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 best 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 best, 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 best 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 best 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

Here Comes the Sun

It's winter, and the sun's rays no longer shine directly on Rjukan,[1] a small town in south-central Norway. While all of Norway has precious few sunlit hours in winter, Rjukan is tucked in a valley between two mountain ridges that completely block sunlight from late September to mid-March. Yet opposite the mountains, an oval mirror afternoon sunlight bathes the market square, thanks to the Solspeil—"sun mirror."

After moving to Rjukan in 2001, the prolonged winter gloom alarmed artist Martin Andersen.[2] He wondered if mirrors placed on one of the ridges above Rjukan could change the situation.[3]

1. Which of the following alternatives to the underlined portion would NOT be acceptable?

A. Rjukan, which is
B. Rjukan
C. Rjukan—
D. Rjukan:

2. **F.** NO CHANGE
G. it was the prolonged winter gloom that alarmed artist Martin Andersen.
H. artist Martin Andersen was alarmed by the prolonged winter gloom.
J. the gloom that lasted all winter was alarming for artist Martin Andersen.

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

redirect sunlight into the town.

Should the writer make this revision?

A. Yes, because it indicates the materials Andersen hoped to use to build the mirrors.
B. Yes, because it more specifically establishes what Andersen hoped to do.
C. No, because it suggests that Andersen's idea differed from the ideas mentioned in the following sentence.
D. No, because the original sentence more succinctly establishes what Andersen's plans were.

MATHEMATICS TEST

60 Minutes—60 Questions

DIRECTIONS: Solve each problem, choose the correct answer, and then fill in the corresponding oval on your answer document.

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.

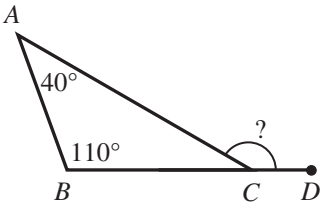
You are permitted to use a calculator on this test. You may use your calculator for any problems you choose, but some of the problems may best be done without using a calculator.

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.

DO YOUR FIGURING HERE.

1. In the figure below, C is on $\overline{BD}$, $\angle BAC$ measures 40°, and $\angle ABC$ measures 110°. What is the measure of $\angle ACD$?



A. 110°
B. 120°
C. 130°
D. 140°
E. 150°

2. For what value of a is the equation $\frac{1}{2}a + 10 = 6$ true?

F. −32
G. −8
H. −2
J. 8
K. 32

3. What is the least common denominator of the fractions $\frac{4}{15}$, $\frac{1}{20}$, and $\frac{3}{8}$?

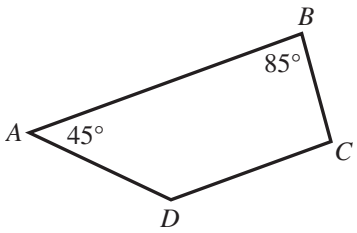
A. 24
B. 120
C. 300
D. 480
E. 2,400

4. $|5 - 3| - |1 - 6| = ?$

F. −7
G. −3
H. 3
J. 7
K. 15

DO YOUR FIGURING HERE.

5. In the trapezoid below, $\overline{AB}$ is parallel to $\overline{DC}$. What is the measure of $\angle C$?



A. 50°
B. 95°
C. 115°
D. 130°
E. 135°

6. Gao earns his regular pay of $12 per hour for up to 40 hours of work per week. For each hour over 40 hours of work per week, Gao is paid $1\frac{1}{2}$ times his regular pay. How much does Gao earn in a week in which he works 56 hours?

F. $ 672
G. $ 756
H. $ 768
J. $1,008
K. $1,344

7. On the first day of school, Ms. Dabacek gave her third-grade students 6 new spelling words to learn. On each day of school after that, she gave the students 3 new spelling words. How many new spelling words had she given the students by the end of the 21st day of school?

A. 60
B. 63
C. 66
D. 69
E. 72

8. What is the value of the expression $\frac{8!}{(4!)^2}$?

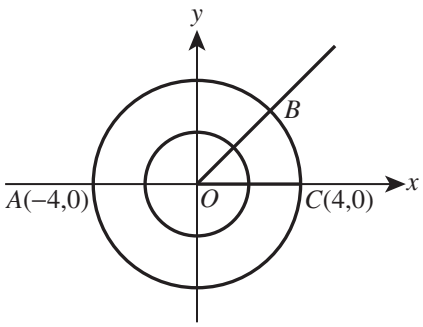
(Note: 3! = 3(2)(1) and 6! = 6(5)(4)(3)(2)(1))

F. 0
G. $\frac{1}{2}$
H. 1
J. 70
K. 420

DO YOUR FIGURING HERE.

Use the following information to answer questions 48–51.

The 2 circles graphed in the standard (x,y) coordinate plane below are centered at the origin, O. In coordinate units, the radius of the smaller circle is 2, and the radius of the larger circle is 4. Points $A(-4,0)$, B, and $C(4,0)$ are on the larger circle. The measure of $\angle BOC$ is 45°.



(Note: Both axes have the same scale.)

48. What is the x-coordinate of B ?

F. $\frac{4}{\sqrt{3}}$
G. $\frac{4}{\sqrt{2}}$
H. 4
J. $4\sqrt{2}$
K. $4\sqrt{3}$

49. A 3rd circle, not shown, is the image resulting from applying the 1st transformation listed below to the *smaller* circle and then applying the 2nd transformation listed below to the result of the 1st transformation.

1st: A dilation with center O and scale factor 2
2nd: A translation of 8 coordinate units to the right

The 3rd circle has how many points in common with the *larger* circle?

A. 0
B. 1
C. 2
D. 4
E. Infinitely many

50. What is the area, in square coordinate units, of the region that is outside the smaller circle and inside the larger circle?

F. 4π
G. 12π
H. 20π
J. 48π
K. 80π

There were also moments when it was quiet, when kids were at school, people were at work, and the merengue-loving neighbors were taking their afternoon siesta. In one of those rare quiet moments, I remember having a revelation while staring at a draft of my first novel on my desk, that if I had waited to tell my story until I had a room of my own, as opposed to a place that always brimmed with people, I would never have finished that novel.

But even more so, without all the family members, who showed up with leftovers and slipped $20 in my hand when I looked tired from long nights at freelance jobs teaching, editing and even window-designing while "estudiando" for my master's degree, I wouldn't have had the confidence that I was right to continue to live my life as a writer. It was the spirit of all that collective activity inside that apartment with elastic walls that gave birth to my first novel.

1. As presented in the passage, Capote's and Cruz's attitudes toward the conditions of their apartments can best be described as:

A. similar; they were both disappointed in their old, shabby apartments.
B. similar; the apartments' defects didn't keep them from appreciating their apartments.
C. different; Capote was disappointed in his apartment's shabbiness, whereas Cruz felt at home despite her apartment's defects.
D. different; Capote felt at home despite his apartment's defects, whereas Cruz was disappointed in her apartment's shabbiness.

2. Details in the passage indicate that, compared to Cruz's first apartment, Capote's first apartment:

F. was somewhat larger.
G. had less natural light.
H. was in a different city.
J. had a clearer view.

3. The primary writing mode of Cruz's essay is:

A. descriptive; Cruz uses imagery and specific details to portray her surroundings.
B. narrative; Cruz recounts the main events of her writing career.
C. persuasive; Cruz uses events from her life to argue that family support systems are crucial.
D. expository; Cruz explains how to thrive in a flawed apartment.

4. The main idea of the ninth paragraph (lines 62–72) is that Cruz's apartment was:

F. too small and cluttered to hold all the people who wanted to stay there.
G. a hospitable, welcoming place despite its clutter and small size.
H. decorated with posters and pictures brought by Cruz's many visitors.
J. much like an office building, with people hurriedly coming and going.

5. The main function of the tenth paragraph (lines 73–82) is to:

A. analyze the relationship Cruz had with her grandmother.
B. explain how world travel and music influenced Cruz's writing.
C. depict the sights and sounds Cruz encountered while at her desk.
D. reveal Cruz's frustration with the cluttered, noisy apartment complex.

6. Which of the following statements best captures Cruz's revelation as it is presented in lines 86–92?

F. For Cruz, a quiet, solitary place to write wasn't available and may not have been helpful.
G. Cruz was opposed to the idea that a room full of people is more inspiring than a quiet one.
H. For Cruz, writing came most easily during quiet moments.
J. Cruz needed to make the most of the few quiet moments she could find.

7. According to the passage, without her family members, Cruz wouldn't have:

A. obtained a college degree.
B. felt confident about her career choice.
C. been able to pay rent for her apartment.
D. continued her freelance teaching jobs.

8. According to the passage, acquiring an apartment in New York has become more daunting because:

F. there are fewer apartments in the city.
G. it has become a transforming rite of passage.
H. more people are moving to the city.
J. apartments have become more expensive.

9. According to Cruz, she returned to the city to:

A. be near family.
B. find an apartment.
C. finish her second novel.
D. study creative writing.

10. Based on the passage, Cruz considered the rent she paid for her apartment to be:

F. lower than that of similar apartments.
G. too high for a one-bedroom in a prewar building.
H. more than she had expected to pay.
J. less than she had paid in the past.

SCIENCE TEST

35 Minutes—40 Questions

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

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

Passage I

Hydrogen peroxide (H_2O_2) decomposes in the presence of the enzyme *catalase*, producing H_2O and oxygen gas (O_2) according to the balanced chemical equation

$$2H_2O_2 \xrightarrow{\text{catalase}} 2H_2O + O_2$$

Students performed 2 experiments to study this decomposition. In each trial of the experiments, Steps 1–3 were performed:

1. A fresh, circular piece of filter paper with a diameter of 6.0 mm was immersed for 2 min in an aqueous catalase solution maintained at a certain pH.

2. The filter paper was removed from the solution. Then a glass rod was used to quickly push the filter paper to the bottom of a beaker containing 500 mL of a freshly prepared aqueous solution having a certain concentration of H_2O_2 (see Figure 1).

3. Once the filter paper reached the bottom of the beaker, the glass rod was immediately removed, and gas bubbles from the reaction surrounded the filter paper, causing it to rise to the surface of the solution. The *rising time*, RT (the time required for the filter paper to rise to the surface), was recorded.

Figure 1

Experiment 1

In Trials 1–5, H_2O_2 solutions that differed in concentration (percent H_2O_2 by volume) were tested while the catalase solution was maintained at a pH of 6. The results are shown in Table 1.

Table 1

Trial	H_2O_2 concentration (percent by volume)	RT (sec)
1	0.2	27
2	0.3	21
3	0.5	17
4	1.0	13
5	2.0	10

Passage II

The number of bacteria that adhere to a surface is affected by the medium in which they are grown. Two studies examined how different media affect the number of bacteria, either *Escherichia coli* or *Salmonella typhimurium*, that adhere to a stainless steel surface.

Study 1

In each of 4 trials, Steps 1–8 were performed:

1. Five 0.36 cm^2 stainless steel chips were placed into a flask.
2. A 125 mL quantity of 10% soy broth (in water) was added to the flask.
3. A 15 mL sample of an *E. coli* culture having a cell density of 100,000 cells/mL was added to the flask.
4. The flask was incubated at 23°C for 1 hr, 24 hr, 48 hr, or 72 hr.
5. The chips were removed from the flask and washed with *Ringer's solution* (an aqueous salt solution).
6. The chips were placed in a solution of *euchrysine* (a dye that stains DNA).
7. The chips were washed with pure water.
8. The number of *E. coli* attached to each chip was counted, and the average number of cells/cm^2 of chip was determined.

Steps 1–8 were repeated; 4 trials were performed for each of 3 other media: 100% soy broth, skim milk, and 20% meat juice (in water).

The results are shown in Table 1.

Table 1

Medium	Average number of *E. coli* cells/cm^2 for an incubation time of:			
	1 hr	24 hr	48 hr	72 hr
10% soy broth	2,300	12,000	49,000	53,000
100% soy broth	4,700	58,000	92,000	61,000
Skim milk	1,100	2,300	780	230
20% meat juice	5,700	51,000	330,000	560,000

Study 2

Study 1 was repeated with *S. typhimurium* instead of *E. coli* (see Table 2).

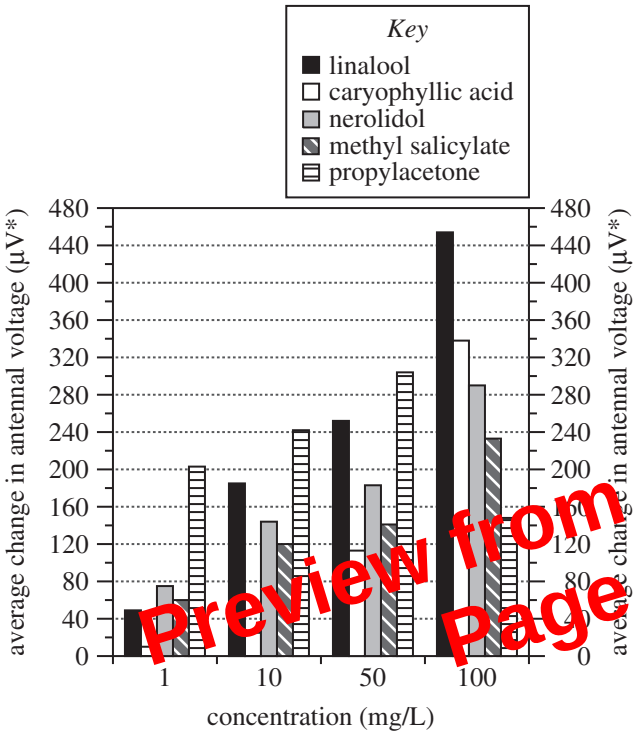
Table 2

Medium	Average number of *S. typhimurium* cells/cm^2 for an incubation time of:			
	1 hr	24 hr	48 hr	72 hr
10% soy broth	550,000	95,000	78,000	78,000
100% soy broth	110,000	56,000	32,000	45,000
Skim milk	98,000	540,000	510,000	540,000
20% meat juice	6,500	62,000	91,000	91,000

Tables adapted from Scott K. Hood and Edmund A. Zottola, "Adherence to Stainless Steel by Foodborne Microorganisms During Growth in Model Food Systems." ©1997 by Elsevier Science B. V.

Passage IV

Certain *odorants* (airborne chemical compounds) can stimulate a change in the electrical activity of the *olfactory neurons* in the antennae of the moth *Manduca sexta*. The change in the electrical activity of an antenna in the presence of an odorant can be detected as an increase in the antenna's voltage relative to its voltage in the absence of odorants. The figure below shows the average change in antennal voltage for adult female *M. sexta* that were exposed to each of 5 odorants at each of 4 concentrations.



*microvolts; 1 μV = 1×10^{-6} V

Figure adapted from Kevin C. Daly, Lynnsey A. Carrell, and Esther Mwilaria, "Detection Versus Perception: Physiological and Behavioral Analysis of Olfactory Sensitivity in the Moth (*Manduca sexta*)." ©2007 by the American Psychological Association.

22. As the odorant concentration increased from 1 mg/L through 100 mg/L, the average change in antennal voltage:

F. decreased only for all 5 odorants.
G. increased only for all 5 odorants.
H. decreased only for 4 odorants but decreased and then increased for 1 odorant.
J. increased only for 4 odorants but increased and then decreased for 1 odorant.

23. Based on the figure, if adult female *M. sexta* are exposed to 5 mg/L of methyl salicylate, the average change in antennal voltage will most likely be:

A. less than 60 μV.
B. between 60 μV and 120 μV.
C. between 120 μV and 185 μV.
D. greater than 185 μV.

24. For which of the following combinations of odorant and concentration was the average change in antennal voltage closest to the average change in antennal voltage for 50 mg/L of nerolidol?

	odorant	concentration
F.	propylacetone	1 mg/L
G.	linalool	10 mg/L
H.	caryophyllic acid	50 mg/L
J.	methyl salicylate	100 mg/L

25. For the *M. sexta* exposed to an odorant concentration of 1 mg/L, what is the order of the 5 odorants, from the odorant that stimulated the least average change in antennal voltage to the odorant that stimulated the greatest average change in antennal voltage?

A. Caryophyllic acid, linalool, methyl salicylate, nerolidol, propylacetone
B. Caryophyllic acid, methyl salicylate, nerolidol, linalool, propylacetone
C. Propylacetone, methyl salicylate, nerolidol, caryophyllic acid, linalool
D. Propylacetone, nerolidol, caryophyllic acid, methyl salicylate, linalool

28. Consider a satellite that completes 1 revolution around Mars in exactly 5 hr. Based on Figure 1, the altitude at which this satellite orbits is most likely closest to which of the following?

F. 3,200 km
G. 3,600 km
H. 4,000 km
J. 4,400 km

29. Consider the hypothesis "For a given central body and a given satellite mass, the greater the altitude of the orbit, the greater the orbital energy." Which group(s) of satellites listed in Table 1 could be cited as evidence in support of this hypothesis?

A. Satellites 1–4 only
B. Satellites 5–8 only
C. Satellites 1–4 and Satellites 9–12 only
D. Satellites 5–8 and Satellites 9–12 only

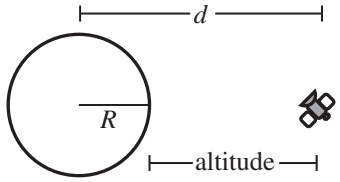
30. Consider 3 satellites: 1 orbiting the Moon, 1 orbiting Earth, and 1 orbiting Mars. Each satellite has the same mass and orbits at the same altitude above its central body. Based on Figure 1, the satellite orbiting which central body most likely completes a revolution in the *least* time?

F. Moon
G. Earth
H. Mars
J. Cannot be determined from the given information

31. Consider the data for Satellites 5–8. The trend in this data set could be more completely demonstrated if which additional satellite were grouped together with Satellites 5–8 ?

A. Satellite 2
B. Satellite 3
C. Satellite 9
D. Satellite 10

32. The diagram below (not drawn to scale) shows the radius, R, of a central body; the *center-to-center distance*, d, between the central body and a satellite; and the satellite's altitude.



Given the data in Table 1 regarding Satellites 2 and 10, for which satellite would d be greater?

F. Satellite 2, because the altitude for Satellite 2 is greater than the altitude for Satellite 10.
G. Satellite 2, because R for the Moon is greater than R for Earth.
H. Satellite 10, because the altitude for Satellite 10 is greater than the altitude for Satellite 2.
J. Satellite 10, because R for Earth is greater than R for the Moon.

33. Which of the following questions requires additional information beyond what is available in Table 1 and Figure 1 in order to be answered?

A. What is the orbital energy of a 100 kg satellite in orbit around Mars at an altitude of 400 km ?
B. At what altitude does a 100 kg satellite orbit Earth if its orbital energy is 3,984 MJ ?
C. Approximately how many revolutions does a satellite complete per hour while in orbit around Mars at an altitude of 400 km ?
D. Approximately how much time is required for a satellite to complete 1 revolution around Earth at an altitude of 400 km ?