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SCIENCE REASONING TEST

35 Minutes—40 Questions

DIRECTIONS: This test includes seven passages, each followed by several questions. Read the passage and choose the best answer to each question. After you have selected your answer, fill in the corresponding bubble on your answer sheet. You should refer to the passages as often as necessary when answering the questions. You may NOT use a calculator on this test.

PASSAGE I

A researcher has conducted two experiments to test the rate of pinecone production in the *Pinus palustris Miller* (a type of pine tree).

Experiment 1

P. palustris Miller seeds were collected from 5 different populations (A1, A2, A3, A4, A5) each of which was from a different site (S1, S2, S3, S4, S5).

The seeds were grown under controlled conditions in a greenhouse. 300 of these seedlings from each population were chosen at random. Each set of seedlings was divided into 30 groups with 10 seedlings in each group. The seedlings were planted in marked cylindrical containers which were then placed at each of the 5 sites. Figure 1 shows the procedure for A1.

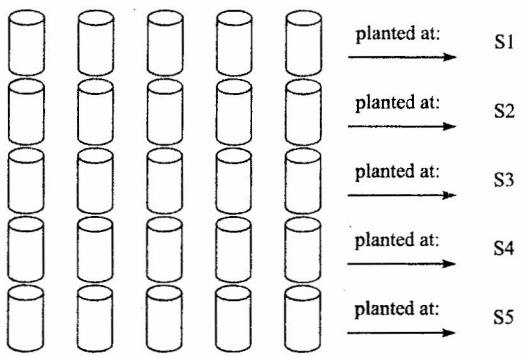

Figure 1 25 Cups containing a total of 250 A1 seedlings

Table 1 shows the number of pinecones that were produced on each tree.

The researchers also collected data on the root structure of the trees. From the information they collected they came up with the following formula relating the root structure in inches to the number of pinecones produced:

number of pinecones = 0.037 + 0.147 (root thickness)

Statistical analysis indicated that this equation was accurate.

Table 1

Site	Pinecones produced per tree				
	A1	A2	A3	A4	A5
S1	2.1	7.1	12.0	2.4	3.1
S2	3.9	2.5	8.5	6.2	6.4
S3	0.4	6.7	3.1	9.3	7.2
S4	5.2	2.1	2.9	0.2	4.5
S5	1.8	6.3	0.9	3.7	8.5

Experiment 2

P. palustris Miller seeds were collected and grown in the same manner as in Experiment 1. When the seeds had grown into seedlings, 150 containers were prepared with 5 A1 seedlings and 5 seedlings from either A2, A3, A4 or A5. Seven containers for each of the 4 combinations were planted at each site.

Table 2 shows how many pinecones were produced on each A1 plant.

Table 2

Site	Pinecones produced per A1 tree when planted with			
	A2	A3	A4	A5
S1	5.7	3.2	6.7	3.5
S2	3.2	1.7	4.3	5.2
S3	9.6	8.4	0.8	7.0
S4	4.2	3.2	1.3	0.2
S5	4.9	6.1	6.1	3.9

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1. In Experiment 1, trees from A5 produced more pinecones than did trees from A4 at which of the following sites?
   A. S4 only
   B. S1 and S5 only
   C. S1, S2, S4, and S5 only
   D. S1, S2, S3, S4, and S5 only

2. In Experiment 1, A1 trees produced the largest number of pinecones at which of the following sites?
   F. S1
   G. S3
   H. S4
   J. S5

3. The procedures utilized in Experiment 2 were repeated, except that only 25 containers were planted at a sixth site (S6). The results appear in Table 3.

Table 3

Site	Pinecones produced per A1 tree when planted with			
	A2	A3	A4	A5
S6	4.1	6.4	1.9	0.3

Based on these data, one should conclude that A1 trees produced more pinecones at S6 than at which of the following sites in Experiment 2?
   A. S1
   B. S3
   C. S4
   D. S5

4. A student wanted to produce the greatest number of pinecones from 6 A1 trees, using the procedures from Experiment 2. Which plants and site should the A1 trees be combined with to achieve the desired results?
   F. A4 and S1
   G. A2 and S3
   H. A3 and S2
   J. A5 and S5

5. In which of the following ways was Experiment 2 different from Experiment 1?
   A. Experiment 2 included trees from more than 1 population.
   B. Experiment 2 combined trees from more than 1 species.
   C. Experiment 2 trees were planted at all 5 sites.
   D. Experiment 2 trees were planted at only 1 site.

6. In Experiment 2, how many seedlings were planted in each container?
   F. 6
   G. 8
   H. 10
   J. 12

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PASSAGE II

Researchers conducted trials on a certain prescription drug delivered in immediate-release capsules and extended-release capsules.

Figure 1 shows the mean concentration (nanograms per milliliter [ng/mL]) of the two active ingredients of the prescription drug in patients' blood plasma over time (hr).

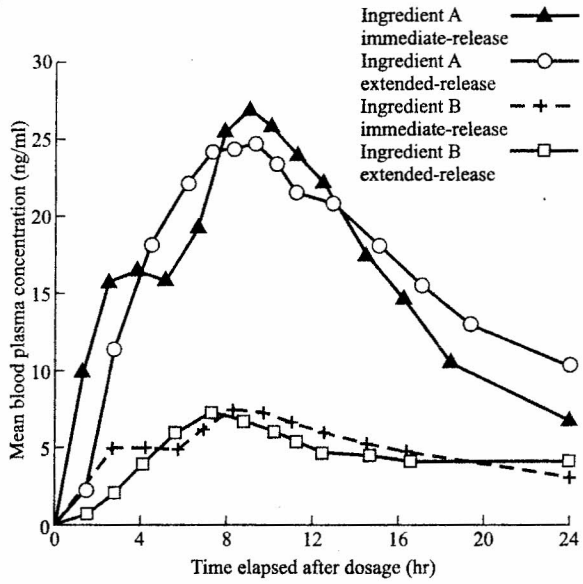

Figure 1

In clinical trials of the prescription drug, subjects given the prescription drug were interviewed at regular intervals about the symptoms the prescription drug is meant to relieve. After each interview, the subjects were assigned a symptom score. A high symptom score corresponds to high intensity of symptoms, and a low symptom score indicates low intensity of symptoms. Figure 2 shows the mean symptom score over time (hr) for subjects who took the prescription drug.

In the clinical trials, some subjects were given the prescription drug and some subjects were given a placebo (an inactive pill). Table 1 shows the percentage of subjects from both groups who reported various adverse side effects.

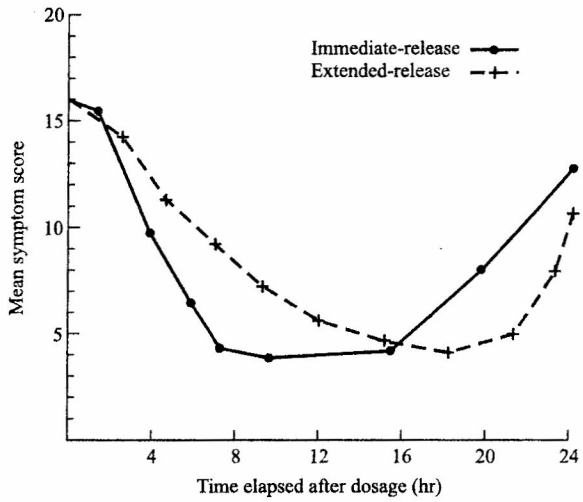

Figure 2

Table 1

Body system	Side effect	Prescription drug group (%)	Placebo group (%)
General	Feeling of weakness	6	5
	Headache	26	14
Digestive system	Loss of appetite	32	5
	Diarrhea	8	0
	Dry mouth	31	5
	Nausea	14	0
Nervous system	Anxiety	7	4
	Dizziness	9	0
	Insomnia	25	11
	Irritability	11	4
Cardiovascular system	Rapid heart rate	10	2
Nutritional	Weight gain	15	0

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7. According to Figure 1, 16 hours after taking the extended-release form of the prescription drug, the difference in mean blood plasma concentration between Ingredient A and Ingredient B is closest to:
   A. 7 ng/ml.
   B. 9 ng/ml.
   C. 11 ng/ml.
   D. 16 ng/ml.

8. Based on the data in Figures 1 and 2, the researchers should make which of the following conclusions about the overall change in mean blood plasma concentration and mean symptom score over time following dosage?
   F. Both mean blood plasma concentration and mean symptom score increase then decrease.
   G. Both mean blood plasma concentration and mean symptom score decrease then increase.
   H. Mean blood plasma concentration increases then decreases, and mean symptom score decreases then increases.
   J. Mean blood plasma concentration decreases then increases, and mean symptom score increases then decreases.

9. According to Figure 1, mean blood plasma concentration of Ingredient A administered in immediate-release form increases most during which of the following time periods?
   A. From the moment of dosage to 3 hours after dosage.
   B. From 3 hours after dosage to 10 hours after dosage.
   C. From 10 hours after dosage to 14 hours after dosage.
   D. From 14 hours after dosage to 24 hours after dosage.

10. Which of the following conclusions about adverse side effects caused by the prescription drug is consistent with the results shown in Table 1?
    F. Results from the placebo group most question the number of instances of feeling of weakness caused by the prescription drug.
    G. Results from the placebo group most question the number of instances of insomnia caused by the prescription drug.
    H. Results from the placebo group least question the number of instances of anxiety caused by the prescription drug.
    J. Results from the placebo group least question the number of instances of irritability caused by the prescription drug.

11. The symptom score of a clinical trial subject given the extended-release form of the prescription drug remained unchanged for 8 hours. Based on Figure 2, the 8-hour period most likely began:
    A. 3 hours after dosage.
    B. 5 hours after dosage.
    C. 9 hours after dosage.
    D. 14 hours after dosage.

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PASSAGE III

The atmosphere is made up of 4 distinct layers: the troposphere, stratosphere, mesosphere, and thermosphere. Different types of clouds form in the different layers depending on the pressure in the atmosphere and the ambient temperature. The cloud types include nimbus, stratus, cumulus, and cirrus. Figure 1 shows the location of the barriers of the atmosphere when the temperature and pressure are at an ideal condition for cloud formation. It also shows the different types of clouds formed at the different levels. Note: Clouds are formed mostly of water crystals, but can also contain particles of rock and dust.

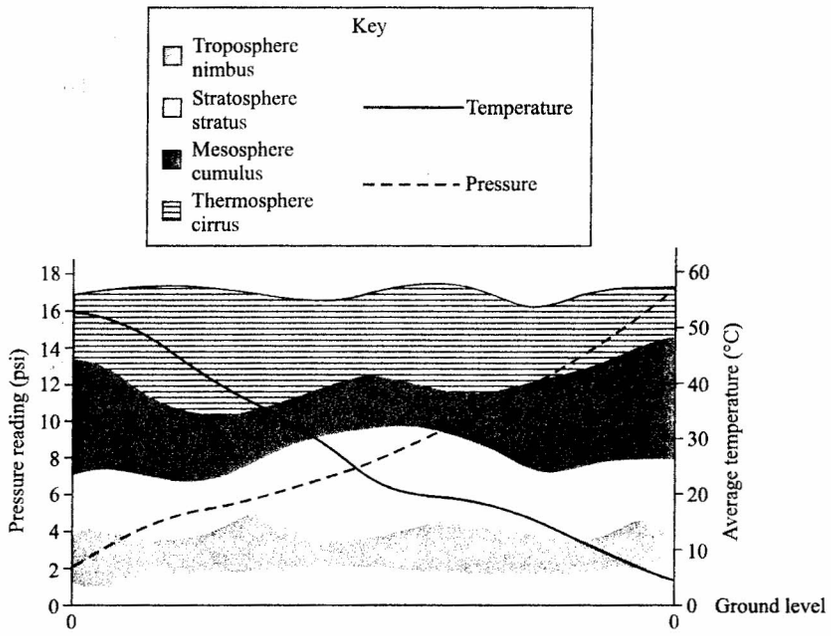

Figure 1

12. According to Figure 1, the atmospheric layer with the greatest range in pressure is the:
- **F.** mesosphere.
- **G.** thermosphere.
- **H.** stratosphere.
- **J.** troposphere.

13. Which of the following statements about the formation of cumulus clouds is supported by the data presented in Figure 1? Cumulus clouds typically form in:
- **A.** pressures between 8 and 12 psi and at an average temperature of 35°C.
- **B.** pressures between 12 and 16 psi and at an average temperature of 22°C.
- **C.** a pressure of 4 psi and at average temperatures between 12°C and 22°C.
- **D.** a pressure of 18 psi and at average temperatures between 50°C and 60°C.

14. According to Figure 1, as pressure within the atmospheric layers increases, temperature within the atmospheric layers:
- **F.** increases only.
- **G.** decreases only.
- **H.** increases up to 6 psi, then decreases.
- **J.** decreases up to 10 psi, then increases.

15. According to the information given in Figure 1, clouds within the stratosphere are most likely formed:
- **A.** under a pressure of 4 psi and 20°C.
- **B.** under a pressure of 10 psi and 30°C.
- **C.** over a pressure of 12 psi and 40°C.
- **D.** over a pressure of 14 psi and 50°C.

16. If a pressure of 7 psi were sustained within the atmosphere, according to Figure 1, which of the following types of clouds would likely form?
- **F.** Cirrus
- **G.** Cumulus
- **H.** Nimbus
- **J.** Stratus

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PASSAGE IV

Because fish live in water they are exposed to any bacteria that exist in the water. Table 1 lists the habitat choices of 7 species of fish in a local pond and the fish's ability to combat the effects of the bacteria found in the water.

Table 1

Fish species	Relative ability to combat bacteria	Habitat	Exposure to waterborne bacteria
A	<0.2	Shallow water with plants	None
B	<0.3	Shallow water with no plants	Low
C	0.2	Shallow water with no plants	Low
D	0.3	Deep water with no plants	Moderate
E	0.4	Shallow water with plants	High
F	0.6	Shallow water with plants	High
G	1.3	Shallow water with plants	High

Figure 1 shows the percent of fish that survive to adulthood in the lab for the 7 species, after exposure to water with bacteria present or exposure to water with the bacteria removed.

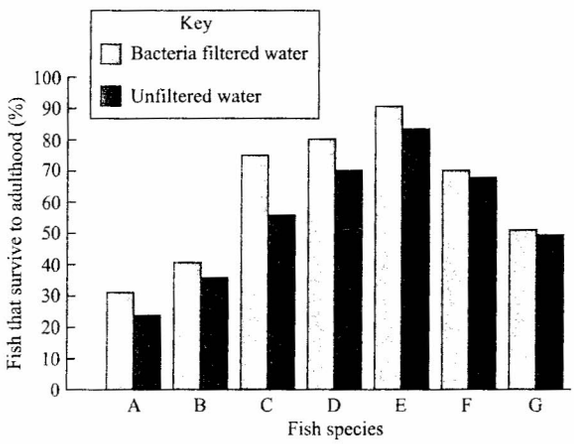

Figure 1

Figure 2 shows predicted bacteria levels over time in 4 geographic regions with fish populations.

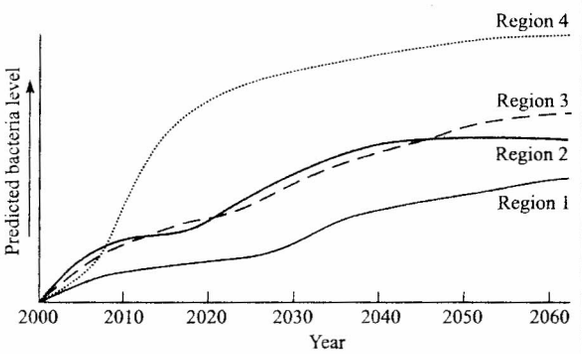

Figure 2

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17. Based on the information in Figure 1, fish from which species are most likely to survive prolonged exposure to bacteria?
    A. Species A
    B. Species B
    C. Species D
    D. Species E

18. According to the data in Figure 1, which species showed the greatest difference between the percent of fish that survived to adulthood after exposure to unfiltered water, and the percent of fish that survived to adulthood after exposure to filtered water?
    F. Species A
    G. Species C
    H. Species E
    J. Species G

19. Researchers recently discovered a new species of fish that lives in deep water without plants. Based on the data in Table 1, the researchers would predict that this species' relative ability to combat bacteria is most likely:
    A. high.
    B. moderate.
    C. low.
    D. nonexistent.

20. According to the information in Table 1, for all the species shown, as the exposure to bacteria increases, the relative ability to combat the bacteria generally:
    F. decreases only.
    G. increases only.
    H. decreases, then increases.
    J. increases, then decreases.

21. Based on the data in Table 1 and Figure 1, fish that had the lowest percent of individuals survive to adulthood when exposed to bacteria tend to:
    A. live in shallow water without plants.
    B. live in shallow water with plants.
    C. live in deep water without plants.
    D. live in deep water with plants.

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PASSAGE V

While digging in a remote site in Africa, paleontologists discovered a collection of fossilized dinosaur bones. The bones were dated back to the Jurassic period, and have been confirmed to be from a dinosaur known as a velociraptor. Two paleontologists discuss the finding.

Paleontologist 1

Once the well-preserved bones are assembled it is clear that they are velociraptor bones from the Jurassic period. The bones are long in the arms, indicating that the velociraptor was definitely capable of flight. You can see that there are cuts within the arm/wing bones of this dinosaur, indicating that it was caught while in flight. Perhaps it was attempting an escape from a more predatory dinosaur, such as tyrannosaurus rex. It is obvious from the body structure of the velociraptor that it was an effective hunter and predator. It was most likely quick to swoop in on its prey and was more than able to carry the prey away on its own. The form and function of the velociraptor has been misunderstood until this important discovery. The condition of these bones offers a clear picture of the way in which the velociraptor lived.

Paleontologist 2

Indeed, the velociraptor bones are in excellent condition. The long arm bones are indicative of the dinosaur's ability to scavenge prey and fend off larger predators. The cuts within the arm bones show that the velociraptor often stole its meals—the marks resemble defense wounds, perhaps from forcing other would-be scavengers away from the free meal. The structure of the velociraptor's feet indicates that it was a fast runner and was able to maneuver well through the high trees and undergrowth. This would certainly have allowed the velociraptor to quickly escape predators and possibly arrive at a kill-site before other larger dinosaurs, such as tyrannosaurus rex, descended upon the leftovers. The bones that were discovered answer many questions about the velociraptor, but they also bring up many new issues to consider.

22. Paleontologist 1's viewpoint contains the basic assumption that the velociraptor must have been:
- **F.** unknown until the discovery of these bones.
- **G.** an ineffective hunter.
- **H.** previously mischaracterized.
- **J.** unable to escape large predators.

23. Paleontologist 1 would most likely state that the cuts on the velociraptor bones were the result of:
- **A.** failed attempts to fly.
- **B.** fending off a competing scavenger.
- **C.** an attack by a larger predator.
- **D.** mistakes made in assembling the bones.

24. Suppose that the fossilized remains of another dinosaur species with long arm bones were discovered, and scientists determined that this dinosaur lived at the same time as the velociraptor. According to the passage, Paleontologist 2 would most likely conclude that:
- **F.** the new dinosaur could fly.
- **G.** the new dinosaur could be a scavenger.
- **H.** the new dinosaur could not escape from predators.
- **J.** the new dinosaur could swoop in on its prey.

25. Paleontologist 2's viewpoint regarding the velociraptor as a scavenger was based on the dinosaur's:
- **A.** strong musculature.
- **B.** excellent condition.
- **C.** long arm bones.
- **D.** ability to fly.

26. Paleontologist 1 would most likely support which of the following statements about the lifestyle of the velociraptor?
- **F.** The velociraptor was a predatory dinosaur capable of flight, and is only now being understood.
- **G.** The velociraptor was a dinosaur who scavenged other dinosaurs' kills.
- **H.** The velociraptor was a fast runner that could easily out-maneuver its predators in order to survive.
- **J.** The velociraptor was hunted by many other dinosaurs during its time on Earth.

27. Assuming all are true, both paleontologists would most likely agree with which of the following facts concerning the velociraptor?
- **A.** It was threatened by larger dinosaurs, such as tyrannosaurus rex.
- **B.** It was unable to sustain flight.
- **C.** It was not built for speed, and therefore, could not easily fend for itself.
- **D.** It was not an effective hunter.

28. Both Paleontologists 1 and 2 would most likely agree with which of the following statements about the discovery of the velociraptor bones? The bones:
- **F.** did not clarify any assumptions about the velociraptor.
- **G.** provided some useful information regarding the velociraptor.
- **H.** could not be assembled properly due to the poor condition in which they were found.
- **J.** completely altered both paleontologist's viewpoints regarding the velociraptor.

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PASSAGE VI

The peaks of mountains often lose sediment due to wind erosion. Figure 1 shows mountain peak compositions, mountain heights, in meters (m), and the net change in meters (m), in mean peak height (MPH) from 1910 to 1970 along a section of the Rocky Mountains. A net negative change in MPH indicates a net loss of sediment and a net positive change in MPH indicates a gain of sediment.

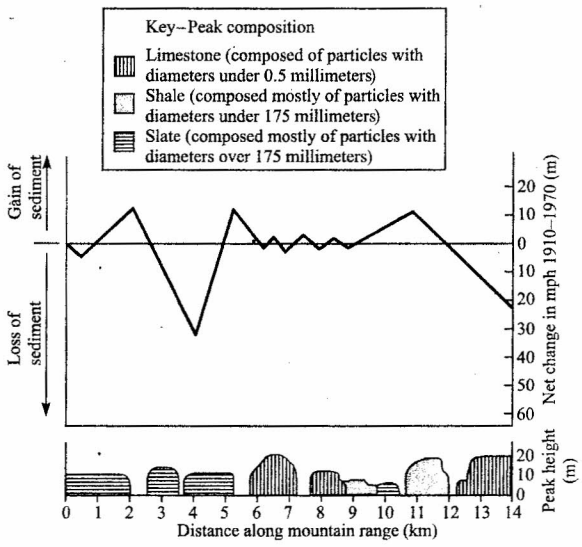

Figure 1

Table 1 shows the percentage of a year that horizontal sections of a mountain are exposed to wind.

Table 1

Peak section height (m)	Percentage of the year that peak section is exposed to wind
0.0–0.5	1.1
0.5–1.0	3.1
1.0–1.5	7.2
1.5–2.0	10.5
2.0–2.5	14.2
2.5–3.0	19.4
3.0–3.5	23.7
3.5–4.0	29.3
4.0–4.5	37.4
4.5–5.0	42.3
5.0–5.5	48.0

Note: Heights are measured from mean (average) sea level.

Figure 2 shows Peak C and D erosion rates, in m/y, as they relate to percentage of a year that mountain peak section is exposed to wind.

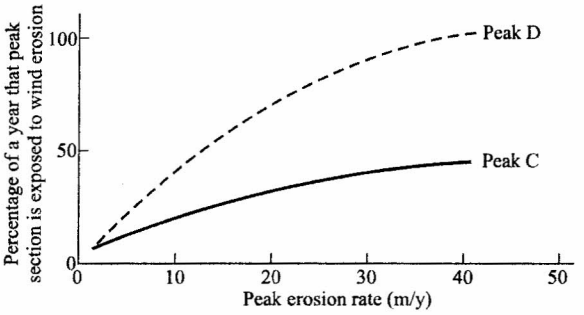

Figure 2

29. According to Figure 1, at a distance of 9 km along the mountain range, peaks of what composition are present, if any?

A. Peaks of slate
B. Peaks of shale
C. Peaks of limestone
D. No peaks are present

30. According to the information in Figure 1, which of the following properties was used to distinguish the various materials that compose the peaks in the study area?

F. Particle size
G. Particle clarity
H. Particle color
J. Particle density

31. Based on the information listed in Table 1, a peak section with a height of 5.5–6.0 m would be exposed to wind approximately what percentage of a year?

A. 22%
B. 39%
C. 48%
D. 53%

32. According to Figures 1 and 2, the difference between Peak C and Peak D erosion rates could best be explained as a difference in the:

F. heights of the two peaks.
G. force of the winds on the two peaks.
H. composition of the two peaks.
J. annual snowfall on the two peaks.

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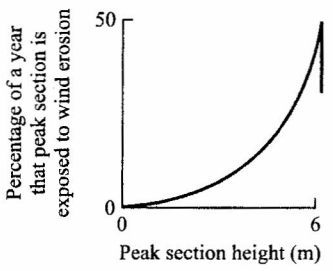
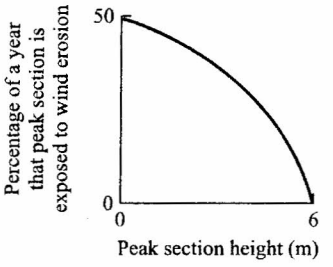
33. According to Table 1, which of the following figures best represents the relationship between the height of a peak section and the percentage of a year that peak section is exposed to wind erosion?

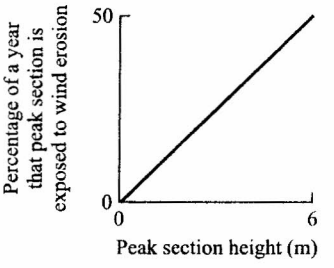
A.



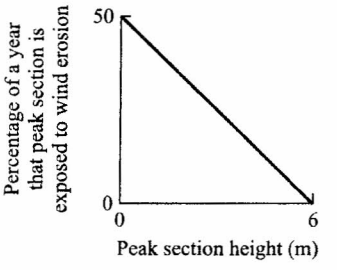
B.



C.



D.



34. According to information in the passage, wind erosion often results in:

F. an increase in the percentage of a mountain peak that is exposed to snow.
G. a reduction in the overall surface area of mountain peaks.
H. a higher number of slate and shale deposits on mountain peaks.
J. a lower number of record snowfalls each year.

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PASSAGE VII

A biologist investigated some of the environmental factors that could influence the growth of certain types of bacteria. The following experiments were conducted at a constant temperature, and no sample was tested more than once.

Experiment 1

Ten samples of bacteria were placed in each of 2 Petri dishes, the bottoms of which were each half moist and half dry. The dishes were covered with Petri dish lids. Dish 1 was placed in a darkened area and Dish 2 was placed in a lighted area. After 2 hours the location of bacterial growth in each dish was recorded (Table 1).

Table 1

	Dry side	Moist side
Dish 1 (in dark)	1	9
Dish 2 (in light)	2	8

Experiment 2

Ten samples of bacteria were placed in each of 2 Petri dishes. The dishes were covered with Petri dish lids. Dish 1 was placed in a darkened area and Dish 2 was placed directly under a 25-watt incandescent lamp, creating a warm, lighted environment. After 2 hours the amount of bacterial growth in each dish was recorded and compared to the amount of growth in a control sample that was placed in a Petri dish and left in a regularly lighted area (Table 2).

Table 2

	Growth proportional to control
Dish 1 (in dark)	0.93
Dish 2 (under lamp)	1.06

Experiment 3

Ten samples of bacteria were placed in each of 2 Petri dishes. Four different environments were created in each dish—dry/lighted, dry/dark, moist/lighted, and moist/dark. The bottoms of the Petri dishes were each half moist and half dry. The dishes were covered with Petri dish lids. Dish 1 was placed in a darkened area and Dish 2 was placed directly under a 25-watt incandescent lamp, creating a warm, lighted environment. After 2 hours the amount of bacterial growth in each dish was recorded and compared to the amount of growth in a control sample that was placed in a Petri dish and left in a regularly lighted area (Table 3).

Table 3

	Growth proportional to control	
	Moist side	Dry side
Dish 1 (in dark)	0.99	0.53
Dish 2 (under lamp)	1.15	0.67

35. One reason refrigeration might be used as a means to control bacteria growth is that bacteria:
- **A.** grow at a faster rate in warm environments.
- **B.** grow at a slower rate in warm environments.
- **C.** require good ventilation.
- **D.** prefer dry environments.

36. Based on the results of Experiment 3, the greatest proportional growth was observed:
- **F.** on the moist side of Dish 1.
- **G.** on the moist side of Dish 2.
- **H.** on the dry side of Dish 1.
- **J.** on the dry side of Dish 2.

37. Which of the following conclusions is supported by the results of Experiment 1?
- **A.** Bacteria prefer light environments to dark environments.
- **B.** Bacteria exhibit an equal preference for light and dark environments.
- **C.** Bacteria prefer moist environments to dry environments, regardless of lighting conditions.
- **D.** Bacteria exhibit an equal preference for dry and moist environments.

38. One criticism of these experiments might be that the presence of more than one sample of bacteria in each Petri dish might have had an effect on the results. Which of the following changes in experimental design could be made to counter this criticism?
- **F.** Use additional species of bacteria in each test.
- **G.** Use only bacteria that was taken directly from nature and not generated in a lab.
- **H.** Place each sample in a separate Petri dish.
- **J.** Vary the size of the starting sample.

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39. Bacteria are known to exist on nearly every surface of the world. On the basis of the experimental results, which of the following environments would provide the conditions best suited for a high growth rate?
A. The surface of a desert rock.
B. The bottom of a Great Lake.
C. The surface of Antarctic ice sheet.
D. Beneath a rock in a tropical forest.

40. In the 3 experiments, the environmental factors that could influence growth were evaluated by recording data about growth after 2 hours. Because bacteria double population size in short intervals, better information about growth might be achieved by recording data:
F. after 10 minutes.
G. at 30-minute intervals for 1 hour.
H. after 1 hour.
J. at 10-minute intervals for 2 hours.

END OF THE SCIENCE REASONING TEST.
STOP! IF YOU HAVE TIME LEFT OVER, CHECK YOUR WORK ON THIS SECTION ONLY.