. If you change your response, erase as completely as possible. Incomplete marks or erasures may affect your score.*

First Name: _____ Last Name: _____

SECTION 3

Science

1	Ⓐ	Ⓑ	Ⓒ	Ⓓ		**21**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
2	Ⓕ	Ⓖ	Ⓗ	Ⓙ		**22**	Ⓕ	Ⓖ	Ⓗ	Ⓙ
3	Ⓐ	Ⓑ	Ⓒ	Ⓓ		**23**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
4	Ⓕ	Ⓖ	Ⓗ	Ⓙ		**24**	Ⓕ	Ⓖ	Ⓗ	Ⓙ
5	Ⓐ	Ⓑ	Ⓒ	Ⓓ		**25**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
6	Ⓕ	Ⓖ	Ⓗ	Ⓙ		**26**	Ⓕ	Ⓖ	Ⓗ	Ⓙ
7	Ⓐ	Ⓑ	Ⓒ	Ⓓ		**27**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
8	Ⓕ	Ⓖ	Ⓗ	Ⓙ		**28**	Ⓕ	Ⓖ	Ⓗ	Ⓙ
9	Ⓐ	Ⓑ	Ⓒ	Ⓓ		**29**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
10	Ⓕ	Ⓖ	Ⓗ	Ⓙ		**30**	Ⓕ	Ⓖ	Ⓗ	Ⓙ
11	Ⓐ	Ⓑ	Ⓒ	Ⓓ		**31**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
12	Ⓕ	Ⓖ	Ⓗ	Ⓙ		**32**	Ⓕ	Ⓖ	Ⓗ	Ⓙ
13	Ⓐ	Ⓑ	Ⓒ	Ⓓ		**33**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
14	Ⓕ	Ⓖ	Ⓗ	Ⓙ		**34**	Ⓕ	Ⓖ	Ⓗ	Ⓙ
15	Ⓐ	Ⓑ	Ⓒ	Ⓓ		**35**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
16	Ⓕ	Ⓖ	Ⓗ	Ⓙ		**36**	Ⓕ	Ⓖ	Ⓗ	Ⓙ
17	Ⓐ	Ⓑ	Ⓒ	Ⓓ		**37**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
18	Ⓕ	Ⓖ	Ⓗ	Ⓙ		**38**	Ⓕ	Ⓖ	Ⓗ	Ⓙ
19	Ⓐ	Ⓑ	Ⓒ	Ⓓ		**39**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
20	Ⓕ	Ⓖ	Ⓗ	Ⓙ		**40**	Ⓕ	Ⓖ	Ⓗ	Ⓙ

ANSWER KEY – TJ Test #5

Section #1 Math

1-	D
2-	D
3-	B
4-	C
5-	B
6-	C
7-	A
8-	C
9-	A
10-	D
11-	A
12-	E
13-	A
14-	A
15-	B
16-	A
17-	C
18-	B
19-	E
20-	B
21-	A
22-	E
23-	B
24-	E
25-	E
26-	22
27-	9/10
28-	$3 + 3\sqrt{3}$

Section #2 Reading

1-	A	21-	D
2-	F	22-	J
3-	A	23-	A
4-	J	24-	H
5-	B	25-	A
6-	F	26-	H
7-	C	27-	B
8-	H	28-	G
9-	B	29-	C
10-	J	30-	F
11-	B	31-	C
12-	H	32-	G
13-	C	33-	C
14-	F	34-	J
15-	B	35-	D
16-	J	36-	F
17-	D	37-	C
18-	G	38-	F
19-	D	39-	D
20-	H	40-	F

Section #3 Science

1-	D	21-	B
2-	F	22-	F
3-	B	23-	C
4-	J	24-	F
5-	B	25-	C
6-	G	26-	G
7-	D	27-	D
8-	G	28-	H
9-	D	29-	C
10-	F	30-	F
11-	B	31-	B
12-	H	32-	J
13-	B	33-	C
14-	F	34-	G
15-	A	35-	A
16-	J	36-	J
17-	C	37-	A
18-	G	38-	F
19-	C	39-	A
20-	H	40-	J