



Chapter 26  
Practice Exam 1



# ACT Diagnostic Test Form

Use a No. 2 pencil only. Be sure each mark is dark and completely fills the intended oval. Completely erase any errors or stray marks.

1. YOUR NAME: \_\_\_\_\_  
(Print) Last First M.I.

SIGNATURE: \_\_\_\_\_ DATE: \_\_\_\_/\_\_\_\_/\_\_\_\_

HOME ADDRESS: \_\_\_\_\_  
(Print) Number and Street

\_\_\_\_\_  
City State Zip

E-MAIL: \_\_\_\_\_

PHONE NO.: \_\_\_\_\_  
(Print)

SCHOOL: \_\_\_\_\_

CLASS OF: \_\_\_\_\_

IMPORTANT: Please fill in these boxes exactly as shown on the back cover of your test book.

**2. TEST FORM**

\_\_\_\_\_

**3. TEST CODE**

0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

**4. PHONE NUMBER**

0	0	0	0	0	0	0
1	1	1	1	1	1	1
2	2	2	2	2	2	2
3	3	3	3	3	3	3
4	4	4	4	4	4	4
5	5	5	5	5	5	5
6	6	6	6	6	6	6
7	7	7	7	7	7	7
8	8	8	8	8	8	8
9	9	9	9	9	9	9

**5. YOUR NAME**

First 4 letters of last name				FIRST INIT	MID INIT
A	A	A	A	A	A
B	B	B	B	B	B
C	C	C	C	C	C
D	D	D	D	D	D
E	E	E	E	E	E
F	F	F	F	F	F
G	G	G	G	G	G
H	H	H	H	H	H
I	I	I	I	I	I
J	J	J	J	J	J
K	K	K	K	K	K
L	L	L	L	L	L
M	M	M	M	M	M
N	N	N	N	N	N
O	O	O	O	O	O
P	P	P	P	P	P
Q	Q	Q	Q	Q	Q
R	R	R	R	R	R
S	S	S	S	S	S
T	T	T	T	T	T
U	U	U	U	U	U
V	V	V	V	V	V
W	W	W	W	W	W
X	X	X	X	X	X
Y	Y	Y	Y	Y	Y
Z	Z	Z	Z	Z	Z

**6. DATE OF BIRTH**

MONTH	DAY		YEAR	
<input type="radio"/> JAN				
<input type="radio"/> FEB				
<input type="radio"/> MAR	0	0	0	0
<input type="radio"/> APR	1	1	1	1
<input type="radio"/> MAY	2	2	2	2
<input type="radio"/> JUN	3	3	3	3
<input type="radio"/> JUL		4	4	4
<input type="radio"/> AUG		5	5	5
<input type="radio"/> SEP		6	6	6
<input type="radio"/> OCT		7	7	7
<input type="radio"/> NOV		8	8	8
<input type="radio"/> DEC		9	9	9

**7. SEX**

MALE

FEMALE

**8. OTHER**

1 A B C D E

2 A B C D E

3 A B C D E

# The Princeton Review Diagnostic ACT Form

Completely darken bubbles with a No. 2 pencil. If you make a mistake, be sure to erase mark completely. Erase all stray marks.

## ENGLISH

- |                    |                    |                    |                    |
|--------------------|--------------------|--------------------|--------------------|
| 1 (A) (B) (C) (D)  | 21 (A) (B) (C) (D) | 41 (A) (B) (C) (D) | 61 (A) (B) (C) (D) |
| 2 (F) (G) (H) (J)  | 22 (F) (G) (H) (J) | 42 (F) (G) (H) (J) | 62 (F) (G) (H) (J) |
| 3 (A) (B) (C) (D)  | 23 (A) (B) (C) (D) | 43 (A) (B) (C) (D) | 63 (A) (B) (C) (D) |
| 4 (F) (G) (H) (J)  | 24 (F) (G) (H) (J) | 44 (F) (G) (H) (J) | 64 (F) (G) (H) (J) |
| 5 (A) (B) (C) (D)  | 25 (A) (B) (C) (D) | 45 (A) (B) (C) (D) | 65 (A) (B) (C) (D) |
| 6 (F) (G) (H) (J)  | 26 (F) (G) (H) (J) | 46 (F) (G) (H) (J) | 66 (F) (G) (H) (J) |
| 7 (A) (B) (C) (D)  | 27 (A) (B) (C) (D) | 47 (A) (B) (C) (D) | 67 (A) (B) (C) (D) |
| 8 (F) (G) (H) (J)  | 28 (F) (G) (H) (J) | 48 (F) (G) (H) (J) | 68 (F) (G) (H) (J) |
| 9 (A) (B) (C) (D)  | 29 (A) (B) (C) (D) | 49 (A) (B) (C) (D) | 69 (A) (B) (C) (D) |
| 10 (F) (G) (H) (J) | 30 (F) (G) (H) (J) | 50 (F) (G) (H) (J) | 70 (F) (G) (H) (J) |
| 11 (A) (B) (C) (D) | 31 (A) (B) (C) (D) | 51 (A) (B) (C) (D) | 71 (A) (B) (C) (D) |
| 12 (F) (G) (H) (J) | 32 (F) (G) (H) (J) | 52 (F) (G) (H) (J) | 72 (F) (G) (H) (J) |
| 13 (A) (B) (C) (D) | 33 (A) (B) (C) (D) | 53 (A) (B) (C) (D) | 73 (A) (B) (C) (D) |
| 14 (F) (G) (H) (J) | 34 (F) (G) (H) (J) | 54 (F) (G) (H) (J) | 74 (F) (G) (H) (J) |
| 15 (A) (B) (C) (D) | 35 (A) (B) (C) (D) | 55 (A) (B) (C) (D) | 75 (A) (B) (C) (D) |
| 16 (F) (G) (H) (J) | 36 (F) (G) (H) (J) | 56 (F) (G) (H) (J) |                    |
| 17 (A) (B) (C) (D) | 37 (A) (B) (C) (D) | 57 (A) (B) (C) (D) |                    |
| 18 (F) (G) (H) (J) | 38 (F) (G) (H) (J) | 58 (F) (G) (H) (J) |                    |
| 19 (A) (B) (C) (D) | 39 (A) (B) (C) (D) | 59 (A) (B) (C) (D) |                    |
| 20 (F) (G) (H) (J) | 40 (F) (G) (H) (J) | 60 (F) (G) (H) (J) |                    |

## MATHEMATICS

- |                        |                        |                        |                        |
|------------------------|------------------------|------------------------|------------------------|
| 1 (A) (B) (C) (D) (E)  | 16 (F) (G) (H) (J) (K) | 31 (A) (B) (C) (D) (E) | 46 (F) (G) (H) (J) (K) |
| 2 (F) (G) (H) (J) (K)  | 17 (A) (B) (C) (D) (E) | 32 (F) (G) (H) (J) (K) | 47 (A) (B) (C) (D) (E) |
| 3 (A) (B) (C) (D) (E)  | 18 (F) (G) (H) (J) (K) | 33 (A) (B) (C) (D) (E) | 48 (F) (G) (H) (J) (K) |
| 4 (F) (G) (H) (J) (K)  | 19 (A) (B) (C) (D) (E) | 34 (F) (G) (H) (J) (K) | 49 (A) (B) (C) (D) (E) |
| 5 (A) (B) (C) (D) (E)  | 20 (F) (G) (H) (J) (K) | 35 (A) (B) (C) (D) (E) | 50 (F) (G) (H) (J) (K) |
| 6 (F) (G) (H) (J) (K)  | 21 (A) (B) (C) (D) (E) | 36 (F) (G) (H) (J) (K) | 51 (A) (B) (C) (D) (E) |
| 7 (A) (B) (C) (D) (E)  | 22 (F) (G) (H) (J) (K) | 37 (A) (B) (C) (D) (E) | 52 (F) (G) (H) (J) (K) |
| 8 (F) (G) (H) (J) (K)  | 23 (A) (B) (C) (D) (E) | 38 (F) (G) (H) (J) (K) | 53 (A) (B) (C) (D) (E) |
| 9 (A) (B) (C) (D) (E)  | 24 (F) (G) (H) (J) (K) | 39 (A) (B) (C) (D) (E) | 54 (F) (G) (H) (J) (K) |
| 10 (F) (G) (H) (J) (K) | 25 (A) (B) (C) (D) (E) | 40 (F) (G) (H) (J) (K) | 55 (A) (B) (C) (D) (E) |
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| 12 (F) (G) (H) (J) (K) | 27 (A) (B) (C) (D) (E) | 42 (F) (G) (H) (J) (K) | 57 (A) (B) (C) (D) (E) |
| 13 (A) (B) (C) (D) (E) | 28 (F) (G) (H) (J) (K) | 43 (A) (B) (C) (D) (E) | 58 (F) (G) (H) (J) (K) |
| 14 (F) (G) (H) (J) (K) | 29 (A) (B) (C) (D) (E) | 44 (F) (G) (H) (J) (K) | 59 (A) (B) (C) (D) (E) |
| 15 (A) (B) (C) (D) (E) | 30 (F) (G) (H) (J) (K) | 45 (A) (B) (C) (D) (E) | 60 (F) (G) (H) (J) (K) |

# The Princeton Review Diagnostic ACT Form

Completely darken bubbles with a No. 2 pencil. If you make a mistake, be sure to erase mark completely. Erase all stray marks.

## READING

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

## SCIENCE REASONING

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

I hereby certify that I have truthfully identified myself on this form. I accept the consequences of falsifying my identity.

\_\_\_\_\_  
Your signature

\_\_\_\_\_  
Today's date







## ENGLISH TEST

45 Minutes—75 Questions

**DIRECTIONS:** In the five passages that follow, certain words and phrases are underlined and numbered. In the right-hand column, you will find alternatives for the underlined part. In most cases, you are to choose the one that correctly expresses the idea, makes the statement appropriate for standard written English, or is worded most consistently with the style and tone of the passage as a whole. If you think the original version is correct, choose “NO CHANGE.” In some cases, you will find in the right-hand column a question about the underlined part. You are to choose the correct answer to the question.

You will also find questions about a section of the passage, or about the passage as a whole. These questions do not refer to an underlined portion of the passage, but rather are identified by a number or numbers in a box.

For each question, choose the alternative you consider correct and fill in the corresponding oval on your answer document. Read each passage through once before you begin to answer the questions that accompany it. For many of the questions, you must read several sentences beyond the question to determine the answer. Be sure that you have read far enough ahead each time you choose an alternative.

## PASSAGE I

## The Special Ingredient

As the firstborn grandchild, I made the most to the years when I had the undivided attention of my adult relatives. I especially loved spending the day with my grandmother. I was ready to “help” around the house with everything; weeding,

changing sheets, even washing windows. Solitary jobs thrilled me because I was spending time alone with her. She made

everyday chores meaningful, when she set to work, hard and easy tasks alike were undertaken as acts of love.

1. A. NO CHANGE  
B. along  
C. of  
D. into
2. F. NO CHANGE  
G. house with, everything:  
H. house with everything:  
J. house. With everything
3. Which choice best suggests the potentially unusual nature of the narrator’s enthusiasm for the kinds of housework she helped her grandmother with?  
A. NO CHANGE  
B. Mundane  
C. Exciting  
D. Necessary
4. F. NO CHANGE  
G. meaningful. When she set to work  
H. meaningful and when she set to work  
J. meaningful. When she set to work,

GO ON TO THE NEXT PAGE.

I loved dinner preparations. No tasks seemed more magical  
 then it.  
 5

Cooking without written recipes, conjuring complex dishes with  
 6  
 the same ease with which a magician pulls a rabbit from

a hat. My favorite dish, however, was a simple one: chicken  
 7

and dumplings. She always began by teasingly asking me to  
 8  
 catch and pluck a chicken, the way she'd had to do growing up.  
 While a store-bought chicken cooked in the soup pot, Grandma  
 transformed a few ingredients into dough, which she let rest and  
 then cut into the thin strips that would plump up in the broth.  
 After my brother was born, I became even more determined to  
 keep some activities just for myself. To reduce the resulting  
 quarrels, we both met with Grandma, whom promised us that  
 9  
 we'd each have special activities. I rejoiced that I got to keep  
 chicken and dumplings.

When I left for college and then began a career abroad,  
 "our dish" came to signal everything I missed about  
 10

home when I was far away from it. In desperation, whenever  
 11  
 I came across chicken and dumplings on a menu, I'd order it  
 with high hopes, but the restaurant's version never tasted as  
 good as Grandma's. Eventually I became resigned to the fact

5. A. NO CHANGE  
 B. then those of the kitchen.  
 C. than it.  
 D. than those of the kitchen.

6. F. NO CHANGE  
 G. Cooking as she did without  
 H. Grandma cooked without  
 J. Without

7. A. NO CHANGE  
 B. moreover,  
 C. naturally,  
 D. then,

8. If the writer were to delete the underlined portion, the paragraph would primarily lose:  
 F. a sense of the relationship between the narrator and her grandmother as they engaged in their cooking rituals.  
 G. an insight into how the grandmother both loved and kept a distance from her granddaughter.  
 H. a suggestion that sometimes the narrator felt her grandmother picked on her.  
 J. a detail that keeps the narrator's reminiscences from seeming too perfect.

9. A. NO CHANGE  
 B. who promised us  
 C. who promised ourselves  
 D. whom promised ourselves

10. F. NO CHANGE  
 G. represent  
 H. stand up for  
 J. give anew

11. A. NO CHANGE  
 B. home when I wasn't there.  
 C. home.  
 D. the place I loved a lot, which was home.

**GO ON TO THE NEXT PAGE.**





that my favorite food was only available over visits home or, after Grandma's death, in my dreams.

After hearing this lament a few times over the years, my mother finally challenged me to cook the dish myself. I objected

that none of Grandma's recipes were written down, but Mom dismissed my concerns, insisting my memories would guide me—especially since I already knew that the most important ingredient was love.

It turned out Mom was right. It took some trial and error, but with help from the internet, I found a recipe for chicken and dumplings that I love.

12. F. NO CHANGE  
G. when  
H. before  
J. on

13. Which choice indicates most specifically how the narrator felt about her access to the dish she craved, prior to her mother's suggestion?  
A. NO CHANGE  
B. explanation  
C. story  
D. long tale

14. F. NO CHANGE  
G. Grandmas' recipes  
H. Grandmas recipes  
J. Grandmas recipe's

15. Which choice best concludes the essay by emphasizing the central point made in the first and second paragraphs?  
A. NO CHANGE  
B. Grandma wouldn't have wanted me to be a quitter.  
C. perfecting a recipe for a dish you love always takes some practice.  
D. memories of how safe, happy, and loved I felt in the kitchen with Grandma helped me remember what to do—and, more importantly, how to do it.

## PASSAGE II

### Ada Lovelace, Programming the Future

[1] In 1833, when Ada Lovelace was seventeen, she met the inventor Charles Babbage at a party. [2] Lovelace's intelligence seems to have fazed him, because he soon offered to show her a device he'd been working on. [3] Babbage introduced Lovelace to his complicated Difference Engine—a towering mechanical

16. F. NO CHANGE  
G. overawed  
H. impressed  
J. motivated

**GO ON TO THE NEXT PAGE.**



calculator. [4] Such was a pivotal moment, as it was only after

17

seeing this machine that Lovelace fully focused her keen understanding on the subject that absorbed her thereafter. [5] With the benefit of an unusually extensive education, Lovelace had excelled in many subjects; after meeting Babbage though,

19

she concentrated on mathematical theories and methods. [20]

Almost a decade later, Babbage delivered a lecture on a new, more sophisticated machine—the Analytical Engine. The transcript of this lecture was published only in French. After reading that version, Lovelace decided to translate it into English. As she did so, she wrote footnotes to contribute her own additional insights, including many that greatly clarified the mechanism of Babbage’s work and expanded on its vast

21

potential. [22] In 1801, Joseph-Marie Jacquard had invented a weaving machine that “read” a series of punched cards to determine which patterns to weave. Babbage proposed that, in his machine, such a card could specify mathematical

17. A. NO CHANGE  
B. These  
C. There  
D. This

18. F. NO CHANGE  
G. Lovelace fully to engage with  
H. Lovelace—she was fully engaged with  
J. Lovelace, she focused fully on

19. A. NO CHANGE  
B. Babbage, though,  
C. Babbage though  
D. Babbage, though

20. For the sake of logic and cohesion, Sentence 2 should be placed:  
F. where it is now.  
G. before Sentence 4.  
H. after Sentence 4.  
J. after Sentence 5.

21. A. NO CHANGE  
B. a number of hers  
C. many of those insights  
D. a lot of her insights

22. At this point, the writer is considering dividing the paragraph into two. Making this change would help organize the essay by separating:  
F. a suggestion that Lovelace took unwarranted liberties in the act of translation from an explanation of why she did so.  
G. an overview of the limitations of Babbage’s lecture from an explanation of how the Analytical Engine could improve industries such as weaving.  
H. details of how Lovelace translated the French text from an explanation of Babbage’s response to that translation.  
J. an introduction to Lovelace’s translation from details that establish why it was so extraordinary.

**GO ON TO THE NEXT PAGE.**

operations Lovelace quickly grasped. This idea's immense potential and strove to demonstrate it. Today, her outline of the input data needed to calculate certain numbers have been widely regarded as the first computer program.

Further, she predicted that such a machine could be used to do more than just manipulate numbers. Lovelace's suggestion that

such a machine could produce diverse things: scientific analysis,

visual images, and music) to foreshadow the digital revolution.

Lovelace died in 1852, decades before the first "real" computer was built, but recognition of her trailblazing role as

a woman in computing has grown. Naturally, in the 1970s, the Department of Defense named a software language "Ada" in her

honor, and, on the second Tuesday of every October, Ada Lovelace Day prompts us to notice women in STEM fields.

23. A. NO CHANGE  
 B. operations. Lovelace quickly grasped this  
 C. operations, Lovelace quickly grasped this  
 D. operations Lovelace quickly grasped; this

24. F. NO CHANGE  
 G. are widely regarded  
 H. have wide regard  
 J. is widely regarded

25. A. NO CHANGE  
 B. could be employed and  
 C. akin to that could be  
 D. like that could be

26. F. NO CHANGE  
 G. things (scientific analysis,  
 H. things, scientific analysis,  
 J. things (scientific analysis

27. A. NO CHANGE  
 B. foreshadowed  
 C. foreshadowing  
 D. DELETE the underlined portion.

28. F. NO CHANGE  
 G. However, in  
 H. In  
 J. By contrast, in

29. Which choice most strongly and specifically emphasizes that Ada Lovelace Day is intended to shine a light on often-overlooked work done by women in math and science fields?  
 A. NO CHANGE  
 B. think about the work of  
 C. celebrate under-recognized contributions of  
 D. honor efforts by

**GO ON TO THE NEXT PAGE.**



Question 30 asks about the preceding passage as a whole.

30. Suppose the writer's primary purpose had been to discuss a mathematician whose work was remarkable but did not receive great recognition during the mathematician's lifetime. Would this essay accomplish that purpose?
- F. Yes, because it proves that Lovelace improved on Babbage's work to change the course of computer science.
  - G. Yes, because it recounts the story of Ada Lovelace's pioneering work in her field and of the recognition she has received decades after her death.
  - H. No, because although it describes the program Lovelace wrote, it does not provide evidence that the program was remarkable.
  - J. No, because the passage speculates that Babbage recognized Lovelace's intelligence.

PASSAGE III

On Volcano's Edge

[1]

The U.S. is home to approximately 170 active volcanoes. While some in Alaska and Hawaii are so active that they erupt daily, many more lie dormant for years—or even decades, between eruptions. Since some of these active volcanoes sit near populated towns and cities, predicting future eruptions is essential to public safety.

[2]

The National Volcano Early Warning System reports that approximately 54 U.S. volcanoes pose a high or very high risk to public safety. The field of volcanology is devoted to understanding the formation and dynamics of volcanoes. [A]

31. A. NO CHANGE  
 B. years,  
 C. years  
 D. years;
32. Given that all the choices are true, which one would provide the most effective introduction to the paragraph?
- F. NO CHANGE
  - G. This task is the responsibility of volcanologists.
  - H. On average, approximately one volcano erupts per week somewhere around the world.
  - J. The deadliest volcanic event in the United States occurred when Mount St. Helens erupted in 1980.

GO ON TO THE NEXT PAGE.



This work can focus on dead and dormant volcanoes, it can also require volcanologists to monitor volcanoes that are active or potentially “reawakening.”

[3]

[B] Field research on dead or dormant volcanoes frequently involves analyzing the chemical makeup of the rocks around the 34

volcano site to determine the amounts of sulfur and iron in the rocks. At active sites, 35

however, volcanologists collect samples and measure lava 36 temperatures, gas emissions, and ongoing earthquake activities. “Long-period” earthquakes can indicate

magma rising through Earth’s crust. As 37

magma liquefied rock that eventually becomes lava, builds up 38 under the surface, a volcano’s shape often changes. Thus,

it’s vital to monitor a volcano using GPS and precisely calibrated 39 instruments to detect and react to such changes.

33. A. NO CHANGE  
B. volcanoes; since  
C. volcanoes  
D. volcanoes, but

34. F. NO CHANGE  
G. have involved  
H. involve  
J. are involving

35. The writer wants to end this sentence by emphasizing that analysis of dormant and dead volcanoes provides insights into the geological history of those sites. Which choice best accomplishes that goal?  
A. NO CHANGE  
B. establish when and how previous eruptions occurred.  
C. confirm that the volcanoes are unlikely to erupt again in the near future.  
D. test for evidence of ancient civilizations that might have lived there.

36. F. NO CHANGE  
G. in fact,  
H. therefore,  
J. furthermore,

37. A. NO CHANGE  
B. behind  
C. of  
D. with

38. F. NO CHANGE  
G. magma, liquefied rock that eventually becomes lava—  
H. magma—liquefied rock that eventually becomes lava—  
J. magma, liquefied rock that eventually becomes lava

39. A. NO CHANGE  
B. it was  
C. its’  
D. its

**GO ON TO THE NEXT PAGE.**



[4]

Volcanologists also help to prepare areas for the chance that a volcano could erupt. Fast-moving lava, avalanches, and sudden rocky explosions pose dire risks to nearby humans, animals, and their homes. Even far from the eruption site, plumes of ash can harm crops and air travel is disrupted in places nowhere near the volcano. Advising the public about when to evacuate and when to stay away from a site can save thousands of lives. [C]

[5]

Because a career that involves camping by a soon-to-erupt volcano might seem spectacularly dangerous, only two U.S. geologists have ever died as a result of volcanic eruption. [D] Recent advances in technology and methods of prediction help volcanologists advise residents living near an active site while greatly minimizing risks to the scientists themselves.

[6]

Like many applied science positions, a volcanologist's job combines direct observation, theoretical modeling, and analyzing of data.

40. F. NO CHANGE  
 G. the possibility that a volcano could erupt in a certain area.  
 H. a possible eruption.  
 J. a likelihood that a volcano will erupt nearby, since they know it could happen.

41. A. NO CHANGE  
 B. ash plumes can cause problems for farmers, crops, air traffic controllers, and airplanes.  
 C. ash that forms massive clouds in the sky can rain down on fields and affect airplane travel in faraway locales.  
 D. plumes of ash can disrupt air travel and affect agriculture.

42. F. NO CHANGE  
 G. Considering that  
 H. Since  
 J. While

43. A. NO CHANGE  
 B. has helped  
 C. is helping  
 D. helps

44. F. NO CHANGE  
 G. they analyze data.  
 H. data to be analyzed.  
 J. data analysis.

Question 45 asks about the preceding passage as a whole.

45. The writer wants to add the following sentence to the essay:

Whatever a volcano's status, volcanologists must conduct much of this monitoring on site.

The sentence would most logically be placed at:

- A. Point A in Paragraph 2.  
 B. Point B in Paragraph 3.  
 C. Point C in Paragraph 4.  
 D. Point D in Paragraph 5.

**GO ON TO THE NEXT PAGE.**



## PASSAGE IV

## Vermeer's Artistry

The following paragraphs may or may not be in the most logical order. Each paragraph is numbered in brackets, and question 59 will ask you to choose where Paragraph 4 should most logically be placed.

[1]

Johannes Vermeer's *The Art of Painting* combines realistic representation with metaphorical details to prompt the viewer to think about how art works. Vermeer is best known for portraying women in everyday domestic moments, since he showed them making lace, reading, or doing chores. This painting, however, centers on a male artist; critics believe represents Vermeer himself, as he paints a female model. Thus, the painting seems to offer the artist's commentary on his art.

[2]

[1] Yet some details are inconsistent with the work's prevailing realism. [2] In one place, the painter's hair fades gradually into the background colors of the map behind him. [3] In another, blurring of background details, the folds of drapery on the table are out of focus, creating an impressionistic effect.

46. Which choice best indicates where Vermeer was born and worked?
- F. NO CHANGE  
 G. in one of the Dutch painter's most self-referential works.  
 H. to produce a complex statement about the politics and practice of painting.  
 J. in a painting owned by the Kunsthistorisches Museum in Vienna.
47. A. NO CHANGE  
 B. showing  
 C. in which he showed  
 D. DELETE the underlined portion.
48. F. NO CHANGE  
 G. artist, critics  
 H. artist. Critics  
 J. artist critics
49. A. NO CHANGE  
 B. another blurring of background details,  
 C. another, blurring of background details  
 D. another blurring, of background details

GO ON TO THE NEXT PAGE.



[4] Basic tools which the painter would need access in order  
to paint, like a palette, are absent from the image. [5] It also  
appears that, were the painter to stand up, he'd bang

50. F. NO CHANGE  
G. to which  
H. for  
J. DELETE the underlined portion.

his head on the chandelier above him. [6] Suggesting the artist's  
metaphorical stature within the scene and reaffirms his

51. A. NO CHANGE  
B. While this suggests  
C. This detail suggests  
D. Since suggesting

significance. 52

52. The writer wants to add the following statement to the paragraph:

This omission has the paradoxical effect of directing attention to the elements of craft that are not shown or that go unnoticed.

This statement would most logically be placed after:

- F. Sentence 1.  
G. Sentence 3.  
H. Sentence 4.  
J. Sentence 5.

[3]

Together, the realistic and metaphorical details make  
Vermeer's work stand out even from other Dutch masterpieces  
that also depict art being made. Emanuel de Witte's *Interior with*  
*a Woman at the Clavichord*, for instance, also shows a domestic  
space as the site of artistic performance. Yet de Witte's work  
does not emphasize the role of an artist's decisions in creating  
the semblance of realism the way Vermeer's does. Vermeer's  
image directly reminds us that an artist's choices are based on  
that artist's personal experiences.

53. A. NO CHANGE  
B. noticeably stand out  
C. draw attention by standing out  
D. stand out with prominence

54. Which choice both supports the claim the writer makes in the preceding sentence about an artist's decisions and best emphasizes how significant those choices are to what we perceive?
- F. NO CHANGE  
G. are affected by a whole range of factors.  
H. always shape what the viewer perceives in a work of art.  
J. are not so different from the everyday choices people make.

**GO ON TO THE NEXT PAGE.**





[4]

The realistic precision of *The Art of Painting* is striking.

Details are so clear that, for instance, historians have diagnosed<sup>55</sup>

the exact document Vermeer must have referenced<sup>56</sup> in his depiction of a map that hangs on the wall in the painting.

Vermeer's mastery of many of painting's components,

including such fundamental elements as light and color,<sup>57</sup>

result in an image that appears as accurate as a photograph.<sup>58</sup>

55. A. NO CHANGE  
B. determined the identification of  
C. identified  
D. put a name to

56. F. NO CHANGE  
G. referenced;  
H. referenced—  
J. referenced,

57. A. NO CHANGE  
B. that are elements  
C. elements as  
D. DELETE the underlined portion.

58. F. NO CHANGE  
G. are resulting  
H. results  
J. have resulted

Questions 59 and 60 ask about the preceding passage as a whole.

59. For the sake of logic and cohesion, Paragraph 4 should be placed:
- A. where it is now.  
B. before Paragraph 1.  
C. before Paragraph 2.  
D. after Paragraph 2.
60. Suppose the writer's primary purpose had been to examine how a work of art reshaped the way historians think about the role of the artist. Would this essay accomplish that purpose?
- F. Yes, because it suggests that other painters were influenced by Vermeer's innovative approach.  
G. Yes, because it indicates the role that historians have played in analyzing the painting.  
H. No, because it states that Vermeer's subject in *The Art of Painting* was atypical for him.  
J. No, because it focuses on the particulars of one painting but does not indicate what effect the painting has had on art criticism overall.

**GO ON TO THE NEXT PAGE.**



## PASSAGE V

The Intricate Layers of *Matryoshka*

Natasha Pugaeva is a professional painter of *matryoshki*, the nesting dolls that rank among Russia’s most recognizable national symbols. She painted her first *matryoshka* doll in 1990, while she was in Kazakhstan, who worked as a painting<sup>61</sup> instructor. The *matryoshka* trade has flourished among former Soviet state employees who could produce the dolls from their

homes. 62 Three years later, she and her husband moved to a city east of Moscow, where she has expanded

her *matryoshka* production.<sup>63</sup>

All dolls in a set except the smallest are hollow, with “daughter” dolls nesting inside one another, so it’s not surprising<sup>64</sup> that the word *matryoshka* recalls the Russian word for “mother.”<sup>64</sup> While the exact origins of *matryoshki* are unclear,

one possibility<sup>65</sup>, travel played a key role, is that a Russian who had visited Asia brought home a Japanese nesting doll in the 1890s. The development of a similar doll in Sergiev Posad—a

61. A. NO CHANGE  
 B. Kazakhstan, and worked  
 C. Kazakhstan, and having work  
 D. Kazakhstan working
62. The writer is considering deleting the preceding sentence. Should the sentence be kept or deleted?  
 F. Kept, because it places Natasha’s painting in a broader social context.  
 G. Kept, because it explains why Natasha was one of many people to begin painting *matryoshka* dolls in the early 1990s.  
 H. Deleted, because it detracts from the paragraph’s focus on the development of Natasha’s *matryoshka*-painting practice.  
 J. Deleted, because it contradicts the paragraph’s explanation of where Natasha learned to paint *matryoshka* dolls.
63. A. NO CHANGE  
 B. her production.  
 C. their production.  
 D. the production of them.
64. Which choice most clearly builds on the information provided earlier in the sentence about the relationship of the dolls’ structure to their name?  
 F. NO CHANGE  
 G. but, while *matryoshka* dolls are more often female, it is possible to find male dolls as well.  
 H. and, as Russian speakers know, the plural of *matryoshka* is *matryoshki*.  
 J. which means the largest *matryoshka* doll is the one most people see.
65. A. NO CHANGE  
 B. possibility and  
 C. possibility, which  
 D. possibility, in which

GO ON TO THE NEXT PAGE.



Russian region famous for its folk art—resulted from, or perhaps simply coinciding with, that cross-cultural exchange. Soon, the

lathes that were operated by local workers to craft various

wooden objects was used to produce great numbers of blank

*matryoshka* dolls (particularly games and nesting Easter eggs).

Then came the painting. Over the years, amateur and

professional artists alike have hand-painted the smooth, curved

surfaces, and brought beautiful images to life. Inspiration for

these designs comes from Russian life, and less traditional

subjects include fantastical fairy tales, politicians of great power,

revered religious figures, and iconic works of art. Since an early

*matryoshka* set was displayed in Paris in 1900, the dolls have

had a long career as an evocative example of traditional

Russian goods.

66. F. NO CHANGE  
G. coincided  
H. as a coincidence  
J. it was to coincide

67. A. NO CHANGE  
B. used  
C. were used  
D. has been used

68. The best placement for the underlined portion would be:  
E. where it is now.  
G. after the word *lathes*.  
H. after the word *workers*.  
J. after the word *objects*.

69. A. NO CHANGE  
B. smooth curved surfaces,  
C. smooth curved, surfaces  
D. smooth, curved surfaces

70. Which choice best maintains the stylistic pattern of descriptions established earlier in the sentence?  
E. NO CHANGE  
G. art.  
H. famous artworks that are imitated.  
J. some famous artworks.

71. The writer is considering revising the underlined portion to the following:

handicrafts.

Should the writer make this revision?

- A. Yes, because the revision better indicates why there is so much variation in the decorations on the dolls.  
B. Yes, because the revision emphasizes the handmade nature of the dolls, which effectively reinforces the essay's framing discussion of an individual artisan.  
C. No, because the original word places the dolls within the larger context of a market in which souvenirs are bought and sold.  
D. No, because the original word more specifically describes the type of object that a *matryoshka* doll is.

**GO ON TO THE NEXT PAGE.**

For Natasha, her exceptional skills offer a means of engaging with her community. Instead, she runs a workshop in which<sup>72</sup> she instructs and collaborates with students. The students do not

pay for their lessons, and they receive a portion of the profits.<sup>73</sup>

<sup>74</sup> With artists like Natasha passing on their skills, Russia's

generation's-old folk tradition of *matryoshka* may well last for<sup>75</sup> generations more.

72. F. NO CHANGE  
G. She  
H. In fact, she  
J. Nevertheless, she
73. Which choice most clearly and concisely indicates that Natasha and her students mutually benefit from selling the *matryoshka* dolls they produce together?  
A. NO CHANGE  
B. money she earns from doll-making.  
C. profits generated by the workshop-made dolls.  
D. money.
74. Which of the following true statements, if added here, would best build on the ideas presented in this paragraph and connect to the final sentence of the essay?  
E. Two recent students have even gone on to establish their own doll businesses.  
G. Natasha's mother and sister are also associated with her workshop.  
H. Many people are surprised and delighted by the less traditional designs and themes found on some more recently made *matryoshka* dolls.  
J. Natasha's work is characterized by dazzlingly detailed faces and small dots of paint that look like gems.
75. A. NO CHANGE  
B. generations'-old  
C. generation's-oldest  
D. generations-old

**END OF TEST 1**

**STOP! DO NOT TURN THE PAGE UNTIL TOLD TO DO SO.**

**MATHEMATICS TEST***60 Minutes—60 Questions*

**DIRECTIONS:** Solve each problem, choose the correct answer, and then darken the corresponding oval on your answer sheet.

Do not linger over problems that take too much time. Solve as many as you can; then return to the others in the time you have left for this test.

You are permitted to use a calculator on this test. You may use your calculator for any problems you choose,

but some of the problems may best be done without using a calculator.

Note: Unless otherwise stated, all of the following should be assumed:

1. Illustrative figures are NOT necessarily drawn to scale.
2. Geometric figures lie in a plane.
3. The word *line* indicates a straight line.
4. The word *average* indicates arithmetic mean.

1. A child randomly selects a jellybean from a jar of jellybeans. The probability that the child selects a grape jellybean is  $\frac{7}{23}$ , and the probability that he selects a grape jellybean or a cherry jellybean is  $\frac{13}{23}$ . What is the probability that the child selects a cherry jellybean?

- A.  $\frac{1}{23}$   
B.  $\frac{6}{46}$   
C.  $\frac{6}{23}$   
D.  $\frac{20}{46}$   
E.  $\frac{20}{23}$

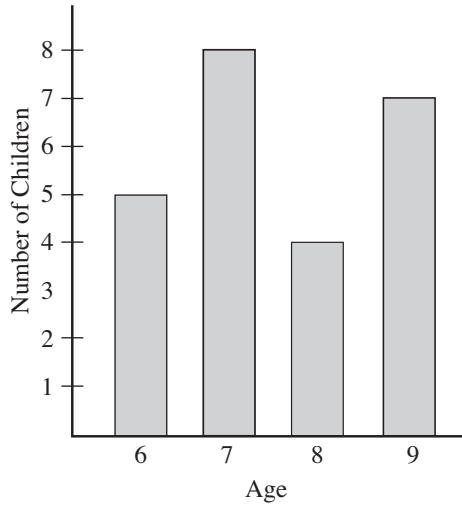
**DO YOUR FIGURING HERE.****GO ON TO THE NEXT PAGE.**



2. The children at a birthday party range from 6 to 9 years old. The graph below shows the number of children of each age at the party. What is the probability that a child selected at random from the children at the party will be 7 years old?

**DO YOUR FIGURING HERE.**

- F.  $\frac{1}{24}$   
 G.  $\frac{1}{8}$   
 H.  $\frac{1}{7}$   
 J.  $\frac{1}{4}$   
 K.  $\frac{1}{3}$



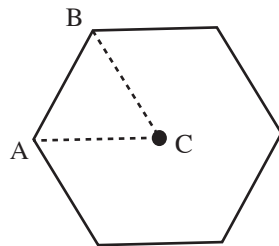
3. For all numbers  $p$  and  $q$ ,  $q = \frac{5}{3}p + 46$ . What is the value of  $p$  when the value of  $q$  is 21?
- A.  $-24$   
 B.  $-15$   
 C.  $-\frac{125}{3}$   
 D.  $\frac{63}{5}$   
 E. 35

**GO ON TO THE NEXT PAGE.**



## DO YOUR FIGURING HERE.

4. What is the value of  $|2 + y|$  when  $y = -6$  ?
- F.  $-8$   
 G.  $-6$   
 H.  $-4$   
 J.  $4$   
 K.  $8$
5. In 2015, the total rainfall in Central City was 13 inches less than the total annual rainfall in Central City in 2000. In 2016, the total rainfall in Central City was 33 inches greater than the total annual rainfall in Central City in 2000. If  $+$  indicates an increase in rainfall and  $-$  indicates a decrease in rainfall, what was the difference, in inches, in the yearly rainfall from 2015 to 2016 in Central City?
- A.  $-46$   
 B.  $-20$   
 C.  $+10$   
 D.  $+20$   
 E.  $+46$
6. Ruben purchases a violin that is on sale for a total price of \$1,250, which includes tax and all other fees. He makes an initial payment of \$300 in cash and puts the remainder on his new credit card. He makes no other purchases on the card and pays off the credit card balance with 9 monthly payments of \$150. What is the difference between the total amount Ruben pays for the violin, including the initial payment and the credit card payments, and the sale price of the violin?
- F. \$ 100  
 G. \$ 250  
 H. \$ 400  
 J. \$1,350  
 K. \$1,650
7. The regular hexagon shown below has a perimeter of 30 and center  $C$ . What is the perimeter of  $\triangle ABC$  ?



- A. 5  
 B. 10  
 C. 15  
 D. 18  
 E.  $5 + 10\sqrt{3}$

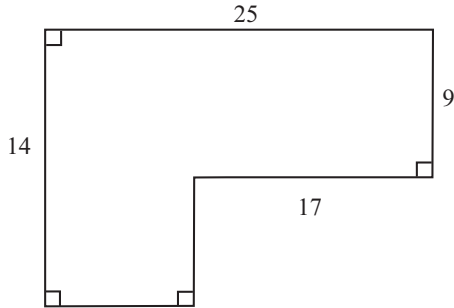
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8. Shown below is the proposed layout for a driveway. The length of each side is marked in feet. What is the area of the driveway, in square feet?

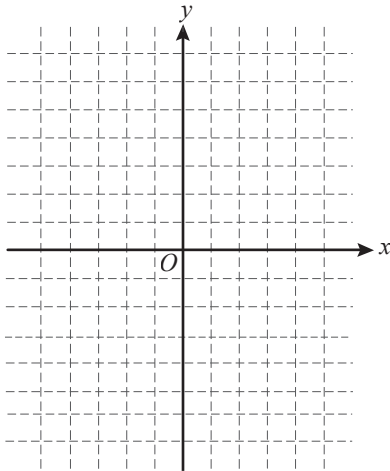
(Note: Edges of the driveway meet at right angles.)

- F. 85
- G. 153
- H. 265
- J. 337
- K. 350



**DO YOUR FIGURING HERE.**

9. Three vertices of a parallelogram are located at the points  $(-1,2)$ ,  $(4,3)$ , and  $(-3,-1)$  in the standard  $(x,y)$  coordinate plane shown below.



Which of the following could be the coordinates of the fourth vertex?

- A.  $( 2, 0)$
- B.  $( 3, -2)$
- C.  $( 1, 1)$
- D.  $(-2, -5)$
- E.  $(-5, -1)$

**GO ON TO THE NEXT PAGE.**





## DO YOUR FIGURING HERE.

10. Consider two functions defined by the equations  $m(x) = 2x - 2$

and  $n(x) = \frac{\sqrt{x}}{3}$ . When  $x = 9$ , what is the value of  $m(n(x))$ ?

F. 0

G. 1

H.  $\frac{4}{3}$

J. 3

K. 16

11. Maria sells homemade holiday cards at a craft fair. The total cost of the supplies and the booth rental is \$150. She sells  $n$  cards for \$3 each. If she makes a profit, which of the following inequalities includes all possible values of  $n$ ?

A.  $n + 150 > 0$

B.  $n - 150 > 0$

C.  $n - 150 < 0$

D.  $3n - 150 > 0$

E.  $3n - 150 < 0$

12. What is the slope of the line  $5x - 11y = 7$  in the standard  $(x, y)$  coordinate plane?

F. -5

G.  $-\frac{5}{7}$

H.  $\frac{5}{11}$

J. 5

K. 7

13. The lines represented by the equations  $x + 3y = 6$  and  $-5x + y = 18$  intersect at point  $A$  in the standard  $(x, y)$  coordinate plane. Which of the following could be the coordinates of  $A$ ?

A.  $(-12, 6)$

B.  $(-3, 3)$

C.  $(-1, 2\frac{1}{3})$

D.  $(0, 2)$

E.  $(1, 1\frac{2}{3})$

GO ON TO THE NEXT PAGE.



14. In a blueprint for a new building,  $\frac{1}{3}$  centimeter represents 9 meters in the finished building. If a hallway shown on the blueprint is  $4\frac{2}{3}$  centimeters long, how long, in meters, will the hallway be in the finished building?

F. 9  
 G. 14  
 H. 27  
 J. 126  
 K. 378

**DO YOUR FIGURING HERE.**

15. The matrix  $3\begin{bmatrix} 2 & -1 \\ 3 & 0 \end{bmatrix}$  is equivalent to which of the following matrices?

A.  $[15 - 3]$

B.  $\begin{bmatrix} 3 \\ 9 \end{bmatrix}$

C.  $\begin{bmatrix} 6 & -3 \\ 9 & 0 \end{bmatrix}$

D.  $\begin{bmatrix} 5 & 2 \\ 6 & 3 \end{bmatrix}$

E.  $\begin{bmatrix} \frac{2}{3} & -\frac{1}{3} \\ 1 & 0 \end{bmatrix}$

16. In right triangle  $XYZ$ , shown below, what is the value of  $\cos Z$ ?

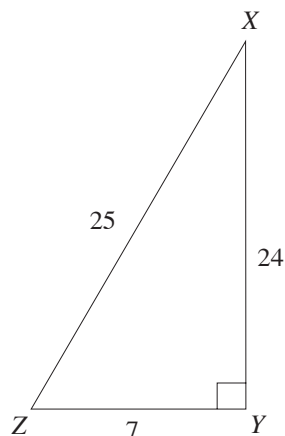
F.  $\frac{7}{25}$

G.  $\frac{7}{24}$

H.  $\frac{24}{25}$

J.  $\frac{24}{7}$

K.  $\frac{25}{7}$



**GO ON TO THE NEXT PAGE.**



17. A snail travels 7 inches in one minute. At this rate, how many inches will the snail travel in 5 seconds?

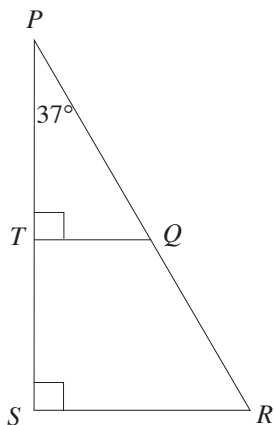
**DO YOUR FIGURING HERE.**

- A.  $\frac{7}{20}$   
 B.  $\frac{7}{12}$   
 C.  $\frac{5}{7}$   
 D.  $1\frac{2}{5}$   
 E.  $1\frac{5}{7}$

18. Given that  $g(x) = -\frac{x^2}{4}$ , what is the value of  $g(-8)$ ?

- F. -16  
 G. -4  
 H. -1  
 J. 4  
 K. 16

19. In the figure shown below,  $Q$  lies on  $\overline{PR}$  and  $T$  lies on  $\overline{PS}$ . What is the measure of  $\angle TQR$ ?



- A.  $53^\circ$   
 B.  $107^\circ$   
 C.  $127^\circ$   
 D.  $137^\circ$   
 E.  $153^\circ$

**GO ON TO THE NEXT PAGE.**



20. A line is graphed in the standard  $(x,y)$  coordinate plane. When  $x$  is equal to 3,  $y$  is equal to 8. When  $x$  is equal to 7,  $y$  is equal to 20. Which of the following expressions could be the equation of the line?

F.  $y = \frac{x+1}{3}$

G.  $y = \frac{3}{8}x$

H.  $y = \frac{8}{3}x$

J.  $y = 2x + 2$

K.  $y = 3x - 1$

21. A park ranger records the height of a river at 7:00 A.M. and 7:00 P.M. daily. On Sunday at 7:00 P.M., the river was at a height of 14 feet. The river height fell at a rate of 1.5 feet per day from Sunday at 7:00 P.M. through Thursday at 7:00 P.M. At that time, heavy rains caused the water to rise at a constant rate of 3 feet per day. At what time will the park ranger first record a height over 14 feet?

- A. Friday at 7 P.M.  
 B. Saturday at 7 A.M.  
 C. Saturday at 7 P.M.  
 D. Sunday at 7 A.M.  
 E. Sunday at 7 P.M.

22. Viviana is competing in a science fair and will receive 5 scores, each out of 60 points, from 5 separate judges. Different colored ribbons are awarded based on a participant's average score,  $A$ , from the five judges. The average scores necessary for each ribbon color are shown in the chart below.

Range	Ribbon
$A \geq 55$	Red
$50 \leq A < 55$	Blue
$40 \leq A < 50$	White
$30 \leq A < 40$	Yellow

The first three judges award Viviana scores of 37, 46, and 49. If  $p$  represents the combined total of the points that Viviana receives from the final two judges, which of the following is a possible value of  $p$  for which Viviana would earn a white ribbon?

- F. 49  
 G. 66  
 H. 98  
 J. 118  
 K. 130

**DO YOUR FIGURING HERE.**

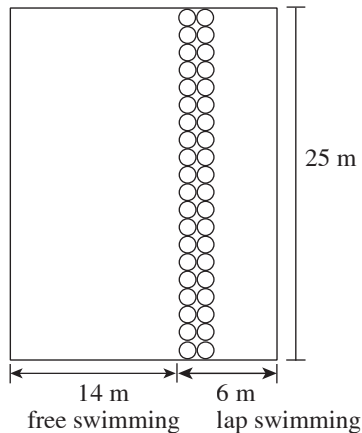
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Use the following information to answer questions 23–25.

DO YOUR FIGURING HERE.

A rectangular swimming pool is divided into a free swim portion and a lap swimming portion with a double stranded lane line. The dimensions of the pool are shown below. Each strand of the lane line consists of 20 spherical buoys.



(Note: Figure not drawn to scale.)

A four-person relay team is swimming a relay in the lap swimming portion. The first three members of the team complete their laps in 63, 65, and 59 seconds, respectively.

23. The diameter of each buoy in the lane line is 1.25 meters, and each buoy sits in the water such that its diameter is level with the pool's surface. What is the approximate area of the pool's surface, in square meters, that the double stranded lane line occupies?
- A. 20  
 B. 49  
 C. 98  
 D. 126  
 E. 196
24. What is the ratio of the area of the surface of the lap swimming portion (including the double lane line) to the area of the surface of the free swimming portion?
- F. 3:7  
 G. 3:10  
 H. 7:10  
 J. 150:323  
 K. 150:359

GO ON TO THE NEXT PAGE.



25. If the relay team finishes with an average time of 60 seconds per person, how long, in seconds, does it take the fourth member to finish his lap?

A. 52  
B. 53  
C. 58  
D. 60  
E. 61

---

**DO YOUR FIGURING HERE.**

26. The width of a rectangle is twice its length, and the area of the rectangle is 72. What is the length of the rectangle?

F. 3  
G. 6  
H. 12  
J. 24  
K. 36

27. Parallelogram  $ABCD$  has a perimeter of 64, and side  $\overline{AB}$  has a length of 12. If it can be determined, what is the length of side  $\overline{BC}$ ?

A. 20  
B. 26  
C. 32  
D. 52  
E. Cannot be determined from the information given

28. A pedestrian bridge used as an outdoor market is divided into an eastbound and westbound side. On each side, there is a 16-foot-wide lane dedicated to foot traffic, a 10-foot-wide lane for browsing and purchasing, and a 9-foot-wide row of wooden vendor stalls. How many total feet wide is the pedestrian bridge?

F. 35  
G. 40  
H. 51  
J. 70  
K. 85

**GO ON TO THE NEXT PAGE.**



29. In Culver City, there are 720 households. If 5 out of every 12 of these households own a dog, and 6 out of every 10 households that own a dog also have a fenced-in backyard, how many of the households in Culver City are dog owners with fenced-in backyards?

- A. 86
- B. 180
- C. 228
- D. 360
- E. 464

**DO YOUR FIGURING HERE.**

30. If  $\tan x = -\frac{7}{24}$  and  $\frac{3\pi}{2} < x < 2\pi$ , what is  $\sin x$ ?

- F.  $-\frac{24}{25}$
- G.  $-\frac{7}{25}$
- H.  $\frac{7}{24}$
- J.  $\frac{24}{25}$
- K.  $\frac{25}{24}$

31. If  $g(n) = \frac{-3}{n+2}$  and  $h(n) = -n$ , for what real value of  $x$  is

$$g(x) = h(x) ?$$

- A. 1 only
- B. 3 only
- C. -1 and 3 only
- D. 1 and -3 only
- E. 1 and 3 only

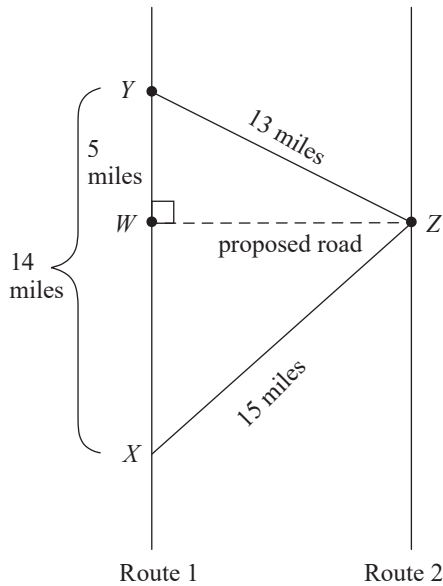
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Use the following information to answer questions 32–35.

DO YOUR FIGURING HERE.

The figure below shows two roads, Route 1 and Route 2, that both run directly north-south through a town. On Route 1, the library is located 14 miles due north of the town hall (at points  $Y$  and  $X$  respectively). The town is considering a proposal to build a new road that will begin at point  $W$  on Route 1, 5 miles south of  $Y$ , and run due east to Point  $Z$  on Route 2. The straight-line distance between point  $Z$  and the library is 13 miles, and the straight-line distance between  $Z$  and the town hall is 15 miles.



32. Which of the following is the length of the proposed road segment, in miles, connecting points  $W$  and  $Z$ ?
- F. 9
  - G. 12
  - H.  $12\frac{1}{2}$
  - J. 13
  - K. 14

GO ON TO THE NEXT PAGE.





## DO YOUR FIGURING HERE.

33. If the roads are mapped in the standard  $(x,y)$  coordinate plane such that the coordinates of  $X$  and  $Y$  are  $(0,0)$  and  $(0,14)$ , respectively, which of the following equations represents the line along which the proposed road would be drawn?
- A.  $y = 9$   
 B.  $y = 14$   
 C.  $x = 5$   
 D.  $x = 9$   
 E.  $x = 14$
34. A car located at point  $Z$  is driving due north on Route 2 at 20 miles per hour. At this rate, how long, in minutes, will it take the car to reach the point due east of the library located at point  $Y$ ?
- F. 4  
 G. 9  
 H. 15  
 J. 27  
 K. 39
35. A city planner suggests that the proposed road be located farther south. If points  $W$  and  $Z$  are both relocated exactly three miles south of their current locations, which of the following describes how the measures of  $\angle X$ ,  $\angle Y$ , and  $\angle Z$  will be adjusted?
- I. The measure of angle  $\angle X$  will increase.  
 II. The measure of angle  $\angle Y$  will decrease.  
 III. The measure of angle  $\angle Z$  will remain unchanged.
- A. I only  
 B. II only  
 C. III only  
 D. I and II only  
 E. I, II, and III
- 
36. In her living room, Christa has a rectangular rug that is 6 feet wide and 8 feet long. She decides that the rug is too small for the room, so she orders a new one that covers twice as much area. If the new rug is 1.5 times as wide as the original rug, how long, in feet, is the new rug?
- F.  $5\frac{1}{3}$   
 G. 9  
 H.  $10\frac{2}{3}$   
 J. 12  
 K. 24

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37. For which of the following values of  $x$  is the equation  $4(x - 2) - 3x = x + 2$  true?

A. The equation has no solution.  
B. 3  
C. 2  
D. -1  
E. All real numbers

**DO YOUR FIGURING HERE.**

38. A teacher plans to use a 40-inch long roll of string to form a border around a rectangular space on her bulletin board reserved for student use. What is the maximum amount of space, in square inches, that she can reserve on her bulletin board using this roll of string?

F. 96  
G. 99  
H. 100  
J. 160  
K. 400

39. In 2010, there are 8 homes on a street and each home is valued somewhere between \$250,000 and \$350,000. Two new houses are built on the street in 2011. One of the new homes is valued at a little over \$2,000,000, and the other is valued at less than \$100,000. The value of the original 8 houses remains the same. If it can be determined, of the mean, median, standard deviation, and range, which of the following will increase the most?

A. The standard deviation  
B. The median  
C. The mean  
D. The range  
E. Cannot be determined from the information given

40. A house painting company assigns three employees to a particular customer's house. The first employee paints  $\frac{3}{7}$  of the house in her 4-hour shift. The second employee paints another  $\frac{1}{4}$  of the house before the third employee takes over. If all three employees paint at the same rate, how many hours will it take the third employee to finish painting the remainder of the house by himself?

F. 0.32  
G. 2.00  
H. 3.00  
J. 3.63  
K. 9.33

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41. Which of the following expressions, where defined, is equivalent

$$\text{to } \frac{(3xy^{-3})^3}{(\sqrt{xy})^{-2}}?$$

A.  $\frac{27x^4}{y^8}$

B.  $\frac{27y^6}{x}$

C.  $\frac{27x}{y^7}$

D.  $\frac{9x}{y^8}$

E.  $9xy^7$

42. A pet sitter knows that her client's five-digit alarm code contains the digits 2, 3, 1, 7, and 8. She cannot remember the order of the first four digits, but she knows that the last digit is 7. If she randomly guesses the order of the first four digits, what is the probability that she enters the correct alarm code on her first attempt?

F.  $\frac{1}{4}$

G.  $\frac{1}{5}$

H.  $\frac{1}{6}$

J.  $\frac{1}{24}$

K.  $\frac{1}{120}$

43. For all real values of  $a$ , which of the following is equivalent to

$$\frac{\frac{1}{3} - \frac{1}{2}}{\frac{1}{3} + \frac{a}{4}}?$$

A.  $4 + 3a$

B.  $\frac{-2}{4 + 3a}$

C.  $\frac{4}{3 + 2a}$

D.  $\frac{-2}{3 + 3a}$

E.  $\frac{2}{3a}$

**DO YOUR FIGURING HERE.**

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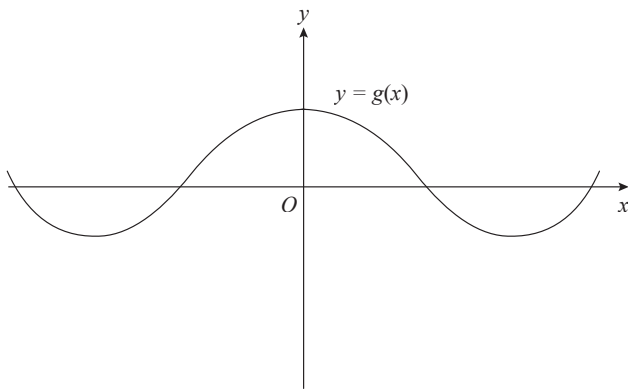


44. A library classifies each of its books using a five-character code. The first character denotes one of 15 different genres represented by the 15 letters A through O, and the second character denotes one of 11 different subgenres denoted by the 11 letters P through Z. The final 3 characters each consist of a single digit from 0 through 9. Digits can be repeated within a classification code. If every book must have a unique classification code, what is the maximum number of books that the library can own?

- F. 260
- G. 4,950
- H. 120,285
- J. 165,000
- K. 225,000

**DO YOUR FIGURING HERE.**

45. The figure below shows the graph of the function  $y = g(x)$  in the standard  $(x,y)$  coordinate plane.



If every point on  $y = g(x)$  is shifted 3 units to the left and 2 units down, the resulting graph would represent the function  $y = h(x)$ . Which of the following could be the equation for  $h(x)$ ?

- A.  $h(x) = g(x - 3) - 2$
  - B.  $h(x) = g(x + 3) - 2$
  - C.  $h(x) = g(x - 2) + 3$
  - D.  $h(x) = g(x + 2) - 3$
  - E.  $h(x) = g(x - 2) - 3$
46. If  $\log_n \frac{1}{27} = -3$ , what is  $n$ ?

- F. -9
- G.  $-\frac{1}{9}$
- H. 3
- J.  $\frac{1}{9}$
- K.  $\frac{1}{3}$

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47. Which of the following sets contains all the integer values of

$$k \text{ for which } \frac{1}{6} < \frac{k}{5} < \frac{3}{4} ?$$

- A.  $\{1, 2\}$
- B.  $\{2\}$
- C.  $\{1, 2, 3\}$
- D.  $\{4\}$
- E.  $\{3, 4, 5\}$

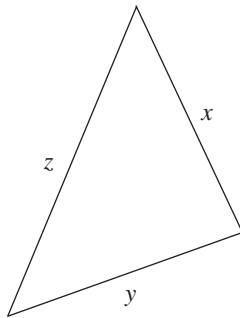
**DO YOUR FIGURING HERE.**

48. For all real numbers  $x$ ,  $y$ , and  $z$ ,  $x < y < z$  and  $xyz < 0$ . Which of the following *must* be true?

- F.  $xy < yz$
- G.  $x + y > y + z$
- H.  $\frac{x}{y} < \frac{y}{z}$
- J.  $x < yz$
- K.  $x + z < y$

49. The triangle shown below has side lengths  $x$ ,  $y$ , and  $z$  such that  $x < y < z$ . Which of the following expressions could be used to find the measure of the smallest angle in the triangle?

(Note: For every triangle with sides of length  $a$ ,  $b$ , and  $c$  that are opposite  $\angle A$ ,  $\angle B$ , and  $\angle C$ , respectively,  $c^2 = a^2 + b^2 - 2ab \cos C$ .)



- A.  $\cos^{-1}(x^2 - y^2 - z^2 - 2yz)$
- B.  $\cos^{-1}(z^2 - y^2 - x^2 - 2xy)$
- C.  $\cos^{-1}\left(-\frac{z^2 - y^2 - x^2}{2xy}\right)$
- D.  $\cos^{-1}\left(-\frac{x^2 - y^2 - z^2}{2yz}\right)$
- E.  $\cos^{-1}\left(-\frac{x^2 + y^2 - z^2}{2yz}\right)$

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50. Kyle scores an average of  $p$  points per game in his first 9 basketball games of the season. After Kyle scores  $n$  points in his 10th game, his season average increases by 3 points per game. What is the value of  $n - p$ ?

F. 3  
 G. 12  
 H. 27  
 J. 30  
 K. 39

**DO YOUR FIGURING HERE.**

51.  $AB$  and  $CD$  are both diameters of a circle with center  $O$ . If the measure of  $\angle AOD$  is 1.5 times the measure of  $\angle AOC$ , what is the measure of  $\angle AOD$ ?

A.  $36^\circ$   
 B.  $54^\circ$   
 C.  $72^\circ$   
 D.  $96^\circ$   
 E.  $108^\circ$

52. The first term in sequence  $A$  is 6 and the third term is 72. Which of the following equations could define sequence  $A$  for all positive values of  $n$ ?

F.  $3(A_{n-1}) + 2n$   
 G.  $12(A_{n-1})$   
 H.  $6(A_{n-1}) + 18n$   
 J.  $6(A_{n-1}) - 6$   
 K.  $3(A_{n-1}) + 2$

53. If  $c^{-1} < c^2 < |c|$ , which of the following describes all possible values of  $c$ ?

A.  $c < -2$   
 B.  $-2 < c < -1$   
 C.  $-1 < c < 0$   
 D.  $0 < c < 1$   
 E.  $c > 1$

54. On a game show, contestants blindly pull a marble out of a bag containing 6 colored marbles. Each color is worth a certain number of points. The bag contains 3 green marbles that are worth 6 points each, 2 purple marbles that are worth 3 points each, and 1 yellow marble that is worth 0 points. A contestant pulls one marble out of the bag at random. If the random variable  $P$  represents the number of points the contestant earns on this single marble draw, what is the expected value of  $P$ ?

F. 0.5  
 G. 1.5  
 H. 3  
 J. 3.5  
 K. 4

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**DO YOUR FIGURING HERE.**

55. If  $a$ ,  $b$ ,  $c$ ,  $d$ , and  $e$  are consecutive integers such that  $a < b < c < d < e$ , which of the following is equivalent to the sum of  $a$ ,  $b$ ,  $c$ ,  $d$ , and  $e$ ?
- A.  $5a + 5$   
B.  $5b$   
C.  $5b + 4$   
D.  $5c$   
E.  $\frac{a+e}{2}$
56. The set  $\{13, 7, 22, 6, 4, a\}$  has a mean of 11 and a median of  $b$ . If it can be determined, what is the value of  $a - b$ ?
- F.  $-24$   
G.  $-4$   
H.  $4$   
J.  $24$   
K. Cannot be determined from the information given
57. A rectangular room has a width of  $n$  feet and a length of  $m$  feet, and  $n \neq m$ . If  $n$  and  $m$  are both integers and the perimeter of the room is 36 feet, which of the following CANNOT be the area of the room?
- A. 45  
B. 56  
C. 72  
D. 77  
E. 81
58. The equation  $(x - 5)^2 + (y + 2)^2 = 20$  defines a circle that lies in the standard  $(x,y)$  coordinate plane. The line with endpoints  $(9,0)$  and  $(a,b)$  is a diameter of the circle. What is the value of  $a$ ?
- F.  $-13$   
G.  $-7$   
H.  $-5$   
J.  $-2$   
K.  $1$

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59. In 2012, a shipping company offered a large flat-rate shipping box with a length of 15 inches, a width of 20 inches, and a height of 10 inches. In 2013, the company decreased both the height and width of the flat-rate box by 20%. Which of the following is closest to the percent decrease in the volume of the flat-rate box between 2012 and 2013 ?

- A. 20%
- B. 36%
- C. 40%
- D. 49%
- E. 56%

60. Which of the following is true if the binomial  $(x - 2)$  is a factor of the equation  $3x^3 - 4x^2 + x - 10 = 0$  ?

- F. The equation has three real solutions.
- G. The equation has two real solutions and one complex solution.
- H. The equation has one real solution and three complex solutions.
- J. The equation has one real solution and two complex solutions.
- K. The equation has no real solutions and three complex solutions.

**DO YOUR FIGURING HERE.**

**END OF TEST 2**  
**STOP! DO NOT TURN THE PAGE UNTIL TOLD TO DO SO.**  
**DO NOT RETURN TO A PREVIOUS TEST.**



## READING TEST

35 Minutes—40 Questions

**DIRECTIONS:** There are several passages in this test. Each passage is accompanied 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

**LITERARY NARRATIVE:** This passage is adapted from the short story “Simple Recipes” by Madeleine Thien (©2002 by Madeleine Thien). Publisher: Little, Brown.

There is a simple recipe for making rice. My father taught it to me when I was a child. Back then, I used to sit up on the kitchen counter watching him, how he sifted the grains in his hands, sure and quick, removing pieces of dirt or sand, tiny imperfections. He swirled his hands through the water and it turned cloudy. When he scrubbed the grains clean, the sound was as big as a field of insects. Over and over, my father rinsed the rice, drained the water, then filled the pot again.

The instructions are simple. Once the washing is done, you measure the water this way—by resting the tip of your index finger on the surface of the rice. The water should reach the bend of your first knuckle.

My father did not need instructions or measuring cups. He closed his eyes and felt for the waterline. Sometimes I still dream of my father, his bare feet flat against the floor, standing in the middle of the kitchen. He wears old buttoned shirts and faded sweatpants drawn at the waist. Surrounded by the gloss of the kitchen counters, the sharp angles of the stove, the fridge, the shiny sink, he looks out of place. This memory of him is so strong, sometimes it stuns me, the detail with which I can see it.

Every night before dinner, my father would perform this ritual—rinsing and draining, then setting the pot in the cooker. When I was older, he passed this task on to me but I never did it with the same care. I went through the motions, splashing the water around, jabbing my finger down to measure the water level. Some nights the rice was a mushy gruel. I worried that I could not do so simple a task right. “Sorry,” I would say to the table, my voice soft and embarrassed. In answer, my father would keep eating, pushing the rice into his mouth as if he never expected anything different, as if he noticed no difference between what he did so well and I so poorly. He would eat every last mouthful, his chopsticks walking quickly across the plate. Then he would rise, whistling, and clear the table, every motion so clean and sure, I would be convinced by him that all was well in the world.

35 My father is standing in the middle of the kitchen. In his right hand he holds a plastic bag filled with water. Caught inside the bag is a live fish.

The fish is barely breathing, though its mouth opens and closes. I reach up and touch it through the plastic bag, trailing my fingers along the gills, the soft, muscled body, pushing my finger overtop the eyeball. The fish looks straight at me, flopping sluggishly from side to side.

My father fills the kitchen sink. In one swift motion he overturns the bag and the fish comes sailing out with the water. It curls and jumps. We watch it closely, me on my tiptoes, chin propped up on the counter. The fish is the length of my arm from wrist to elbow. It floats in place, brushing up against the sides of the sink.

I keep watch over the fish while my father begins the preparations for dinner. The fish folds its body, trying to turn or swim, the water nudging overtop. Though I ripple tiny circles around it with my fingers, the fish stays still, bobbing side to side in the cold water.

For many hours at a time, it was just the two of us. While my mother worked and my older brother played outside, my father and I sat on the couch, flipping channels. He loved cooking shows. We watched *Wok with Yan*, my father passing judgement on Yan’s methods. I was enthralled when Yan transformed orange peels into swans. My father sniffed. “I can do that,” he said. “You don’t have to be a genius to do that.” He placed a sprig of green onion in water and showed me how it bloomed like a flower. “I know many tricks like this,” he said. “Much more than Yan.”

Still, my father made careful notes when Yan demonstrated Peking Duck. He chuckled heartily at Yan’s punning. “Take a wok on the wild side!” Yan said, pointing his spatula at the camera.

“Ha ha!” my father laughed, his shoulders shaking. “*Wok on the wild side!*”

In the mornings, my father took me to school. At three o’clock, when we came home again, I would rattle off everything

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70 I learned that day. “The brachiosaurus,” I informed him, “eats only soft vegetables.”

My father nodded. “That is like me. Let me see your forehead.” We stopped and faced each other in the road. “You have a high forehead,” he said, leaning down to take a closer look.

75 “All smart people do.”

I walked proudly, stretching my legs to match his steps. I was overjoyed when my feet kept time with his, right, then left, then right, and we walked like a single unit.

1. Based on the passage, it could be assumed that the narrator learned to make rice by:

- A. carefully following the complicated process her father taught her.
- B. studiously watching cooking shows with her father.
- C. following her father’s steps in a half-hearted way that led to unsatisfying results.
- D. reading about the process in books her father left her.

2. In the context of the passage, which of the following statements most strongly foreshadows the joy and connection the narrator feels in the last paragraph?

- F. “There is a simple recipe for making rice” (line 1).
- G. “When I was older, he passed this task on to me but I never did it with the same care” (lines 23–24).
- H. “Then he would rise, whistling, and clear the table, every motion so clean and sure, I would be convinced by him that all was well in the world” (lines 32–34).
- J. “My father sniffed. ‘I can do that,’ he said. ‘You don’t have to be a genius to do that’” (lines 59–60).

3. The passage suggests that in walking to match her father, the daughter:

- A. folded her body, trying to turn away.
- B. found joy in copying his movements.
- C. felt inferior to her father in every way.
- D. did not find Yan’s puns as amusing as her father did.

4. Which of the following is true of the fish after the father has put it into the sink?

- I. It does not respond to the narrator touching the water.
- II. It is as long as the narrator’s arm from wrist to elbow.
- III. It looks straight at the narrator while flopping sluggishly.
- IV. It brushes against the sides of the sink.

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

5. Which of the following best paraphrases the narrator’s comments in lines 5–7?

- A. The rice her father made was better prepared than that of Chef Yan.
- B. She viewed the many rice kernels as so many individual insects.
- C. She was concerned that her father’s repetitious actions signaled a mental disorder.
- D. Her father was very thorough in preparing the rice for cooking.

6. As it is used in line 39, the word *trailing* most nearly means:

- F. pursuing.
- G. tracing.
- H. losing.
- J. hanging.

7. The narrator suggests that her father ate her rice out of:

- A. pleasure; it was nearly as good as one of his own meals.
- B. obligation; it was important never to waste any food.
- C. consideration; he wanted his daughter to have the feeling that all was well.
- D. embarrassment; otherwise, he would have to admit her incompetence.

8. Based on the passage, it’s most logical to conclude that the fish is:

- F. ill and dying.
- G. restless and fearful.
- H. confined and sluggish.
- J. alert and watchful.

9. According to the passage, the father regarded *Wok with Yan* as:

- A. providing some information worthy of his attention.
- B. irrelevant to an accomplished chef like himself.
- C. the primary source of his own cooking methods.
- D. the funniest cooking show on television.

10. The narrator states that she is sometimes stunned by:

- F. her father’s ability to make rice without instructions or measuring cups.
- G. the way her father dressed when he cooked.
- H. the contrast between her father’s appearance and that of the kitchen.
- J. how detailed her memory of her father is.

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## Passage II

**SOCIAL SCIENCE:** Passage A is adapted from “Fertilizer History” by Gary Hergert, Rex Nielsen, and Jim Margheim (© 2015 by University of Nebraska-Lincoln). Passage B is adapted from “Fertilizers, a Boon to Agriculture, Pose Growing Threat to U.S. Waterways” by Tatiana Schlossberg (© 2017 by The New York Times Company).

### Passage A by Gary Hergert, Rex Nielsen, and Jim Margheim

For thousands of years after agriculture came into existence, manure was the main source of fertilizer. But sometime in the 18th century, it became common knowledge that ground-up bones provided crop nutrients. It wasn’t until the 19th century that ground-breaking research, done by several innovative scientists, finally ushered in the modern era of soil chemistry and plant nutrition. One of the most prominent of these chemists was Justus von Liebig (1803–1873), a German chemist who did pioneering research in organic and biological chemistry.

Ammonia and nitric acid, basic components of many chemical fertilizers, could be manufactured by the early 20th century, but until the middle of the century, use of chemical fertilizer was limited.

However, this would all change.

With the start of World War II, there was a tremendous increase in nitrogen production, mainly because nitrogen is a principal ingredient in explosives. After World War II, the need to manufacture war munitions was replaced with the need to restore food supplies in Europe and the United States.

The development of high-tech equipment has led to “precision” and “best-management” farming practices, which have resulted in the ability to apply various fertilizer types to a given crop in site-specific amounts. Technological advances in various fields of study, including crop genetics and breeding, plant and soil testing, and the development of techniques to monitor the movement of nutrients and water within the soil profile have allowed today’s farmers to use fertilizers more effectively and efficiently, in addition to being better stewards of the land and environment.

Manure is still an important source of plant nutrients; however, during the last 75 years, its use has been surpassed by the large-scale production and use of chemical fertilizers. In the mid- to late 1940s, about 2 million tons of chemical fertilizers were used per year. By 1960, over 7 million tons were used each year and by 2014 over 20 million tons were used.

There is still much to learn about the complex interactions involving fertilizer use in differing soil and plant ecosystems; however, we have made historical progress since the first use of manure—progress that has been foundational to feeding our nation and providing food and hope to other parts of the world.

### Passage B by Tatiana Schlossberg

Nitrogen-based fertilizers, which came into wide use after World War II, helped prompt the agricultural revolution that has allowed the Earth to feed its seven billion people.

But that revolution came at a cost: artificial fertilizers, often applied in amounts beyond what crops need to grow, are carried in runoff from farmland into streams, lakes and the ocean. New research suggests that climate change will substantially increase this form of pollution, leading to more damaging algae blooms and dead zones in American coastal waters.

A study published Thursday in *Science* concludes that eutrophication, excessive nutrient enrichment, is likely to increase in the continental United States as a result of the changes in precipitation patterns brought by climate change. Heavier rains caused by warmer temperatures will cause more agricultural runoff, sluicing more nutrients into rivers, lakes and oceans.

The authors found that future climate change-driven increases in rainfall in the United States could boost nitrogen runoff by as much as 20 percent by the end of the century.

“When we think about climate change, we are used to thinking about water quantity—drought, flooding, extreme rainfall and things along those lines,” said Anna Michalak, a professor of global ecology at the Carnegie Institution for Science in Stanford, Calif., and one of the authors of the study. “Climate change is just as tightly linked to issues related to water quality, and it’s not enough for the water to just be there, it has to be sustainable.”

Excess nitrogen from the fertilizers can cause eutrophication in the ocean, which can lead to harmful algae blooms or hypoxia—reduced levels of oxygen that create conditions in which organisms can’t survive.

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Questions 11–14 ask about Passage A.

11. In Passage A, the primary purpose of the details about the “ground-breaking research” (line 5) is to:
- A. show that few fertilizers were successful until the development of chemical fertilizers.
  - B. demonstrate how manure replaced ground-up bones as the main source of fertilizer in the 18<sup>th</sup> century.
  - C. connect prominent scientists to their contributions to the agricultural industry.
  - D. provide details that show how knowledge of effective fertilizers grew over time.
12. According to Passage A, one reason for the development of chemical fertilizers was that:
- F. the United States needed a practical use for nitrogen left-over from the war.
  - G. wartime industry created a way to mass-produce the components necessary for the fertilizer.
  - H. soldiers coming home from the war were able to return to their jobs as chemists.
  - J. farming practices provided crucial technologies which allowed nitrogen production to expand dramatically.
13. In the context of Passage A, the authors use the description of technological advances and techniques (lines 24–26) most nearly to:
- A. critique farmers for their reliance on technology.
  - B. present factors that helped make chemical fertilizer use more efficient.
  - C. list the strategies that farmers rely on to improve their harvests.
  - D. explain different technologies that are used to monitor water usage on a farm.
14. The main idea of the sixth paragraph (lines 30–35) is that chemical fertilizers:
- F. are twice as effective as manure is for large-scale agricultural production.
  - G. have only begun to be used by farmers in the last 75 years.
  - H. are growing in how widely they are used compared to other common types of fertilizers.
  - J. have become more important, but still have yet to surpass manure in annual usage.

Questions 15–17 ask about Passage B.

15. It can reasonably be inferred from Passage B that a major factor in the reshaping of global agriculture was:
- A. an increase in the use of chemical fertilizers.
  - B. a revolutionary fertilizing technique that maximized crop yields.
  - C. the discovery of a farming method that encouraged crop growth while avoiding ecological consequences.
  - D. a focus on lessening the impacts of the agricultural industry on climate change.
16. In the context of Passage B, the statement “But that revolution came at a cost” (line 44) most nearly refers to the way that chemical fertilizers:
- F. place financial burdens on those who commit to using them.
  - G. increase the amount of money required to feed 7 billion people.
  - H. have environmental disadvantages in addition to economic advantages.
  - J. are less effective in coastal regions than in plains regions.
17. Passage B most nearly suggests that, compared to concerns about water quantity, concerns about water quality are:
- A. equally connected to effects of climate change.
  - B. less important for those in urban areas than for those in rural areas.
  - C. more important on a global scale.
  - D. more heavily focused on salt water bodies.

Questions 18–20 ask about both passages.

18. Both passages suggest that the agricultural industry has been significantly impacted by types of fertilizer that were:
- F. impractical.
  - G. artificially manufactured.
  - H. naturally produced.
  - J. ammonia-based.

**GO ON TO THE NEXT PAGE.**

19. Which of the following statements best compares the ways the authors of Passage A and Passage B use details about the effects of incorporating nitrogen-based fertilizers into agriculture?
- A. Passage A looks to the fertilizer as a source of hope for the future while Passage B considers it a source of concern.
  - B. Passage A uses the fertilizer as one example in a discussion of farming advances, while Passage B focuses exclusively on the fertilizer.
  - C. Passage A considers the effects of the fertilizer on land, while Passage B considers the effects of the fertilizer on aquatic life.
  - D. Both passages discuss the effects of the increased fertilizer use on the environment.
20. To support their claims about the impact of increasing use of nitrogen-based fertilizers, the authors of both passages:
- F. define key terms related to ecology.
  - G. quote experts in a related field.
  - H. provide statistics to support a point.
  - J. outline a specific timeline of development.

**GO ON TO THE NEXT PAGE.**

## Passage III

**HUMANITIES:** This passage is adapted from the article “And where are the lilacs?” by Andrew Motion (©2004 by *The Guardian*).

Pablo Neruda couldn't hold a tune. “My ear,” he admitted, “could never recognise any but the most obvious melodies, and even then, only with difficulty.” This is remarkable: Neruda's cadences are crucial to his writing. No one reading his poems in their original Spanish would want to separate their sense from their sound. Even translated into English, their meaning is inseparable from their melody.

Adam Feinstein's new biography is fuelled by an infectious enthusiasm for Neruda's poems, but it also has an admirable patience with his life's dizzying details. It's difficult to think of a 20th-century poet who did more than Neruda. He wrote a huge number of books, he travelled like a man possessed, he loved and lost many women, he collected a host of famous friends. Some of these things are grist to the biographer's mill: Feinstein's account is crammed with adventure stories, narrow scrapes, passionate encounters. Others are harder to deal with: globe-trottings have to be logged but risk becoming a list of place-names. By pacing the story so as to give pre-eminence to the writing and the adventuring, while recording the duller passages more briefly, Feinstein creates his own sympathetic music. His book turns Neruda's life into an opera—a blend of aria and recitative.

Sensibly, he relies a good deal on Neruda's own *Memoirs*. These are packed with marvellous details that give colour to the story, as well as providing a way of understanding how Neruda's fascination with real things gives shape to even his most vatic poems. At a parting with a grief-stricken girlfriend, for instance: “She kissed my arms, my suit, in a kind of ritual, and suddenly slipped down to my shoes, before I could stop her. When she stood up again, the chalk polish of my white shoes was smeared like flour all over her face.”

Feinstein is too thorough to accept the *Memoirs* at face value, wonderful as they are. He understands that an author's reminiscences are a way of creating disguises as well as revealing secrets, and regularly checks them against available evidence, amplifying the many complicated or contentious issues hushed up by Neruda himself. Feinstein acknowledges, from the first, that Neruda grew up among secrets and was therefore likely to enjoy them later.

Leaving his hometown for the relatively cosmopolitan Santiago, Neruda's interests expanded to accommodate social as well as family matters, and to create a more suggestive style. He relied on French symbolist poetry to stretch his imagination, combining his own fidelity to facts with surrealist touches and impressionistic overviews. The result was a fusion previously unseen in Chilean poetry—or poetry anywhere—and his success was meteoric. But his exploded imagination needed a larger

canvas, and the cultural and economic conditions of Chile both compelled and exasperated him.

Consular activity served as his means of escape. By 1927 he was in Rangoon, then moved on through France, Japan, China, Ceylon and Java (where he met his first wife, Maria), before returning home in 1932. By this time his Spanish was apparently “quite odd...very much influenced by his solitude,” and his sense of himself much altered. But these were not changes which threatened his audience: they added authority to his originality.

They didn't, however, do much for his political conscience, which began to develop during his posting to Spain in the early 1930s, when he fell in love with Delia del Carril. Delia persuaded him to become a communist—a process which meant that he inflicted a great deal of pain on his first wife and their sickly daughter, while producing poems that exalted the suffering masses. It confronts Feinstein with the classic biographer's dilemma—how to respect the work while dealing with a contradictory private life—and he copes with it by presenting the facts rather than wagging his finger, and by foregrounding the writing. As the scenery changes from France to Chile again, we see Neruda the romantic lyricist turning into Neruda the “truth-teller and exposé of the world's injustices.”

Neruda spent the late 30s and early 40s travelling round South America, converting his experience of other people's suffering into poems, standing as a senator, and defending the new emphasis of his work. Given the political climate, it was bound to end in trouble—or rather, trouble and adventure. In 1949 Neruda made a daring escape from Chile over the Andes into Buenos Aires, then soon set off again, speaking for the oppressed everywhere while neglecting Delia in favour of Matilde, who eventually became his third wife.

These paradoxes bring their own difficulties—but their tensions are intensified by fault-lines in Neruda's politics. Feinstein lets his readers draw their own conclusions about the moral muddle of Neruda's life, shining the same clear light on his politics that he turns on his private life (even Matilde was betrayed, when Neruda had a late fling with her niece). This is as well. The faults and weaknesses are plain to see, but so is the undimmed exuberance and generosity of the work, which feeds hungrily off the life and yet stands as a thing apart.

21. The primary function of the first paragraph is to:

- A. clarify misunderstandings about what made Neruda so talented as a Spanish singer and musician.
- B. outline how Neruda wrote his poems.
- C. tell a story from Neruda's youth.
- D. contrast a statement of Neruda's with a characteristic of his poetry.

**GO ON TO THE NEXT PAGE.**

22. Based on the passage, which of the following best describes the passage author's opinion of Neruda's poetry?
- F. He prefers Neruda's *Memoirs* to Neruda's poetry.
  - G. He considers Neruda's poetry to be original.
  - H. He thinks Neruda's poetry is too heavily based on his own life.
  - J. He believes that Neruda's poetry shows faults and weaknesses.
23. The "melody" mentioned in lines 6–7 most nearly refers to:
- A. the aria for Neruda's opera that was discovered by Adam Feinstein.
  - B. the effect Neruda's word choice and pacing has on a reader's understanding of his poems.
  - C. the connection between Neruda's life and his poetry discussed by the passage author.
  - D. the many adventures, narrow scrapes, and passionate encounters Neruda had during his life.
24. The passage most strongly suggests that a reader might appreciate Feinstein's treatment of the "dizzying details" (lines 9–10) of Neruda's life because Feinstein:
- F. is critical of Neruda's many travels and adventures.
  - G. concentrates on explaining Neruda's writing process rather than focusing on his life.
  - H. never elaborates on why Neruda was a globe-trotter and prolific writer.
  - J. keeps dull passages brief to ensure the reader does not lose interest.
25. As it is used in line 17, the word *logged* most nearly means:
- A. cut.
  - B. completed.
  - C. recorded.
  - D. harvested.
26. According to the passage, Neruda's reminiscences as related in his autobiography:
- F. amplified contentious issues.
  - G. should be studied as literature.
  - H. create disguises and reveal secrets.
  - J. were a guide for Feinstein's writing style.
27. The passage indicates that Feinstein addresses Neruda's conversion to communism by:
- A. avoiding the topic of politics as much as possible.
  - B. contradicting Neruda's own account of that time period.
  - C. respecting Neruda's first wife and sickly daughter to ensure the biography does not cause pain.
  - D. recording information truthfully without passing judgment on it.
28. According to Feinstein, Neruda's Spanish became "quite odd" (line 54) during his:
- F. travels to Rangoon and other countries.
  - G. studies of French symbolist poetry.
  - H. escape from consular activity.
  - J. marriage to Delia del Carril.
29. The passage author indicates that Feinstein's treatment of Neruda's contradictions allows Feinstein to:
- A. muddle the picture of Neruda's life.
  - B. show the downside of Neruda's exuberance.
  - C. let readers draw their own conclusions.
  - D. make Neruda appear less noble.
30. As it is used in line 86 the word *work* refers to Neruda's:
- F. poetry.
  - G. biography.
  - H. travels.
  - J. marriage.

**GO ON TO THE NEXT PAGE.**

## Passage IV

**NATURAL SCIENCE:** This passage is adapted from the essay “The Higgs at Last” by Michael Riordan, Guido Tonelli, and Sau Lan Wu (©2013 by Scientific American).

The Higgs boson is the cornerstone of the Standard Model, an interwoven set of theories that constitute modern particle physics. This particle’s existence had been suggested in 1964 by Peter W. Higgs of the University of Edinburgh as the result of a subtle mechanism—independently conceived by François Englert and Robert Brout in Brussels plus three theorists in London—that endows elementary particles with mass. The Higgs boson is the physical manifestation of an ethereal fluid (called the Higgs field) that permeates every corner of the cosmos and imbues particles with distinctive masses.

Although theorists asserted that the Higgs boson—or something like it—must exist, they could not predict what its mass might be. For this and other reasons, researchers had few clues about where to look for it. An early candidate, weighing in at less than nine times the proton mass, turned up in 1984 at a refurbished, low-energy electron-positron collider in Hamburg, Germany. Yet the evidence withered away after further study.

Most theorists agreed that the Higgs mass should be 10 to 100 times higher. If so, discovering it would require a much larger and more energetic particle collider than even the Fermi National Laboratory’s Tevatron, a collider completed in 1983. That same year CERN began building the billion-dollar Large Electron Positron (LEP) collider, boring a 27-kilometer circular tunnel that crossed the French-Swiss border four times near Geneva. Although LEP had other goals, the Higgs boson was high on its target list. Discoveries and precision measurements made at LEP and the Tevatron soon implied that the Higgs boson should be no more than 200 GeV, which put it potentially within reach of these colliders. (GeV is the standard unit of mass and energy in particle physics, about equal to a proton mass.) In over a decade of searching, however, physicists found no lasting evidence for Higgs-like data bumps.

During the final LEP runs in the summer of 2000, physicists decided to push the collision energy beyond what the machine was designed to handle. That is when hints of a Higgs boson began appearing. After a heated debate, CERN’s then-director Luciano Maiani decided to shut LEP down and begin its planned conversion into the LHC, a machine designed to find the Higgs boson.

The LHC is the most spectacular collection of advanced technology ever assembled. Built inside the original LEP tunnel, it uses little left from that collider. Its principal components include more than 1,200 superconducting dipole magnets—shiny, 15-meter-long cylinders worth nearly \$1 million each. Probably the most sophisticated components ever mass-produced, by firms in France, Germany and Italy, they harbor twin beam tubes that are flanked by niobium-titanium magnet coils bathed in liquid helium at 1.9 kelvins, or –271 degrees Celsius. Inside, twin proton

beams circulate in both directions at energies up to 7 TeV and velocities approaching light speed.

Although the LHC is a giant collider feeding multiple experiments, only the two largest ones—ATLAS and CMS—had been tasked with finding the Higgs boson. The ATLAS and CMS experiments couldn’t observe a Higgs boson directly—it would decay into other particles far too quickly. They looked for evidence that it was created inside. Depending on the Higgs boson’s mass, it could decay into lighter particles in a variety of ways. In 2011, attention began to focus on its rare decays into two photons and four charged leptons, because these signals would stand out starkly against tremendous backgrounds of data. By May 2012, the LHC was producing data 15 times faster than the Tevatron had ever achieved.

On June 15, 2012, CMS physicists began gathering to hear the preliminary reports. Signals from their data were occurring again in the same vicinity—near 125 GeV—that had so tantalized researchers six months earlier. Scientists realized almost immediately that if they were to combine the new data with the 2011 results, chances were good that CMS could claim a Higgs discovery. Similar revelations occurred in the ATLAS experiment. At the thrilling moment of recognition, one ATLAS group of about a dozen physicists erupted in loud clapping and cries of joy, which echoed down the hallway. CMS and ATLAS independently concluded that the chances that the apparition was a fluke, due to random fluctuations, were less than one in three million. It had to be real.

These results were shared at a public joint seminar at CERN on July 4, 2012. When the camera panned to Dr. Higgs, he could be seen pulling out a handkerchief to wipe his eyes.

Few physicists doubt that a heavy new particle has turned up at CERN, but there is still debate about its exact nature—since July 2012, attention has focused on whether the new particle is indeed “the” Higgs boson predicted by the Standard Model. The particle opens up a fabulous new laboratory for further experimentation. Are its properties exactly as predicted? The apparent discrepancies in the early data could be random fluctuations that disappear in months to come. Or perhaps they are offering subtle hints of intriguing new physics.

31. The overall organization of the passage is best described as a:
- chronological account of scientists determining the correct mass of various elementary particles.
  - step-by-step explanation of how the Large Hadron Collider was constructed.
  - series of important events leading to the discovery of the Higgs boson.
  - collection of stories describing how the Standard Model of physics evolved over time.

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32. The main function of the first paragraph is to:
- F. list the information discovered about the Higgs boson by research scientists in Hamburg.
  - G. demonstrate what led scientists to build larger and more energetic particle colliders.
  - H. summarize contributions made by theorists in London.
  - J. explain the origin and importance of the Higgs boson theory.
33. Based on the passage, one similarity between the two particle colliders described in lines 19–32 is that:
- A. neither provided lasting evidence that definitively proved the existence of the Higgs boson.
  - B. both cost upwards of one billion dollars to build.
  - C. construction for both particle accelerators was completed in the same year.
  - D. they both had the size and energy that enabled them to discover the Higgs boson.
34. The main idea of the last paragraph is that:
- F. the properties of the new particle were predicted by the Standard Model only recently and leave physicists' results in doubt.
  - G. recent research by physicists makes earlier data gathered by scientists look faulty by comparison.
  - H. few doubt a new heavy particle has been discovered and additional research should explain its properties.
  - J. the heavy particle discovered weighs far more than originally predicted by scientists.
35. According to the passage, scientists in Brussels and London:
- A. suggested in 1964 that the Higgs boson exists.
  - B. developed an interwoven set of theories for particle physics.
  - C. discovered the cornerstone of the Standard Model.
  - D. independently conceived of a subtle mechanism that endows elementary particles with mass.
36. Based on the passage, to make the particle collider functional, French, Italian, and German firms designed the dipole magnets to be capable of:
- F. utilizing the principal components from the LEP accelerator and fitting in the original tunnel.
  - G. accelerating protons to velocities approaching light speed and having the protons circulate in two directions.
  - H. floating in the air when filled with liquid helium and achieving energies up to 7 TeV.
  - J. costing under one million dollars each and fitting into a fifteen meter long cylinder.
37. The passage indicates that physicists could not discover the Higgs boson until:
- A. they used a low-energy collider.
  - B. a new collider was built.
  - C. they applied Englert's mechanism.
  - D. the Tevatron and LEP came online.
38. The passage suggests that compared to work at the LHC, work at the Tevatron was:
- F. less rapid.
  - G. less reliable.
  - H. more expensive.
  - J. more insightful.
39. It can reasonably be inferred from the passage that the author includes the description of the scientists' reactions to data gained from the ATLAS and CMS experiments (lines 69–71) primarily to:
- A. illustrate how pleased the researchers were to meet Peter Higgs when he visited CERN.
  - B. describe their reaction to data gained from the Tevatron experiments.
  - C. suggest that the physicists' celebration may have disrupted other scientists in the building.
  - D. highlight the magnitude of their discovery by showing their emotional reaction to the results.
40. As it is used in line 78, the phrase *turned up* most nearly means:
- F. been amplified.
  - G. been discovered.
  - H. arrived on site.
  - J. grown in height.

**END OF TEST 3**

**STOP! DO NOT TURN THE PAGE UNTIL TOLD TO DO SO.  
DO NOT RETURN TO A PREVIOUS TEST.**



## SCIENCE TEST

35 Minutes–40 Questions

**DIRECTIONS:** There are several passages in this test. Each passage is accompanied 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

As substrate is added to an enzyme, *enzyme velocity*, or the rate at which an enzyme can change substrate into products, varies with initial substrate concentration, temperature, and time since the reaction began. Table 1 shows, for each of 4 enzymes (A, B, C, and D), the enzyme velocity 10 seconds after addition of substrate for different substrate concentrations and temperatures.

Enzyme	Initial substrate concentration	Enzyme velocity (mmol/s) at a substrate temperature of:		
		20°C	30°C	60°C
A	5 mM	9.1	6.5	4.6
	10 mM	13.2	8.9	6.4
	15 mM	17.6	11.4	7.5
B	5 mM	13.1	7.3	4.9
	10 mM	20.3	10.9	6.9
	15 mM	25.5	13.8	8.6
C	5 mM	20.7	14.3	10.6
	10 mM	30.3	20.8	13.1
	15 mM	35.2	23.1	14.9
D	5 mM	50.2	23.5	14.6
	10 mM	57.6	28.3	18.6
	15 mM	63.3	30.7	19.9

Table 1

Figure 1 shows how each enzyme's velocity changes over time with an initial substrate concentration of 12 mM at a temperature of 40°C.

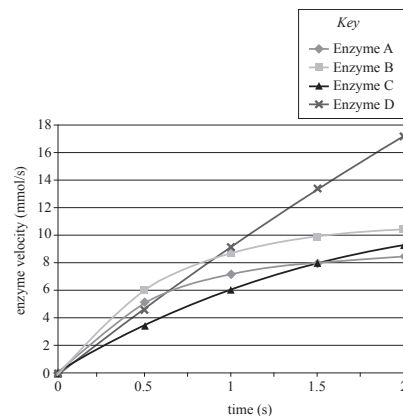


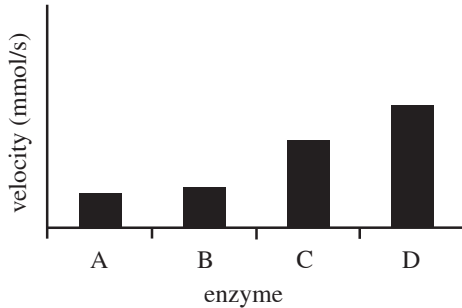
Figure 1

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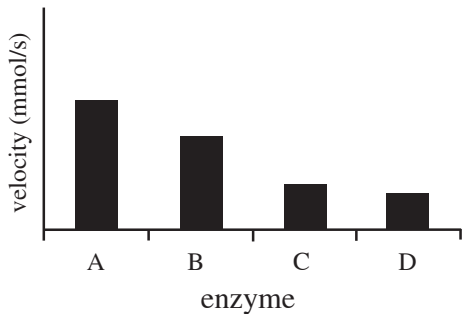


1. According to Table 1, which of the following graphs accurately depicts the velocities of Enzymes A, B, C, and D after 10 seconds at an initial substrate concentration of 5 mM and a temperature of 60°C ?

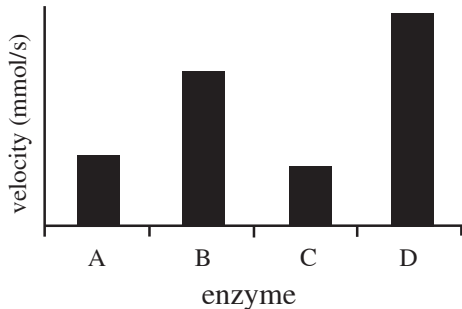
A.



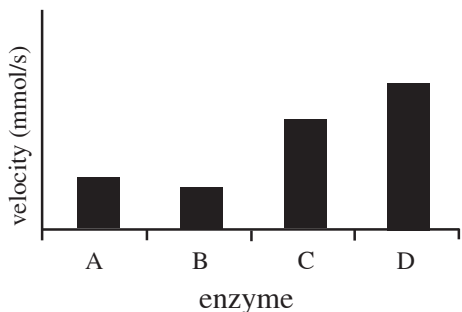
B.



C.



D.



2. Based on Table 1, the enzyme velocity of Enzyme B after 10 seconds in a solution with a substrate concentration of 10 mM at a temperature of 35°C would most likely be:
- F. less than 7 mmol/s.
  - G. between 7 and 11 mmol/s.
  - H. between 11 and 20 mmol/s.
  - J. greater than 20 mmol/s.
3. According to Figure 1, which of the following correctly orders the enzymes according to their enzyme velocities from highest to lowest after 1 second at a substrate concentration of 12 mM and a temperature of 40°C ?
- A. Enzyme A, Enzyme B, Enzyme C, Enzyme D
  - B. Enzyme A, Enzyme C, Enzyme D, Enzyme B
  - C. Enzyme D, Enzyme A, Enzyme B, Enzyme C
  - D. Enzyme D, Enzyme B, Enzyme A, Enzyme C
4. According to Figure 1, at a substrate concentration of 12 mM and a temperature of 40°C, which of the enzymes had the highest enzyme velocity after 0.75 seconds?
- F. Enzyme A
  - G. Enzyme B
  - H. Enzyme C
  - J. Enzyme D
5. Based on Table 1, the enzyme velocity for Enzyme C in a solution with an 8 mM substrate concentration at 60°C after 10 seconds would likely be approximately:
- A. 12.0 mmol/s.
  - B. 13.5 mmol/s.
  - C. 14.5 mmol/s.
  - D. 16.0 mmol/s.
6. According to Figure 1, which enzyme takes the *shortest* amount of time to reach an enzyme velocity of 6 mmol/s in a solution with a substrate concentration of 12 mM at a temperature of 40°C ?
- F. Enzyme A
  - G. Enzyme B
  - H. Enzyme C
  - J. Enzyme D

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## Passage II

Ozone ( $O_3$ ) is an inorganic gas found primarily in the stratosphere of Earth's atmosphere. Stratospheric ozone is formed naturally when UV (*ultra-violet*) light breaks apart an oxygen molecule to form two highly reactive oxygen atoms. The oxygen atoms each then collide with another oxygen molecule to form ozone. Though ozone makes up a very small percentage of the gas in the stratosphere, it is the primary absorber of the sun's UV-B rays, allowing only a small percentage of these harmful rays to reach Earth's surface. Ozone also absorbs light in the infrared spectrum, as does carbon dioxide ( $CO_2$ ).

A researcher performed three studies on the behavior of ozone and  $CO_2$ .

## Study 1

The researcher modeled the transmittance of both  $O_3$  and  $CO_2$  at their average concentrations in the atmosphere at various wavelengths in the UV spectrum from 0.25–0.35 microns ( $\mu m$ ) and in the infrared spectrum from 2.5–11  $\mu m$ . The *transmittance* of a gas is the percent of incoming solar radiation that is transmitted through that gas towards Earth's surface. The model is shown below in Figure 1.

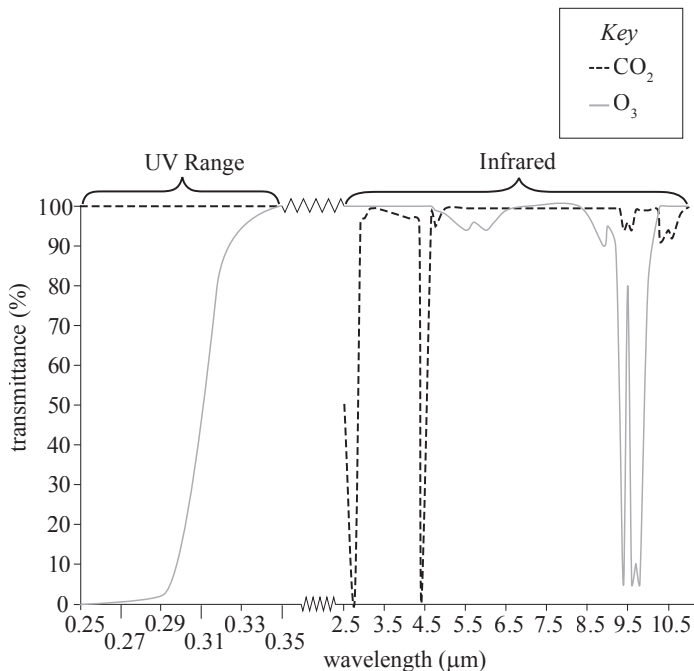


Figure 1

## Study 2

Ozone levels vary throughout the stratosphere by both location and season. The researcher modeled the transmittance through the stratosphere at five different concentrations of ozone, in milligrams per cubic meter ( $mg/m^3$ ), at a wavelength of 0.31 microns (see Figure 2).

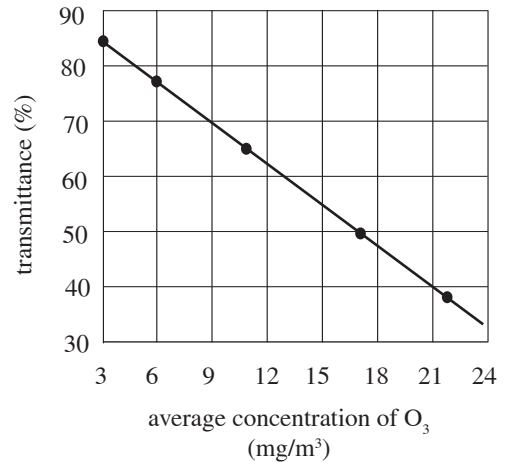


Figure 2

## Study 3

The researcher also estimated the average stratospheric ozone concentration, in  $mg/m^3$ , at five different locations (Locations 1–5) on a particular day. The concentrations were estimated at standard temperature and pressure. The results are shown in Table 1.

Location	Concentration ( $mg/m^3$ )
1	10
2	6
3	21
4	14
5	9

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7. Based on the data in Figure 2, the transmittance at 0.31 microns at a concentration of  $18 \text{ mg/m}^3$  would most likely be:
- less than 45%.
  - between 45 and 50%.
  - between 50 and 55%.
  - greater than 55%.
8. In Study 2, as the concentration of ozone increased from 3 to  $24 \text{ mg/m}^3$ , the transmittance at 0.31 microns:
- increased only.
  - decreased only.
  - increased and then decreased.
  - decreased and then increased.
9. Based on the model in Study 2, which of the locations in Study 3 likely has the greatest transmittance at 0.31 microns?
- Location 1
  - Location 2
  - Location 3
  - Location 5
10. According to the passage, which of the following pairs of equations represents the production of ozone in the stratosphere?
- $\text{O}_2 + \text{UV light} = 2 \text{ O}$   
 $2 \text{ O} + 2 \text{ O}_2 = 2 \text{ O}_3$
  - $2 \text{ O} + \text{UV light} = \text{O}_3$   
 $\text{O}_3 + 3 \text{ O}_2 = 3 \text{ O}_3$
  - $\text{O}_2 + \text{UV light} = 2 \text{ O}$   
 $\text{O}_3 + \text{O} = 2 \text{ O}_2$
  - $\text{O}_2 + \text{O} = \text{O}_3$   
 $\text{O}_3 + \text{UV light} = 3 \text{ O}$
11. The researcher plans to repeat Study 2, but this time he wants to study the effects on transmittance of different  $\text{CO}_2$  concentrations instead of  $\text{O}_3$  concentrations. Based on Figure 1, should he measure the transmittance at 4.3 microns or at 9.5 microns?
- At 4.3 microns; the transmittance of  $\text{CO}_2$  is lower at this wavelength than it is at 9.5 microns.
  - At 4.3 microns; the transmittance of  $\text{CO}_2$  is higher at this wavelength than it is at 9.5 microns.
  - At 9.5 microns; the transmittance of  $\text{CO}_2$  is lower at this wavelength than it is at 4.3 microns.
  - At 9.5 microns; the transmittance of  $\text{CO}_2$  is higher at this wavelength than it is at 4.3 microns.
12. Planet Z has the same atmospheric make-up as Earth, except that the concentration of carbon dioxide is higher and there is no ozone. Would the total transmittance of sunlight on Planet Z at a wavelength of 0.3 microns likely be higher or lower than the transmittance on Earth at a wavelength of 0.3 microns?
- Higher; the transmittance of  $\text{CO}_2$  is lower than the transmittance of  $\text{O}_3$  at 0.3 microns.
  - Higher; the transmittance of  $\text{CO}_2$  is higher than the transmittance of  $\text{O}_3$  at 0.3 microns.
  - Lower; the transmittance of  $\text{CO}_2$  is lower than the transmittance of  $\text{O}_3$  at 0.3 microns.
  - Lower; the transmittance of  $\text{CO}_2$  is higher than the transmittance of  $\text{O}_3$  at 0.3 microns.
13. Based on Table 1, assuming that the atmospheric gases are uniformly mixed in the stratosphere, what would be the approximate mass of  $\text{O}_3$ , in *grams*, in 100 cubic meters of stratospheric air at Location 3 on the date of the study?
- 0.21
  - 2.1
  - 210
  - 2,100

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## Passage III

Ocean depth affects both temperature and dissolved oxygen levels. In Figure 1, the values of temperature,  $t$ , in degrees Celsius, and dissolved oxygen,  $D.O.$ , in milligrams per liter (mg/L), are graphed versus depth,  $d$ , in meters below the ocean's surface. Five distinct ocean zones are also identified in Figure 1.

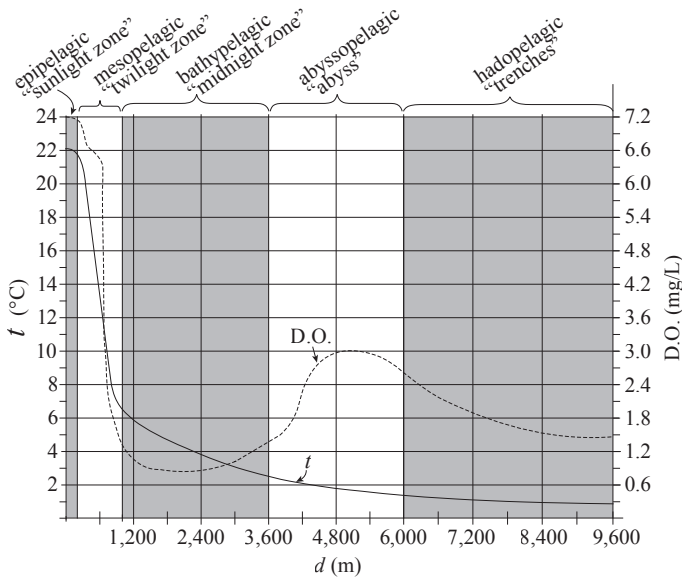


Figure 1

Approximately 98% of marine life is located in the epipelagic, mesopelagic, and bathypelagic zones. Figure 2 shows the percent of marine life that is located between sea level and a given depth within these three zones. For example, 20% of all marine life is located between sea level and a depth of 50 meters.

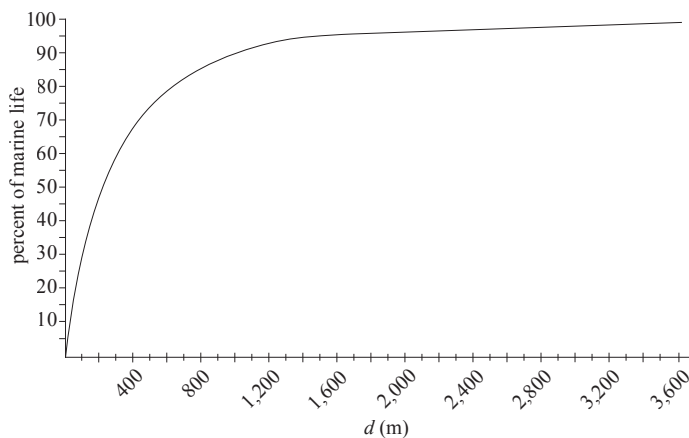


Figure 2

14. The range of a zone refers to the difference in depth between the top and the bottom of that zone. According to Figure 1, which two zones have similar ranges?
- F. Epipelagic and mesopelagic  
G. Mesopelagic and bathypelagic  
H. Mesopelagic and abyssopelagic  
J. Bathypelagic and abyssopelagic
15. Figure 2 indicates that approximately 35% of marine life lives between  $d = 0$  m and:
- A.  $d = 50$  m.  
B.  $d = 100$  m.  
C.  $d = 300$  m.  
D.  $d = 500$  m.
16. According to the information in Figures 1 and 2, the bathypelagic zone extends to a depth of approximately:
- F. 1,000 m.  
G. 1,500 m.  
H. 3,600 m.  
J. 6,000 m.
17. Based on Figure 1, the dissolved oxygen levels at  $d = 10,000$  m would most likely be:
- A. less than 0.3 mg/L.  
B. between 0.3 and 0.9 mg/L.  
C. between 0.9 and 1.2 mg/L.  
D. between 1.2 and 1.5 mg/L.
18. Depths below 1,000 meters are considered *aphotic* because no sunlight penetrates that deep. Based on Figure 2, the aphotic zones account for approximately what percentage of marine life?
- F. 2%  
G. 10%  
H. 90%  
J. 98%
19. Colder ocean water is denser than warmer ocean water. A scientist compares the masses of two 1-liter samples of water: one collected at  $d = 1,000$  m and one collected at  $d = 3,600$  m. Based on Figure 1, which of the samples of water, if either, would have a lower mass?
- A. The sample at  $d = 3,600$  m has a lower mass because the water temperature is lower and the density is higher.  
B. The sample at  $d = 1,000$  m has a lower mass because the water temperature is higher and the density is lower.  
C. Both samples have the same mass because the density is the same for both samples.  
D. Both samples have the same mass because the volume is the same for both samples.

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**Passage IV**

*Fibromyalgia* is a central nervous system disorder characterized by chronic widespread pain and a heightened pain response. Four students each propose a theory of what causes fibromyalgia.

*Student 1*

Fibromyalgia is caused only by an abnormal immune response to an infection or injury. When the body detects damaged tissue, white blood cells release chemicals called cytokines that direct blood flow to the damaged cells and cause inflammation. The inflammation aggravates the nerves and makes the infected area more sensitive to pain. Usually the increased sensitivity goes away after the inflammation subsides, but sometimes the inflammation causes irreparable physical damage to the nerve cells. Fibromyalgia is the result of the damaged nerve cells disrupting the normal functioning of the central nervous system.

*Student 2*

Fibromyalgia is caused only by the overproduction of excitatory neurotransmitters. Neurons transmit pain signals by firing chemicals called neurotransmitters that bind to pain receptors on another neuron. The most prevalent of these neurotransmitters is glutamate. When the nerve cells chronically overproduce glutamate, the pain receptors adapt by physically changing shape to more readily absorb the signals. This change makes neurons more sensitive to pain, which results in fibromyalgia. Injury and illness can cause nerve damage to specific neurons, but they do not create the widespread pain of fibromyalgia.

*Student 3*

Fibromyalgia is caused only by abnormal estrogen or thyroid hormone levels. These hormones affect the production of serotonin and norepinephrine, two inhibitory neurotransmitters that suppress pain transmission through the central nervous system. When levels of these inhibitory neurotransmitters are low, the body is unable to suppress pain transmission, and fibromyalgia is the result. While it is true that some people do overproduce glutamate, sufficient levels of serotonin and norepinephrine neutralize the excess glutamate before it interacts with any pain receptors.

*Student 4*

Fibromyalgia results only from a diet low in L-tryptophan, an essential amino acid necessary for the production of serotonin. Serotonin helps the brain interpret pain signals. When serotonin levels drop due to inadequate L-tryptophan intake, the brain is unable to properly interpret various pain signals, causing fibromyalgia. Nerve damage from injury only creates localized pain. Excess glutamate is harmless because it is not absorbed by the pain receptors. Estrogen and thyroid hormone imbalances do not limit the production of serotonin.

20. Which of the students theorized that fibromyalgia is triggered by neurons that are in some way physically altered?
- F. Student 1 only  
G. Student 4 only  
H. Students 1 and 2 only  
J. Students 2 and 3 only
21. A researcher discovers that female fibromyalgia patients report a higher incidence of pain during pregnancy and menopause when estrogen levels are rapidly changing. This discovery best supports which student's theory?
- A. Student 1  
B. Student 2  
C. Student 3  
D. Student 4
22. Based on the information provided by Student 4, people consume L-tryptophan through foods containing which of the following?
- F. Carbohydrates  
G. Protein  
H. Saturated fat  
J. Unsaturated fat
23. Substance P is an excitatory neurotransmitter similar in function to glutamate. Which student, if any, would be most likely to predict that people that produce higher than average levels of Substance P have a higher than average risk of developing fibromyalgia within their lifetimes?
- A. None of the medical students  
B. Student 1  
C. Student 2  
D. Student 3
24. Which of the students theorized that fibromyalgia is the result of low levels of certain neurotransmitters?
- F. Students 1 and 2 only  
G. Student 3 only  
H. Students 2 and 3 only  
J. Students 3 and 4 only

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25. Which of the following research findings, if true, best supports Student 4's theory?
- A. The prevalence of fibromyalgia is lower than average among people who consume diets low in L-tryptophan.
  - B. The prevalence of fibromyalgia is higher than average among people that consume diets low in L-tryptophan.
  - C. Patients with fibromyalgia have lower levels of thyroid hormone than patients that do not have fibromyalgia.
  - D. Patients with fibromyalgia have higher levels of thyroid hormone than patients that do not have fibromyalgia.
26. Prescription C is a powerful anti-inflammatory medication often prescribed to patients recovering from serious injury. A study examined the incidence of fibromyalgia following serious injury and found that the likelihood of developing fibromyalgia was the same among patients treated with Prescription C and patients that were not treated with any anti-inflammatory medications. These study results *weaken* the viewpoint(s) provided by which student(s)?
- F. Student 1 only
  - G. Students 1 and 2 only
  - H. Student 3 only
  - J. Students 2 and 3 only

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### Passage V

Sufficient nitrogen levels in soil are necessary for crops to grow. Often, fertilizers rich in ammonium ( $\text{NH}_4^+$ ) are applied to fields to increase crop yields, and nitrogen-fixing bacteria convert the applied ammonium into nitrate ( $\text{NO}_3^-$ ) in a process known as *nitrification*. Nitrate is susceptible to loss through leaching before crops are able to use it, so nitrogen inhibitors are often used to prevent the conversion of ammonium into nitrate. Three studies examined the rates of nitrification in several regions using different nitrogen inhibitors: N-1, N-2, and N-3.

Soil samples of 3 cubic meters were collected from five different biomes (grassland, desert, tropical forest, coniferous forest, and deciduous forest). The samples were immediately placed in a sealed container in a cooler kept at a constant  $20^\circ\text{C}$  before they were transported to the same greenhouse. Each sample was thoroughly mixed, tested for the ammonium levels, and then divided evenly into three 1-cubic-meter plots in the same greenhouse. The plots had a mesh bottom to allow for drainage of the soils. The plots were each irrigated once with 2 L of water and then maintained at  $20^\circ\text{C}$  with constant humidity for one week before the fertilizer and nitrogen inhibitors were applied.

#### Study 1

The following procedures were performed for one plot from each biome. A 50 g sample of crystallized N-1 was added to 5 L of liquid fertilizer and the mixture was stirred until there were no remaining solids suspended in the mixture. The mixture was then sprayed uniformly along the top of each soil plot. For the next 8 weeks, the plots were watered once weekly with 2 L of water and the greenhouse remained at  $20^\circ\text{C}$  with constant humidity. After 8 weeks, the soil was analyzed to determine the percentage of the applied ammonium that was converted to nitrate over the 8-week period. The results are shown in Figure 1.

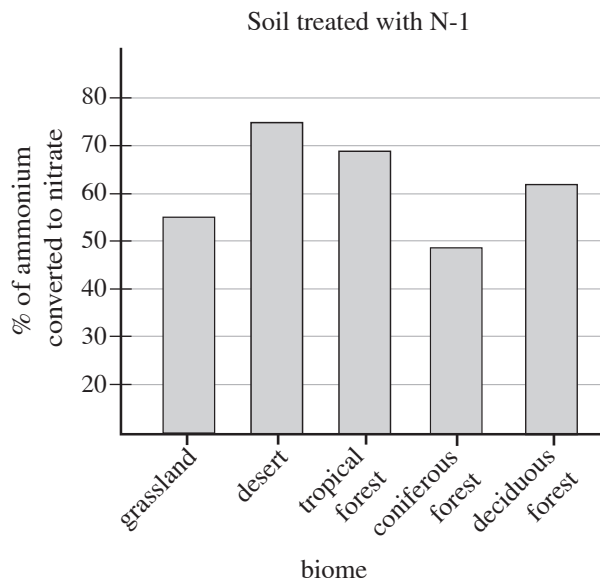


Figure 1

#### Study 2

Study 1 was repeated with a 50 g sample of crystallized N-2 substituted for the crystallized N-1 (see Figure 2).

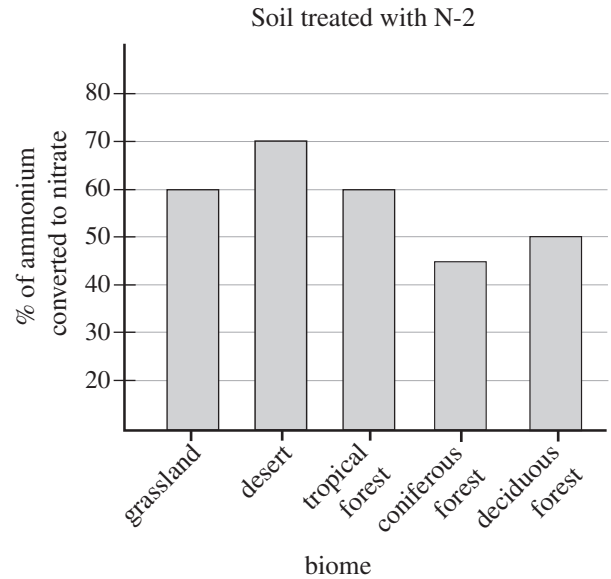


Figure 2

#### Study 3

Study 1 was repeated with a 50 g sample of crystallized N-3 substituted for the crystallized N-1 (see Figure 3).

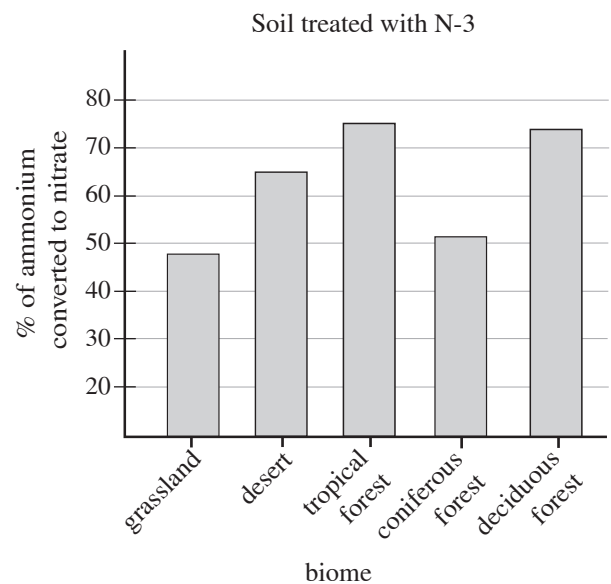


Figure 3

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27. According to the results of the studies, the soil from which of the five biomes had the lowest percentage of ammonium converted to nitrate after treatment with N-1, N-2, and N-3, respectively?
- |    | <u>N-1</u>        | <u>N-2</u>        | <u>N-3</u>       |
|----|-------------------|-------------------|------------------|
| A. | coniferous forest | deciduous forest  | grassland        |
| B. | coniferous forest | coniferous forest | grassland        |
| C. | desert            | desert            | tropical forest  |
| D. | tropical forest   | desert            | deciduous forest |
28. According to the results of Study 2, the percent of ammonium converted to nitrate in the soils treated with N-2, averaged across all 5 biomes, was closest to which of the following?
- F. 40%  
G. 50%  
H. 60%  
J. 70%
29. Do the results of Studies 1 and 3 support the statement “A greater percentage of applied ammonium was converted to nitrate in the tropical forest soil treated with N-3 than the same soil treated with N-1”?
- A. Yes; 63% of the applied ammonium was converted to nitrate in N-3, whereas only 47% was converted to nitrate in N-1.  
B. Yes; 75% of the applied ammonium was converted to nitrate in N-3, whereas only 68% was converted to nitrate in N-1.  
C. No; 63% of the applied ammonium was converted to nitrate in N-1, whereas only 47% was converted to nitrate in N-3.  
D. No; 75% of the applied ammonium was converted to nitrate in N-1, whereas only 68% was converted to nitrate in N-3.
30. Which of the following correctly identifies the independent (experimental) variable across the 3 studies?
- F. Biome  
G. Concentration of ammonia  
H. Type of nitrogen inhibitor  
J. Concentration of nitrate
31. The concentration of applied ammonium ions was reduced by less than 50% in the deciduous forest soil treated with which, if any, of the inhibitors?
- A. None of the inhibitors  
B. N-2 only  
C. N-1 and N-3 only  
D. All of the inhibitors
32. Is the mixture of N-1 and liquid fertilizer a solution when it is applied to the soil?
- F. Yes, because the N-1 dissolved in the liquid fertilizer.  
G. Yes, because the N-1 was suspended in the liquid fertilizer.  
H. No, because the N-1 dissolved in the liquid fertilizer.  
J. No, because the N-1 was suspended in the liquid fertilizer.
33. In soil, nitrogen-fixing bacteria are inactive in temperatures below 12°C. Which of the following steps was incorporated in the experimental design to ensure that the bacteria in all five soils were active?
- A. The soil samples were all gathered when the outside temperature was 20°C.  
B. The soil samples were tested for nitrate levels before the fertilizer was applied.  
C. The soil samples were transported and maintained at 20°C throughout the study.  
D. The soil samples were tested for ammonium levels before the fertilizer was applied.

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**Passage VI**

Yeast cells exhibit *bipolar growth*: they grow in length from both tips in a straight-rod shape. However, the presence of an external electrical field can affect the growth patterns of yeast cells. Two researchers created a genetically modified strain of the fission yeast *Schizosaccharomyces pombe* (*S. pombe*). The genetically modified (GMO) strain was deficient in one of the proteins used to regulate the intracellular pH.

The researchers conducted two experiments to examine how an electric field affects the growth of both the non-GMO yeast cells (*S. pombe* – *N*) and the GMO yeast cells (*S. pombe* – *GM*).

*Experiment 1*

The researchers put a sugar-based agar into four square petri dishes (designated A, B, C, and D). Three *S. pombe* cells were placed into each of the dishes. The yeast placed in Dishes A and B were all *S. pombe* – *N* cells, and the yeast placed in Dishes C and D were all *S. pombe* – *GM*. A battery was used to generate a current through Dishes B and D. Figure 1 shows the growth of the cells in all four petri dishes and the direction of the electric fields (where present). The shaded portion of the cell represents the original shape of the cell when it was placed in the dish, while the dotted lines indicate the size and shape of the cell after 3 days at a constant temperature of 20°C. The nucleus is also shown for each cell.

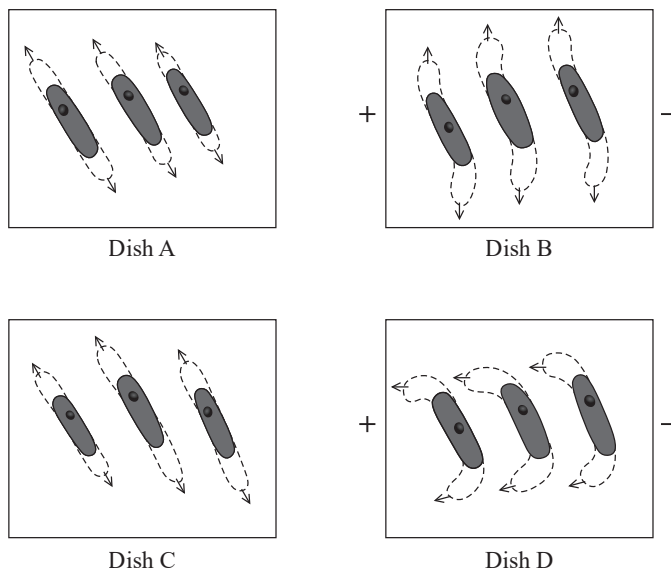


Figure 1

*Experiment 2*

A sugar-based agar was placed into four new petri dishes (designated W, X, Y, and Z). Three *S. pombe* cells were placed into each dish: *S. pombe* – *N* cells in Dishes W and X, and *S. pombe* – *GM* cells in Dishes Y and Z. A battery was used to generate a current through all four dishes. After 3 days at a constant temperature of 20°, the researchers measured the length, *L*, from tip to tip of each yeast cell along the axis parallel to the orientation of the cell body as shown for one particular yeast cell in Figure 2.

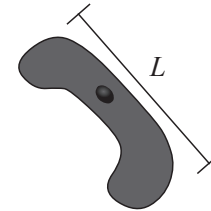


Figure 2

Dishes W and Y were moved to a room with a constant temperature of 15°C while Dishes X and Z were moved to a second room with a constant temperature of 30°C. The researchers measured each cell's length every 12 hours for the following three days. The results of the average cell lengths in each dish are shown in Figure 3.

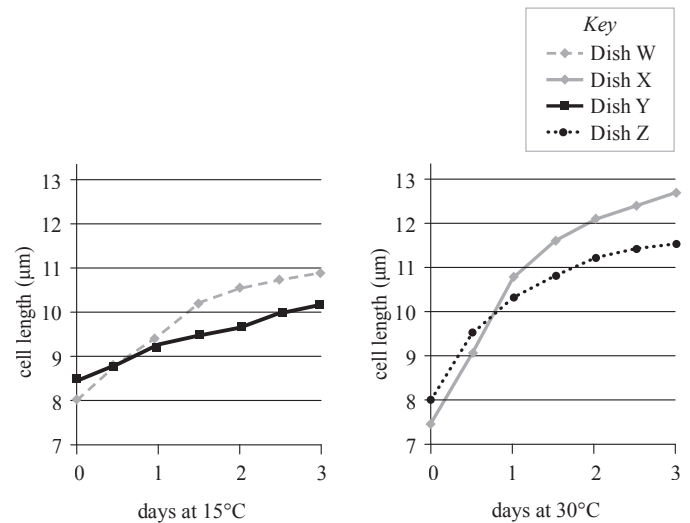


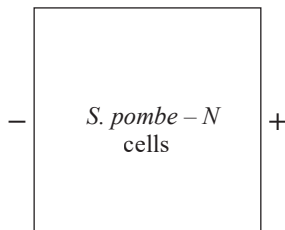
Figure 3

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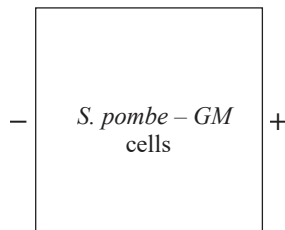


34. The cell shown in Figure 2 is oriented exactly how it appeared in its dish. Which of the following diagrams most likely represents the petri dish from which this cell is found?

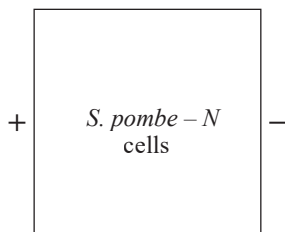
F.



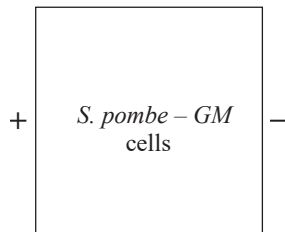
G.



H.



J.



35. Before Dish X was moved to a higher temperature room, the cells in Dish X likely exhibited growth most similar to the cells in which of the dishes in Experiment 1?

- A. Dish A
- B. Dish B
- C. Dish C
- D. Dish D

36. In Experiment 1, in the presence of an electrical field, did the *S. pombe - N* cells exhibit the same growth patterns as the *S. pombe - GM* cells?

- F. Yes; the yeast cells in both Dishes A and C exhibited bipolar growth with a straight-rod morphology.
- G. Yes; the yeast cells in both Dishes B and D exhibited bipolar growth with an s-shaped morphology.
- H. No; the yeast cells in Dish B exhibited bipolar growth with an s-shaped morphology, but the yeast cells in Dish D exhibited bipolar growth with a c-shaped morphology.
- J. No; the yeast cells in Dish A exhibited bipolar growth with an s-shaped morphology, but the yeast cells in Dish C exhibited bipolar growth with a c-shaped morphology.

37. The anode of the petri dishes in Experiment 2 is the positively charged electrode, and the cathode is the negatively charged electrode. Did the yeast cells in Dish Y likely grow towards the anode or towards the cathode?

- A. Cathode; the *S. pombe - N* cells in Dish B grew towards the negatively charged electrode.
- B. Cathode; the *S. pombe - GM* cells in Dish D grew towards the negatively charged electrode.
- C. Anode; the *S. pombe - N* cells in Dish B grew towards the positively charged electrode.
- D. Anode; the *S. pombe - GM* cells in Dish D grew towards the positively charged electrode.

38. Based on the information shown in Figure 1, is *S. pombe* a eukaryotic or prokaryotic cell?

- F. Prokaryotic; each cell has a nucleus.
- G. Eukaryotic; each cell has a nucleus.
- H. Prokaryotic; each cell does not have a nucleus.
- J. Eukaryotic; each cell does not have a nucleus.

39. In Experiment 2, how many times was the length of each cell measured?

- A. 2
- B. 3
- C. 5
- D. 7

40. If researchers wanted to examine the effects of different temperatures on the growth of *S. pombe - GM* cells, which two dishes should they compare?

- F. Dish W and Dish X
- G. Dish W and Dish Y
- H. Dish Y and Dish X
- J. Dish Y and Dish Z

END OF TEST 4

STOP! DO NOT RETURN TO ANY OTHER TEST.

## DIRECTIONS

This is a test of your writing skills. You will have forty (40) minutes to write an essay. Before you begin planning and writing your essay, read the writing prompt carefully to understand exactly what you are being asked to do. Your essay will be evaluated on the evidence it provides of your ability to express judgments by taking a position on the issue in the writing prompt; to maintain a focus on the topic throughout your essay; to develop a position by using logical reasoning and by supporting your ideas; to organize ideas in a logical way; and to use language clearly and effectively according to the conventions of standard written English.

You may use the unlined pages in this test booklet to plan your essay. These pages will not be scored. ***You must write your essay on the lined pages in the answer folder.*** Your writing on those lined pages will be scored. You may not need all the lined pages, but to ensure you have enough room to finish, do NOT skip lines. You may write corrections or additions neatly between the lines of your essay, but do NOT write in the margins of the lined pages. ***Illegible essays cannot be scored, so you must write (or print) clearly.***

If you finish before time is called, you may review your work. Lay your pencil down immediately when time is called.

**DO NOT OPEN THIS BOOK UNTIL YOU ARE TOLD TO DO SO.**

# ACT Assessment Writing Test Prompt

## Globalization

Improved travel and communication networks have the potential to transform the world population into a single, global society. We can now travel across the globe in a matter of hours. The internet enables us to spread ideas and share cultural norms instantly. Many of the products we use every day are produced on the other side of the world. Globalization can be seen as beneficial, but is generally thought of as a more complicated issue. Given the accelerating pace of globalization, what are the implications it could have for humanity?

*Read and carefully consider these perspectives. Each suggests a particular way of thinking about increasing globalization.*

### Perspective One

As the development of a single world culture becomes a real possibility, we risk losing the diversity that makes life interesting. As people become more similar, the unique elements that identify various cultures will be lost in a global melting pot.

### Perspective Two

The ability to cheaply ship goods across the planet makes necessities and luxuries more affordable to all. Increased product affordability leads to an increase in the quality of life for millions of people globally.

### Perspective Three

Globalization brings greater interaction between countries, which could lead to more conflict. The more we interact with other cultures, the more our differences and disagreements will be emphasized. It would be better for cultures to be more isolated from one another in order to exist harmoniously.

## Essay Task

Write a unified, coherent essay in which you evaluate multiple perspectives on the question of the implications increased globalization may have on humanity. In your essay, be sure to:

- analyze and evaluate the perspectives given
- state and develop your own perspective on the issue
- explain the relationship between your perspective and those given

Your perspective may be in full agreement with any of the others, in partial agreement, or wholly different. Whatever the case, support your ideas with logical reasoning and detailed, persuasive examples.