First Name: _____ Last Name: _____

Email: _____ Phone: _____

Student ID #: _____ Date: _____

mm/dd/yyyy

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!

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

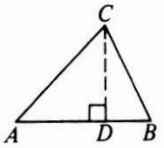
In this section solve each problem, using any available space on the page for scratchwork. Then decide which is the best of the choices given and fill in the corresponding oval on the answer sheet.

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 $\triangle ABC = \frac{AB \times CD}{2}$

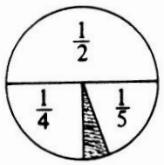
(2) $AC^2 = AD^2 + DC^2$

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. Which of the following must be even?

   I. The sum of two odd numbers
   II. The sum of an odd and an even number
   III. The sum of two even numbers

   (A) I only (B) II only (C) I and II only
   (D) I and III only (E) I, II, and III



2. In the figure above, the shaded region is what fractional part of the area of the circle?

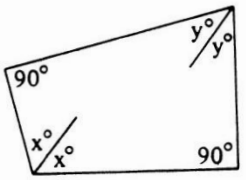
   (A) $\frac{1}{60}$ (B) $\frac{1}{40}$ (C) $\frac{1}{20}$ (D) $\frac{1}{10}$ (E) $\frac{1}{6}$

3. If $P_1 = 4 \times 0.095$ and $P_2 = 0.004 \times 0.095$, which of the following is true?

   (A) $P_1 = P_2$
   (B) $P_2 > P_1$
   (C) $P_1 + P_2 > 5$
   (D) $P_1 > 4$
   (E) $P_1 > P_2$

4. If $x + 3 = x - b$, then $b =$

   (A) -3 (B) 3 (C) $-x$ (D) x (E) $-2x + 3$



5. In the figure above, $x + y =$

   (A) 30 (B) 45 (C) 60 (D) 90 (E) 120

6. How many numbers between 20 and 50 are each equal to 9 times an integer?

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

7. If $(r + 1)\left(\frac{1}{r}\right) = 0$, what is r ?

   (A) 2 (B) 1 (C) -1
   (D) -2 (E) Any integer

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8. If x, y, and z are consecutive integers and x + y + z = 270, what is the value of the LEAST of the three integers?

   (A) 80 (B) 89 (C) 90 (D) 268

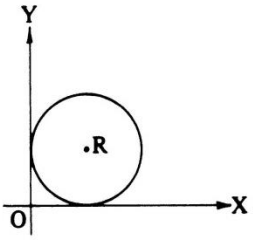
   (E) It cannot be determined from the information given.

9. If the average of 2 numbers is 7 and the product of the 2 numbers is 48, then the positive difference between the 2 numbers is

   (A) 1
   (B) 2
   (C) 3
   (D) 4
   (E) 6

0. If $3 \cdot 5 \cdot 7 = x$ and $3 \cdot 5 = y$, then $x - y$ is equal to the product of 15 and

   (A) 7 (B) 6 (C) 1 (D) -6 (E) -7



1. In the figure above, a circle with center R has an area of 36π square units and just touches the X- and Y-axes. What are the coordinates of R ?

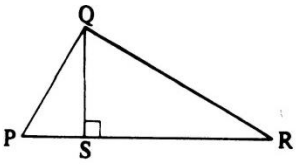
   (A) (3, 12) (B) (4, 9) (C) (6, 6)
   (D) (18, 18) (E) (36, 36)

---

2. If $\frac{1}{x+y} = 1$, then $x =$

   (A) $1 - y$ (B) $y - 1$ (C) $\frac{1}{1+y}$

   (D) $1 + y$ (E) $-y$



Note: Figure not drawn to scale.

13. In ΔPQR above, $QS \perp PR$. Which of the following conditions will insure that area $\Delta PQS <$ area ΔSQR ?

    (A) $QS < PQ$ (B) $PQ < PR$ (C) $QR < PR$
    (D) $PQ < QR$ (E) $QS < PR$

---

14. If 3 persons who work at the same rate can do a job together in 5 days, what fractional part of that job can one of these persons do in 1 day?

    (A) $\frac{1}{15}$ (B) $\frac{1}{12}$ (C) $\frac{1}{9}$ (D) $\frac{1}{5}$ (E) $\frac{1}{3}$

15. If the pattern of the first 5 arrows above continues to the right, the 107th arrow would be in which of the following directions?

    (A) ↓ (B) ↘ (C) ↗ (D) ↑ (E) →

Row A	7	2	5	4	6
Row B	3	8	6	9	7
Row C	5	4	3	8	2
Row D	9	5	7	3	6
Row E	5	6	3	7	4

16. Which row in the list above contains both the square of an integer and the cube of a different integer?

    (A) Row A (B) Row B (C) Row C
    (D) Row D (E) Row E

GO ON TO THE NEXT PAGE

17. Jack begins reading at the top of page N and finishes at the bottom of page R. If the pages are numbered and read consecutively and if there are no blank pages, how many pages has he read?

(A) R - N + 1
(B) N - R + 1
(C) N - R - 1
(D) R - N
(E) N - R

18. Out of a total of 154 games played, a ball team won 54 more games than it lost. If there were no ties, how many games did the team win?

(A) 94
(B) 98
(C) 100
(D) 102
(E) 104

19. On a scale drawing, if 4 centimeters represent 16 meters, how many centimeters represent 2 meters 8 centimeters?
(100 centimeters = 1 meter)

(A) 0.52
(B) 0.58
(C) 0.70
(D) 2.08
(E) 2.50

20. If x is k per cent of y, what per cent of y is kx ?

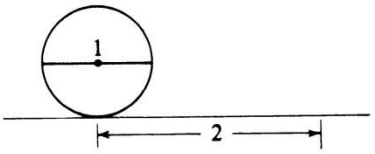
(A) $\frac{k}{100}\%$

(B) $\frac{100}{k}\%$

(C) k%

(D) 100k%

(E) $k^2\%$



21. The figure above shows a circle with diameter 1. If $\frac{22}{7}$ is used as an approximation to π and if the circle rolls a distance 2, what part of a complete rotation does it make?

(A) $\frac{7}{44}$

(B) $\frac{7}{22}$

(C) $\frac{7}{11}$

(D) $\frac{11}{7}$

(E) $\frac{22}{7}$

22. At a cost of 5 oranges for t cents, how many oranges can be bought for x dollars?

(A) $\frac{500x}{t}$

(B) $\frac{500t}{x}$

(C) $\frac{20x}{t}$

(D) $\frac{20t}{x}$

(E) 20tx

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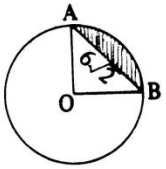
23. A triangle is obtuse if and only if the degree measure of one of its angles is greater than 90 and less than 180. A certain triangle has sides of lengths 5, 5, and x. What are all numbers x for which this triangle is obtuse?

(A) $5 \leqq x \leqq 5\sqrt{2}$
(B) $5 < x < 5\sqrt{2}$
(C) $5\sqrt{2} \leqq x \leqq 10$
(D) $5\sqrt{2} < x \leqq 10$
(E) $5\sqrt{2} < x < 10$

$$\begin{array}{r} AB \\ +CD \\ \hline AAA \end{array}$$

24. In the correct addition problem shown above, A, B, C, and D represent nonzero digits. What is the value of C ?

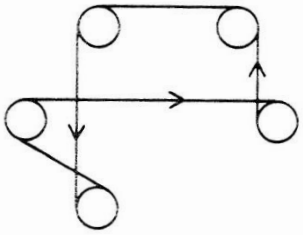
(A) 9 (B) 8 (C) 7 (D) 1
(E) It cannot be determined from the information given.



25. In the figure above, if O is the center of the circle and the length of side AB of right triangle AOB is $6\sqrt{2}$, what is the area of the shaded region?

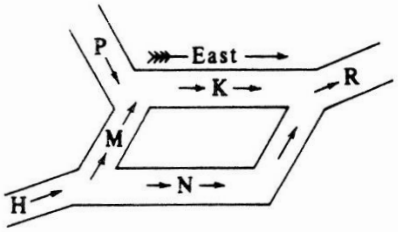
(A) $27\pi + 18$
(B) $27\pi - 18$
(C) $9\pi + 18$
(D) $9\pi - 18$
(E) It cannot be determined from the information given.

26.



In the figure above, a belt which runs over five wheels moves in the direction of the arrows. How many of the wheels are turning clockwise?

27. A closed rectangular tank 1 meter by 2 meters by 4 meters contains 4 cubic meters of water. When the tank is placed level on its various sides, the water depth changes. What is the greatest possible difference in water depths?



28. In the highway system illustrated above, one-tenth of the eastbound cars from highway H turn into M; the rest continue on N. One-fifth of the eastbound cars on K come from P; the rest, from M. If traffic on all highways is in the direction of the arrows, what is the ratio of the traffic on H to that on R ?

End of Section 1 - Math

READING TEST

35 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 *Chamber Music* by Doris Grumbach (©1979 by Doris Grumbach). The narrator, Caroline Maclaren, was married to a well-known composer, Robert Maclaren. *The Community* refers to an artists' colony.

I have decided to write this account because, long as my life has been, it has given me no opportunity before this to say what I wish to put down here. Perhaps the time was not right to do it before.

When I was young, and even into my middle years, a scrim of silence surrounded what really happened in our lives. If there was talk, it was quiet conjecture about the indiscretions of our friends and neighbors. Rumor and gossip were conveyed in whispers. Secrets were surely no better kept than they are now, but they lived quietly, under the breath. They never appeared in public print or were reported by professional gossips on the air waves. They were confined to the inner coils of the private ear, a foot away, perhaps, no farther. We closeted our secrets, or forgot them. This we called decorum, and we lived securely under its warm protection.

But now the Maclaren Foundation, which I headed for so many years, almost fifty by now, wishes to have a permanent record of Robert's life, and mine. Ours together, to put it more exactly, and mine alone with the Community, after his death. The government has become interested, they tell me, in "the arts." There is a chance that, with its financial help, in some place, the Community will be restored to life.

My initial reluctance to accede to their request is a matter of personal habit, I suppose. I am an old woman born in the last quarter of the nineteenth century, with all that decent age's love of a calm surface to our society. It was then the custom to have a regular, uniform pattern to our lives, to present the historian with only those facts which would contribute to an orderly picture.

So I am not equipped to write a confession in the modern sense. Whether what I remember here will be useful as a record to the new Foundation I cannot say. I am of an age not to care, almost ninety. My hearing is defective, my bones seem to lie upon each other like dry kindling, my skin falls away in slack little pinches of flesh. I am dry and brittle, I strain and break easily. Rarely any more do I insert my two rows of teeth; few persons bother to visit.

I write this description of myself not because I want pity—who pities the very old?—but to explain my unaccustomed openness in this account. I have nothing to lose that extreme old age has not already taken from me, and no time to gain. The way the world thinks of me may well change, but even that, if it happens, I will not survive. The Foundation promises me that it will be some time before the history of the founding of the Community can be completely collated and that it has no plans to publish it. I will not be here to witness the astonishment of the reader. I am comforted by the realization that there is no one I know alive to be surprised at me.

For the representation of truth, old age is a freeing agent. No one should write of her life until all the witnesses and acquaintances, family and lovers, are dead. In addition, it helps to outlive the mode of one's time until it has changed beyond recognition. Then one is left alone with what was. The wrinkled, spotted hand writes of a time out of the memory of everyone alive but itself. So what one tells is unavailable to verification or correction.

I write this, then, because I am freed by my survival into extreme old age, and because I write in the air of freer times. Whether this air is entirely salutary, whether the old must of chests, of closets, bell jars, and horsehair sofas is not a better climate for the storage of the private life, I do not know. But I tire very quickly these days and must speak openly, for once. I am now free. Extraordinary for me, and for one of my time, I intend to put down extraordinary truths.

I rejected the offer to dictate to a secretary, deciding I would celebrate my ninetieth year with a final effort to donate to paper my inner life together with the externals already known. I would put it down in my own hand as a way, I think, of signifying, attesting to the truth by the witness of my handwriting as well as the force of my own words.

The Foundation will say: What you have managed to remember is perhaps only partial and personal

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biased truth. You have not given us Robert's truth. Surely it would have differed from yours. I would reply: True. He never wrote about his life.

But, at the last, I think, the historian's view always superimposes itself upon history. Out of a vast amount of available facts from an infinite acreage he chooses what fits his limited and single vision and writes one story. In this case, the story is mine alone. It is all I am able to know.

1. As presented in the passage, how does the narrator's attitude toward writing her account change over time?
   - **A.** She is hesitant at first but later embraces the project as a useful opportunity.
   - **B.** She is enthusiastic about the work until she realizes she can't tell "Robert's truth."
   - **C.** She is reluctant to write the account but relents when the Foundation offers to publish it.
   - **D.** She is highly motivated until she begins to feel the limiting effects of her advanced age.

2. The second paragraph (lines 5–17) primarily emphasizes an earlier era's:
   - **F.** sense of discretion.
   - **G.** lack of intimacy.
   - **H.** lack of honesty.
   - **J.** sense of optimism.

3. The narrator makes clear that the Foundation is now interested in an account of her and Robert's lives because:
   - **A.** Robert's fame has grown substantially since his death.
   - **B.** Foundation officials worry she will not live much longer.
   - **C.** it would help correct the public history of the Community.
   - **D.** it could help solicit funds needed to revive the Community.

4. The narrator indicates that she provides the information in lines 37–42 in order to:
   - **F.** evoke the sympathy of the reader.
   - **G.** explain why her current writing is unusually frank.
   - **H.** suggest that old age has robbed her of vitality.
   - **J.** reveal that she has nothing to lose and little motivation to write.

5. When the narrator talks about being "left alone with what was" (line 61), she most nearly means that she:
   - **A.** finds most people prefer living in the past to enjoying the present.
   - **B.** has the freedom now to re-create the past without fear of contradiction.
   - **C.** feels abandoned by those who have died before her.
   - **D.** thinks outliving one's time can be exhilarating but sometimes lonely.

6. In the passage, how does the narrator respond to the Foundation's hypothetical reaction to her account (lines 81–84)?
   - **F.** She argues that she can in fact do justice to "Robert's truth."
   - **G.** She contends that "Robert's truth" and her own are ultimately the same.
   - **H.** She acknowledges the uniqueness of her version but claims she has no other choice.
   - **J.** She admits that her account is biased but feels that her writing is more honest than Robert's was.

7. The narrator indicates that unlike in modern times, in her youth and into her middle years:
   - **A.** secrets were better kept.
   - **B.** gossip was not as common.
   - **C.** friends were less respectful of privacy.
   - **D.** private matters were not publicized.

8. It can most reasonably be inferred that in her youth and into her middle years, the narrator found the idea of decorum:
   - **F.** restrictive.
   - **G.** pretentious.
   - **H.** comforting.
   - **J.** inspiring.

9. As it is used in line 29, the phrase *decent age* most nearly refers to:
   - **A.** the extremely advanced age of the narrator.
   - **B.** a time long past that embraced propriety.
   - **C.** the period when the narrator ran the Foundation.
   - **D.** an early period in the history of the Community.

10. The narrator states that she feels which of the following about the usefulness of her account to the new Foundation?
    - **F.** Curious
    - **G.** Pleased
    - **H.** Uncertain
    - **J.** Anxious

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Passage II

SOCIAL SCIENCE: This passage is adapted from the article "Farewell to Mr. Fix-It" by James Surowiecki (©2001 by The Condé Nast Publications Inc.).

Ricardo Gomez runs an electronics-repair shop in Brooklyn. He started in the business fifteen years ago. Today, he can fix just about anything, from tape-eating VCRs to CD players with errant lasers. The one thing he can't fix is the fact that people don't seem to get things fixed anymore.

"Years ago, I had more work," Gomez says. "But today prices have come down so much for things like TVs and VCRs that people would rather just buy a new one than fix an old one. That also means that I can't charge that much for repairs. It's a tough life, being a technician."

And it's getting tougher. The shelves at the back of Gomez's shop hold rows of TVs and VCRs with their innards spilling out, but Gomez makes just a slim profit on them. He charges around forty dollars to fix a VCR, a bit more for a stereo or a TV. There are some things he generally doesn't bother with—camcorders, some brands of disc-players—because it costs as much to buy parts as it would to buy a replacement. But at least he's still in business. By some accounts, only a fifth of the repair shops that were open fifteen years ago are around today. Even the computer-service business is slow. In the good old days, the repair trade was a business where you were guaranteed a steady stream of customers. Today, about all you're guaranteed is a long lunch break.

That's because the repair business is on the wrong side of the most powerful trends in global manufacturing of the past twenty years: the sharp rise in quality and the steady decline in price. When it comes to most manufactured goods, these are the good old days. Products are more reliable and more durable than ever. In a recent survey, *Consumer Reports* found that, in most product categories, repair rates were between just ten and twenty per cent.

The average life of a car is up by nearly half since 1970. All this, and stuff often actually costs less. Your run-of-the-mill VCR is forty per cent cheaper than it was seven years ago. High quality, low price: for the repair shop, it's a deadly combination.

"You don't find the kinds of things you had decades ago, like toasters that could electrocute you or TVs that blew up," David Heim, the managing editor of *Consumer Reports*, says. "If you buy a TV, you're going to get a good picture, and if you buy a stereo you're going to get great sound. In fact, the guy who used to test stereos for us told me that you cannot buy a bad stereo. They don't make the parts anymore."

Americans have become the most demanding consumers in the history of the world—we expect our machines to work. Nonetheless, we have a vestigial memory of the days when they didn't. How else to explain the fact that, every year, people shell out millions of dollars on extended warranties that they seldom get a chance to take advantage of?

For manufacturers and retailers, warranties are easy money. Service plans usually run just two or three years and cover products that either will last much longer or are easily replaced. The consumer pays up front and rarely collects. You can see the results in the quarterly reports for any major electronics retailer. A big chunk of the profit margin comes from the sale of extended warranties. Some retailers even call customers months after a sale to offer repair plans and warranties. Needless to say, they wouldn't make such offers if they really believed that your TV was likely to go on the fritz. But folks still bite. "People spend a lot of money for a little extra peace of mind," Heim says.

The lingering allure of warranties is understandable if you consider how recent the quality revolution is. Before the nineteen-eighties, most American corporations saw quality as something that cost them a lot and profited them little. They believed that it didn't play a big role in a consumer's decision to buy a product, and that there was no way to make things both better and cheaper. Japan's success in the seventies changed that. Japanese companies, influenced by the ideas of the quality-control guru W. Edwards Deming, began winning market share by producing televisions, cameras, cars, and VCRs that were vastly superior to American products. Eventually, American companies woke up and adopted Deming as a prophet.

The impact of the quality revolution was immediate. The marketplace no longer tolerates shoddy products. Consumers have grown so accustomed to things being ever cheaper and ever more reliable that companies have to keep driving cost down and quality up just to stay in the game.

11. In the context of lines 28–49, the statement "They don't make the parts anymore" (line 49) is used to support the idea that:

- **A.** it is hard for repair-shop owners to find the parts for electronic devices made before 1980.
- **B.** no one knows as well as repair-shop owners how long it takes to receive parts from manufacturers.
- **C.** consumers are increasingly frustrated over products that have to be replaced rather than repaired when they break down.
- **D.** manufacturers are making products of a higher quality and durability than ever before.

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12. It can reasonably be inferred from the passage that Heim's attitude toward the plight of repair workers is that they:

- **F.** unknowingly helped create the circumstances that are putting them out of business.
- **G.** are casualties of changes in manufacturing practices that have many positive outcomes for consumers.
- **H.** deserve the increased income from work that is a result of the widespread success of extended warranties.
- **J.** would be wise to specialize in the advanced electronics products on the market today rather than on the products that date back a decade or more.

13. It can reasonably be inferred from the passage that before the 1980s, the percentage of most categories of American manufactured products that required repair was:

- **A.** under 10 percent.
- **B.** between 10 and 15 percent.
- **C.** between 15 and 20 percent.
- **D.** 20 percent or more.

14. Which of the following best expresses the paradox described in the seventh paragraph (lines 50–56)?

- **F.** Manufacturers are selling more products than ever to American consumers but having to spend less than ever on sales promotions.
- **G.** Americans are spending more on repairs than ever before and less than ever on adequate warranties.
- **H.** Products are more reliable than ever, but Americans are spending a great deal on extended warranties.
- **J.** American consumers are complaining more than ever about the quality of manufactured products, but products have never been more reliable.

15. According to the passage, the impact of extended warranties on the financial status of American electronics businesses is that the warranties account for a:

- **A.** significant loss that is usually compensated for by high sales of high-quality products.
- **B.** small loss that is easily compensated for by skyrocketing sales of an increasingly varied range of products.
- **C.** substantial portion of the profits earned by these companies.
- **D.** profit or loss depending on a company's ability to identify its market.

16. The author traces the quality revolution back to its origins in:

- **F.** Japan in the 1970s.
- **G.** Japan in the 1980s.
- **H.** the United States in the 1970s.
- **J.** the United States in the 1980s.

17. The main point of the first paragraph is that:

- **A.** even highly competent and experienced repair technicians are struggling under current market conditions.
- **B.** tape-eating VCRs are harder to fix than CD players with errant lasers.
- **C.** Gomez takes on more work to compensate for the fact that he can't increase his repair-work rates.
- **D.** fifteen years ago Gomez could not fix a VCR but today he is an expert at it.

18. According to the passage, which of the following statements is accurate regarding the decline in the number of repair shops?

- **F.** Of the repair shops in business fifteen years ago, only one in five is still open.
- **G.** Of the repair shops open twenty years ago, only 5 percent are still in business.
- **H.** Twenty percent of the repair shops that specialize in TVs and VCRs are expected to close in the next five years.
- **J.** Half of the electronics repair shops in New York City are expected to close in the next ten years.

19. The passage states that before the 1980s, most American corporations viewed quality as all of the following EXCEPT:

- **A.** almost irrelevant to consumers' buying decisions.
- **B.** something that could not be achieved at the same time as lowering prices.
- **C.** something that cost them a lot.
- **D.** an unnecessary hardship on the repair industry and therefore to be avoided.

20. According to the passage, Deming's role in the quality revolution is as:

- **F.** a spokesperson for the electronics-repair industry.
- **G.** an American manufacturer who brought Japanese ideas to the American market.
- **H.** an influential figure in shifting the Japanese and American manufacturing industries to produce high-quality goods for a low price.
- **J.** a journalist for *Consumer Reports* focusing on the issue of international growth in the quality of manufactured goods.

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Passage III

HUMANITIES: This passage is adapted from the essay "The Mambo King" by Oscar Hijuelos (©2001 by The New York Times).

In 1966, at the age of 15, I was a member of a rock group in the South Bronx. We used to practice our songs in the basement of an apartment building off 169th Street and Third Avenue.

Once or twice a week I would make the trip to the Bronx from Manhattan with my father, and while, down below, we youngsters pursued our noisy musical education, through buzzy amplifiers and $10 microphones, the adults gathered upstairs in a third-floor apartment and ate, talked and listened to music. On our breaks, we would head upstairs to grab some food, and in that congenial atmosphere, we mixed with the adults, who seemed amused by our preoccupation with rock. While we chatted and ate, their music played out of a stereo console—Cuban *charangas* and *sons*, Puerto Rican *plenas* and the music of the great mambo orchestras, led by the likes of Machito, Noro Morales, Mario Bauzá and the upstart bandleader, already a star, Tito Puente.

Of course, as teenagers smitten by American pop culture, we sort of only half-listened to that music; we considered Latin music archaic—the music of our immigrant parents. It was the kind of music we had been hearing every day of our lives in the city, on the streets, in people's living rooms, out of car radios. "Time for something new" is what went through our heads. Latin music was so much a part of growing up in New York that we, or at least I, took it for granted. What was happening *now*, the music of the Beatles and the Rolling Stones and so many others, was what we aspired to. And yet, on one of those afternoons when our bandleader, breathlessly late for rehearsal, burst into our dingy practicing room and announced: "Tito Puente's playing a block party! Come on, let's go," we swarmed out behind him, anxious about missing something special.

The block party was up on East Fordham Road, around Roosevelt High School. We arrived while the band was performing one of Tito's classics, "El Cayuco" or "Oye Cómo Va" or "Ran Kan Kan." A crowd filled the street—vendors were selling hot dogs, *pasteles*, chorizo sandwiches, sodas; women danced; most of the men too, in T-shirts or guayaberas, weary from their week of work but happy to be there. It was a hot day, and we worked our way through all the people toward the stage. There, on the plumber's-pipe platform, were a trombonist, a saxophone player, a few trumpeters, a pianist, a fellow banging the congas and bongos, then a bassist, a man playing a standard drum kit and Tito Puente himself, drumsticks in hand, poised before the thin kettledrums that were his timbales, beside the vibraphone on which he would also perform the sublime "Hong Kong Mambo."

When you're a young musician—or think you are—you watch everything a real musician does. So he observed Tito Puente carefully. There he was, performing regally, as if his working-class audience were king and queens, as if that street were the greatest venue in all of New York. He was already a legend, so much a part of the history of New York and of Latin music (for he had been a hallmark performer in the glory days of the Palladium ballroom in the 1950's) that it would have been easy for him to slough the music off. But he played his heart out. He froze time, dissipated heat and cheered hearts.

He went into jams—long, sustained mambo sections, during which his instrumentalists improvised—and played his drums as if there were no tomorrow. He sweated, dabbing his brow with a kerchief, and off handedly introduced his own formidable compositions as if they were simply little tunes. That music flew toward us like elongating barrels of mischief, like singing angels, like mysterious sonic hieroglyphics, as transmitted from some sacred musical place for our amusement. From the time we arrived, he and his band played for another hour, and not once did he give the impression that he wanted the party to be over. Most beautifully, when the band had finished its last encore when everybody, even the kids hanging off the rooftops, were chanting "Tito!" he bowed to the audience, sent kisses flying and then began to walk off stage. That's when our lead singer, Santiago, who had passed the concert jumping up and down in place scrambled toward him. He caught Tito's ear with the phrase "*Soy borinqueño!*"—"I'm Puerto Rican"—and Tito, nodding, called him aside and listened to Santiago's story—19 years old and I want to be a great musician like you—and what I, eavesdropping, heard from Tito were the words, "I'll look out for you, kid *Y exitos*"—much success.

21. The point of view from which this passage is narrated is best described as:

A. an adult reflecting on his youth.
B. a parent recalling his son's rock band.
C. a teenager who aspires to be a musician.
D. Santiago, a teenager who meets Puente.

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22. Which of the following best summarizes the emotional shift that is presented by the narrator in the passage?

- **F.** A narrator moves from being preoccupied with the newness of Latin music to appreciating American pop culture.
- **G.** Young musicians move from merely accepting the music of their heritage to deeply identifying with it.
- **H.** The teenagers change from pursuing their noisy musical education to preferring the *charangas* and *plenas* of Puente.
- **J.** The band members move from hoping to be band-leaders like Puente to wanting to be better rock musicians.

23. Puente is presented by the narrator as being:

- **A.** talented but distant.
- **B.** energetic and accessible.
- **C.** gracious but intimidating.
- **D.** responsive and overconfident.

24. The fifth and last paragraphs (lines 54–90) most nearly indicate that in his relationship to the community, Puente is:

- **F.** overbearing though committed.
- **G.** distracted yet concerned.
- **H.** supportive and loyal.
- **J.** famous and therefore isolated.

25. In the second paragraph (lines 5–19), the adults' attitude toward the teens' music-making can best be characterized as:

- **A.** delighted.
- **B.** accepting.
- **C.** confused.
- **D.** impatient.

26. It can most reasonably be inferred that with his declaration "*Soy borinqueño!*" (line 85), Santiago intends to:

- **F.** join in the chant of the kids on the rooftops.
- **G.** show admiration for the encore Puente's band had just performed.
- **H.** capture Puente's attention by expressing a mutual connection.
- **J.** introduce the members of his band in hopes of being discovered.

27. Which of the following best represents the narrator's band's initial opinions about Latin music?

- **A.** It was old-fashioned and the music of their parents.
- **B.** Because it was so familiar, it formed the basis for their rock music.
- **C.** It represented the music that they considered to be "happening *now*."
- **D.** It was a huge part of their growing-up experience in New York and what they aspired to play.

28. When the narrator states that the band was "anxious about missing something special" (lines 35–36), he most nearly means that the band:

- **F.** recognized a fun opportunity to avoid practice for a day.
- **G.** hated to miss any good block party.
- **H.** was nervous they might miss an opportunity to play music.
- **J.** was excited by the chance to see a legend perform.

29. As it is used in line 63, the phrase "slough the music off" most nearly means to:

- **A.** perform wholeheartedly.
- **B.** ignore his audience.
- **C.** not give a full effort.
- **D.** shed his old music for newer styles.

30. As it is used in line 83, the word *passed* most nearly means:

- **F.** continued on.
- **G.** succeeded.
- **H.** gone by.
- **J.** experienced.

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Passage IV

NATURAL SCIENCE: This passage is adapted from the book *Wind* by Jan DeBlieu (©1998 by Jan DeBlieu). *Convection currents* in the atmosphere, which are responsible for breezes, begin when air is heated over warm land masses or seas and then expands and rises. *Thermals* are columns of rising warm air.

No other class of animals lives so starkly at the mercy of wind as the insects. In its benign, convective form, wind plucks up bugs by the millions, the trillions, every day and scatters them widely. (This is not to say they are dispersed at random. Biologists have often seen insects choose a precise moment to set out—say, just before the onset of a light rainstorm with west-bearing winds—presumably so that they are most likely to arrive in protected, food-rich habitat.) Once aloft they depend on horizontal currents to ferry them onward. Often they drift all night. In the atmosphere's upper strata they encounter waves of turbulence and layers of different densities that sort and compress them into compact swarms. They may drift as a unit through honeycombs of thermals and land lightly in a rogue's paradise—a flower garden, a newly cultivated field of vegetables. Or they may be accosted by a freshening gale, tossed out to sea, and slammed rudely into the water.

Many insects are wingless, at least in their larval forms, and must depend entirely on wind for transit. Those that can fly have neither the mass nor the strength to fight headwinds. So they ride the breeze, perhaps passively, perhaps with some precise collective plan. In certain species, individuals bunch together like flocks of birds, turning as one organism. In studies conducted during the 1950s, aphids carried by west winds from the irrigated oasis of southern California into the arid basin of the Colorado desert showed an uncanny knack for finding potted alfalfa plants left out for them. Some investigators speculate that spiders and other balloon-riding creatures may control their altitude by trimming the lengths of silk that lift them. At present, however, scientists do not know whether insect wayfarers have anything but the crudest ability to navigate from one habitat to another.

Until the 1920s researchers were unaware that insects can survive well up into the troposphere (the lowest part of Earth's atmosphere). It had been known for a century that the smallest insects could be easily transported by wind. In 1827 and again in 1924 British Arctic explorers discovered live spruce aphids and syrphid flies on the Norwegian island of Spitsbergen. Apparently they had been carried by wind from Russia, 800 miles away. Monarch butterflies had been observed 500 miles from land over the South Pacific, and once a swarm of migratory locusts was seen over the North Atlantic, 1,500 miles from land. With the spread of tree-destroying European gypsy moth larvae through the eastern United States during the early 1920s, research into the dispersal of insects took on special urgency.

In 1926 Perry Glick, an entomologist in Louisiana, made a series of flights in which he sampled the fauna of the air with traps made of wire screen mounted on the wings of a small biplane. Few scientists had tried to examine life at such heights, and Glick's study is regarded as a pioneering work. At 200 feet he found a great number and diversity of insects. He caught by far the most when wind velocities were between five and eight miles an hour. Lesser winds seemed to discourage insect flight; greater winds made it nearly impossible.

Above 300 feet the insect population rapidly thinned. Nevertheless, Glick found a few spiders and flies as high as 5,000 feet. He never devised an accurate means of measuring the flow of convection currents in the atmosphere. But on days when the plane encountered turbulent air, he caught many more bugs at 1,000 feet, as if strong thermals had tossed them to unusual heights. Over five years Glick trapped 700 identifiable species. In the end he calculated that on any midsummer day the air above each square mile of Louisiana contained more than 14 million insects.

Many insects travel at night, presumably to avoid the upper-air turbulence caused by convection. Most individuals migrate no more than five miles over the course of their lives. Only a few species embark on lengthy seasonal movements, and then largely because of their proximity to favorable avenues of wind. Monarch butterflies, migrating from the eastern United States to their overwintering grounds in Mexico, follow routes that parallel the major flyways used by birds. In the North American interior and in northern China and Japan (all regions where winters tend to be particularly severe), certain butterfly species ride jets of warm air north with the coming of spring.

31. The main purpose of the passage is to:

- **A.** document insects' reliance on wind for transport.
- **B.** discuss the dangers wind can pose for insects.
- **C.** provide data on the seasonal migrations of wind borne insects.
- **D.** describe the research techniques of scientists studying insects.

32. It can reasonably be inferred that the most important and intense research into insects and insect dispersal occurred in which of the following decades?

- **F.** 1820s
- **G.** 1870s
- **H.** 1920s
- **J.** 1950s

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33. As presented in the passage, the statement in lines 71–73 is best characterized as:

- **A.** a fact based on a full count of insects in one square mile of air above Louisiana.
- **B.** speculation based on nearly a year's study of the insect population in Louisiana.
- **C.** an estimate based on extensive sampling at varying altitudes.
- **D.** a hypothesis based on the work of Glick and other scientists who came after him.

34. The author uses the information in parentheses in lines 4–9 primarily to:

- **F.** undermine some scientists' claim that wind has a benign, convective form.
- **G.** suggest that biologists are divided over whether insects can pick times to travel.
- **H.** support her assertion that wind affects the lives of trillions of insects every day.
- **J.** prevent readers from misinterpreting her claim that wind scatters insects widely.

35. Based on the passage, some scientists speculate that compared to many insects, spiders may be:

- **A.** better able to control their travel by wind.
- **B.** less interested in eating alfalfa plants.
- **C.** more inclined to bunch together.
- **D.** less able to fight headwinds.

36. The main purpose of the third paragraph (lines 37–52) is to:

- **F.** suggest the need for research into highly destructive insect species transported by wind.
- **G.** chronicle a century of insect-related discoveries made by Arctic explorers.
- **H.** trace the typical geographical range of insects such as monarch butterflies and locusts.
- **J.** offer several examples highlighting the power of wind to transport insects.

37. Suppose that a scientist were exactly repeating Glick's experiments as described in the passage. Under which of the following conditions would the scientist reasonably expect to find the most insects?

- **A.** At 210 feet with a 7 mph wind
- **B.** At 230 feet with a 12 mph wind
- **C.** At 240 feet with no measurable wind
- **D.** At 310 feet with a 6 mph wind

38. Based on the passage, how should the claim that Glick "caught many more bugs at 1,000 feet" (lines 68–69) most likely be read?

- **F.** Glick found many more insects at 1,000 feet than he ever did at 200 feet.
- **G.** Under turbulent conditions, Glick found more insects at 1,000 feet than he normally did.
- **H.** Glick found many insects at 1,000 feet when his biplane was accidentally tossed to unusual heights.
- **J.** Strong thermals at 1,000 feet enabled Glick to trap 700 identifiable insect species.

39. The passage identifies which of the following as a limitation to Glick's research?

- **A.** His use of a small biplane to gather insect samples
- **B.** His failure to conduct research at night, the time when most insects travel
- **C.** His inability to measure accurately the flow of atmospheric convection currents
- **D.** His narrow focus on studying Louisiana

40. The author most nearly characterizes the type of seasonal migration made by monarch butterflies as:

- **F.** unusual among insects.
- **G.** typical among butterflies.
- **H.** common for North American insects.
- **J.** uncommon for day-traveling butterflies such as monarchs.

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

Transient luminous events (TLEs) are brief flashes of light that appear above large thunderstorm clouds. A TLE is produced by a positive cloud-to-ground (+CG) lightning stroke. However, not every +CG lightning stroke is followed by a TLE. Figure 1 shows the typical shape, width, and altitudes of 3 types of TLEs—red sprites, blue jets, and elves. Table 1 shows the typical duration (in milliseconds, msec) and brightness (in kiloRayleighs, kR) of each type of TLE. Figure 2 shows the number of +CG lightning strokes of a given peak electrical current (in kiloamperes, kA) from 6 thunderstorms and the percent of those +CG lightning strokes that produced a TLE.

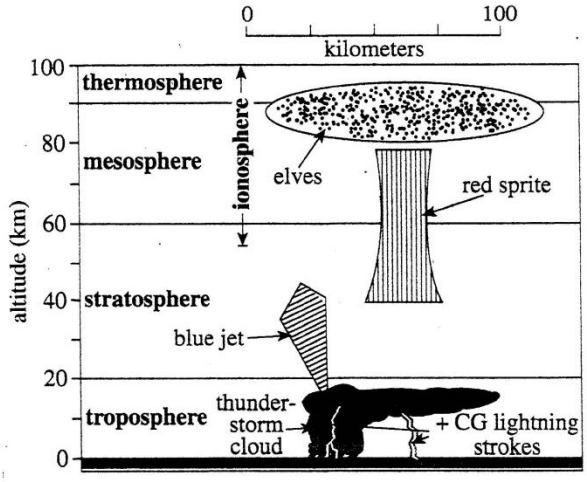
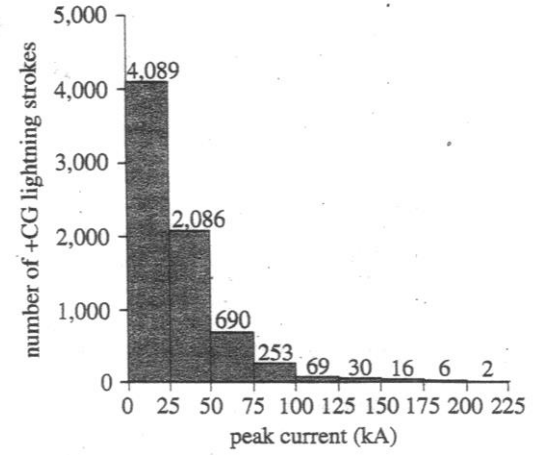


Figure 1

Table 1		
Type of TLE	Duration (msec)	Average brightness (kR)
Red sprite	10–100	10
Blue jet	100–300	800
Elves	< 1	1,000



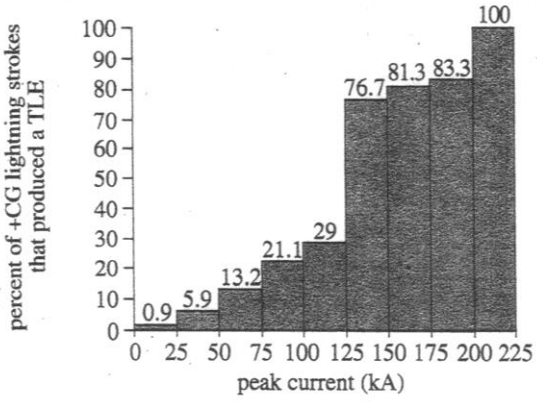


Figure 2

Figure 1 adapted from W. Lyons, R. J. Vavrek, and R. Holle, "Mysterious Flashes: Red Sprites–Blue Jets–Elves." ©2000 by the National Earth Science Teachers Association.

Figure 2 adapted from W. Lyons et al., "Characteristics of Thunderstorms and Lightning Flashes Which Produce Mesospheric Transient Luminous Events." ©1999 by the National Aeronautics and Space Administration.

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1. Figure 1 defines the ionosphere as a region of the atmosphere that overlaps which of the following atmospheric layers?

   I. Mesosphere
   II. Stratosphere
   III. Troposphere

   A. II only
   B. III only
   C. I and II only
   D. II and III only

2. A flash was observed above a large thunderstorm cloud. The flash had a duration of 100 msec and an altitude between 50 km and 80 km. Based on Figure 1 and Table 1, that flash was most likely which of the following?

   F. A red sprite
   G. A blue jet
   H. Elves
   J. A +CG lightning stroke

3. According to Figure 2, the percent of +CG lightning strokes that produced a TLE more than doubled between which of the following 2 peak current ranges?

   A. Between 75–100 kA and 100–125 kA
   B. Between 100–125 kA and 125–150 kA
   C. Between 125–150 kA and 150–175 kA
   D. Between 175–200 kA and 200–225 kA

4. According to Figure 2, the probability that a TLE will follow a +CG lightning stroke is highest for which of the following ranges of peak currents?

   F. 25 kA to 50 kA
   G. 75 kA to 100 kA
   H. 125 kA to 150 kA
   J. 175 kA to 200 kA

5. Based on Figure 2, TLEs were produced by approximately what fraction of +CG lightning strokes with peak currents between 75 kA and 100 kA ?

   A. $\frac{1}{2}$
   B. $\frac{1}{3}$
   C. $\frac{1}{4}$
   D. $\frac{1}{5}$

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Passage II

Soils are classified by *texture* (nature of the soil based on the proportions of sand, silt, and clay particles) and *porosity* (percent of a soil's volume occupied by open space). Typical soil particle categories and their particle diameters are shown in Table 1. A soil with particles that have a small range of different diameters is described as *well sorted*, whereas a soil with particles that have a wide range of different diameters is described as *poorly sorted*.

Table 1

Particle category	Particle diameter (mm)
Gravel	> 2.0
Very coarse sand	1.1–2.0
Coarse sand	0.6–1.0
Medium sand	0.26–0.5
Fine sand	0.14–0.25
Very fine sand	0.07–0.13
Silt	0.004–0.06
Clay	< 0.004

Study 1

A dry, 500 g sample of a soil (Soil 1) was washed through a screen with 0.06 mm holes to remove all of the silt and clay particles. The soil remaining on the screen was dried and weighed, then sifted through a series of screens, each successive screen having smaller holes than the one before, to separate the particles in different categories. The particles of each category were then weighed, and the procedure was repeated for samples of 4 other soils (Soils 2–5). The results are shown in Table 2.

Table 2

	Weight (g) of particles				
Particle category	Soil 1	Soil 2	Soil 3	Soil 4	Soil 5
Gravel	0	0	0	0	36
Very coarse sand	0	132	0	0	54
Coarse sand	0	241	0	0	197
Medium sand	0	127	35	134	76
Fine sand	14	0	136	245	36
Very fine sand	11	0	79	96	33

Study 2

Another sample of each soil was dried by heating at 101°C for 24 hours, and was then weighed. The porosity and the *void ratio* (ratio of the volume of open space to the volume of solid material) of each soil sample were calculated (see Table 3).

Table 3

Soil	Porosity (%)	Void ratio
1	45	0.82
2	34	0.52
3	43	0.75
4	42	0.72
5	10	0.11

6. It is known that soils with a higher porosity can hold more water when saturated than can soils with a lower porosity. Based on this information, which of the following soils in Study 2 would hold the most water when saturated?

   F. Soil 1
   G. Soil 2
   H. Soil 4
   J. Soil 5

7. Based on the results of Study 2, another soil sample that had a porosity of 25% would have had a corresponding void ratio of:

   A. less than 0.11.
   B. between 0.11 and 0.52.
   C. between 0.52 and 0.72.
   D. greater than 0.72.

8. In Study 2, if a soil sample had shown virtually no decrease in weight during the heating process, the scientist conducting the study would most likely have concluded which of the following?

   F. The particles in the soil sample were all larger than 2 mm in diameter.
   G. The particles in the soil sample were all smaller than 0.06 mm in diameter.
   H. The heating process removed significant amounts of water.
   J. The heating process removed little or no water.

9. In Study 1, after removing the silt and clay particles, it was necessary to dry the soil samples before passing them through a series of screens to ensure that the particles:

   A. larger than 2 mm in diameter would pass through all of the screens.
   B. smaller than 0.06 mm in diameter would stick to each other.
   C. would more easily stick to the screens and to each other.
   D. would not stick to the screens or to each other.

10. The sample of which soil in Study 1 would most likely be considered the most poorly sorted?

    F. Soil 1
    G. Soil 2
    H. Soil 3
    J. Soil 5

11. Assume that *permeability* (a measure of how fast water moves through a soil) increases as the proportion, by weight, of a soil's particles that are coarse sand size or larger increases. Based on the results of Study 1, the sample of which of the following soils most likely has the highest permeability?

    A. Soil 2
    B. Soil 3
    C. Soil 4
    D. Soil 5

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Passage III

Ice cream was made by stirring an ice cream mixture (M1) at a constant rate in the apparatus shown in Figure 1.

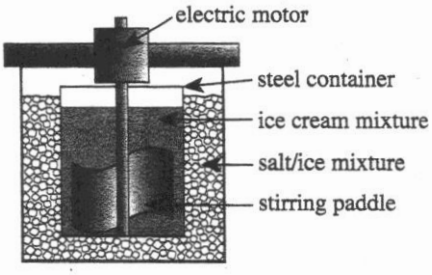

Figure 1

Figure 2 shows how the temperature of M1 and the temperature of the salt/ice mixture varied with mixing time.

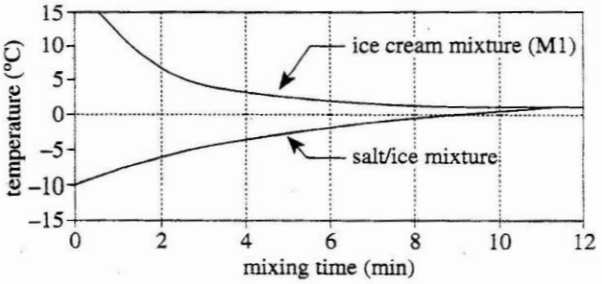

Figure 2

The *viscosity* (resistance to flow) of M1 was monitored by measuring how the current drawn by the motor turning the stirring paddle changed with mixing time. Two other ice cream mixtures (M2 and M3) were also monitored under conditions identical to those used during the mixing of M1 (see Figure 3).

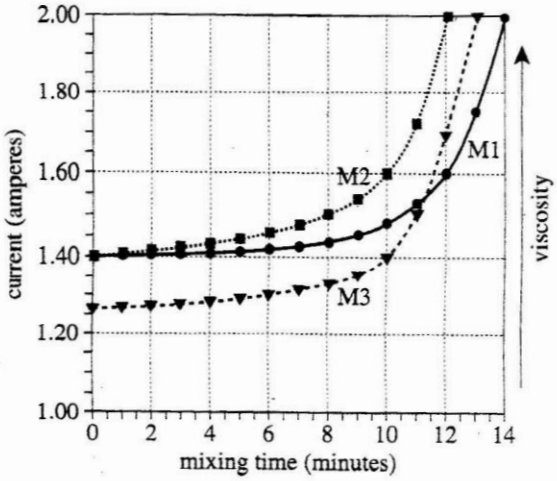

Figure 3

Figures adapted from D. Gibbon et al., "The Thermodynamics of Home-Made Ice Cream." ©1992 by Division of Chemical Education, Inc., American Chemical Society.

12. Based on Figures 2 and 3, for M1, as the temperature of the salt/ice mixture increased, the electrical current:

- **F.** increased only.
- **G.** decreased only.
- **H.** increased, then decreased.
- **J.** decreased, then increased.

13. A fourth ice cream mixture (M4) was monitored under the same conditions used to gather the data for Figure 3. The current at 0 min was 1.33 amperes. How did the initial viscosity of M4 compare with that of M1–M3 ? The initial viscosity of M4 was:

- **A.** less than that of M1, M2, and M3.
- **B.** less than that of M1 and M2, but greater than that of M3.
- **C.** greater than that of M1 and M2, but less than that of M3.
- **D.** greater than that of M1, M2, and M3.

14. According to Figure 3, the current drawn by the motor at a mixing time of 8 min for M2 was closest to which of the following?

- **F.** 1.40 amperes
- **G.** 1.45 amperes
- **H.** 1.50 amperes
- **J.** 1.55 amperes

15. Some ice cream makers automatically shut off when the current drawn by the electric motor reaches 2 amperes to indicate that the process is complete. Based on Figure 3, in this type of ice cream maker, which ice cream mixture, if any, would have the longest completion time?

- **A.** M1
- **B.** M2
- **C.** M3
- **D.** All 3 mixtures would have the same completion time.

16. Based on Figure 1, which of the following best explains the trends in the results shown in Figure 2 ? Overall, as mixing time increased, heat was conducted by the:

- **F.** steel container from the ice cream mixture to the salt/ice mixture.
- **G.** steel container from the salt/ice mixture to the ice cream mixture.
- **H.** electric motor from the stirring paddle to the ice cream mixture.
- **J.** electric motor from the ice cream mixture to the stirring paddle.

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Passage IV

To grow on a *medium* (a nutrient system) that lacks *arginine* (an amino acid), the bacterium *E. coli* must synthesize arginine from the medium. Figure 1 shows a portion of the reaction pathway for the synthesis of arginine in *E. coli*. Each of these reactions is catalyzed by an enzyme (E1–E4). In the first reaction, acetylornithine is the precursor, ornithine is the product, and E1 is the enzyme. In the second reaction, ornithine is the precursor, citrulline is the product, and E2 is the enzyme.

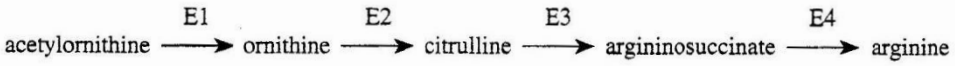

Figure 1

Figure 1 adapted from Ursula Goodenough, *Genetics*, 3rd ed. ©1984 by CBS College Publishing.

Table 1 lists the *E. coli* genes that normally code for the enzymes in Figure 1.

Table 1	
Gene	Enzyme
arg1	E1
arg2	E2
arg3	E3
arg4	E4

Sometimes a gene that normally codes for an enzyme is damaged in such a way that the enzyme is not produced. The pathway then shuts down at the reaction catalyzed by that enzyme. As a result, the precursor increases in concentration and the product is not produced. An undamaged gene is labeled with a plus sign (for example, $arg1^+$). A damaged gene that cannot code for its enzyme is labeled with a minus sign (for example, $arg1^-$).

Experiment

A biologist grew *wild-type* (naturally occurring) *E. coli* on *minimal medium* (MM), a medium that lacks arginine.

To induce genetic damage, the biologist exposed wild-type *E. coli* to radiation. She then identified those *E. coli* that could no longer synthesize arginine from MM. She tested these *E. coli* on various media, classifying them into 5 types depending on the media on which they grew (see Table 2).

In Table 2, an "×" indicates that a given type could grow on a given medium and thus could synthesize arginine from that medium.

Table 2					
Medium	Type: 1	2	3	4	5
MM					
MM + acetylornithine					×
MM + ornithine	×				×
MM + citrulline	×	×			×
MM + argininosuccinate	×	×	×		×

Table 2 adapted from Anthony J. F. Griffiths et al., *Genetic Analysis*, 5th ed. ©1993 by W. H. Freeman and Company.

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17. One of the media listed in Table 2 acted as a control to provide evidence for the biologist's belief that each of the 5 types of *E. coli* listed in Table 2 had some genetic damage. This medium was:

A. MM.
B. MM + acetylornithine.
C. MM + citrulline.
D. MM + argininosuccinate.

18. For each of the 5 types of *E. coli* listed in Table 2, if a given type was able to grow on MM + citrulline, it was also able to grow on:

F. MM.
G. MM + acetylornithine.
H. MM + ornithine.
J. MM + argininosuccinate.

19. Which of the following statements best describes the relationships between argininosuccinate, citrulline, and ornithine as shown in the reaction pathway represented in Figure 1 ?

A. Ornithine is a precursor of argininosuccinate, and argininosuccinate is a precursor of citrulline.
B. Ornithine is a precursor of citrulline, and citrulline is a precursor of argininosuccinate.
C. Argininosuccinate is a precursor of citrulline, and citrulline is a precursor of ornithine.
D. Argininosuccinate is a precursor of ornithine, and ornithine is a precursor of citrulline.

20. According to the information provided, *E. coli* that are $arg1^+$ $arg2^-$ $arg3^+$ $arg4^-$ CANNOT produce:

F. E1 and E2.
G. E1 and E3.
H. E2 and E4.
J. E3 and E4.

21. Based on the information presented, the highest concentration of argininosuccinate would most likely be found in which of the following *E. coli* ?

A. *E. coli* that cannot produce E1
B. *E. coli* that cannot produce E2
C. *E. coli* that cannot produce E3
D. *E. coli* that cannot produce E4

22. Type 1 *E. coli* were most likely NOT capable of converting:

F. acetylornithine into ornithine.
G. ornithine into citrulline.
H. citrulline into argininosuccinate.
J. argininosuccinate into arginine.

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Passage V

In a study of human sleep cycles, subjects in 4 different age groups performed a brief mental task at a scheduled time. Immediately following the task, their oral temperatures were taken and then the time for each subject to fall asleep was measured.

The results were averaged for each group. Figure 1 shows how the average time to fall asleep for the 4 groups varied with the time of day that the task was performed. Figure 2 shows how the average oral temperature of 2 of the groups varied with the time of day that the task was performed.

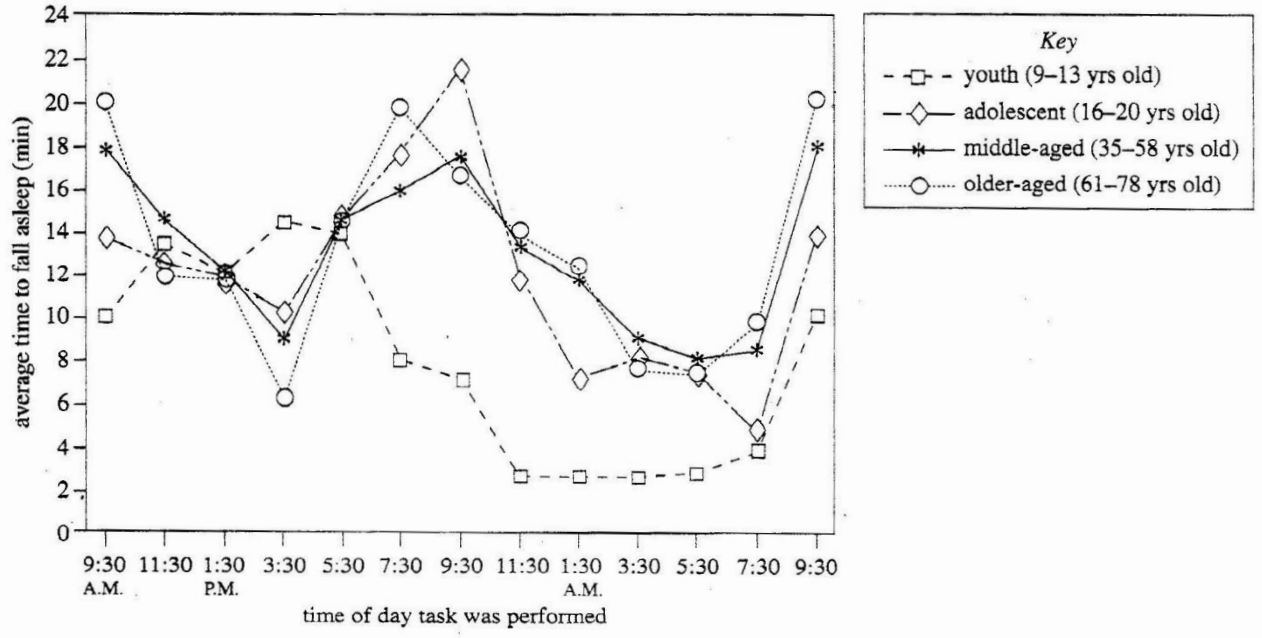

Figure 1

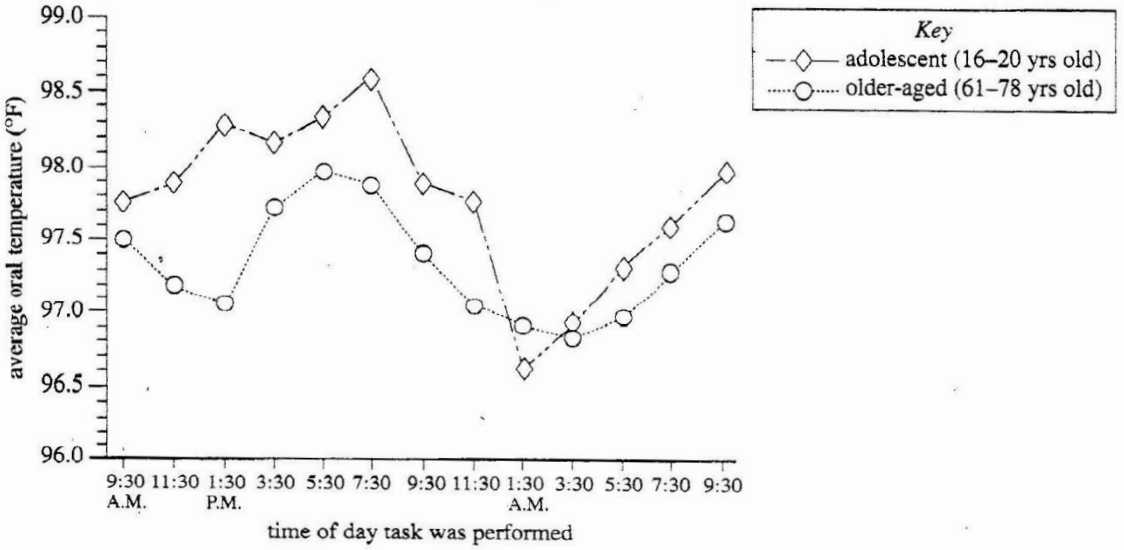

Figure 2

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23. Based on Figure 1, at which of the following times was the average time to fall asleep most similar for the 4 age groups?

A. 11:30 A.M.
B. 1:30 P.M.
C. 9:30 P.M.
D. 1:30 A.M.

24. A scientist claimed that the average oral temperature of the subjects in the older-aged group was always lower than that of the subjects in the adolescent group. The data for which of the following times shown in Figure 2 are *inconsistent* with this claim?

F. 9:30 A.M.
G. 5:30 P.M.
H. 1:30 A.M.
J. 5:30 A.M.

25. According to Figure 1, for the adolescent group, the average time to fall asleep was greatest at which time of day?

A. 1:30 P.M.
B. 5:30 P.M.
C. 9:30 P.M.
D. 1:30 A.M.

26. According to Figure 1, the average time to fall asleep at 3:30 A.M. was *least* for which age group?

F. Youth
G. Adolescent
H. Middle-aged
J. Older-aged

27. Suppose that there were 4 subjects in each age group, and that in 1 age group the time to fall asleep at 3:30 P.M. for the 4 subjects was 14 min, 11 min, 16 min, and 17 min. Based on Figure 1, these 4 subjects were most likely:

A. 9–13 yrs old.
B. 16–20 yrs old.
C. 35–58 yrs old.
D. 61–78 yrs old.

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Passage VI

Polarity is a measure of the separation of charge in a molecule. Molecules are attracted to other molecules based on polarity. In *liquid column chromatography*, a mixture is carried by the flow of solvent through a glass column containing an adsorbent material. If the components of the mixture have different polarities, they will interact differently with the solvent and adsorbent, causing the mixture to separate into its components. When the components *elute* (exit) from the column, they pass through a detector (see Figure 1).

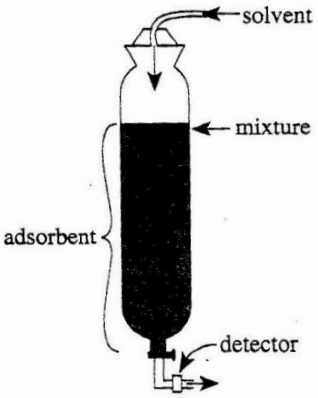

Figure 1

The following experiments were done to study how using solvents and adsorbents of differing polarities affects the separation of a mixture. A component's *elution time* is the time it takes (from the start of the flow) for 100% of the component to be eluted. Table 1 shows the relative polarities (0 being nonpolar and 10 being extremely polar) of the components of the mixture and of the solvents used.

Table 1

Substance	Polarity
Component	
A	5.6
B	4.2
C	1.1
D	0.4
Solvent	
I	8.2
II	4.1
III	0.2

Experiment 1

A glass column 50 cm tall and 7 cm in diameter was packed with 3 kg of a *normal-phase* (highly polar) adsorbent. A mixture containing 0.2 g each of Components A–D was dissolved and then added to the top layer of the adsorbent. Solvent I was then allowed to flow through the column at a constant rate. The *% eluted* of each component was measured for 50 min. The procedure was repeated using Solvents II and III (see Figure 2).

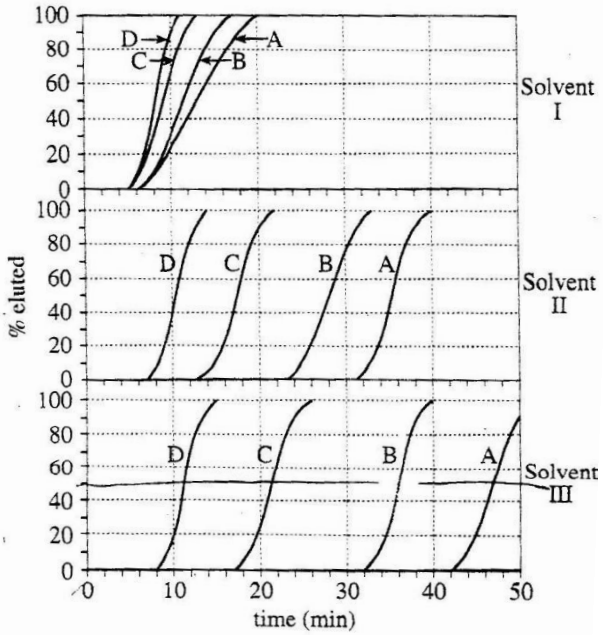

Figure 2

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Experiment 2

Experiment 1 was repeated, but a *reverse-phase* (non-polar) adsorbent was used in each trial (see Figure 3).

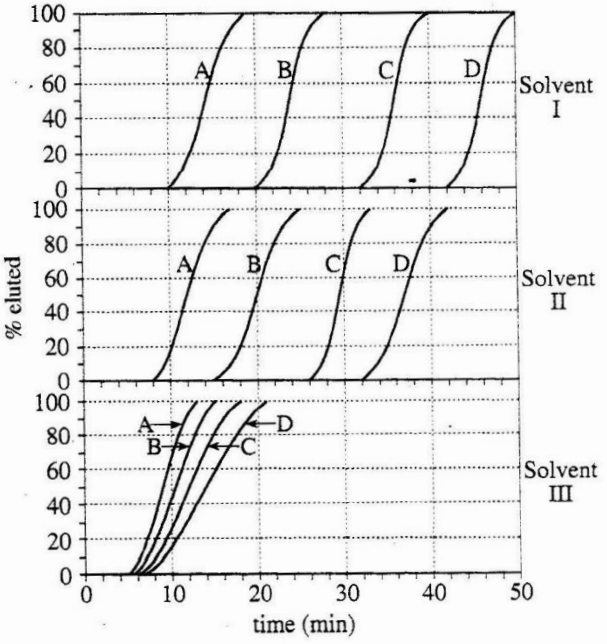

Figure 3

28. In Experiment 1, when Solvent III was used, exactly half the amount of Component B had eluted from the column at a time closest to:

F. 10 min.
G. 15 min.
H. 35 min.
J. 40 min.

29. Component X has a polarity of 3.9. The results of Experiments 1 and 2 would have been most similar to those shown in Figures 2 and 3 if, in each trial, Component X had been substituted in the mixture for:

A. Component A.
B. Component B.
C. Component C.
D. Component D.

30. Suppose that Experiment 1 will be repeated using Solvent I, but 0.2 g of Component Z (polarity = 0.7) will be part of the mixture. Which of the following best predicts the order of the elution times of the 5 components, from shortest to longest?

F. A, B, C, Z, D
G. A, Z, B, C, D
H. D, Z, C, B, A
J. D, C, B, Z, A

31. The *resolution* of a chromatographic separation increases as the amount of time between the elutions of each of the components increases. Based on the results of Experiments 1 and 2, which of the following sets of conditions had the greatest resolution for the separation of the mixture?

	Normal-phase	Reverse-phase
A.	Solvent I	Solvent II
B.	Solvent I	Solvent III
C.	Solvent II	Solvent I
D.	Solvent III	Solvent I

32. In Experiment 1, for Solvent I, at the time when exactly 50% of the amount of Component B had eluted from the column, the percent of Component D that had eluted from the column was closest to:

F. 10%.
G. 20%.
H. 90%.
J. 100%.

33. Suppose that Experiment 2 was repeated using a solvent with a polarity of 9.3. The elution time of Component D would most likely be:

A. less than 20 min.
B. between 20 min and 40 min.
C. between 40 min and 50 min.
D. greater than 50 min.

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Passage VII

Introduction

Students studying a unit on motion and conservation of energy were given the following information:

- *Kinetic energy* (energy that changes as an object's speed changes) and *gravitational potential energy* (energy that changes as an object's altitude changes) are forms of mechanical energy.
- An object's *total mechanical energy* is the sum of its kinetic energy and its gravitational potential energy.
- If an object's total mechanical energy is constant, its total mechanical energy is said to be *conserved.*
- Friction causes some of an object's total mechanical energy to be lost, in which case its total mechanical energy is *not* conserved.

The students' teacher then described the following experiment:

> Suppose a student placed a block upon a surface and gave the block a single push. As the block moved along the surface, the student measured the block's speed twice in succession and found that the second measured speed was lower than the first.

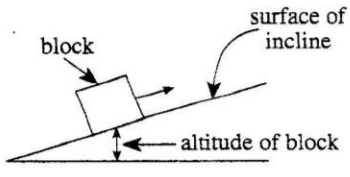
Given no other information, 3 students were asked to explain the results of the 2 measurements and to predict the block's motion after the 2 measurements.

Student 1

The block was moving on a rough, *horizontal* surface (a surface with no incline). There was a constant frictional force between the block and the surface. This force alone caused the block to slow down at a constant rate and would have caused the block eventually to stop. Once stopped, the block would have remained at rest.

Student 2

When the 2 measurements were made, the block was moving up a frictionless, inclined surface as shown in the figure, and was slowing down at a constant rate. No air was present.



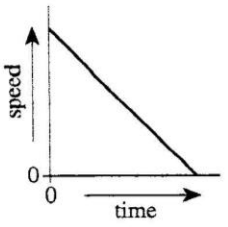
Eventually, the block would have stopped moving up the incline; then gravity alone would have caused the block to accelerate down the incline. At any specified altitude, the block's speed going down the incline would have been the same as its earlier speed going up the incline.

Student 3

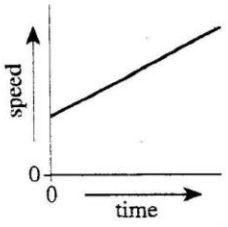
The block moved on a frictionless, horizontal surface. As a result of its motion, the block encountered air resistance. Air resistance alone caused the block to slow down and lose mechanical energy. The rate at which the block slowed down depended upon the amount of air resistance it encountered. As the block's speed decreased, the amount of air resistance decreased.

34. Assume that the block was pushed and then released at time = 0. Student 1's description of the block's speed over time after its release is best illustrated by which of the following graphs?

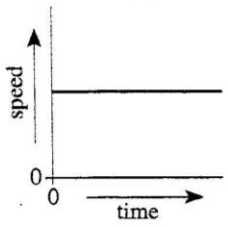
F.



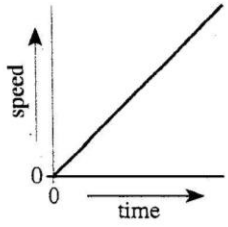
H.



G.



J.



35. The 3 explanations of the block's motion are similar to each other in that all 3 explanations:

A. contradicted the law of conservation of total mechanical energy.
B. were based on 2 measurements.
C. were formulated using the assumption that no friction would exist between the block and the air.
D. were formulated using the assumption that there would be no friction between the block and the surface on which it moved.

36. Based on the explanations of the 3 students, what did the 3 students most likely assume about the block's speed between the times the 2 measurements were made?

F. The speed increased only.
G. The speed decreased only.
H. The speed increased, then decreased.
J. The speed changed, but with no general trend.

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37. The teacher posed another question: Suppose, in a second experiment, the student placed the block and the surface in an airless chamber. Then the student repeated the procedure from the first experiment, except that he measured the block's speed throughout the experiment. If the block's speed remained constant throughout this second experiment, the explanation(s) of which student(s) for the results of the first experiment would be best supported?

A. Student 1 only
B. Student 3 only
C. Students 1 and 2 only
D. Students 1 and 3 only

38. Based on Student 2's explanation, the block's gravitational potential energy at the highest point on its path most likely equaled:

F. the block's kinetic energy one-third of the way up the incline.
G. the block's gravitational potential energy two-thirds of the way up the incline.
H. the block's total mechanical energy.
J. zero.

39. According to Student 1, while the block was moving, did the block's speed affect the frictional force on the block?

A. Yes; as the block's speed increased, the frictional force on the block decreased only.
B. Yes; as the block's speed increased, the frictional force on the block increased, then decreased.
C. No; as the block's speed decreased, the frictional force on the block decreased, then increased.
D. No; as the block's speed decreased, the frictional force on the block was unaffected.

40. Assuming that Student 1's explanation is correct, while the block moved, was the total mechanical energy of the block conserved?

F. Yes, because the block's kinetic energy increased and its gravitational potential energy remained constant.
G. Yes, because both the block's kinetic energy and its gravitational potential energy increased.
H. No, because the block's kinetic energy decreased and its gravitational potential energy remained constant.
J. No, because both the block's kinetic energy and its gravitational potential energy decreased.

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.*

TJ Test #1 Answer Form/Bubble Sheet & Key

First Name: _____ Last Name: _____

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.*

SECTION 1

Math

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

Student-Produced Responses:

26 _____

27 _____

28 _____

First Name: _____ Last Name: _____

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.*

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**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
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16	Ⓕ	Ⓖ	Ⓗ	Ⓙ	**36**	Ⓕ	Ⓖ	Ⓗ	Ⓙ
17	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**37**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
18	Ⓕ	Ⓖ	Ⓗ	Ⓙ	**38**	Ⓕ	Ⓖ	Ⓗ	Ⓙ
19	Ⓐ	Ⓑ	Ⓒ	Ⓓ	**39**	Ⓐ	Ⓑ	Ⓒ	Ⓓ
20	Ⓕ	Ⓖ	Ⓗ	Ⓙ	**40**	Ⓕ	Ⓖ	Ⓗ	Ⓙ

First Name: _____ Last Name: _____

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.*

SECTION 3

Science

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

First Name: _____ Last Name: _____

ANSWER KEY – TJ Test #1

Section #1 Math

1-	D
2-	C
3-	E
4-	A
5-	D
6-	C
7-	C
8-	B
9-	B
10-	B
11-	C
12-	A
13-	D
14-	A
15-	B
16-	B
17-	A
18-	E
19-	A
20-	E
21-	C
22-	A
23-	E
24-	A
25-	D
26-	2
27-	1.5
28-	40:41

Section #2 Reading

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

Section #3 Science

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