

Braude & McCutchan

REVIEW OF
MEDICAL
MICROBIOLOGY

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Review of Medical Microbiology

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PREFACE

Anyone looking for a direct and efficient route to success in microbiology examinations should find it in this book, which gives students a method for testing their understanding of microbiology and learning more. The questions conform to the presentation of subjects in Braude's textbooks *Medical Microbiology and Infectious Diseases* and *Microbiology: Basic Science and Medical Applications*, and allow a systematic review that begins with the basic aspects of microbiology. The questions in this basic section address the general principles of microbial genetics, taxonomy, physiology, biochemistry, replication, and chemotherapy; and deal with bacteriology, virology, mycology, and parasitology. After mastering the questions in the first section on the fundamentals of microbiology, the student should be ready to take on the specific agents of infectious diseases. The group of questions on specific agents is divided into four sections covering only those properties of pathogenic organisms that should be common knowledge among those who handle infectious agents or infected patients. The finer details that were placed in the textbook for reference purposes are not examined. The last group of questions deals with the immunologic and metabolic response to infection.

Although certain parts of this manual will meet the needs of some specialists more than others, all students of microbiology will find exercises of value in each of the six sections. Those with a special interest in bacteriology or mycology, for example, should benefit not only from those sections, but also from the questions in closely related fields dealing with the other microbial agents. In order to facilitate such correlations, many questions are designed to span related areas. In addition, the answers are presented in the form of a succinct discussion that amplifies the point of each question and integrates closely related information. Anyone who completes the questions and learns the ideas presented in each discussion should know the essentials of medical microbiology and be able to handle other examinations in this subject.

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INSTRUCTIONS

This book is designed to provide a comprehensive review of microbiology in the form of a self-assessment examination. The format enables you to answer the questions, to determine quickly which ones you got right and wrong, and then to review those questions you answered incorrectly. The examination is divided into 6 Parts. These Parts may be taken individually, in any order. To take advantage of this book's special features, we suggest the following steps:

1. Tear out the answer sheet (located on perforated pages at the end of the book) for the Part you want to use.

2. Take the test, recording your answers on the answer sheet. Note that there are three different question types used; be sure to read and follow the directions for each of them.

3. To determine quickly how many questions you answered correctly, compare your answers with the answer key (pp. 171–174). On your answer sheet, circle any questions you may have missed.

4. For a detailed discussion of questions answered incorrectly, refer to the Answers following the questions in each Part. Chapter references to Braude: *Medical Microbiology and Infectious Diseases* and *Microbiology: Basic Science and Medical Applications* are provided for more extensive review. As time permits, reading the discussions of questions you answered correctly should also prove beneficial.

No criteria for deciding “how well” you did are provided because we believe that in a self-assessment examination you are the best judge. Read the discussions of the questions you missed and decide for yourself why you answered incorrectly, whether you should have known the answer, and whether the material deserves further study.

No time limits have been set, and no harm will be done by taking a Part over several days. We recommend that you do not look up any answers until you have completed the entire Part. In order to get maximal benefit from this style of review, it is essential that you treat the questions as you would questions in a “real” examination. Don't just “take a stab” at a question because you know the answer is easy to look up. Reading the answers is not an adequate substitute for taking as much time as you need and doing your best on each question.

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Part 1

General Microbiology

DIRECTIONS: For questions 1 to 37, choose the ONE BEST answer to each question.

1. Which of the following is present in the cells of fungi and protozoa, but *not* present in bacterial cells?
 - A. Cytoplasm
 - B. Chromosome
 - C. Organelles
 - D. Nucleoid
 - E. Ribosomes
2. Heterotrophs are bacteria that can grow and divide
 - A. by relying on light as a source of energy
 - B. by using only inorganic chemicals as a source of energy
 - C. by using simple organic molecules as a source of energy
 - D. only in the absence of O₂
 - E. only in the presence of CO₂
3. The physical properties of bacterial protoplasts result from the absence of
 - A. a cytoplasmic membrane
 - B. a cell wall
 - C. a capsule
 - D. mesosomes
 - E. flagella
4. When stained by Gram's method, the ability of bacteria to resist decolorization with alcohol, ether, or acetone depends primarily on the thickness of the
 - A. cytoplasmic membrane
 - B. peptidoglycan
 - C. capsule
 - D. outer membrane
 - E. pili

2 Part 1—General Microbiology

5. After staining with hot carbol fuchsin, mycobacteria remain red upon treatment with 3 per cent HCl in alcohol because of their

- A. cytoplasmic membrane
- B. peptidoglycan
- C. firmly bound lipids
- D. lipopolysaccharides
- E. capsular polysaccharides

6. The catalase test is useful for distinguishing between

- A. *Staphylococcus aureus* and *Staphylococcus epidermidis*
- B. *Streptococcus pyogenes* and *Staphylococcus aureus*
- C. *Streptococcus pyogenes* and *Streptococcus pneumoniae*
- D. *Streptococcus pyogenes* and *Peptostreptococcus*
- E. *Enterococcus* and *Peptostreptococcus*

7. Which of the following is LEAST reliable in evaluating the degree to which bacteria are related?

- A. The number of genes they share in common
- B. The similarity of their nucleotide composition
- C. The similarity of their guanine and cytosine content
- D. The ability of their DNA to recombine in hybridization experiments
- E. The ability of DNA from one organism to transform another organism

8. The Gram stain will *not* differentiate

- A. staphylococci from streptococci
- B. pneumococci from *Listeria*
- C. *Candida* from cryptococcus
- D. *Escherichia coli* from enterococci
- E. meningococci from gonococci

9. Which one of the following tests will *not* help to differentiate among members of the Enterobacteriaceae?

- A. Motility
- B. Gram stain
- C. Urease activity
- D. Cyanide sensitivity
- E. Antibiotic sensitivity pattern

10. The Gram stain does *not* differentiate vibrios from

- A. *E. coli*
- B. *Staphylococcus*
- C. clostridia

- D. *Campylobacter*
- E. gonococcus

11. Which of the following is most important in distinguishing the *Bacteroides fragilis* group from all other strictly anaerobic gram-negative bacilli?

- A. Catalase activity
- B. Sensitivity to air
- C. Sensitivity to clindamycin
- D. Enhancement of growth by bile
- E. Polar monotrichous flagella

12. Each of the following gram-negative rods is characteristic of peritrichous flagella EXCEPT

- A. *Pseudomonas aeruginosa*
- B. *Escherichia coli*
- C. *Salmonella typhosa*
- D. *Alcaligenes faecalis*
- E. *Proteus mirabilis*

13. Each of the following occurs in the *Bacteroides* group of bacteria EXCEPT

- A. pigment formation
- B. corrosion of agar
- C. fermentation of glucose
- D. penicillinase production
- E. spore formation

14. Certain intestinal bacteria, such as *Streptococcus faecalis* and *Bacteroides fragilis*, can grow in the presence of high concentrations of bile. These two species of bacteria also have in common the ability to

- A. grow in air
- B. resist killing by streptomycin
- C. cause frequent urinary infections
- D. decompose H_2O_2
- E. clot plasma

15. Which of the following compounds involved in energy exchanges in bacteria has the highest potential energy?

- A. Adenosine triphosphate
- B. Adenosine diphosphate
- C. Succinate
- D. Creatine phosphate
- E. Pyruvate

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- 16.** Synthesis of the bacterial peptidoglycan begins in the
- A. cell wall
 - B. cell membrane
 - C. cytoplasm
 - D. nucleus
 - E. carrier lipids
- 17.** *Salmonella* organisms are serotyped on the basis of their
- A. aldobionic acids
 - B. dextrans
 - C. lipids
 - D. lipopolysaccharides
 - E. hexosamines
- 18.** Water-soluble nutrients are carried across the lipid bilayer of bacterial cells by membrane-bound
- A. proteins
 - B. polysaccharides
 - C. phospholipids
 - D. glycolipids
 - E. waxes
- 19.** In contrast to transport by bacterial permeases, the process known as active transport in bacteria is characterized by
- A. transport of glycerol
 - B. a requirement for energy
 - C. the movement of substrate from high to low concentration
 - D. absence of chemical change in the substrate
 - E. the need for a transport protein
- 20.** In 1928 Griffith showed that injection of heat-killed strains of encapsulated pneumococci plus live unencapsulated strains killed the mouse and that live encapsulated pneumococci appeared in its blood. The genetic mechanism underlying this phenomenon in pneumococci is known as
- A. conjugation
 - B. integration
 - C. transduction
 - D. transformation
 - E. additive recombination

21. Bacterial plasmids are
- A. extrachromosomal proteins
 - B. extrachromosomal genetic elements
 - C. cytoplasmic enzymes
 - D. permeases
 - E. cytoplasmic viral inclusions
22. Both cholera toxin and certain hormones (thyrotropin and epinephrine) stimulate adenylate cyclase, but cholera toxin has only harmful effects whereas hormones are required for good health. Cholera toxin and hormones differ because
- A. the toxin is an endotoxin
 - B. tolerance is developed to hormones
 - C. only cholera toxin acts on the bowel
 - D. hormones cause a drop in cyclic AMP
 - E. only cholera toxin causes a permanent change in the enzyme
23. The antitoxin to clostridial phospholipase (alpha antitoxin) protects against *Clostridium perfringens* primarily by
- A. neutralizing the lethality of circulating toxin
 - B. blocking attachment to nerve cell gangliosides
 - C. preventing tissue necrosis by the toxin
 - D. neutralizing cardiotoxicity
 - E. neutralizing collagenase activity
24. Each of the following is a component of lipid A EXCEPT
- A. β -hydroxymyristic acid
 - B. 3-myristoxymyristic acid
 - C. lauric acid
 - D. muramic acid
 - E. palmitic acid
25. Which of the following animals is most sensitive to the pyrogenic action of bacterial lipopolysaccharides (LPS)?
- A. Turtle
 - B. Rabbit
 - C. Cat
 - D. Dog
 - E. Human

- 26.** The common feature of endotoxic shock in all animals, regardless of species, is
- A. increased resistance to flow in pulmonary veins
 - B. constriction of hepatic veins
 - C. constriction of mesenteric vein
 - D. reduced cardiac output
 - E. correction by intravenous saline
- 27.** In contrast to other micro-organisms, virions contain only
- A. RNA
 - B. DNA
 - C. a single type of nucleic acid
 - D. linear molecules of nucleic acid
 - E. single-stranded nucleic acid
- 28.** The most convincing evidence that the viral nucleic acid is the sole genetic information required for the production of progeny virus is the demonstration that
- A. certain virions contain DNA genomes only
 - B. the nucleic acid alone can be infectious
 - C. progeny viruses have the same nucleic acids as the parent
 - D. there is a good correlation between genome size and complexity of the capsid
 - E. empty capsids are not infectious
- 29.** Each of the following statements concerning helical nucleocapsids is true EXCEPT
- A. They occur in animal viruses
 - B. They occur in plant viruses
 - C. They have been observed in all DNA viruses
 - D. The helical ribonucleoprotein under the capsid is flexible
 - E. All animal viruses containing helical nucleocapsids also have a lipid-containing envelope
- 30.** Viral lipids are
- A. present in the viral envelope
 - B. arranged in the form of a monolayer
 - C. coded by the viral genome
 - D. acquired from the host cell membranes along with host cell membrane proteins
 - E. resistant to extraction by organic solvents

31. The term “viroid” has been given to agents that have *no*
- A. lipid envelope
 - B. protein coat
 - C. infectivity for plants
 - D. circular RNA molecules
 - E. lateral bodies
32. The wart, JC, and BK viruses are all members of the relatively small, ether-resistant group of viruses known as
- A. *Parvovirus*
 - B. *Papovavirus*
 - C. adenovirus
 - D. myxovirus
 - E. herpesvirus
33. Which of the following is common to picornaviruses, togaviruses, coronaviruses and oncornaviruses?
- A. Lipoprotein envelope
 - B. Single-stranded RNA
 - C. Double-stranded DNA
 - D. Prominent spikes on the viral surface
 - E. Oncogenic potential
34. Herpes simplex virus acquires its lipoprotein envelope
- A. from the membrane of an endocytic vacuole
 - B. upon budding through the nuclear envelope
 - C. from the cytoplasmic membrane upon penetration into a host cell
 - D. during passage out of the host cell through the cytoplasmic membrane
 - E. by synthesis of herpes-encoded glycoproteins that enclose the icosahedral shell after it has reached the cytoplasm
35. Each of the following DNA viruses replicates in the nucleus EXCEPT
- A. poxvirus
 - B. adenovirus
 - C. herpes simplex virus
 - D. Epstein-Barr virus
 - E. SV40 virus

36. Which of the following viruses is able to change its antigenic type in response to host immunity?

- A. rubella
- B. influenza
- C. measles
- D. rhinovirus
- E. smallpox

37. Interferon prevents infection with viruses by

- A. inactivating them directly before infection occurs
- B. blocking their absorption to cells
- C. blocking their penetration of cells
- D. enzymatically cleaving their nucleic acid
- E. inhibiting their intracellular multiplication

DIRECTIONS: For questions 38 to 75, *one or more* of the answers may be correct. Choose

- A** if only **1**, **2**, and **3** are correct
- B** if only **1** and **3** are correct
- C** if only **2** and **4** are correct
- D** if only **4** is correct
- E** if **all** are correct

38. Spheroplast formation occurs in the presence of

1. H_2O_2
2. penicillin
3. polymyxin B
4. hypertonic sucrose

39. When energy is released from high-energy phosphate bonds for the conversion of ADP to ATP in the glycolytic cycle for bacteria, which of the following processes *may* occur?

1. Glyceraldehyde-3-phosphate is oxidized by nicotinamide adenine dinucleotide (NAD)
2. A high-energy phosphate bond is produced through a carboxy linkage in 1,3-diphosphoglyceric acid
3. The high-energy phosphate bond is transferred from 1,3-diphosphoglyceric acid to form a molecule of ATP
4. Formation of the high-energy phosphate bond in 1,3-phosphoglyceric acid releases electrons to NAD to form NADH (reduced NAD)

40. In contrast to substrate level phosphorylation, oxidative phosphorylation in bacteria is characterized by

1. phosphorylation of ADP to ATP
2. oxidation-reduction reactions mediated by flavoproteins and cytochromes
3. the sudden release of energy from reduced coenzymes
4. the prominent role of oxygen as final electron receptor

41. The pentose phosphate pathway is important to bacteria because

1. it offers a pathway for glucose metabolism in obligate aerobic bacteria
2. it provides the ribose and erythrose-4-phosphate essential for the biosynthesis of nucleic acids
3. it provides more reducing power in the form of NADPH

(reduced nicotinamide adenine dinucleotide phosphate)
than does the Embden-Meyerhof pathway

4. its net yield of ATP is twice that of the Embden-Meyerhof pathway
- 42.** In fermentation reactions used to distinguish *Salmonella typhosa* from other salmonellas and enteric bacteria, its failure to produce gas from formate is a key finding. Among the reactions involved in this differential test is/are
1. production of H_2 from formate
 2. production of CO_2 from formate
 3. action of the enzyme formic hydrogenylase
 4. decarboxylation of pyruvate
- 43.** Both *E. coli* and *S. aureus* have
1. teichoic acid
 2. peptidoglycan
 3. lipopolysaccharides
 4. carrier lipids
- 44.** A high lipid content is characteristic of
1. corynebacteria
 2. mycobacteria
 3. salmonellas
 4. staphylococci
- 45.** Point mutations in bacteria are characterized by which of the following changes in the base sequence of DNA?
1. Substitution of one base pair by a different base pair
 2. Deletion of a large segment of DNA
 3. Addition of a base pair during breakage of the sugar-phosphate backbone of DNA
 4. Insertion of a large segment of DNA
- 46.** In the fluctuation test of Luria and Delbrück, when multiple tubes of bacteria are cultured overnight in the absence of streptomycin and then plated onto agar containing streptomycin, which of the following conclusions is/are justified?
1. Mutation to resistance can occur spontaneously
 2. Mutation to resistance is influenced to some extent by the environment
 3. There is a large variation in the number of resistant cells from different tubes