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| **Chapter # and Question type** | **Question** | **Answer** |
| Chapter 1  Short answer #1. | How did Louis Pasteur help disprove spontaneous generation? | Pasteur demonstrated that swan necked flasks containing sterile growth medium would remain sterile indefinitely if the bend in the flask did not come in contact with the medium. |
| Chapter 1  Short answer #2. | Give three reasons why life could not exist without the activities of  microorganisms. | * Nitrogen would not be available in a form that humans and plants could use. * The supply of oxygen would be depleted after about 20 years if microorganisms were not available to replenish it. * A wide variety of materials would pile up if microorganisms were not present to degrade them. |
| Chapter 1  Short answer #3. | List five beneficial applications of bacteria. | * Their role in food and beverage production * Role in pollutant degradation * Synthesis of commercially valuable products * Their importance in synthesizing medically important products, following genetic modification * Their importance as model organisms for the study of universal biological processes |
| Chapter 1  Short answer #4. | State three reasons why there is a resurgence of infectious diseases  today. | * Aging population is more susceptible to disease * Organisms controlled by antimicrobial medications have become resistant to the medications * Children are not being routinely vaccinated against many diseases |
| Chapter 1  Short answer #5. | Name the prokaryotic groups in the microbial world. | *Bacteria* and *Archaea* |
| Chapter 1  Short answer #6. | Name one location where you could isolate members of the  Archaea. | The hot springs of Yellowstone National Park |
| Chapter 1  Short answer #7. | How might you distinguish a prokaryotic cell from a eukaryotic cell? | The prokaryotic cell does not have a nucleus whereas the eukaryotic cell does. |
| Chapter 1  Short answer #8. | In the designation *Escherichia coli* B, what is the genus? What is the species? What is the strain? | *Escherichia* is the genus; *coli* is the species and *B* is the strain. |
| Chapter 1  Short answer #9. | Why are viruses not microorganisms? | . Viruses do not have all of the machinery necessary to live and so they must use that of a host cell in order to replicate. |
| Chapter 1  Short answer #10. | Name three non-living groups in the microbial world and describe  their major properties. | * Viruses contain a protein coat and either DNA or RNA. They are obligate intracellular parasites of all forms of life. * Viroids contain only a short RNA molecule. They cause serious plant diseases   Prions consist only of protein that is a misfolded version of normal cellular protein found in the brain of animals. They are resistant to the commonly used sterilizing procedures that kill viruses and bacteria. They are responsible for fatal neurological diseases |
| Chapter 1  Multiple Choice #1 | The property of endospores that led to confusion in the experiments  on spontaneous generation is their  a) small size.  b) ability to pass through cork stoppers.  c) heat resistance.  d) presence in all infusions.  e) presence on cotton plugs. | . (C) |
| Chapter 1  Multiple Choice #2 | The “Golden Age of Microbiology” was the time when  a) microorganisms were first used to make bread.  b) microorganisms were first used to make cheese.  c) most pathogenic bacteria were identified.  d) a vaccine against influenza was developed.  e) antibiotics became available. | . (C) |
| Chapter 1  Multiple Choice #3 | Microorganisms play a role in  a) disease. b) biodegradation. c) cheese production.  d) nitrogen recycling. e) all of the above. | (E) |
| Chapter 1  Multiple Choice #4 | Which disease was once thought to be due to stress but is now  known to be caused by a bacterium?  a) smallpox b) peptic ulcers c) AIDS  d) plague e) influenza | . (B) |
| Chapter 1  Multiple Choice #5 | The prokaryotic members of the microbial world include  1. algae. 2. fungi. 3. prions. 4. bacteria. 5. archaea.  a) 1, 2 b) 2, 3 c) 3, 4 d) 4, 5 e) 1, 5 | (D) |
| Chapter 1  Multiple Choice #6 | The Archaea  1. are microscopic.  2. are commonly found in extreme environments.  3. contain peptidoglycan.  4. contain mitochondria.  5. are most commonly found in the soil.  a) 1, 2 b) 2, 3 c) 3, 4 d) 4, 5 e) 1, 5 | (A) |
| Chapter 1  Multiple Choice #7 | Prokaryotes typically do not have  a) cell walls. b) flagella. c) a nuclear membrane.  d) specific shapes. e) genetic information. | . (C) |
| Chapter 1  Multiple Choice #8 | Nucleoids are associated with  1. genetic information. 2. prokaryotes.  3. eukaryotes. 4. viruses. 5. prions.  a) 1, 2 b) 2, 3 c) 3, 4 d) 4, 5 e) 1, 5 | . (A) |
| Chapter 1  Multiple Choice  # 9 | Viruses  1. contain both protein and nucleic acid.  2. infect all domains of life.  3. can grow in the absence of living cells.  4. are generally the same size as prokaryotes.  5. always kill the cells they infect.  a) 1, 2 b) 2, 3 c) 3, 4 d) 4, 5 e) 1, 5 | (A) |
| Chapter 1  Multiple Choice #10 | Antony van Leeuwenhoek could not have observed  a) roundworms. b) Escherichia coli.  c) yeasts. d) viruses. | (D) |
| Chapter 1  Applications #1 | The American Society for Microbiology is preparing a “Microbe-Free” banquet to emphasize the importance of microorganisms in the diet. What foods could not be on the menu? | . Nothing would be available to eat. Microorganisms are needed for crop production, so vegetables or fruits would not be available to eat. Cattle, chickens, pigs and other animals need microorganisms to assist with the digestion of food. They would be undernourished and not provide quality meat or products adequate for human consumption. Do not look for fish or any other lake or ocean products because these ecosystems are needed for their survival. Milk and alcoholic beverages would be off the menu. Any beverage prepared with water would be unsafe to consume. Water is cleaned and treated to be disease-free with microorganisms. |
| Chapter 1  Applications #2 | If you were asked to nominate one of the individuals mentioned in this chapter for the Nobel Prize, who would it be? Make a statement supporting your choice. | Any answer that is supported. |
| Chapter 1  Critical Thinking #1 | A microbiologist obtained two pure biological samples: one of a virus, and the other of a viroid. Unfortunately, the labels had been lost. The microbiologist felt she could distinguish the two by analyzing for the presence or absence of a single molecule.  What molecule would she search for and why? | Test for proteins. |
| Chapter 1  Critical Thinking #2 | Why is the bacterium that causes anthrax such an effective agent of bioterrorism? | Spores, in general, are an effective agent of bioterrorism because they are environmentally tough, “invisible” and can be readily delivered through the air, all of which enables them to potentially infect large numbers of people easily. |
| **Chapter 2** |  |  |
| Chapter 2  Short Answer #1 | Differentiate between an atom, a molecule, and a compound. | An atom is the basic unit of all matter. A molecule is composed of two or more atoms joined through chemical bonds. A compound consists of molecules of two or more different elements. |
| Chapter 2  Short Answer #2 | Why is water a good solvent? | Because of its polar nature, water can form hydrogen bonds with all all polar molecules thereby preventing the association of the atoms comprising the molecules. |
| Chapter 2  Short Answer #3 | Which solution is more acidic, one with a pH of 4 or a pH of 5? What is the concentration of H+ ions in each? The concentration of OH- ions? | A pH of 4 is more acidic. A solution of 4 has a H+ concentration of 10-4 and a 10-10 0H- concentration.A solution with a pH of 5 has a H+ concentration of 10-5 and an 0H concentration of 10-9. |
| Chapter 2  Short Answer #4 | Name the subunits of proteins, polysaccharides, and nucleic acids. | Subunits of proteins are amino acids; subunits of polysaccharides are monosaccharides; subunits of nucleic acids are nucleotides |
| Chapter 2  Short Answer #5 | Give an example of dehydration synthesis. Give an example of a hydrolysis reaction. How are these reactions related? | Dehydration synthesis is involved in the joining together of two amino acids with the loss of water in the chemical reaction. Hydrolysis is involved in the splitting part of the two amino acidswith the addition of H+ to one amino acid and OH- to the other.  Dehydration synthesis is the reverse of hydrolysis. |
| Chapter 2  Short Answer #6 | List four functions of proteins. | Catalyse enzymatic reactions  Move the cell  Serve as components of certain cell structures  Turn genes off and on |
| Chapter 2  Short Answer #7 | What are the four levels of protein structure, and what is the distin­guishing feature of each? | Primary structure—The sequence of amino acids comprising the protein  Secondary structure—The three-- dimensional shape of localized regions  Tertiary structure---The three—dimensional shape of the entire molecule  Quarternary structure—The three-dimensional shape of a protein molecule consisting of more than one polypeptide chain. |
| Chapter 2  Short Answer #8 | How do the two types of nucleic acids differ from one another in (a) composition, (b) size, and (c) function? | (a) DNA contains deoxyribose; RNA contains ribose.  (b)DNA is much longer than RNA  (c) DNA codes for all of the genetic information of the cell. RNA is involved in decoding the information in DNA. |
| Chapter 2  Short Answer #9 | What are the two major groups of lipids? Give an example of each group. What feature is common to all lipids? | Simple and compound  Fats are simple lipids; phospholipids are compound.  All lipids are insoluble in water. |
| Chapter 2  Short Answer #10 | What features do all lipids share? | All lipids are heterogeneous in their chemical composition and insoluble in water but soluble in organic solvents. |
| Chapter 2  Multiple Choice #1 | Choose the list that goes from the lightest to the heaviest:  a) proton, atom, molecule, compound, electron.  b) atom, proton, compound, molecule, electron.  c) electron, proton, atom, molecule, compound.  d) atom, electron, proton, molecule, compound.  e) proton, atom, electron, molecule, compound. | C |
| Chapter 2  Multiple Choice #2 | The strongest chemical bonds  between two atoms in  solution are  a) covalent. b) ionic.  c) hydrogen bonds. d) hydrophobic interactions. | . A |
| Chapter 2  Multiple Choice #3 | Dehydration synthesis is  involved in the synthesis of  all of the following except  a) DNA. b) proteins. c) polysaccharides.  d) lipids. e) monosaccharides. | . E |
| Chapter 2  Multiple Choice #4 | The primary structure of a  protein relates to its  a) sequence of amino acids. b) length. c) shape.  d) solubility. e) bonds between amino acids. | A |
| Chapter 2  Multiple Choice #5 | Pure water has all of the  following properties except  a) polarity. b) ability to dissolve lipids. c) pH of 7.  d) covalent joining of its atoms. e) ability to form hydrogen bonds. | . B |
| Chapter 2  Multiple Choice #6 | The macromolecules that are  composed of carbon,  hydrogen, and oxygen in an  approximate ratio of 1:2:1 are  a) proteins. b) lipids. c) polysaccharides.  d) DNA. e) RNA. | . C |
| Chapter 2  Multiple Choice #7 | In proteins, α helices and β pleatedstructures  are associated with the  a) primary structure. b) secondary structure.  c) tertiary structure. d) quaternary structure.  e) multiprotein complexes. | . B |
| Chapter 2  Multiple Choice #8 | Complementarity plays a major role in the structure of  a) proteins. b) lipids. c) polysaccharides. d) DNA.  e) RNA. | D |
| Chapter 2  Multiple Choice #9 | A bilayer is associated with  a) proteins. b) DNA. c) RNA.  d) complex polysaccharides. e) phospholipids. | D. |
| Chapter 2  Multiple Choice #10 | Isomers are associated with  1. carbohydrates. 2. amino acids. 3. nucleotides. 4. RNA. 5. fatty acids. a) 1, 2 b) 2, 3 c) 3, 4 d) 4, 5 e) 1, 5 | . A |
| Chapter 2  Applications #1 | A group of prokaryotes known as thermophiles thrive at high temperatures that would normally destroy other organisms. Yet these thermophiles cannot survive well at the lower tempera­tures normally found on the earth. Propose an explanation for this observation. | The enzymes can function well at the high temperatures but function poorly at the lower temperatures. |
| Chapter 2  Applications #2 | Microorganisms use hydrogen bonds to attach to surfaces. Many of the cells lose hold of the surface because of the weak nature of these bonds. Contrast the benefits and disadvantages of using covalent bonds as a means of attaching to surfaces. | The weak hydrogen bonds allow the organisms to detach and reattach very quickly and so the organisms can respond very quickly to changing conditions in the environment. Further, very little energy is required to attach and detach from surfaces. |
| Chapter 2  Critical Thinking #1 | What properties of the carbon atom make it ideal as the key atom for all molecules in organisms? | Carbon is the major building block of all matter because it can form four covalent bonds with other atoms including carbon atoms. Since these bonds can be single, double or triple bonds, with a variety of elements, a wide variety of different molecules can be formed. The bonds can be polar or non polar so a wide variety of molecules with different weak bonding properties can be formed. |
| Chapter 2  Critical Thinking #2 | A biologist determined the amounts of several amino acids in two separate samples of pure protein. The data are shown here: **Amino Acid Leucine Alanine Histidine Cysteine Glycine**  Protein A 7% 12% 4% 2% 5%  Protein B 7% 12% 4% 2% 5%  The scientist concluded that protein A and protein B were the same protein. Do you agree with this conclusion? Justify your answer. | No. The amino acids might be arranged differently so the two proteins would be quite different and have different properties. |
| Chapter 2  Critical Thinking #3 | This table indicates the freezing and boiling points of several molecules: **Molecule Freezing Point (°C) Boiling Point (°C)**  Water 0 100  Carbon tetrachloride (CCl4) – 23 77  Methane (CH4) – 182 – 164  Carbon tetrachloride and methane are non-polar molecules. How does the polarity and non-polarity of these molecules explain why the freezing and boiling points for methane and carbon tetrachlo­ride are so much lower than those for water? | Because of the hydrogen bonding between water molecules, much energy is required in the form of heat to break the bonds and convert the liquid into a gas. If there is no hydrogen bonding between molecules, less energy ( a lower temperature ) is required.  Further, as the temperature drops, weak hydrogen bonds between water molecules are broken less frequently until a crystalline structure ( ice ) is formed in which hydrogen bonding between molecules is most stable. Molecules that can not form hydrogen bonds between molecules must reach lower temperatures to achieve stability between molecules and form a crystalline structure. |
| **Chapter 3** |  |  |
| Chapter 3  Short Answer #1 | Explain why resolving power is important in microscopy. | The resolving power, which is the minimum distance that can exist between two objects when those objects can still be observed as separate entities, determines how much detail actually can be seen. |
| Chapter 3  Short Answer #2 | Explain why basic dyes are used more frequently than acidic dyes in staining. | Basic dyes carry a positive charge; opposite charges attract, so these dyes are drawn to the many negatively charged components of cells, including nucleic acid and many proteins. Acidic dyes carry a negative charge and are repelled by those cell components. |
| Chapter 3  Short Answer #3 | Describe what happens at each step in the Gram stain. | #1 Crystal violet is the primary stain, entering the cytoplasm and imparting a color to all cells that can be stained.  #2 Iodine complexes with the crystal violet within the cell, acting as a “mordant” to enhance the affinity of the cellular components for a dye.  #3 Acetone/alcohol removes the crystal violet-iodine complex from Gram-negative cells making them colorless.  #4 Safranin serves as a counterstain that imparts a pink color to the otherwise colorless Gram-negative cells. |
| Chapter 3  Short Answer #4 | Compare and contrast ABC transport systems with group translocation. | An ABC transport system is an active transport mechanism that requires the energy of ATP to drive the accumulation of molecules against a concentration gradient; the process does not alter the transported molecule. Group translocation chemically alters a molecule during passage, often by phosphorylating it; the energy expended to phosphorylate the molecule can be regained when that sugar is later broken down to provide energy. |
| Chapter 3  Short Answer #5 | Give two reasons why the outer membrane of Gram-negative bac­teria is medically significant. | #1 The outer membrane prevents entry of important antimicrobial drugs such as vancomycin.  #2 The Lipid A component of lipopolysaccharide (LPS) is responsible for many of the symptoms associated with Gram-negative infections, which is why the LPS-containing outer membrane is called endotoxin. |
| Chapter 3  Short Answer #6 | Compare and contrast penicillin and lysozyme. | Penicillin interferes with the synthesis of peptidoglycan; it binds to proteins involved in cell wall synthesis (penicillin-binding proteins). This prevents the cross-linking of adjacent glycan chains. Lysozyme destroys existing bonds in the glycan chain; it breaks the bond that links the alternating *N*-acetylglucosamine and *N*-acetylmuramic acid molecules. Both penicillin and lysozyme result in a weakened cell wall, ultimately causing the cell to lyse. However, penicillin works only on actively growing cells, while lysozyme can cause lysis of both growing and nongrowing cells. |
| Chapter 3  Short Answer #7 | Describe how a plasmid can help a cell. | Plasmids encode genetic characteristics such as antibiotic resistance that may be advantageous in certain situations. However, excess genetic information can slow a cell’s replication, which can put the cell at a competitive disadvantage when the information does not provide an advantage. |
| Chapter 3  Short Answer #8 | How is an organ different from tissue? | Cells of plants and animals function in cooperative associations called tissues; examples include muscle, connective, nerve, epithelial, blood and lymphoid. Combinations of various tissues function together to make up larger units, organs, including skin, heart and liver. |
| Chapter 3  Short Answer #9 | How is receptor-mediated endocytosis different from phagocytosis? | Receptor-mediated endocytosis allows cells to internalize relatively small extracellular molecules that bind to the cell’s receptors. Certain regions of the cell membrane are lined with a protein called clathrin and studded with receptors. These regions are internalized to form an endocytic vesicle, bringing with them the receptors along with their bound ligands. In contrast, phagocytosis allows a cell to bring in relatively large particles, including bacteria. The cells send out arm-like extensions, pseudopods, which surround and enclose extracellular material. This action envelopes the material, bringing it into the cell in an enclosed compartment called a phagosome. |
| Chapter 3  Short Answer #10 | Explain how the Golgi apparatus cooperatively functions with the endoplasmic reticulum. | Macromolecules such as proteins and lipids are synthesized in the endoplasmic reticulum and then transported in vesicles to the Golgi apparatus. There, they are modified, sorted and packaged in vesicles for transport to other cellular locations or to the outside of the cell. |
| Chapter 3  Multiple Choice #1 | Which of the following is  most likely to be used in a  typical micro­biology laboratory?   1. Bright-field microscope 2. Confocal scanning microscope   c) Phase-contrast microscope  d) Scanning electron microscope  e) Transmission electron microscope | A |
| Chapter 3  Multiple Choice #2 | When a medical technologist wants to determine if a clinical specimen contains a Mycobacterium species, which should be used?  a) Acid-fast stain b)Capsule stain  c) Endospore stain  d) Gram stain  e) Simple stain | A |
| Chapter 3  Multiple Choice #3 | When a medical technologist wants to determine if a clinical specimen contains a Mycobacterium species, which should be used?  a) Acid-fast stain b)Capsule stain  c) Endospore stain  d) Gram stain  e) Simple stain | E |
| Chapter 3  Multiple Choice #4 | Endotoxin is associated with  a) Gram-positive bacteria.  b) Gram-negative bacteria.  c) the cytoplasmic membrane.  d) the endospore. | B |
| Chapter 3  Multiple Choice #5 | The “O157” in the name *E.* coli O157:H7 refers to the type of O antigen. From this information you know that E. coli a) has a capsule. b) is a rod.  c) is a coccus. d) is Gram-positive. e) is Gram-negative. | E |
| Chapter 3  Multiple Choice #6 | Eliminating which structure is always deadly to cells? a) Flagella b) Capsule c) Cell wall  d) Cytoplasmic membrane e) Fimbriae | D |
| Chapter 3  Multiple Choice #7 | Which of the following do  bacterial cells use for  attachment? 1.Capsule  2. Pilus 3.Cytoplasmic membrane.  4.Periplasm 5. Peptidoglycan  a) 1, 2 b) 2, 3 c) 3, 4 d) 4, 5 e) 1, 5 | A |
| Chapter 3  Multiple Choice #8 | Endocytosis is associated with a) mitochondria.  b) prokaryotic cells.  c) eukaryotic cells.  d) chloroplasts.  e) ribosomes. | C |
| Chapter 3  Multiple Choice #9 | Protein synthesis is associated with  1. lysosomes. 2. the cytoplasmic membrane.  3. the Golgi apparatus. 4. rough endoplasmic reticulum. 5. ribosomes.  a) 1, 2 b) 2, 3 c) 3, 4 d) 4, 5 e) 1, 5 | D |
| Chapter 3  Multiple Choice #10 | If a eukaryotic cell were treated with a chemical that destroys tubulin, all of the following would be directly affected except a) actin.  b) cilia. c) eukaryotic flagella.  d) microtubules. e) More than one of these. | A |
| Chapter 3  Applications #1 | You are working in a laboratory producing new antibiotics for human and veterinary use. One compound with potential value inhibits the action of prokaryotic ribosomes. The compound, how­ever, was shown to inhibit the growth of animal cells in culture. What is one possible explanation for its effect on animal cells? | The antibiotic could be entering the cells and acting on the mitochondria. Mitochondria, like bacteria, have 70S ribosomes. |
| Chapter 3  Applications #2 | A research laboratory is investigating environmental factors that inhibit the growth of archaea. They wonder if penicillin would be effective in controlling their growth. Explain the probable results of an experiment in which penicillin is added to a culture of archaea. | Penicillin interferes with the synthesis of peptidoglycan. The cell walls of archaea do not have peptidoglycan so they are probably not affected by penicillin. |
| Chapter 3  Critical Thinking #1 | This graph shows facilitated diffusion of a compound across a cytoplasmic membrane and into a cell. As the external concentra­tion of the compound is increased, the rate of uptake increases until it reaches a point where it slows and then begins to plateau. This is not the case with passive diffusion, where the rate of uptake continually increases. Why does the rate of uptake slow and then eventually plateau with facilitated diffusion? | In facilitated diffusion, transported compounds combine with a transporter or carrier on the outside surface of the cytoplasmic membrane, resulting in translocation of the compound across the membrane. When the external concentration of a compound is low, carrier molecules are readily available; solute molecules can easily “find” a free carrier. When the external concentration is high, competition for free carriers occurs. Eventually, all carriers will become saturated, and the rate of transport will be constant. At this point, the number of carriers and the time it takes the carriers to translocate the compound across the membrane limits transport. |
| Chapter 3  Critical Thinking #2 | Most medically useful antibiotics interfere with either peptidogly­can synthesis or ribosome function. Why would the cytoplasmic membrane be a poor target for antibacterial medications? | The structure of the cytoplasmic membrane of prokaryotes is similar to that of eukaryotes: a phospholipid bilayer. Thus, medications that damage the prokaryotic membrane would likely adversely impact mammalian membranes as well. In contrast, peptidoglycan is unique to prokaryotes, and the prokaryotic ribosome (70S) is different from that of eukaryotic cells (80S) (although it is the same as the mitochondrial ribosomes). |
| **Chapter 4** |  |  |
| Chapter 4  Short Answer #1 | Describe a detrimental and a beneficial effect of biofilms. | Detrimental effect — dental plaque. Beneficial effect — bioremediation and sewage treatment |
| Chapter 4  Short Answer #2 | Define a pure culture. | A population of organisms that are descended from a single cell. |