• Be sure to put your name on the mark-sense sheet and on the exam booklet. Both must be turned in at the end of the period.
• Indicate the correct version letter of your exam in the upper left corner of the mark-sense sheet in the box marked “KEY ID.”
• Each question has only one correct answer. When a group of choices is used for more than one question, a choice may be used more than once.
• You may write in the exam booklet, but only the mark-sense sheet will be graded. No other paper, scratch paper, etc., may be used.
• Students must turn in the exam before leaving the room for any reason. A student may not continue working on the exam after having left the room.

50 questions, 2 pt each

The following choices are used for questions 1 – 2.

(a) coryneform  (b) sarcina  (c) spirillum
(d) spirochete  (e) vibrio

1. This term refers to bacteria with irregularly rod-shaped cells arranged at angles to form V- and L-shaped arrangements.
2. This term refers to bacteria with flexible, spiral-shaped cells, often appearing as helical or corkscrew-shaped with tapered ends.

3. The average size of *Escherichia coli* cells is

(a) 0.1 μm in diameter  (b) 1 mm x 5 mm  (c) 1 μm x 5 μm
(d) 5 mm in diameter  (e) 5 μm in diameter

4. Which of the following is characteristic of peptidoglycan structure?

(a) Alternating units of N-acetylglucosamine and N-acetylmuramic acid
(b) Peptide crosslinking between N-acetylmuramic acid units
(c) Teichoic acid crosslinking between N-acetylgulosamine units
(d) Both (a) and (b), but not (c)
(e) Both (b) and (c), but not (a)
5. Which of the following is characteristic of the gram stain technique?

(a) The decolorizer is iodine.
(b) The mordant is safranin
(c) The primary stain is crystal violet.
(d) Both (a) and (b), but not (c)
(e) Both (b) and (c), but not (a)

6. Which of the following is characteristic of bacterial capsules?

(a) They are located within a specialized region of the cell’s cytoplasm.
(b) They are composed of polysaccharide or polypeptide.
(c) They appear as clear halos surrounding cells in a slide stained with safranin and nigrosin.
(d) Both (a) and (b), but not (c)
(e) Both (b) and (c), but not (a)

7. A typical gram positive cell wall contains

(a) teichoic acid
(b) peptidoglycan
(c) porin
(d) Both (a) and (b), but not (c)
(e) Both (b) and (c), but not (a)

8. The absence of a cell wall is characteristic of which group of bacteria?

(a) archaea
(b) mycobacteria
(c) mycoplasmas
(d) Both (a) and (b), but not (c)
(e) Both (b) and (c), but not (a)

9. Metachromatic granules are composed of

(a) phosphate
(b) protein
(c) peptidoglycan
(d) Both (a) and (b), but not (c)
(e) Both (b) and (c), but not (a)

10. Which of the following statements is true?

(a) Chromosomal DNA molecules are typically much smaller than plasmid DNA molecules.
(b) Genes on an F-plasmid encode for the structure of a specialized pilus.
(c) Genes on an R-plasmid encode for antibiotic resistance.
(d) Both (a) and (b), but not (c)
(e) Both (b) and (c), but not (a)
11. Which of the following statements is true?

(a) Flagella are found in all species of bacteria.
(b) The structure of bacterial flagella consists of a filament made of flagellin, attached to the cell surface by a hook-and-rotor assembly.
(c) As a bacterial cell approaches a repellent, the amount of time that its flagella spin counterclockwise increases.
(d) Both (a) and (b), but not (c)
(e) Both (b) and (c), but not (a)

12. Which of the following conditions is adequate for killing bacterial spores in a liquid medium?

(a) Autoclaving under pressure at 120°C for 30 min.
(b) Boiling at 100°C for 30 min.
(c) Heating to 70°C for 30 min.
(d) Both (a) and (b), but not (c)
(e) Both (b) and (c), but not (a)

The following choices are used for questions 13 – 14.

(a) autotroph
(b) auxotroph
(c) chemotroph
(d) heterotroph
(e) phototroph

13. This term refers to organisms that can use CO₂ as their sole carbon source.

14. This term refers to organisms that obtain all of their energy from the breakdown of nutrient molecules.

The following choices are used for questions 15 – 17.

(a) acidophile
(b) mesophile
(c) microaerophile
(d) neutrophile
(e) psychrophile

15. This is the best term to describe any bacterial species that grows best in a refrigerator at 7°C.

16. This is the best term to describe any bacterial species that grows best at a pH of 3.0.

17. This is the best term to describe any bacterial species that grows best in an incubator set at 37°C.
The following information pertains to questions 18 – 19. Thioglycolate broth is a differential medium used to determine the oxygen requirements of bacteria. When a test tube of thioglycolate broth is prepared, an oxygen gradient is established. This means that there is a high concentration of oxygen at the surface of the broth, less oxygen in the middle of the tube, and no oxygen at the bottom of the tube. The following choices are used for questions 9 - 11.

(a) aerotolerant anaerobe
(b) facultative anaerobe
(c) microaerophile
(d) strict aerobe
(e) strict anaerobe

18. If cells of a bacterial species grow only at the surface of the thioglycolate broth tube, to which group does the species belong?

19. If cells of a bacterial species grow throughout a thioglycolate broth tube, but they grow better at the top of the tube than at the bottom of the tube, to which group does the species belong?

The following choices are used for questions 20 – 22.

(a) acute infection
(b) chronic infection
(c) localized infection
(d) opportunistic infection
(e) secondary infection

20. This is the best term to describe an infection characterized by sudden onset, rapid progression, and often with severe symptoms.

21. This is the best term to describe an infection that develops in an individual who is already infected with a different pathogen.

22. This term is commonly used to describe infections caused by organisms in the normal flora.

23. Lipid A

(a) is a component of lipopolysaccharide
(b) is found in gram-negative cell walls but not in gram positive cell walls
(c) is an exotoxin
(d) Both (a) and (b), but not (c)
(e) Both (b) and (c), but not (a)

24. The periplasmic space

(a) contains hydrolytic enzymes and transport proteins.
(b) is found in gram-positive bacteria but not in gram-negative bacteria.
(c) is located between the capsule and the outer membrane.
(d) Both (a) and (b), but not (c)
(e) Both (b) and (c), but not (a)
25. Which of the following statements is true?

(a) Encapsulated strains of *Streptococcus pneumoniae* are usually nonvirulent, while nonencapsulated strains of *Streptococcus pneumoniae* are usually virulent.

(b) A fomite is an inanimate object capable of being an intermediate in the indirect transmission of an infectious agent.

(c) Phenylketonuria, an inherited genetic condition caused by the inability to metabolize phenylalanine, is an infectious disease.

(d) Both (a) and (b), but not (c)

(e) Both (b) and (c), but not (a)

26. Which of the following statements is true?

(a) A pandemic disease is an endemic disease affecting a population on a wide geographic scale, often worldwide.

(b) The transmission of malaria by the bite of an *Anopheles* mosquito is an example of a biological animal vector.

(c) “Typhoid Mary,” the woman who could transmit typhoid fever even though she herself showed no symptoms, is an example of a mechanical animal vector.

(d) Both (a) and (b), but not (c)

(e) Both (b) and (c), but not (a)

The following choices are used for questions 27 – 28.

(a) Commensalism

(b) Mutualism

(c) Parasitism

(d) Plagiarism

(e) Syncytialism

27. This term refers to a symbiotic relationship in which one species benefits, and the other species is neither helped nor harmed.

28. This term refers to a symbiotic relationship in which both species benefit.

29. Which of the following statements is true?

(a) In humans, normal microbial flora is commonly present in muscle tissue.

(b) In humans, normal microbial flora is commonly present in the intestinal tract.

(c) In humans, normal microbial flora is commonly present in the cerebrospinal fluid.

(d) Both (a) and (b), but not (c)

(e) Both (b) and (c), but not (a)
30. A litter of newborn mice was separated at birth into two groups. One group was placed in a germ-free environment, so it never developed a normal microbial flora. The other group was raised in a normal environment, so it developed its normal flora. What results do you expect in this experiment?

(a) The mice raised in the germ-free environment will be healthier and have a stronger immune system.
(b) The mice raised in the germ-free environment will be less healthy and have a weaker immune system.
(c) The mice raised in the germ-free environment will be more prone to inherited genetic diseases, such as phenylketonuria.
(d) The mice raised in the germ-free environment will develop a normal flora later in life due to spontaneous generation.

The following choices are used for questions 31 – 33.

(a) Convalescence (b) Incubation period (c) Invasive period (d) Prodromal period

31. This is the stage of infection characterized by the appearance of the first symptoms.
32. This is the stage of infection between the initial contact with the pathogen and the appearance of the first symptoms.
33. This is the stage of infection characterized by increasingly severe symptoms and infection spreading to other sites in the body.
34. This is an asymptomatic period during which the pathogenic microbes are increasing in numbers.

The following choices are used for questions 35 – 39.

(a) capsule polysaccharide (b) hyaluronidase (c) lipid A (d) protein A (e) streptokinase

35. This enzyme dissolves fibrin clots.
36. This substance contributes to the adhesion of pathogenic \textit{Staphylococcus aureus} cells to host tissue.
37. This enzyme is isolated from the same bacterial species that makes Protein M. It is used in medicine to treat certain types of cardiovascular disease.
38. This substance contributes to the evasion of phagocytosis by virulent strains of \textit{Streptococcus pneumoniae}.
39. This enzyme destroys an important carbohydrate component between host cells, which loosens the connection between the cells in host tissue.
40. Which of the following statements is true?

(a) Endotoxins produce varied effects such as neurotoxic or protein inhibition effects, but exotoxins produced generalized irritation and inflammation of epithelial surfaces.
(b) Exotoxins may be found in either gram-positive or gram-negative bacteria, but endotoxins are found only in gram-negative bacteria.
(c) Exotoxins include the neurotoxins of botulism and tetanus, while endotoxins include the enterotoxin of *Staphylococcus aureus*.
(d) Both (a) and (b), but not (c)
(e) Both (b) and (c), but not (a)

41. Which of the following statements is true?

(a) Bacterial colonies are isolated by growing the bacteria in a nutrient broth medium.
(b) The morphological properties of a bacterial colony (size, color, texture, margin, etc.) can be useful information when identifying a bacterial species.
(c) Ideally, an isolated bacterial colony contains cells of only a single species of bacteria.
(d) Both (a) and (b), but not (c)
(e) Both (b) and (c), but not (a)

The following choices are used for questions 42 – 46.

(a) Koch  
(b) Lister  
(c) Pasteur  
(d) Semmelweis  
(e) Snow

42. He suggested that the incidence of infections in mothers after childbirth could be reduced if the attendants washed their hands before delivering the baby.

43. He developed antiseptic surgical procedures that used carbolic acid (phenol) as a disinfectant.

44. By using maps to localize the source of a cholera epidemic in London to a specific public water pump, he was able to reduce its spread by implementing public health measures.

45. He developed a vaccine for rabies.

46. Using colony isolation techniques on agar media, he isolated the anthrax and tuberculosis bacteria and demonstrated their roles in disease.
The following information pertains to questions 47 - 50.

In each of the following questions, a description of a microorganism is given. Based on the description, determine which of the following choices best describes the microorganism.

(a) The microorganism is prokaryotic.
(b) The microorganism is eukaryotic.
(c) The microorganism is a virus.

47. The organism responsible for anthrax consists of rod-shaped cells. Each cell is surrounded by a thick layer of highly cross-linked peptidoglycan. The DNA of the cell is a circular DNA molecule found in the nucleoid region of the cell’s cytoplasm. Cellular respiration is carried out by proteins located in the cell’s plasma membrane.

48. *Rickettsia rickettsii* is responsible for the condition known as Rocky Mountain Spotted Fever. Although this organism grows only within an infected host, it has its own DNA and RNA to direct the synthesis of its protein and to control its cell division. Its DNA is found in the nucleoid region of its cytoplasm, but there is no nuclear membrane surrounding the DNA.

49. *Euglena gracilis* is a member of the kingdom Protista. It is a free-living organism often found on the surfaces of ponds. The most notable feature of this single-celled organism is its chloroplast, a membrane-enclosed organelle that absorbs light energy and uses it to manufacture carbohydrates. The organism is motile by means of a flagellum that moves back and forth in a whip-like motion to propel the organism forward.

50. When the pathogen responsible for dengue fever penetrates its host cells, its RNA is released from the protein shell. Within the host cell, the dengue RNA directs the synthesis of protein and RNA molecules that are assembled into many more infectious dengue particles.