

Name	Test Bank Chapter 02
Description	
Instructions	It is particularly concerned about water quality on this tract because the existing park is widely known for its pristine streams. You visit the tract and begin conducting an on-site assessment of stream water quality. Several important issues arise as you begin this assessment. Please put your knowledge of the properties of water to work in answering the following questions about this assessment.

Question 1 ▼ **Essay**

Question You begin by measuring the acidity of one small stream (called Soft Branch) on this tract and find that its pH is 4.5. What would this finding lead you to conclude?

Answer The stream is abnormally acidic, given that the typical range of pH for small ponds and streams is between 6 and 9. The cause of the acidity should be determined. One might check for the existence of anthropogenic sources of acidity, such as acidic drainage from mining wastes.

Question 2 ▼ **Essay**

Question Your survey of the watershed of Soft Branch reveals no unusual sources of acidity, such as old mine tailings. Can you suggest another potential cause of the stream's acidity?

Answer Streams draining areas with bedrock deficient in calcium and magnesium (such as granite) may be naturally acidic, and this acidity may be exacerbated by acidic precipitation. Thus one might wish to determine the bedrock geology in the watershed of this stream. Data on the acidity of precipitation in the region might also be useful.

Question 3 ▼ **Essay**

Question You discover that populations of mollusks (such as snails, clams, and mussels) are relatively low in Soft Branch, compared with populations of these animals in streams of similar size in the adjacent Great Smoky Mountains National Park. What is one of the first things you might suspect as a cause of the scarcity of mollusks?

Answer The scarcity of hard-shelled animals might be due to a scarcity of calcium, essential for the formation of shells. Acidic streams are "soft," which means they carry relatively high levels of hydrogen ions (the case here) and low concentrations of calcium ions. As is the case for the previous question, one might wish to explore the cause of the acidity and low calcium further.

Question 4 ▼ **Essay**

Question The acidity of Soft Branch suggests that soils in the adjacent

watershed may also be acidic. If so, water in these soils will also be acidic, ultimately contributing to the acidity and chemical makeup of the stream. Hydrogen ions in soil water play an important role in dissolving essential elements (such as calcium) from the minerals in rocks and soils. This capability may also have negative environmental consequences in certain landscapes. Why?

Answer Hydrogen ions can dissolve naturally occurring toxic heavy metals, such as arsenic, cadmium, and mercury. These metals will then be carried into streams, where they create undesirable health effects for stream residents and animals feeding on aquatic organisms from these streams.

Question 5



Essay

Question You survey another small stream (called Hard Branch) flowing through the same tract of land. To your surprise, you discover that this stream is alkaline (pH in excess of 7). Upon further analysis the water is found to be "hard" with a relatively high concentration of calcium ions. What possible cause of this alkalinity might you consider?

Answer The alkalinity of this stream may be a reflection of bedrock geology. In particular, one might wish to consult a geological map of the area to determine whether this stream may drain an area with abundant limestone bedrock. The occurrence of such calcium-rich bedrock could explain the alkalinity of this stream.

Question 6



Essay

Question "The physical world provides the context for life, but also constrains its expression." Using an example from this chapter, show that you understand the meaning of this quotation.

Answer There are many possible answers. Each kind of habitat provides space and resources for organisms, but also constrains these organisms. The brine shrimp (*Artemia*) thrive in the Great Salt Lake (where the salinity can be as much as 8 times more than normal seawater) by excreting salt at a prodigious rate. To do so they incur a high energy cost, requiring an abundant food supply, in this case the photosynthetic bacteria that live in their hypersaline environment.

Question 7



Essay

Question In this chapter, Dr. Ricklefs draws an analogy between biological systems and buildings. Please summarize this analogy in your own words.

Answer Living organisms have a purposeful existence that transcends the constraints imposed by physical laws. In a similar fashion, architecture is constrained by the properties of building materials, but buildings have functions and purposes that transcend these constraints.


Question 8



Essay


Question What is acidity in aquatic systems and how is the acidity of water commonly expressed? Why do ecologists typically determine the acidity of aquatic systems?

Answer Acidity is the concentration of hydrogen ions, expressed as pH, the negative of the common logarithm of hydrogen ion concentration. Acidity, in turn, is important in dissolving minerals, determining the availability of nutrients, and regulating many life processes. Acidity may be used, along with other indicators, as a means of assessing the "health" of an aquatic system. For example, an unusually acidic lake in a particular region may have been affected by acidic seepage from mine tailings or acidic atmospheric deposition.

Question 9  **Essay**


Question The need to acquire carbon dioxide from the atmosphere creates a unique problem for terrestrial plants. As small amounts of carbon dioxide enter the leaf through tiny openings (called stomates), what essential resource are plants losing to the atmosphere?

Answer In order to gain carbon dioxide from the atmosphere, the plant must also lose prodigious amounts of water vapor to the atmosphere. For every gram of carbon assimilated, a plant will transpire approximately 500 grams of water.

Question 10  **Essay**

Question How do terrestrial plants regulate the amount of water they transpire? What negative consequences might result from prolonged reduction of the amount of water transpired?

Answer By closing their stomates, plants can reduce the amount of water lost to the atmosphere by transpiration. However, in so doing, plants also prevent the carbon dioxide required for photosynthesis from entering the leaf. As transpiration is reduced, so also is the essential flux of water and nutrients into the plant from the soil. Finally, the evaporation of water from leaf surfaces helps cool the leaves, which might otherwise overheat if exposed to direct sunlight.

Question 11  **Multiple Choice**


Question Sperm whales dive to great depths, spending more than an hour underwater before returning to the surface to breathe. During their extended dives, where do they store oxygen to maintain their metabolic processes?

Answer in the lungs (as a gas)

in the blood (bound to hemoglobin) and in the muscles (bound to myoglobin)

in the brain (bound to neurons) and in the heart (bound to the pericardium)

in extracellular fluids (as dissolved oxygen)

Question 12  **Multiple Choice**

Question Diving birds living in very cold regions (like the Adélie penguin described in the text) rely on what kind of insulation against the extreme cold of their surroundings?

Answer

a layer of fat beneath their skin

a layer of specialized proteins beneath their skin



air trapped in their plumage

water trapped in their plumage

Question 13

Multiple Choice

Question Water has an unusual property relevant to its significance as the basis of life as we know it. Which property is it?

Answer



Water has an immense capacity to dissolve inorganic compounds, facilitating the chemical processes of living systems.

The high density of water achieves the concentrations of molecules necessary for rapid chemical reactions.

No other common substance is liquid under most conditions at the earth's surface.

Question 14

Multiple Choice

Question Which of the following properties of water is *most* important in preventing the bottoms of large bodies of water (lakes and oceans) from freezing solid?

Answer

Water conducts heat rapidly.



Water is most dense at 4°C.

Water is capable of dissolving a wide array of substances.

Freezing of water requires the removal of 80 times as much heat as that needed to lower the temperature of the same quantity of water by 1°C.

Question 15

Multiple Choice

Question The bodies of many plants and animals are denser than the water in which they live. Which of the following attributes helps prevent these organisms from sinking?

Answer

gas-filled swim bladder (some fish)

filamentous appendages (some tiny marine animals)

accumulation of fats and oils (many aquatic organisms)



all of the above

Question 16

Multiple Choice

Question Of the nutrients listed below, all except one are required by all organisms. Which is it? (Hint: This element is required by diatoms.)

Answer

nitrogen
phosphorus
potassium
sulfur

silicon

Question 17

Multiple Choice

Question The element molybdenum is required in relatively large amounts by which of the following organisms?

Answer

nitrogen-fixing bacteria

all bacteria
all plants
all animals

Question 18

Multiple Choice

Question With the exception of oxygen, carbon, and some nitrogen, plants acquire their essential elements in what form?

Answer

as elements occurring in atmospheric gases
as elements occurring in minerals in soils and rocks

as elements occurring in ions dissolved in water

all of the above

Question 19

Multiple Choice

Question By the time rivers deliver water to the oceans, that water is enriched in many dissolved substances. Given that water droplets that condense from water vapor in the atmosphere are essentially pure water, what is the source of these dissolved substances?

Answer

atmospheric gases
minerals acquired from particles of dust and droplets of ocean spray in the atmosphere
minerals acquired from rocks and soils

all of the above

Question 20

Multiple Choice

Question The oceans of the earth have been receiving substances dissolved in water for much of the earth's history, resulting in the present levels of dissolved salts (about 3.4% by weight). Of the two important oceanic solutes listed below, one reached its current level eons ago, while the other is still

gradually increasing today. Which is still increasing today?

Answer calcium carbonate (CaCO_3)



sodium chloride (NaCl)

Question 21

Multiple Choice

Question How would you characterize the acidity/alkalinity of most naturally occurring surface waters?

Answer highly acidic

moderately acidic



approximately neutral

moderately alkaline

highly alkaline

Question 22

Multiple Choice

Question Phosphorus often limits plant production in terrestrial environments. Why is this the case?

Answer Phosphorus forms volatile compounds that are rapidly lost to the atmosphere.

Phosphorus binds with heavy metals (arsenic, cadmium, and mercury), forming compounds toxic to plants.



Phosphorus, even when abundant, forms compounds in the soil that do not dissolve easily in water.

Phosphorus typically exists as phosphate ions (PO_4^{3-}), which are not biologically active.

Question 23

Multiple Choice

Question Of the following size classes of soil mineral particles, which are the smallest, thus having the greatest surface area per unit volume of soil?

Answer clay

silt

sand

All of the above are equivalent in size and surface area per unit volume.

Question 24

Multiple Choice

Question Of the following size classes of soil mineral particles, which contribute the most to water-holding capacity of a soil?

Answer



clay

silt

sand

All of the above are equivalent in contribution to water-holding capacity

Question 25



Multiple Choice

Question Water molecules tend to adhere to the surfaces of soil particles. This physical force determines the matric potential of the soil, which in turn contributes to the water potential of the soil. As a soil dries out, the remaining water molecules are bound more _____ to the soil mineral particles, resulting in an increasingly _____ soil matric potential.

Answer

loosely, positive

loosely, negative

tightly, positive



tightly, negative

Question 26



Multiple Choice

Question Equal volumes of dry mineral soil are placed in two containers. The containers are designed to retain the soils they contain, but both have bottoms that are freely permeable to water. One soil is clayey and the other is sandy. Water is applied to the top of each container until it drains freely from the bottom of the container. No additional water is added, and each container is allowed to stand until no water drains from the bottom. Which container retains more water?

Answer



The container with the clayey soil.

The container with the sandy soil.

Both will contain the same amount of water.

Neither will contain any water.

Question 27



Multiple Choice

Question Which of the following soil matric potentials is considered by agronomists to represent the wilting point?

Answer

-0.01 MPa

-0.1 MPa



-1.5 MPa

-10 MPa

Question 28



Multiple Choice

Question When a membrane permeable to water separates water of more negative potential on one side of the membrane from water of less negative potential on the other, what will be the tendency of the water molecules?

Answer There will be a net diffusion of water molecules across the membrane from the side of more negative potential to the side of less negative potential.



There will be a net diffusion of water molecules across the membrane from the side of less negative potential to the side of more negative potential.

There will be equal movement of water molecules across the membrane in both directions.

There will be no movement of water molecules across the membrane.

Question 29



Multiple Choice

Question How do plants cause water to move from the soil into their roots?

Answer They actively pump water molecules across the cell membranes of their root cells.

They excrete substances from their roots that "push" water molecules into their root cells.

They maintain low concentrations of solutes in their root cells.



They maintain high concentrations of solutes in their root cells.

Question 30



Multiple Choice

Question How do plants prevent the depletion of solutes from their root cells into the dilute aqueous solution contained in the surrounding soil?

Answer They actively pump solute molecules from the soil solution, across their cell membranes, and into their root cells.

They have semipermeable membranes surrounding their root cells.

They maintain large molecules, such as soluble carbohydrates and proteins, in their root cells.



all of the above

Question 31



Multiple Choice

Question How do plants growing in deserts and salty environments obtain water from the soil?

Answer by greatly expanding the surface area of their root systems
by actively pumping water molecules from the soil into their root cells



by increasing the concentrations of solutes in their root cells

by decreasing the concentrations of solutes in their root cells

Question 32 **Multiple Choice**

Question According to the cohesion-tension theory of water movement in plants, what generates the force needed to move water from the roots to the tops of the tallest trees?

- Answer**
- pressure generated by molecular pumps located in the root cells
 - pressure generated by molecular pumps located in the xylem cells of the stem

- the highly negative potential generated when water evaporates from leaf cells into the atmosphere
- none of the above

Question 33 **Multiple Choice**

Question Transpiration occurs when water evaporates from leaf cell surfaces into the air spaces within the leaves, exiting the leaves through _____.

- Answer**
- stomates
 - xylem elements
 - guard cells
 - surface hairs

Question 34 **Multiple Choice**

Question Mangroves grow on salt-laden coastal mudflats that are inundated daily by high tides. How do these plants address problems of water acquisition and elimination of excess salts?

- Answer**
- by maintaining high concentrations of organic solutes in their roots
 - by excluding salts from their roots by active transport
 - by actively excreting salt from glands located on the surfaces of their leaves

- all of the above

Question 35 **Multiple Choice**

Question Certain marine birds and reptiles have evolved specialized organs to assist in the elimination of excess salts. What are these organs?

- Answer**
- enlarged kidneys
 - modified tear glands
 - specialized cells in the stomach lining

specialized scales on their legs

Question 36 **Multiple Choice**

Question Freshwater fish are hyperosmotic, living in a medium that has lower salt concentration than their bodies. As a consequence, these animals have to contend with which of the following?

Answer replacing water lost to the surrounding medium while eliminating excess salts

retaining salts while eliminating excess water absorbed from the surrounding medium

Question 37 **Multiple Choice**

Question Marine fish (excluding certain sharks and rays) are hypo-osmotic, living in a medium with a higher salt concentration than their bodies. As a consequence, these animals have to contend with which of the following?

Answer replacing water lost to the surrounding medium while eliminating excess salts

retaining salts while eliminating excess water absorbed from the surrounding medium

Question 38 **Multiple Choice**

Question Which of the following kinds of fish would you expect to drink water?

Answer freshwater fish

marine fish

Question 39 **Multiple Choice**

Question Marine species of sharks and rays have a unique way of raising the osmotic potential of their blood to that of the surrounding seawater. What is this mechanism?

Answer retention of urea in the bloodstream

retention of sodium chloride in the bloodstream
retention of small carbohydrate molecules in their bloodstream
all of the above

Question 40 **Multiple Choice**

Question What challenge do carnivorous terrestrial animals face with regard to their nitrogen economy?

Answer



They consume nitrogen (in the form of proteins and nucleic acids) in excess of their needs, but cannot afford the large amount of water required to eliminate this nitrogen as ammonium ions.

Because their diets are deficient in nitrogen, they must exert strict control over loss of ammonium ions along with other waste products.

Question 41



Fill in the Blank

Question As water cools, its density increases until it reaches a temperature of _____°C, at which point it becomes less dense upon further cooling.

Answer 4

Incorrect Feedback As water cools, its density increases until it reaches a temperature of 4°C, at which point it becomes less dense upon further cooling.

Question 42



Fill in the Blank

Question The _____ of water resists the movement of a body through it but also slows the rate of sinking.

Answer viscosity

Incorrect Feedback The viscosity of water resists the movement of a body through it but also slows the rate of sinking.

Question 43



Fill in the Blank

Question The element _____ is a structural component of nucleic acids, phospholipids, and bone.

Answer phosphorus

Incorrect Feedback The element phosphorus is a structural component of nucleic acids, phospholipids, and bone.

Question 44



Fill in the Blank

Question The element _____ is a structural component of plant cell walls.

Answer calcium

Incorrect Feedback The element calcium is a structural component of plant cell walls.

Question 45



Fill in the Blank

Question Some solid compounds consist of electrically charged atoms or groups of atoms called _____.

Answer ions

**Incorrect
Feedback**

Some solid compounds consist of electrically charged atoms or groups of atoms called ions.

Question 46

Fill in the Blank

Question Acidity is commonly expressed as _____, which is the negative of the common logarithm of hydrogen ion concentration, measured in moles per liter.

Answer pH

**Incorrect
Feedback**

Acidity is commonly expressed as pH, which is the negative of the common logarithm of hydrogen ion concentration, measured in moles per liter.

Question 47

Fill in the Blank

Question The amount of water that is held in a soil against the force of gravity by a matric potential of less than -0.01 MPa is called the _____.

Answer field capacity

**Incorrect
Feedback**

The amount of water that is held in a soil against the force of gravity by a matric potential of less than -0.01 MPa is called the field capacity.

Question 48

Fill in the Blank

Question The force with which an aqueous solution attracts water by osmosis is known as its _____ potential.

Answer osmotic

**Incorrect
Feedback**

The force with which an aqueous solution attracts water by osmosis is known as its osmotic potential.

Question 49

Question Most aquatic animals produce a simple metabolic by-product of nitrogen metabolism called _____.

Answer ammonia

**Incorrect
Feedback**

Most aquatic animals produce a simple metabolic by-product of nitrogen metabolism called ammonia.

Question 50

Question Terrestrial animals face the dual challenges of excreting nitrogen while conserving water. Birds and reptiles face these challenges by excreting excess nitrogen in the form of _____, which can be passed as a highly concentrated paste.

Answer uric acid

**Incorrect
Feedback**

Terrestrial animals face the dual challenges of excreting nitrogen while conserving water. Birds and reptiles face these challenges

by excreting excess nitrogen in the form of uric acid, which can be passed as a highly concentrated paste.