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SCIENCE REASONING TEST

35 Minutes—40 Questions

DIRECTIONS: This test includes seven passages, each followed by several questions. Read the passages 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

Earth's habitability is sustained by the sun. Currently, the sun provides enough light and warmth to maintain temperature conditions that can support life on our planet. It is undisputed that the sun is a star. All stars go through phases where they change in size, temperature, and brightness. Two scientists present their views on how long Earth will remain habitable.

Scientist 1

Earth's sun has another 7 billion years before it enters the Red Giant phase. Currently, Earth could not sustain human life during the Red Giant phase. However, it is important not to believe that human life on Earth will immediately cease to exist as we know it in 7 billion years. Technology has played a huge role in helping humans adapt to conditions on this planet. We humans have 7 billion years to advance technology and find solutions to adapt to the atmospheric changes the Red Giant phase would bring. For instance, creating a large sunshade to protect Earth would allow life to continue even when the sun enters the Red Giant phase. Another solution would be to develop technology that would stir the sun and bring new hydrogen to the sun's core. This would greatly extend the current phase that our sun is in. There is enough time and incentive to discover ways to thwart the natural progress of nature. Therefore, I believe that human life on this planet will exist indefinitely.

Scientist 2

The sun will enter its Red Giant phase in about 7 billion years. However, new models suggest that Earth has less than a billion years before atmospheric carbon dioxide levels drop to levels that can no longer support photosynthesis. This would lead to a dramatic temperature increase. Once Earth's average temperature rises to above 70°C, the oceans will evaporate and Earth's water sources will be almost completely eliminated. One billion years is not long enough for humans to evolve in order to meet large atmospheric and environmental changes, or to develop the technology needed to make Earth habitable. In a billion years, atmospheric changes will eliminate all life on Earth as we know it. Humans need to accept the reality that advanced life flourishes for only a limited period of time. Science fiction—inspired plans to create space colonies or massive sunshades are unrealistic and will not likely be developed in the next billion years.

1. If the interpretation of Scientist 1 is correct, which of the following generalizations about technology is most accurate?
- **A.** Technology only develops when there is a dire need for it and plenty of time to conduct experiments.
- **B.** Some technology can either alter or enhance natural forces.
- **C.** Technology is solely responsible for making the planet habitable.
- **D.** Technology can help prevent the sun from changing indefinitely.

2. Studies show that Venus may once have had an atmosphere and environment almost identical to Earth's. Now, Venus has no water on its surface or in its atmosphere. How would Scientist 2 most likely explain the change in Venus's atmosphere and environment?
- **F.** Venus's living beings were not able to stir the sun to bring new hydrogen to its core.
- **G.** Venus's sun entered its Red Giant phase much earlier in the planet's development.
- **H.** The carbon dioxide levels in the atmosphere dropped to levels that no longer supported photosynthesis.
- **J.** Venus's location to the sun made it more vulnerable to atmospheric and environmental changes.

3. Which of the following does Scientist 1 suggest would postpone the sun reaching its Red Giant phase?
- **A.** Using technology to create space colonies built from pieces of meteorites
- **B.** Using technology to create a giant sunshade to protect Earth from the sun
- **C.** Using technology to change the levels of hydrogen in the sun's core
- **D.** Using technology to increase the amount of hydrogen in Earth's core

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4. Scientist 1 suggests that:
- **F.** humans will always be adapt to any changes in Earth's atmosphere and environment.
- **G.** the earth will no longer be able to sustain human life in 7 billion years.
- **H.** sufficient time and incentive are not necessary elements in advancing technology.
- **J.** creating sunshades would help to increase levels of carbon dioxide in the air, which is important in maintaining life on the planet.

5. The passage argues that Scientists 1 and 2 disagree on:
- **A.** whether technology will evolve in time to prevent Earth from becoming inhabitable.
- **B.** whether the sun will ever enter the Red Giant phase.
- **C.** whether water and a temperate climate are needed for human survival.
- **D.** whether the technology to create space colonies already exists.

6. The views of both scientists are similar because they both argue that:
- **F.** humans will be able to exist indefinitely on Earth.
- **G.** 7 billion years is long enough to create technology that will protect the earth from a changing sun.
- **H.** the earth is subject to future atmospheric changes.
- **J.** it might be possible to discover new planets that are able to sustain human life.

7. Which of the following findings, if true, would weaken the arguments of Scientist 2?
- **A.** The planet Venus was unable to sustain life when atmospheric changes occurred.
- **B.** Studies have shown that, during prehistoric times, Earth's temperature reached 75° Celsius.
- **C.** It is impossible to create a space colony large enough to support life for long periods of time.
- **D.** Recent scientific models have shown that the earth will not be habitable in 1 billion years.

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PASSAGE II

Radon is a radioactive gas that occurs naturally in the environment as a result of the decay of uranium. If inhaled into the lungs at high concentrations and over a long period of time, radon gas can increase the chance that an individual will develop lung cancer.

Outdoors, radon levels are rarely high enough to pose a health threat to individuals. Indoors, however, radon is a concern because it can seep into the foundation of a home through the ground and accumulate in areas with little ventilation, where levels can then become threatening. Radon gas can seep from the ground through many different pathways, such as cracks in the basement floor, through drains and sump pumps, or through loose-fitting pipes.

The only way to detect radon levels is through testing, using a specialized sensing device. Radon is colorless and odorless, and the levels are constantly changing from one area to the next and from one day to the next. In addition, radon exposure produces no short-term health symptoms. Therefore, radon levels should be monitored on a regular basis.

Radon potential is an estimate of the radon level of a structure measured in *picocuries* per liter of air (pCi/L). A picocurie is one-trillionth of a Curie (a measurement unit of radioactivity). The Environmental Protection Agency (EPA) assigns each county in the United States to a zone, based on its radon potential. Radon potential is not used to determine which houses should be tested in an area. Instead, levels are used to determine if radon-resistant features should be installed in new structures being built in an area. Table 1 shows the radon levels in pCi/L for each of 3 zones, with areas in Zone 1 indicating a high radon potential, areas in Zone 2 indicating a moderate radon potential, and areas in Zone 3 indicating a low radon potential.

Table 1

Zone	Radon level (pCi/L)
3	<2
2	2 to 4
1	>4

8. According to the passage, radon levels are tested in indoors because:
- **F.** radon levels are different in every area, but they are always the same indoors.
- **G.** radon accumulates in the air inside a home and poses a possible health threat.
- **H.** radon gas has a strong, unpleasant smell that can only be detected indoors.
- **J.** radon levels vary from season to season but are similar for most houses.

9. All of the following are mentioned as characteristics of radon that contribute to the importance of continual in-home testing EXCEPT:
- **A.** radon is colorless and odorless.
- **B.** radon produces no short-term symptoms.
- **C.** radon levels vary from day to day.
- **D.** radon is a naturally occurring radioactive gas.

10. Studies have shown that existing homes in the same neighborhood can have very different radon levels. Are these findings consistent with information presented in the passage?
- **F.** No, because radon levels cannot be measured in existing homes.
- **G.** No, because radon seeps into all homes in the same way.
- **H.** Yes, because the occurrence of radon is very rare.
- **J.** Yes, because radon levels vary depending on many different factors.

11. According to the passage, which of the following radon levels would be considered most harmful?
- **A.** 5.2 pCi/L
- **B.** 4.0 pCi/L
- **C.** 3.0 pCi/L
- **D.** 1.9 pCi/L

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PASSAGE III

Predation is an interaction between individuals of 2 species in which one is harmed (the prey), and the other is helped (the predator). Predation can occur among plants and animals as well as between plants and animals. Some biologists contend that *herbivores*, or plant eaters, are predators. Table 1 indicates some characteristics and examples of certain predators.

Table 1

Predator	Characteristics	Examples
Herbivore	Eats plants only, can be very selective in the plants that they eat	Rabbits, deer, some birds, some insects
Carnivore	Eats herbivores and other carnivores	Lions, wolves, some birds, some insects
Parasite	Feeds on another organism's parts, generally without killing the organism	Bacteria, some worms, some plants

Predation is very important in maintaining a natural balance in any given ecosystem. For example, without predators, prey populations tend to grow exponentially. Without prey, predator populations tend to decline exponentially. Predators consume individual members of the prey population, thereby controlling the overall numbers in the ecosystem. The number of prey consumed depends on the number of prey present as well as the number of predators present. The rate of change in the number of prey is a function of the birth of new prey minus the death of other prey, due either to predation or other causes. The death rate is assumed to depend on the number of prey available and the number of predators. The rate of change in the number of predators is a function of the births of new predators—which depends on the number of prey—minus the death of some predators.

Over long periods of time, predator and prey tend to balance each other out. This is called the *predator-prey cycle*. Prey numbers will increase when predator numbers decrease. When the number of prey reaches a certain point, predators will start to increase until they eat enough prey to cause a decline in prey numbers. When this happens, the number of predators will begin to decrease because they can't find enough prey to eat, and the cycle will begin again. Figure 1 represents an example of a *predator-prey cycle*.

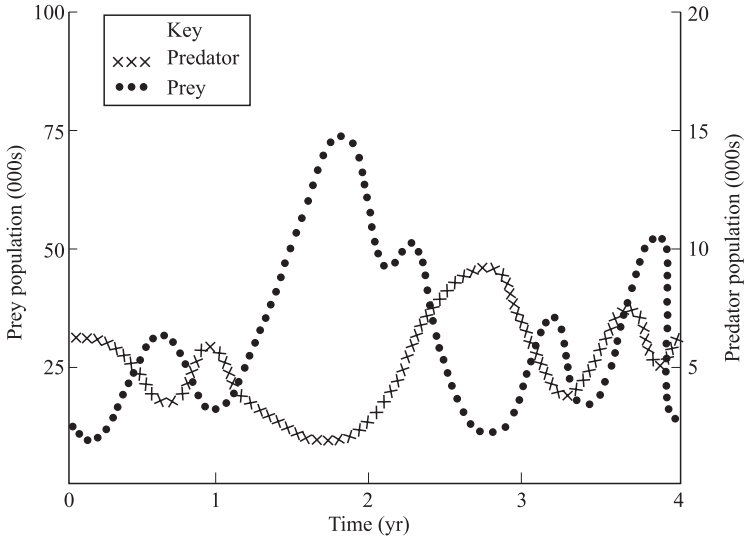

Figure 1

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12. Based on information in the passage and in Table 1, an herbivore is:
- **F.** a predator only.
- **G.** both a parasite and a predator.
- **H.** prey only.
- **J.** both a predator and prey.

13. According to information in the passage, the number of prey consumed in an ecosystem is dependent on:
- **A.** the natural balance of the ecosystem.
- **B.** the total number of predators that die because of predation.
- **C.** the type of parasites available in the ecosystem.
- **D.** the number of predators present and the number of prey present.

14. Based on Figure 1, during the first year, predator numbers were mostly:
- **F.** higher than prey numbers.
- **G.** lower than prey numbers.
- **H.** equal to prey numbers.
- **J.** unable to be determined.

15. Studies have shown that a certain species of deer will only eat a specific type of plant found in the deer's natural habitat, and nothing else. Is this finding supported by the information in the passage?
- **A.** No, because a deer is an herbivore, which means it eats all plants
- **B.** No, because a deer is a carnivore and does not eat plants
- **C.** Yes, because a deer is an herbivore, and herbivores can be selective eaters
- **D.** Yes, because a deer is a prey animal, so it must use caution when eating

16. Based on Figure 1, during which year were the greatest number of prey animals available?
- **F.** 1
- **G.** 2
- **H.** 3
- **J.** 4

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PASSAGE IV

The term *weathering* refers to the processes that cause surface rock to disintegrate into smaller particles or dissolve in water. These processes are often slow, taking place over thousands of years. The amount of time that rock has been exposed to the elements (primarily wind and water) influences the degree to which the rock will weather.

Weathering processes are divided into three categories: physical, chemical, and biological.

Table 1 shows some of the factors that contribute to physical weathering.

Table 1	
Physical weathering	
Mechanism	Results
Animals and plants	Animals burrow into the earth, moving rock fragments and sediment. Plant roots have the same effect.
Crystallization	Water evaporates from rock, which leads to the development of salt crystals. The crystals grow, eventually breaking apart the rock.
Temperature variation	Minerals in rocks expand and contract with temperature changes. Repeated expansion and contraction cracks and splits the rocks.
Exfoliation	Exfoliation occurs as slabs of cracked rock slip off other rock, which leads to further erosion.

Chemical weathering occurs when minerals in rock are chemically altered. Table 2 shows some of the factors that contribute to chemical weathering.

Table 2	
Chemical weathering	
Mechanism	Results
Carbonation	Water combines with carbon dioxide to form carbonic acid. The carbonic acid chemically alters the rock, so that it dissolves.
Hydrolysis	Water, usually in the form of rain, disrupts the chemical composition of the minerals, destabilizing the rock.
Hydration	When water combines with compounds in rock, the mineral's grain will be physically altered.
Oxidation	Oxygen combines with compound elements in rock to form oxides and weaken the rock.

Plants and bacteria contribute to biological weathering. The ultimate product of biological agents on rock is soil. Table 3 shows some factors of biological weathering.

Table 3	
Biological weathering	
Mechanism	Results
Lichens	Lichens are rich in chelating agents, which trap elements of the decomposing rock, resulting in etching and grooving.
Bacteria	Alters the acidity of groundwater, which can lead to erosion of the rock.

17. Based on the data in the passage, plants contribute to which of the following types of weathering?
- **A.** Physical only
- **B.** Both physical and biological
- **C.** Biological only
- **D.** Physical, chemical, and biological

18. According to Table 1, extreme temperature changes can lead to:
- **F.** increased acidity in groundwater.
- **G.** the creation of carbonic acid.
- **H.** the development of salt crystals.
- **J.** cracked and split rock.

19. A layer of fine sediment mixed with some organic material is found surrounding a rock formation. The most likely cause for this is:
- **A.** chemical weathering.
- **B.** exfoliation.
- **C.** biological weathering.
- **D.** oxidation.

20. Based on Table 2, the factor that contributes most to the alteration of minerals and rock is:
- **F.** the acidity level.
- **G.** the presence of water.
- **H.** the availability of oxygen.
- **J.** the mineral composition of the rock.

21. According to Table 3, a chelating agent:
- **A.** releases elements into the soil.
- **B.** alters the acidity of groundwater.
- **C.** dissolves rapidly in water.
- **D.** traps elements of the decomposing rock.

22. Rainwater is slightly acidic, and it can dissolve many minerals over time. This process is most consistent with the mechanism of:
- **F.** exfoliation.
- **G.** oxidation.
- **H.** hydrolysis.
- **J.** chelation.

GO ON TO THE NEXT PAGE.

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PASSAGE V

Sea anemones look like plants, but they actually are predatory animals. They are invertebrates, which means that they do not have a skeleton. To protect themselves, they will attach to firm objects on the sea floor, such as rock or coral.

Sea anemones can alter their body shape according to changes in their environment. For example, when ocean currents are strong, the sea anemone will reduce its internal volume in order to decrease the surface area that is exposed to the current. Sea anemones are dependent on water flow for food and nutrients and also for assistance in eliminating waste.

Most anemones share a symbiotic relationship with marine algae called *zooxanthellae*. These are photosynthetic organisms whose waste products are a food source for the sea anemone. The sea anemone also enjoys a mutualistic relationship with the clown fish. This fish is immune to the stinging tentacles of the sea anemone, and it helps the anemone by actually cleaning the tentacles. The cleaning process yields food for the clown fish, while it remains protected from potential predators by the sea anemones stinging tentacles.

Figure 1 shows a cross-section of portions of the internal anatomy of a sea anemone.

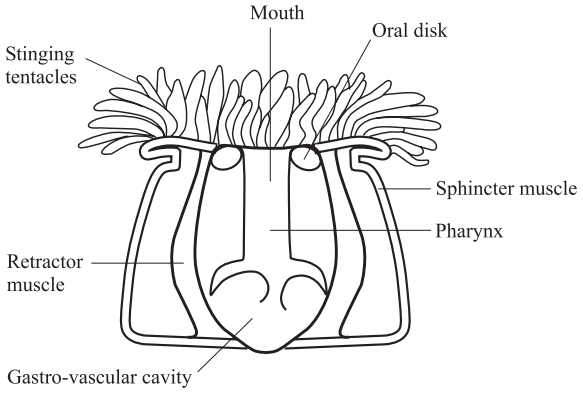

Figure 1

23. According to Figure 1, the sea anemone's mouth is located:
- **A.** below the pharynx.
- **B.** at its center.
- **C.** near its base.
- **D.** inside the sphincter muscle.

24. According to information in the passage, the sea anemone benefits from the presence of:
- **F.** both the clown fish and zooxanthellae.
- **G.** the clown fish only.
- **H.** zooxanthellae only.
- **J.** neither the clown fish nor zooxanthellae.

25. Which of the following statements about the sea anemone is supported by the passage? The sea anemone most resembles:
- **A.** a clown fish.
- **B.** a flower.
- **C.** marine algae.
- **D.** a rock.

26. Suppose that a strong storm stirred up the water in which a sea anemone was living. The sea anemone's response would most likely be:
- **F.** to expose itself to the strong current.
- **G.** to seek the protection of a clown fish.
- **H.** to reduce its internal volume.
- **J.** to detach itself from the seafloor.

27. As shown in Figure 1, the part of the sea anemone's anatomy that connects its mouth to its gastrovascular cavity is the:
- **A.** oral disk.
- **B.** tentacle.
- **C.** pharynx.
- **D.** sphincter muscle.

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PASSAGE VI

Compost is the name given to a mixture of decaying leaves and other organic material. This mixture is often used as fertilizer. Several students designed experiments to test various types of soil, and various combinations of soil and compost on plant growth.

Experiment 1

The students dug a soil sample from an empty field next to the school. They put soil into 4 different clay pots, and mixed in various amounts of compost so that the volume of soil mixture was the same in each pot. They then planted the same number of radish seeds (4) in each pot. The soil/compost mixtures for each pot are shown in Table 1. The clay pots were placed next to each other on a windowsill and watered at the same time each day. The students took care to ensure that the pots each received the same amount of sunlight and water each day. After 2 weeks, the students began recording the growth of the radish plants. They continued recording this data for two more weeks. The results are shown in Table 2.

Experiment 2

The students repeated Experiment 1, with the following changes; each pot contained a different soil type, and no compost was used. This experiment was begun at the same time as Experiment 1. The results of Experiment 2 are shown in Table 3.

Table 1

Soil/compost mixture (Pot #)	% Soil/% compost
1	25%/75%
2	50%/50%
3	75%/25%
4	100% soil

Table 2

Soil/compost mixture (Pot #)	Average plant height (cm)			Average number of leaves		
	14 days	21 days	28 days	14 days	21 days	28 days
1	4.2	5.3	6.2	3	5.5	8
2	3.8	4.8	5.1	3	4.5	6.5
3	3.3	4.4	4.8	2	4	5.5
4	3.2	4.1	4.4	2	3.5	4.5

Table 3

Soil type	Average plant height (cm)			Average number of leaves		
	14 days	21 days	28 days	14 days	21 days	28 days
Sand (l)	2.4	2.9	3.4	1	2.5	3.5
Potting soil (2)	3.9	4.7	5.3	3	4	6
Soil from field near the school (3)	3.2	4.2	4.3	2	3.5	4.5
Mixture of sand and potting soil (4)	3.1	3.3	4.2	2	4	5.5

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28. Based on the results of Experiment 2, which soil type yielded the most overall growth after 28 days?
F. Sand
G. Potting soil
H. Soil from the field near the school
J. Mixture of sand and potting soil

29. Based on the results of Experiment 1, which soil/compost mixture yielded the greatest average plant height after the first 2 weeks?
A. 4
B. 3
C. 2
D. 1

30. Experiment 2 was different from Experiment 1 in that none of the clay pots:
F. were watered during the first 2 weeks.
G. contained any compost.
H. contained any soil.
J. were placed on the windowsill.

31. The results of Soil Type 3 in Experiment 2 and Pot Number 4 in Experiment 1 were almost identical. This is most likely because:
A. the same amount of compost was used.
B. the plants were allowed to grow for 2 more weeks.
C. the pots were the same size.
D. the same type of soil was used.

32. In Experiment 2, how many seeds were planted in each clay pot?
F. 4
G. 14
H. 21
J. Cannot be determined.

33. According to the results of Experiment 1, what percentage of compost yielded the highest average number of leaves?
A. 100%
B. 75%
C. 50%
D. 25%

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PASSAGE VII

The Great Lakes—Huron, Ontario, Michigan, Erie, and Superior—form the largest freshwater system in the world. Each of the lakes tends to *stratify*, or form layers of warmer and colder water, depending on the season. This is called *seasonal turnover*. In winter, for example, the coldest water in the lake lies just below the surface ice. The water gets progressively warmer at deeper levels. In spring, the sun melts the ice, and the surface water warms. Because the surface water is still cooler than the layers below, the water at the surface sinks to the bottom of the lake, forcing the cooler water at the bottom of the lake to the surface. This mixing, known as *spring turnover*, eliminates the temperature stratification that was established during the winter. In the absence of this thermal layering, wind continues to mix the water to a greater depth, bringing oxygen (O_2) to the bottom of the lake and nutrients to the surface. This results in a relatively even distribution of O_2 throughout the lake. When summer arrives, the lake again becomes stratified, with warm water at the surface, and cold water at the bottom. A narrow zone of water undergoing rapid temperature changes separates these layers. This zone is called the *thermocline*. Cool, fall temperatures cause the lake water to mix again, until the surface begins to freeze and the winter stratification is reestablished.

The stability of the lake's stratification depends on several factors: the lake's depth, shape, and size, as well as the wind and both the inflow and outflow of lake water. Lakes with a lot of water flowing into and out of them do not develop consistent and lasting thermal stratification.

Figure 1 shows an example of lake stratification during the summer.

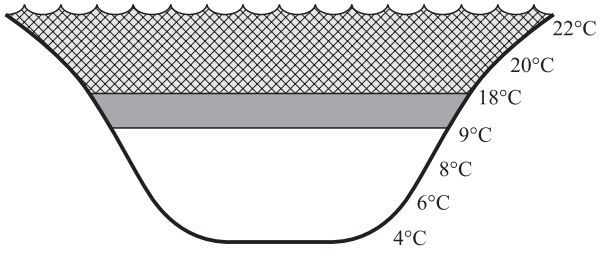


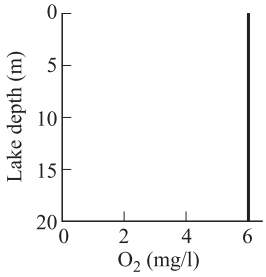
Figure 1 Cross-section of a lake during the summer.

34. According to Figure 1, the temperature of the water below the thermocline is:

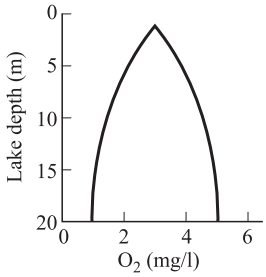
- **F.** higher than the temperature of the water above the thermocline.
- **G.** equal to the temperature of the water above the thermocline.
- **H.** lower than the temperature of the water above the thermocline.
- **J.** equal to the average temperature of the water in the lake.

35. Based on the passage, which of the following best represents O_2 levels in one of the Great Lakes during the spring?

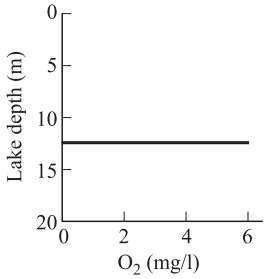
A.



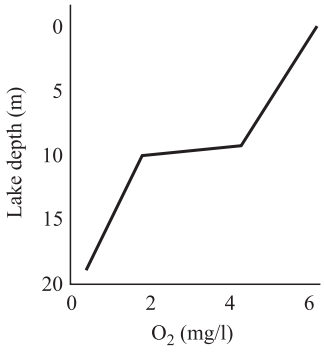
B.



C.



D.



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36. According to the passage, the thermocline is:
- **F.** established during the winter.
- **G.** responsible for bringing nutrients to the surface.
- **H.** a zone of constant temperatures.
- **J.** a zone of rapidly changing temperatures.

37. According to the passage, Lake Michigan experiences thermal stratification during:
- **A.** the summer and the winter.
- **B.** the summer only.
- **C.** the spring and fall.
- **D.** the spring only.

38. A small, inland lake, fed by a fast-flowing river was found to have very little thermal stratification. Based on the passage, this is most likely because:
- **F.** not enough water was flowing into the lake.
- **G.** the inflow of water from the river was too high.
- **H.** the lake was too shallow to support stratification.
- **J.** too much water was flowing out of the lake into the river.

39. According to Figure 1, during the summer, as the depth of the lake increases, the temperature of the water:
- **A.** decreases suddenly, then gradually increases.
- **B.** increases only.
- **C.** remains stable.
- **D.** decreases only.

40. Based on the passage, the stability of thermal stratification depends on all of the following EXCEPT:
- **F.** the depth of the lake.
- **G.** seasonal turnover.
- **H.** the amount of wind.
- **J.** water inflow.

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