

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

- 1) Which statement is generally NOT true? 1) _____
A) Microbial cells exist as single cells.
B) Microbial cells exclude the cells of plants and animals.
C) Microbial cells carry out their life processes of growth independently.
D) Microbial cells include both bacteria and viruses.

Answer: D

- 2) Basic microbiology can be used to 2) _____
A) probe the fundamental processes of life.
B) model our understanding of cellular processes in multicellular organisms, including humans.
C) study characteristics of cells of multicellular organisms.
D) do all of the above.

Answer: D

- 3) Applied microbiology deals with important practical problems in 3) _____
A) agriculture. B) industry. C) medicine. D) all of the above.

Answer: D

- 4) The largest mass of living material on Earth comes from 4) _____
A) microorganisms. B) plants.
C) plants and animals together. D) animals.

Answer: A

- 5) Differential selection and reproduction of phenotypes occurs during a process called 5) _____
A) growth. B) transformation.
C) cellular differentiation. D) evolution.

Answer: D

- 6) In what/which domain(s) of life is/are microorganisms represented? 6) _____
A) Bacteria B) Archaea C) Eukarya D) all of the above

Answer: D

- 7) A specific molecule, used especially by evolutionary biologists, that is unique to a particular taxonomical group is called a 7) _____
A) genome. B) metabolic tracer.
C) taxon. D) biomarker.

Answer: D

- 8) Protein catalysts involved in the acceleration of the rate of chemical reactions are called 8) _____
A) growth agents. B) enzymes.
C) evolutionary molecules. D) catalytic converters.

Answer: B

- 9) Regarding early life on Earth, 9) _____
A) microbial life, plant life, and animal life all appeared at about the same time.
B) microbial life existed long before animals but has been around for about the same amount of time as plants.
C) microbial life existed for billions of years before plant and animal life.
D) it is impossible to determine which type of life first appeared.

Answer: C

- 10) Most prokaryotic cells reside 10) _____
A) in the oceanic and terrestrial subsurfaces.
B) in and on nonprokaryotic organisms (including humans and other animals).
C) in lakes, rivers, and oceans.
D) on Earth's surface.

Answer: A

- 11) The person who described the "wee animalcules" was 11) _____
A) Louis Pasteur. B) Robert Hooke.
C) Antoni van Leeuwenhoek. D) Ferdinand Cohn.

Answer: C

- 12) Fannie Hesse is credited with giving _____ the idea to use agar as a solidifying agent. 12) _____
A) Robert Koch B) Sergei Winogradsky
C) Louis Pasteur D) Ferdinand Cohn

Answer: A

- 13) Which of the following is/are characteristic of cellular organisms? 13) _____
A) regeneration and reproduction B) communication
C) metabolism D) all of the above

Answer: D

- 14) Which of the following is NOT a major ecosystem? 14) _____
A) terrestrial
B) atmospheric
C) aquatic
D) other organisms, such as plants and animals

Answer: B

- 15) Which statement is TRUE? 15) _____
A) Habitats are assemblages of microbial communities.
B) Populations are assemblages of microbial communities.
C) Populations are assemblages of habitats.
D) Microbial communities are assemblages of populations.

Answer: D

- 16) Louis Pasteur developed the vaccine(s) for 16) _____
A) fowl cholera. B) rabies. C) anthrax. D) all of the above.

Answer: D

- 17) The discovery of antibiotics and other important chemicals led to the field of _____ 17) _____
A) agricultural microbiology. B) marine microbiology.
C) industrial microbiology. D) aquatic microbiology.

Answer: C

- 18) Microbial sterilization is used to _____ 18) _____
A) clean a work area.
B) decrease the possibility of contaminants growing in a culture.
C) kill bacteria but not necessarily viruses or other microbes.
D) kill all microbes in or on objects.

Answer: D

- 19) Transparent double-sided dishes used for growing microbes are most commonly called _____ 19) _____
A) sterilization plates. B) culture medium plates.
C) baker dishes. D) Petri dishes.

Answer: D

- 20) Microbes playing a role in nitrogen fixation in plants live in _____, while those playing a role in the digestive tract of certain herbivores live in _____. 20) _____
A) fortrans / rumens B) nodules / rumens
C) nodules / fortrans D) rumens / nodules

Answer: B

- 21) Which of the following is NOT an accomplishment of Louis Pasteur? 21) _____
A) determined that the alcohol-making process was mediated by microbial fermentation and thus refuted the theory of spontaneous generation
B) developed enrichment culture techniques
C) developed the first rabies vaccine and treated thousands of individuals
D) developed heat sterilization techniques that involved the creation of a specialized swan-necked flask

Answer: B

- 22) The theory of spontaneous generation was refuted by the work of _____ 22) _____
A) Antoni van Leeuwenhoek. B) Robert Koch.
C) Louis Pasteur. D) Robert Hooke.

Answer: C

- 23) A Pasteur flask has a(n) _____ 23) _____
A) inverted upper edge to prevent spillage while swirling.
B) swan neck to prevent particulate matter from getting into the main body of the flask.
C) secondary opening at the base to allow for drainage.
D) double neck so two substances may be added at the same time.

Answer: B

- 24) Robert Koch's greatest accomplishment in the field of medical bacteriology was with _____ 24) _____
A) *Bacillus subtilis*. B) *Escherichia coli*.
C) *Mycobacterium tuberculosis*. D) *Bacillus cereus*.

Answer: C

- 25) A pure culture _____
A) is sterile.
B) is made of a clearly defined chemical medium.
C) was cultured for a certified stock culture.
D) is a population of identical cells.
Answer: D
- 26) Martinus Beijerinck was the first to isolate _____
A) certain nitrogen-fixing root nodule bacteria.
B) certain sulfate-reducing bacteria.
C) green algae.
D) all of the above.
Answer: D
- 27) Chemolithotrophy involves _____
A) reduction of organic compounds. B) metabolic autotrophy.
C) oxidation of inorganic compounds. D) oxidation of organic compounds.
Answer: C
- 28) Developments in the fields of immunology and medical microbiology were practical extensions of the work of _____
A) Sergei Winogradsky. B) Robert Koch.
C) Antoni van Leeuwenhoek. D) Joseph Lister.
Answer: B
- 29) Microbial control in wastewaters would most logically be a part of _____
A) aquatic microbiology. B) microbial genetics.
C) bacterial energetics. D) microbial technology.
Answer: A
- 30) Robert Koch contributed to the field of microbiology by being the first person to _____
A) formulate four postulates for definitively linking a specific microorganism to a specific disease.
B) develop the tuberculin test.
C) use agar as a solidifying agent in growth media.
D) all of the above.
Answer: D
- 31) The science of grouping and classifying microorganisms is known as _____
A) metabolomics. B) proteomics.
C) microbial physiology. D) microbial systematics.
Answer: D
- 32) Mycobacterium tuberculosis is very difficult to stain because of the _____
A) location of the DNA within the cell.
B) lack of a cell wall.
C) large amounts of a waxy lipid present in its cell wall.
D) presence of ribosomes in the cytoplasm.
Answer: C

- 33) Louis Pasteur's most famous success was his work on _____
A) *Mycobacterium tuberculosis*. B) the rabies vaccine.
C) fermentation in the winemaking process. D) optical isomers.

Answer: B

- 34) Microorganisms play key roles in the cycling of important nutrients in plant nutrition, particularly those of _____
A) carbon. B) carbon, nitrogen, and sulfur.
C) nitrogen. D) sulfur.

Answer: B

- 35) Microbial ecology is the study of _____
A) microbial processes in the soil that benefit plant growth.
B) microorganisms in their natural environments.
C) the diversity and activities of marine microorganisms.
D) the grouping and classifying of microorganisms.

Answer: B

- 36) The structure that confers structural strength on the cell is known as the _____
A) cytoplasmic membrane. B) cytoplasm.
C) ribosome. D) cell wall.

Answer: D

- 37) Which part of the human body does not contain a significant normal microbial flora? _____
A) skin B) oral cavity C) large intestine D) stomach

Answer: D

TRUE/FALSE. Write 'T' if the statement is true and 'F' if the statement is false.

- 38) Without microorganisms, all higher life forms on Earth would cease to exist. _____
Answer: True False

- 39) Most microorganisms are pathogenic. _____
Answer: True False

- 40) All microorganisms require molecular oxygen to carry on life functions. _____
Answer: True False

- 41) Metabolism is common to all cellular organisms. _____
Answer: True False

- 42) According to our present understanding, each of the major domains has what is known as its own universal ancestor. _____
Answer: True False

- 43) Microbiology as a distinct science did not develop until the eighteenth century. _____
Answer: True False

- 44) The environment in which a microbial population lives is its habitat. _____
Answer: True False

- 45) Differentiation occurs only in multicellular organisms. 45) _____
 Answer: True False
- 46) The discipline of microbiology is intimately associated with biochemistry and genetics, because cells are both biochemical catalysts and genetic coding devices. 46) _____
 Answer: True False
- 47) Smallpox is a major killer in parts of the developing world. 47) _____
 Answer: True False
- 48) Sergei Winogradsky worked with bacteria involved in cycling nitrogen and sulfur. 48) _____
 Answer: True False
- 49) *Treponema pallidum*, a bacterium associated with syphilis, is not considered a pathogen because to date it remains unculturable in the lab, and, therefore, Koch's postulates are unable to be fulfilled. 49) _____
 Answer: True False
- 50) Marine microorganisms likely control many important global parameters, including climate and atmospheric chemistry. 50) _____
 Answer: True False

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

- 51) A microbial cell's membrane is considered _____, because its internal constituents are maintained within the cell, however it also imports and exports other molecules in response to its environment. 51) _____
 Answer: semi-permeable
- 52) Some microorganisms can undergo _____ in which various cell types can become specialized and arise from one parent cell type. 52) _____
 Answer: cellular differentiation
- 53) Cyanobacteria and purple bacteria both obtain energy from light, however only the _____ are capable of releasing _____. 53) _____
 Answer: cyanobacteria / oxygen
- 54) The process whereby microorganisms are used to help clean up pollution created by human activities is known as _____. 54) _____
 Answer: bioremediation
- 55) An ecosystem could be defined as _____ along with their _____. 55) _____
 Answer: living organisms (biotic) / chemical and physical environments (abiotic)
- 56) Robert Koch received the 1905 Nobel Prize for Physiology or Medicine for _____. 56) _____
 Answer: his contributions on tuberculosis
- 57) The three major bioenergy products of microorganisms are _____, _____, and _____. 57) _____
 Answer: biodiesel / methane / ethanol (any order)

- 58) Microbial biochemistry involves the discovery of _____ and the _____. 58) _____
 Answer: microbial enzymes / chemical reactions they perform
- 59) DNA sequencing to study organisms' entire nucleotide sequences initially brought about 59) _____
 the field of _____, which has itself spawned the subdisciplines of _____ and
 _____ that represent more functional-based approaches.
 Answer: genomics / proteomics / metabolomics (second and third in either order)
- 60) The _____ is the fundamental unit of life. 60) _____
 Answer: cell
- 61) The disease anthrax is caused by the pathogenic bacterium _____, which produces 61) _____
 heat-resistant structures known as _____.
 Answer: *Bacillus anthracis* / endospores
- 62) Groups of cells derived from a single parent cell by successive cell divisions are known as 62) _____
 _____ and which live in environments known as _____.
 Answer: (microbial) populations / (microbial) habitats
- 63) The first documented description of a microorganism was of a _____ by _____. 63) _____
 Answer: mold / Robert Hooke
- 64) _____ produced by microbial fermentation of glucose from sugarcane or cornstarch is 64) _____
 becoming a more important component of biofuels in the United States, and specialized
 _____ microbiologists are needed to make this a commercially available product.
 Answer: Ethanol / industrial
- 65) _____ was the first to describe microorganisms, while _____ was the first person to 65) _____
 see bacteria.
 Answer: Robert Hooke / Antoni van Leeuwenhoek
- 66) A population of identical cells is known as a(n) _____. 66) _____
 Answer: pure culture
- 67) _____ described the first virus and the basic principles of virology. 67) _____
 Answer: Martinus Beijerinck
- 68) The discoveries of Martinus Beijerinck and Sergei Winogradsky led to practical advances 68) _____
 in the field of _____.
 Answer: agricultural microbiology
- 69) Bioremediation _____ by introducing pollutant-consuming microorganisms or specific 69) _____
 nutrients that help microorganisms degrade pollutants.
 Answer: accelerates the natural cleanup process
- 70) _____ was the first to identify a new form of autotrophy in which energy is obtained 70) _____
 from oxidizing inorganic compounds called _____.
 Answer: Sergei Winogradsky / chemolithotrophy

ESSAY. Write your answer in the space provided or on a separate sheet of paper.

71) Explain the nature and function of an enrichment culture.

Answer: Answers will vary, but an enrichment culture uses media, chemicals, or culture conditions to select for or enhance specific characteristics of an organism.

72) Why is it incorrect to say that an object is partially sterile?

Answer: Answers will vary, but sterile means the absence of living organisms. Something is either sterile or it is not.

73) Microbes were first formally observed during the mid-1600s, but the cell theory was not enunciated until 1839.

Write a brief essay explaining why microbiology did not become a formally recognized science until Louis Pasteur's and Robert Koch's time.

Answer: Answers will vary, but a theme should be the lack of powerful microscopy tools.

74) List three contributions of Ferdinand Cohn to the development of microbiology.

Answer: Answers could possibly include: founding bacteriology as a separate science, studying *Beggiatoa*, discovering the genus *Bacillus* (along with its endospore formation and its life cycle), devising methods to prevent contamination, and founding a major scientific journal.

75) Compare and contrast the works of Louis Pasteur and Robert Koch in terms of both applied and basic science.

Answer: Answers will vary, but should highlight the differences between basic scientific research in which fundamental ideas are discovered opposed to the usage of microbiological principles to solve larger questions. Examples of Pasteur's basic science contributions are his work showing that fermentation was mediated by microorganisms and the preferential metabolism of particular optical isomers by microbes. Pasteur also applied his ideas to develop sterilization techniques. Robert Koch focused more on the application of microbiology to identify the cause of tuberculosis by developing pure culturing techniques and the four postulates to link microbes to a disease.

76) Explain why microbial cells are excellent models for understanding cell function in higher organisms.

Answer: Answers will vary but should include commonality of function, biochemical and genetic similarities, and ease and speed with which they can be grown in large quantities.

77) Compare and contrast the leading causes of death in 1900 with the leading causes of death today. What roles have microbiologists played in the dramatic changes that are evident?

Answer: Answers will vary, but a focus should be that pathogens that killed people in the early 1900s are now treatable due to knowledge learned from microbiologists.

78) Explain how you would use Robert Koch's postulates to determine that *Streptococcus pyogenes* is the causative agent of streptococcal pharyngitis ("strep throat").

Answer: Answers will vary but will need to detail how *S. pyogenes* will be subjected to all four postulates.

79) The text states that antibiotics are derived from microorganisms. What is the benefit to an antibiotic-producing microorganism of producing an antibiotic in its natural habitat?

Answer: Answers will vary, but it must first be stated the antibiotic-producing microbe would need to be resistant to the antibiotic. This should then follow into a discussion on how antibiotic production could be viewed as a way to persist in the environment, such as maintaining dominance in a community over others.

80) Describe beneficial and harmful ways in which microorganisms interact with agricultural crops.

Answer: Certain microbes are beneficial to crops when they produce nutrients (e.g., NH_4^+ , SO_4^{2-}) usable by a crop from a substrate that was unusable. Other microbes can cause diseases in plants, much like pathogens cause disease in humans.

81) Provide evidence supporting the statement that an ecosystem is controlled by microbial activities.

Answer: Answers will vary, but one example could be oxygen depletion, where a loss of oxygen would then favor anaerobic microorganisms.

82) Explain why only anaerobic bacteria inhabited Earth for the first two billion years of its existence.

Answer: Answers will vary, but the key idea is an anoxic environment will not allow aerobic organisms to survive.

83) How would the presence of endospores in Louis Pasteur's nutrient solutions have affected his conclusions about spontaneous generation?

Answer: Answers will vary, but ultimately this could have confounded Pasteur if the endospores sometimes went into a vegetative growth phase and other times no growth was observed.

84) Using specific examples, explain why it is sometimes impossible to satisfy Robert Koch's postulates.

Answer: Answers will vary, but one issue is the consideration for a model animal host that will react to the (human) pathogen in the same manner as in a human host. For example, a chicken would not show flu-like symptoms when infected with the influenza virus.

85) Explain why infectious diseases are much less lethal in developed countries than in underdeveloped countries.

Answer: Answers will vary but should emphasize ways in which increased knowledge about microbial pathogenesis has influenced preventative care (e.g., sanitation) and treatment (e.g., antimicrobial drugs).

86) Describe two capabilities of microbes that exemplify their dynamic nature.

Answer: Answers could possibly include cell-cell communication, ability to move (motility), and exchange of materials (any two).

87) Compare and contrast the functions microbes serve in the digestive systems of both humans and ruminants (e.g., cattle).

Answer: Answers will vary but should focus on humans having a high cell localized density in the colon (large intestine), whereas ruminants have higher microbial populations in the rumen.