PASSAGE IV

When connection to a municipal water system is not feasible, wells are drilled to access ground water. Engineers employed by the company interested in developing a remote plot of land conducted studies to compare the water quality of 2 possible well locations on the land. Water quality is determined by a number of factors, including the levels of nitrates, lead, microbes, pH, hardness (calcium carbonate), and alkalinity. The water samples were kept at a constant temperature of 72°F throughout the entire study. The results in Table 1 show the readings of each test for the two different 100 ml samples of water , as well as the ideal level or concentration for each chemical.

Table 1

Factor	Ideal	Sample 1	Sample 2
Nitrates	<10 mg/L	8 mg/L	7 mg/L
Lead	<0.015 mg/L	0.01 mg/L	0.008 mg/L
Iron	<0.3 mg/L	0.45 mg/L	<0.40 mg/L
pH	6.5–8.5	6.0	7.5
Hardness	80–100 mg/L	40 mg/L	200 mg/L
Alkalinity	200–500 mg/L	120 mg/L	350 mg/L
Total disolved solids	<1,500 mg/L	1,050 mg/L	900 mg/L

The pH scale measures how acidic or basic a substance is on a scale of 0 to 14. Lower numbers indicate increasing acidity and higher numbers indicate increasing basicity. The normal pH level of groundwater systems is between 6 and 8.5. Water with a low pH (<6.5) could be acidic, soft, and corrosive and could contain elevated levels of toxic metal that might cause premature damage to metal piping. Water with a pH >8.5 could indicate that the water is hard. Hard water does not pose a health risk, but can cause mineral deposits on fixtures and dishes and can have a bad taste and odor.

Alkalinity is the water's capacity to resist changes in pH that would make the water more acidic. This resistance is achieved through a process called *buffering* (a buffered solution resists changes in pH until the buffer is used up). Alkalinity of natural water is determined by the soil and bedrock through which it passes. The main sources for natural alkalinity are rocks that contain carbonate, bicarbonate, and hydroxide compounds. These compounds, however, also cause hardness, which is less desirable in a drinking source. To illustrate the affect of alkalinity on pH stability, acid was added to two 100 milliliters sample solutions that initially had a pH of 6.5. The solution in Figure 1A had an alkalinity level of 200 mg/L while the solution in Figure 1B tested at zero alkalinity. The pH of the two solutions was recorded after every addition of acid and the results are shown in the figures below.

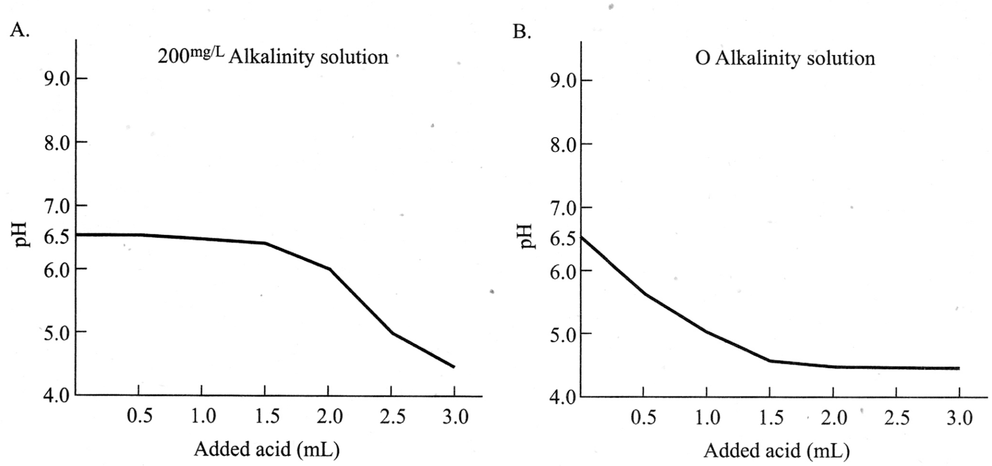

Figure 1

20. Which of the following statements best describes the concentration of lead in Sample 1?
F. The concentration of lead in Sample 1 is above the ideal level.
G. The concentration of lead in Sample 1 may be corrosive to surfaces.
H. The concentration of lead in Sample 1 is at or below the ideal level.
J. The concentration of lead in Sample 1 is less than the concentration of lead in Sample 2.

21. An ideal alkalinity level prevents pH levels from becoming too low. Which statement is best supported by this fact? When testing drinking water:
A. an alkalinity test is not necessary.
B. an alkalinity level above 500 is ideal.
C. ideal samples will have levels similar to that of Sample 1.
D. a proper alkalinity level can prevent water from becoming overly corrosive.

22. The test results of Sample 1 indicate that:
F. the water from Sample 1 is probably balanced and safe.
G. the water from Sample 1 is too acidic and corrosive.
H. alkalinity levels are high enough to prevent it from becoming overly acidic.
J. the water tested in Sample 1 is hard water.

23. Based on the test results, Sample 2 is acceptable as a water source as long as the developers:
A. are willing to accept high iron levels and hard water.
B. are willing to accept high lead levels and soft water.
C. are willing to accept high alkalinity levels and soft water.
D. treat the water to reduce its corrosive nature.

24. Suppose chemicals could be added to treat the high iron levels in either sample. The chemical additive would be safe to use in Sample 2 and not safe to use in Sample 1 if:
F. the chemical additive caused a drastic increase in pH levels in unbuffered solutions.
G. the chemical additive caused an increase in water hardness levels.
H. the chemical additive caused a decrease in total dissolved solids.
J. the chemical additive increased the amount of dissolved solids by at least 200 mg/L.

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20. The best answer is H. According to Table 1, the ideal lead level is below 0.015 mg/L. Sample 1 has a lead level of 0.01 mg/L, which is at the ideal lead level.

21. The best answer is C. The passage explains, "Water with a low pH (<6.5) could be acidic, soft, and corrosive." If an ideal alkalinity level prevents pH levels from becoming too low, it will also prevent water from becoming overly corrosive. Answer choice B can be eliminated because the ideal alkalinity level shown in Table 1 is between 200 and 500 mg/L.

22. The best answer is G. Table 1 shows that Sample 1's water had a pH of 6.0. Because the ideal pH level is between 6.5 and 8.5, the water in Sample 1 is too acidic, and therefore, too corrosive. Answer choice H can be eliminated because the alkalinity level of Sample 1 was below the ideal level.

23. The best answer is A. According to Table 1, Sample 2 water has the ideal levels of all of the tested factors except iron and hardness. The water tested above the ideal level for both of these factors. This water would be acceptable as long as the developers are willing to accept high iron levels and hard water. Answer choices B and C can be eliminated because only Sample 1 contained soft water.

24. The best answer is F. Sample 2 has an ideal level of alkalinity and can effectively buffer the water. Sample 1, however, has a level of alkalinity below the ideal and is susceptible to changes in pH. If the chemical additive caused a drastic increase in pH levels in un-buffered solutions, Sample 1's pH level would be unsafe but Sample 2 would be unaffected.