Microbiology

CREDIT HOURS 3

LEVEL LOWER

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Before You Choose This UExcel Exam

Uses for the Examination

- Excelsior College, the test developer, recommends granting three (3) semester hours of lower-level undergraduate credit to students who receive a letter grade of C or higher on this examination. The examination satisfies the Nursing Science core requirement in microbiology for the Excelsior College associate and baccalaureate degrees in nursing.

- Other colleges and universities also recognize this exam as a basis for granting credit or advanced standing.

- Individual institutions set their own policies for the amount of credit awarded and the minimum acceptable score.

Exam-takers who have applied to Excelsior College should ask their academic advisor where this exam fits within their degree program.

Exam-takers not enrolled in an Excelsior College degree program should check with the institution from which they wish to receive credit to determine whether credit will be granted and/or to find out the minimum grade required for credit. Those who intend to enroll at Excelsior College should ask an admissions counselor where this exam fits within their intended degree program.

Examination Length and Scoring

The examination consists of approximately 130 questions, most of which are multiple choice; for samples of all the item types on this exam, see the sample items in the back of this guide. Some items are unscored, pretest items. The pretest items are embedded throughout the exam and are indistinguishable from the scored items. You will have three (3) hours to complete the examination. Your score will be reported as a letter grade.

UExcel Exam Resources

Excelsior College Bookstore

The Excelsior College Bookstore offers recommended textbooks and other resources to help you prepare for UExcel exams.

The bookstore is available online at: www.excelsior.edu/bookstore

UExcel Practice Exams

The official UExcel practice exams are highly recommended as part of your study plan. Once you register for your UExcel exam, you are eligible to purchase the corresponding practice exam, which can be taken using any computer with a supported Web browser. Each practice exam includes two forms that you may take within a 180-day period.
Excelsior College Library

Enrolled Excelsior College students can access millions of authoritative resources online through the Excelsior College Library. Created through our partnership with the Sheridan Libraries of The Johns Hopkins University, the library provides access to journal articles, books, websites, databases, reference services, and many other resources. Special library pages relate to the nursing degree exams and other selected exams. To access it, visit www.excelsior.edu/library (login is required).

Our library provides:

- 24/7 availability
- The world’s most current authoritative resources
- Help and support from staff librarians

Online Tutoring

Excelsior College offers online tutoring through SMART THINKING™ to connect with tutors who have been trained in a variety of academic subjects. To access SMART THINKING, go to www.excelsior.edu/smarthinking. Once there, you may download a copy of the SMART THINKING Student Handbook as a PDF.

MyExcelsior Community

MyExcelsior Community enables Excelsior College students and alumni to interact with their peers online. As members, students can participate in real-time chat groups, join online study groups, buy and sell used textbooks, and share Internet resources. Enrolled students have automatic access from their MyExcelsior page. Visit www.excelsior.edu/myexcelsiorcommunity.

Preparing for UExcel Exams

How Long Will It Take Me to Study?

A UExcel exam enables you to show that you’ve learned material comparable to one or more 15-week college-level courses. As an independent learner, you should study and review as much as you would for a college course. For a 3-credit course in a subject they don’t know, most students would be expected to study nine hours per week for 15 weeks, for a total of 135 hours.

Study Tips

Become an active user of the resource materials. Aim for understanding rather than memorization. The more active you are when you study, the more likely you will be to retain, understand, and apply the information.

The following techniques are generally considered to be active learning:

- preview or survey each chapter
- highlight or underline text you believe is important
- write questions or comments in the margins
- practice re-stating content in your own words
- relate what you are reading to the chapter title, section headings, and other organizing elements of the textbook
- find ways to engage your eyes, your ears, and your muscles, as well as your brain, in your studies
- study with a partner or a small group (if you are an enrolled student, search for partners on MyExcelsior Community)
- prepare your review notes as flashcards or create recordings that you can use while commuting or exercising

When you feel confident that you understand a content area, review what you have learned. Take a second look at the material to evaluate your understanding. If you have a study partner, the two of you can review by explaining the content to each other or writing test questions for each other to answer. Review questions from textbook chapters may be helpful for partner or individual study, as well.
Using UExcel Practice Exams

We recommend taking the first form of the practice exam when you begin studying, to see how much you already know. After taking the first practice exam, check your performance on each question and find out why your answer was right or wrong. This feedback will help you improve your knowledge of the subject and identify areas of weakness that you should address before taking the exam. Take the second form of the practice exam after you have finished studying. Analyze your results to identify the areas that you still need to review.

Although there is no guarantee, our research suggests that students who do well on the practice exams are more likely to pass the actual exam than those who do not do well (or do not take advantage of this opportunity).

About Test Preparation Services

Preparation for UExcel® exams and Excelsior College® Examinations, though based on independent study, is supported by Excelsior College with a comprehensive set of exam learning resources and services designed to help you succeed. These learning resources are prepared by Excelsior College so you can be assured that they are current and cover the content you are expected to master for the exams. These resources, and your desire to learn, are usually all that you will need to succeed.

There are test-preparation companies that will offer to help you study for our examinations. Some may imply a relationship with Excelsior College and/or make claims that their products and services are all that you need to prepare for our examinations.

Excelsior College is not affiliated with any test preparation firm and does not endorse the products or services of these companies. No test preparation vendor is authorized to provide admissions counseling or academic advising services, or to collect any payments, on behalf of Excelsior College. Excelsior College does not send authorized representatives to a student’s home nor does it review the materials provided by test preparation companies for content or compatibility with Excelsior College examinations.

To help you become a well-informed consumer, we suggest that before you make any purchase decision regarding study materials provided by organizations other than Excelsior College, you consider the points outlined on our website at www.excelsior.edu/testprep.

Preparing for This Exam

Prior Knowledge

A general knowledge of chemistry, as well as biology or anatomy and physiology, is assumed.

Using the Content Outline

Each content area in the outline includes (1) the recommended minimum hours of study to devote to that content area and (2) the most important sections of the recommended resources for that area. These annotations are not intended to be comprehensive. You may need to refer to other chapters in the recommended textbooks. **Chapter numbers and titles may differ in other editions.**

This content outline contains examples of the types of information you should study. Although these examples are numerous, do not assume that everything on the exam will come from these examples. Conversely, do not expect that every detail you study will appear on the exam. Any exam is only a broad sample of all the questions that could be asked about the subject matter.

Using the Sample Questions and Rationales

Each content guide provides sample questions to illustrate those typically found on the exam. These questions are intended to give you an idea of the level of knowledge expected and the way questions are typically phrased. The sample questions do not sample the entire content of the exam and are not intended to serve as an entire practice test.
Recommended Resources for the UExcel Exam in Microbiology

The study materials listed below are recommended by Excelsior College as the most appropriate resources to help you study for the examination. For information on ordering from the Excelsior College Bookstore, see page 1 of this guide. You may also find resource materials in college libraries. Public libraries may have some of the textbooks or may be able to obtain them through an interlibrary loan program.

You should allow sufficient time to obtain resources and to study before taking the exam.

Textbooks

These textbooks were used by the examination development committee to verify all questions on the exam. These study materials may be purchased from the Excelsior College Bookstore.

www.excelsior.edu/bookstore


These study materials may be purchased from the Excelsior College Bookstore.

These textbooks were identified by the examination development committee as additional resources to help you gain a deeper understanding of the subject.


These study materials may be purchased from the Excelsior College Bookstore.

Open Educational Resources

The Saylor Foundation provides free, high quality courses through online, self-paced, free learning resources.

While the course below is listed as upper level, we believe it provides excellent preparation for the exam in Microbiology:

Saylor Foundation: Microbiology
http://www.saylor.org/courses/bio307/

Annenberg, Unseen Life on Earth: An Introduction to Microbiology
http://www.learner.org/resources/series121.html

MIT, Systems Microbiology, Fall 2006 (Lecture Notes and Assignments sections)
http://ocw.mit.edu/courses/biological-engineering/20-106j-systems-microbiology-fall-2006/

Open CourseWare, Tufts: Microbiology (Lectures, Readings, and Student Notes sections)
http://ocw.tufts.edu/Course/2

Many colleges and universities have free versions of their courses available through iTunes U.

Basic Microbiology, HACC

Microbiology, HACC

Reducing Textbook Costs

Many students know it is less expensive to buy a used textbook, and buying a previous edition is also an option. The Excelsior College bookstore includes a buyback feature and a used book marketplace, as well as the ability to rent digital versions of textbooks for as long as students need them. Students are encouraged to explore these and the many other opportunities available online to help defray textbook costs.
Content Outline

General Description of the Examination

The UExcel Microbiology examination is based on material typically taught in a one-semester, three-credit, lower-level course in microbiology for those majoring in science or an applied science field such as nursing.

The examination measures the knowledge and understanding of concepts and principles related to microbiology, including biology and control of microorganisms, disease, resistance, and the immune system, the biology of infectious disease, and environmental, food, and industrial microbiology, and the ability to apply this information to real-life examples.

Those beginning to study for this exam should be familiar with the concepts generally covered in chemistry, biology, or anatomy and physiology.

Learning Outcomes

After you have successfully worked your way through the recommended study materials, you should be able to demonstrate the following learning outcomes:

1. Describe the basic concepts of microbiology and its historical development.
2. Describe microbial laboratory techniques.
3. Describe the anatomy, growth and nutrition, metabolism, and genetics of microorganisms.
4. Describe principles of microbial control.
5. Describe diseases, resistance to diseases, and the role of the immune system.
6. Describe the biology of infectious diseases.
7. Describe environmental, food, and industrial microbiology.
**Content Outline**

The content outline describes the various areas of the test, similar to the way a syllabus outlines a course. To fully prepare requires self-direction and discipline. Study involves careful reading, reflection, and systematic review.

The major content areas on the Microbiology examination, the percent of the examination, and the hours to devote to each content area are listed below.

<table>
<thead>
<tr>
<th>Content Area</th>
<th>Percent of the Examination</th>
<th>Hours of Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Introduction to Microbiology</td>
<td>5%</td>
<td>7</td>
</tr>
<tr>
<td>II. Biology of Microorganisms</td>
<td>25%</td>
<td>34</td>
</tr>
<tr>
<td>III. Control of Microorganisms</td>
<td>15%</td>
<td>20</td>
</tr>
<tr>
<td>IV. Disease, Resistance, and the Immune System</td>
<td>20%</td>
<td>27</td>
</tr>
<tr>
<td>V. Biology of Infectious Disease</td>
<td>25%</td>
<td>34</td>
</tr>
<tr>
<td>VI. Environmental, Food, and Industrial Microbiology</td>
<td>10%</td>
<td>14</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
<td></td>
</tr>
</tbody>
</table>

**NOTE ON TOPICS:** Occasionally, examples will be listed for a content topic to help clarify that topic. However, the content of the examination is not limited to the specific examples given.

**NOTE ON CHAPTERS:** Chapters relevant to the major content areas are listed. Some chapters may be relevant to more than one area and are listed in each area. In some cases, only parts of a given chapters are relevant. The content outline will guide you as to which sections of a chapter to focus on.

### I. Introduction to Microbiology

5 PERCENT OF EXAM  | 7 HOURS OF STUDY

Tortora (2016)

*Ch. 1, The Microbial World and You*

Ch. 3, Observing Microorganisms Through a Microscope

Ch. 10, Classification of Microorganisms

Ch. 11, The Prokaryotes: Domains Bacteria and Archaea

Ch. 12, The Eukaryotes: Fungi, Algae, Protozoa, and Helminths

Ch. 13, Viruses, Viroids, and Prions

### A. Early history

1. Discovery of microorganisms
2. Disproving spontaneous generation
3. Development of germ theory of disease
4. Discovery of immunity
5. Discovery of viruses
6. Development of chemotherapeutic agents

### B. Place of microorganisms in the world

1. Prokaryotes vs. eukaryotes
2. **Prokaryotae**
   a. **Bacteria**
   b. **Cyanobacteria**
3. **Archaeobacteria**
4. **Eukaryotae**
   a. **Protista**
      1) **Protozoa**
      2) **Simple algae**
   b. **Fungi**
5. **Viruses**

C. **Microbial laboratory techniques**
   1. **Microscopy**
   2. **Stain procedures**
   3. **Media preparation and growth**
   4. **Pure culture and aseptic techniques**

II. **Biology of Microorganisms**

<table>
<thead>
<tr>
<th>25 PERCENT OF EXAM</th>
<th>34 HOURS OF STUDY</th>
</tr>
</thead>
</table>

**Tortora**

*Ch. 4*, Functional Anatomy of Prokaryotic and Eukaryotic Cells

*Ch. 5*, Microbial Metabolism

*Ch. 6*, Microbial Growth

*Ch. 8*, Microbial Genetics

*Ch. 9*, Biotechnology and DNA Technology

*Ch. 10*, Classification of Microorganisms

*Ch. 11*, The Prokaryotes: Domains Bacteria and Archaea

*Ch. 12*, The Eukaryotes: Fungi, Algae, Protozoa, and Helminths

*Ch. 13*, Viruses, Viroids, and Prions

A. **Anatomy**
   1. **Prokaryotes**
      a. **Bacteria**
         1) **Gross morphology** — cell size, shape, and arrangement

   2) **Component parts** — name, chemistry, function, and importance
      a) **Cell envelope**
         i) **Capsule**
         ii) **Cell wall**
         iii) **Cell membrane**
      b) **Cytoplasm**
         i) **Chromosome and plasmids**
         ii) **Ribosomes**
         iii) **Cell inclusions**
      c) **Spores**
      d) **Appendages**
         i) **Flagella**
         ii) **Pili**
   b. **Cyanobacteria** — special features

B. **Growth and nutrition**
   1. **Patterns of nutrition**
   2. **Requirements for growth** (increase in numbers/mass)
      a. **Physical** — pH, temperature
      b. **Chemical** — nitrogen, carbon, energy sources; vitamins; trace elements
      c. **Gaseous** — anaerobic, aerobic, facultative
3. Cultivation
   a. Selective, enrichment, and differential media
   b. Mixed and pure cultures
   c. Culture techniques — solid and liquid media
4. Dynamics of populations
   a. Growth mechanisms — binary fission, mycelial growth, budding
   b. Growth rates, generation times
   c. Growth curve: lag, exponential growth, and stationary phases
   d. Enumeration of cell number and culture mass — viable and total counts, turbidity

C. Metabolism — basic mechanisms of metabolism and energy conversion
   1. Enzymes (mediators of all reactions)
      a. Structures and function
      b. Factors that influence enzyme activity
   2. Photosynthetic vs. chemosynthetic metabolism
   3. Cellular respiration
      a. Aerobic
      b. Anaerobic
      c. Fermentation
   4. Photosynthesis
   5. Biosynthetic mechanisms
      a. Macromolecular synthesis
         1) Nucleic acid
         2) Gene expression and protein synthesis
      b. Regulation
         1) Control of enzyme activity (feedback regulation)
         2) Control of enzyme synthesis

D. Genetics
   1. Variation in populations of cells and viruses
      a. Genotype and phenotype
   b. Haploidy and diploidy
   c. Asexual and sexual
2. Mutations
   a. Spontaneous, induced
   b. Selection of mutants
   c. Types of mutations
3. Recombination
   a. Transformation
   b. Transduction (generalized, specialized)
   c. Conjugation
4. Gene manipulation
   a. Plasmids
   b. Genetic elements
   c. Genetic engineering/recombinant DNA techniques
   d. Applications of genetic engineering

E. Viruses
   1. Structure
      a. Type of nucleic acid
      b. Capsid, envelope, specialized structures
   2. Multiplication of viruses
      a. Lytic cycle
      b. Lysogenic cycle
      c. Retroviruses
   3. Effects of viruses on cells
      a. Isolation and detection of viruses
      b. Cytopathological effects
      c. Transformation and oncogenesis
      d. Control of viral replication

III. Control of Microorganisms

15 PERCENT OF EXAM | 20 HOURS OF STUDY

Tortora
Ch. 7, The Control of Microbial Growth
Ch. 20, Antimicrobial Drugs
A. Principles of microbial control

1. Factors influencing success of control methods
   a. Number and nature of microorganisms
   b. Strength of control agent
   c. Time, temperature, and pH

2. General methods of control
   a. Bactericidal vs. bacteriostatic
   b. Sterilization
   c. Asepsis
   d. Disinfection and antisepsis
   e. Sanitation
   f. Antibiosis and chemotherapy

B. Physical methods of control

1. Incineration
2. Dry heat
3. Moist heat
   a. Boiling water
   b. Pressurized steam (autoclave)
   c. Pasteurization
4. Radiation
   a. Ultraviolet
   b. Ionizing
5. Filtration

C. Chemical methods of control

1. Chemical agents
   a. Halogens
   b. Alcohols
   c. Phenols
   d. Heavy metals
   e. Aldehydes
   f. Gases
   g. Detergents
   h. Peroxides
2. Tests for effectiveness of antiseptics and disinfectants
   a. Phenol coefficient test
   b. Use-dilution test

D. Chemotherapeutic agents and antibiotics

1. Modes of action
2. Chemotherapeutic agents (nucleic acid analogs and others)
   a. Antiviral agents
   b. Antifungal agents
   c. Antiparasitic agents
3. Antibiotics (penicillin and others)
   a. The problem of antibiotic resistance
   b. Antibiotic sensitivity assays

IV. Disease, Resistance, and the Immune System

20 percent of exam | 27 hours of study

Tortora

Ch. 14, Principles of Disease and Epidemiology
Ch. 15, Microbial Mechanism of Pathogenicity
Ch. 16, Innate Immunity: Nonspecific Defenses of the Host
Ch. 17, Adaptive Immunity: Specific Defenses of the Host
Ch. 18, Practical Applications of Immunology
Ch. 19, Disorders Associated with the Immune System

A. The disease process

1. Host-parasite relationships
   a. The concepts of infection and disease
   b. The normal flora
   c. Commensalism
   d. Mutualism
   e. Antibiosis
   f. Opportunists
   g. Virulence
2. Progress of disease
   a. Periods of disease
   b. Clinical and subclinical disease
3. Types of diseases
   a. Communicable and noncommunicable diseases
   b. Endemic, epidemic, and pandemic diseases
   c. Acute and chronic diseases
   d. Primary and secondary diseases
   e. Local and systemic diseases
   f. Nosocomial diseases

4. Establishment of disease
   a. Transmission
   b. Portal of entry
   c. Dose
   d. Virulence factors

B. Nonspecific resistance to disease
   1. Mechanical and chemical factors
      a. Skin
      b. Mucous membranes
      c. pH (cell, tissue, organ)
      d. Lysozyme

2. Phagocytosis
   a. Types of phagocytes
   b. Mechanism of phagocytosis
   c. Reticuloendothelial system (mononuclear phagocytic system)

3. Inflammation

4. Individual, species, and racial immunities

C. Principles of immunology
   1. Antigens
      a. Definition, composition, and types of antigens
      b. Haptens
      c. Immunologic tolerance
      d. Self vs. nonself

2. The immune system
   a. B lymphocytes
   b. T lymphocytes
   c. Location and operation of the immune system
   d. Cell-mediated immunity — process, stimulation, lymphokines
   e. Antibody-mediated (humoral) immunity — antibody structure and origin, five types of antibodies, primary and secondary antibody responses, opsonization, antigen-antibody reactions, neutralization, precipitation, agglutination
   f. The complement system
   g. The alternative pathway

3. Types of immunity
   a. Naturally acquired, active immunity
   b. Artificially acquired, active immunity
   c. Naturally acquired, passive immunity
   d. Artificially acquired, passive immunity

4. Serological and diagnostic reactions
   a. Radioimmunoassays
   b. Neutralization reactions
   c. Precipitation and agglutination
   d. Complement fixation
   e. Monoclonal antibody
   f. Fluorescent antibody tests
   g. Enzyme-linked immunosorbent assay (ELISA)
   h. Western-blot analysis
   i. Polymerase chain reaction (PCR)
   j. Gene probe

D. Disorders of the immune system
   1. Type I anaphylactic hypersensitivity
      a. Allergens and IgE
      b. Basophils and mast cells
      c. Degranulation and mediator release
      d. Atopic diseases

   2. Type II cytotoxic hypersensitivity
a. Transfusion reactions
b. Hemolytic disease of the newborn
c. Autoimmune reactions

3. Type III immune complex hypersensitivity
   a. Immune complex formation
   b. Serum sickness
   c. Systemic lupus erythematosus (SLE)

4. Type IV cellular hypersensitivity
   a. Infection allergy
   b. Contact dermatitis
   c. Tuberculin skin test

5. Immune-deficiency diseases

V. Biology of Infectious Diseases

Parameters for the study of infectious disease:
• Recognition of the disease syndrome (symptoms)
• Etiology of the disease
  – unique morphological characteristics of the agent(s)
  – unique physiological characteristics of the agent(s)
  – unique cultural characteristics of the agent(s)
• Mode of transmission and portal of entry
• Methods of immunization

• Methods of prevention, control, and/or treatment

A. Respiratory tract diseases
1. Bacterial diseases
   a. Tuberculosis
   b. Diphtheria
   c. Pertussis
   d. Streptococcal diseases
   e. Bacterial pneumonia
   f. Primary atypical pneumonia
   g. Legionnaires’ disease
   h. Bacterial meningitis
   i. Chlamydial diseases

2. Viral diseases
   a. Common cold
   b. Influenza
   c. Measles
   d. Mumps
   e. Chickenpox
   f. Rubella
   g. Viral pneumonia

3. Fungal diseases
   a. Cryptococcosis
   b. Histoplasmosis
   c. Aspergillosis

4. Protozoan diseases — Pneumocystis carinii pneumonia

B. Gastrointestinal tract diseases and intoxications
1. Bacterial diseases and intoxications
   a. Typhoid fever
   b. Cholera
   c. Salmonellosis
   d. Escherichia coli disease
   e. Campylobacter disease
   f. Helicobacter pylori disease
   g. Shigellosis
   h. Botulism
i. Staphylococcal food poisoning
j. *Clostridium perfringens* food poisoning
k. Brucellosis

2. Viral diseases
   a. Hepatitis A
   b. Enteroviral infections

3. Protozoan diseases
   a. Amoebiasis
   b. Giardiasis
   c. Cryptosporidiosis

C. Urogenital tract diseases
   1. Bacterial diseases
      a. Gonorrhea
      b. Syphilis
      c. Chlamydia
   2. Viral diseases
      a. Genital herpes
      b. Genital warts
   3. Fungal diseases — candidiasis
   4. Protozoan diseases — trichomoniasis

D. Skin and wound diseases
   1. Bacterial diseases
      a. Tetanus
      b. Staphylococcal diseases
      c. Anthrax
      d. Leprosy
      e. Gas gangrene
   2. Viral diseases
      a. Smallpox
      b. Rabies
      c. Warts
      d. Herpes simplex infections
   3. Fungal diseases
      a. Ringworm (tinea)
      b. Candidiasis

E. Blood diseases

1. Bacterial diseases
   a. Plague
   b. Tularemia
   c. Spotted fevers
   d. Typhus fevers
   e. Q fever
   f. Lyme disease
   g. Toxic shock syndrome

2. Viral diseases
   a. Yellow fever
   b. Viral encephalitis
   c. Hepatitis B and hepatitis C
   d. Infectious mononucleosis
   e. Hemorrhagic fevers

3. Protozoan diseases
   a. Malaria
   b. Sleeping sickness
   c. Toxoplasmosis

F. Nosocomial diseases

G. Acquired immunodeficiency syndrome (AIDS)
   1. Human immunodeficiency virus (HIV)
   2. Transmission and epidemiology
   3. Pathology (including opportunistic infections)
   4. Diagnosis
   5. Treatment

VI. Environmental, Food, and Industrial Microbiology

<table>
<thead>
<tr>
<th>10 PERCENT OF EXAM</th>
<th>14 HOURS OF STUDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tortora</td>
<td></td>
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<tr>
<td>Ch. 27, Environmental Microbiology</td>
<td></td>
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<tr>
<td>Ch. 28, Applied Industrial Microbiology</td>
<td></td>
</tr>
</tbody>
</table>

A. Environmental (ecological) microbiology
   1. Terrestrial environment (soils)
      a. Flora of soil
b. Biogeochemical cycles (carbon, nitrogen, sulfur, phosphorus)

c. Biodegradation and recycling

2. Aquatic environment
   a. Fresh water and marine environment
   b. Aquatic pollution (eutrophy, human waste, food waste, industrial waste)
   c. Pollution abatement
      (1) Waste water treatment
      (2) Preparation of drinking water

B. Food microbiology
   1. Foods produced using microorganisms
   2. Spoilage of food by microorganisms
   3. Preservation methods

C. Industrial microbiology
   1. Alcoholic beverages (beer, wine, distilled spirits)
   2. Production of organic compounds (organic acids, amino acids, vitamins, enzymes, steroids, antibiotics, other pharmaceuticals)
   3. Biological insecticides
   4. Genetically engineered or recombinant DNA products
The sample questions give you an idea of the level of knowledge expected in the exam and how questions are typically phrased. They are not representative of the entire content of the exam and are not intended to serve as a practice test.

Rationales for the questions can be found on pages 18–21 of this guide. In that section, the correct answer is identified and each answer is explained. The number in parentheses at the beginning of each rationale refers to the corresponding section of the content outline. For any questions you answer incorrectly, return to that section of the content outline for further study.

During your exam, a basic 8-function calculator will also be available on your computer. The calculator button is in the top left hand corner of the page as each question is presented.

1. Which microorganisms are classified as prokaryotes?
   1) algae
   2) archaeobacteria
   3) protozoans
   4) yeasts

2. The Gram stain is an example of which type of stain?
   1) differential
   2) lipid granule
   3) negative
   4) simple

3. The presence of a spore in a vegetative bacterial cell helps establish that the organism is of which genus?
   1) Bacillus
   2) Erwinia
   3) Pseudomonas
   4) Salmonella

4. Euglena gracilis is generally classified as having which nutrition process?
   1) autotrophic
   2) heterotrophic
   3) parasitic
   4) saprophytic

5. In a mixed culture, a particular bacterial species represents 0.01% of the total cell population. What is the best way to isolate this species in a pure culture?
   1) Use the pour plate isolation method.
   2) Grow the culture on a minimal medium.
   3) Grow the culture on an enrichment medium and then use the streak plate method.
   4) Use the streak plate method directly.

6. A barrier that prevents the passage of bacteria, but not smaller particles, is placed between a genetic donor and a genetic recipient. Which gene transfer will be stopped by this barrier?
   1) conjugation
   2) generalized transduction
   3) specialized transduction
   4) transformation
7. If a bacterial gene coding for a repressor protein were to be mutated so that it would no longer bind to the operator site on the DNA, what would happen to the structural genes controlled by that repressor?
   The structural genes would be
   1) permanently turned on.
   2) turned on only in the presence of the inducer.
   3) turned on only in the absence of the inducer.
   4) turned off.

8. What can be determined from the one-step growth curve exhibited by lytic bacteriophage?
   1) the extent of recombination during the latent period
   2) the site of the virion particles
   3) the average number of viruses released per infected cell
   4) the evolutionary relatedness of bacteriophage and animal viruses

9. Which method ensures sterilization because of its high sporicidal activity?
   1) desiccation
   2) pasteurization
   3) pressurized steam
   4) ultraviolet light

10. How does moist heat kill bacteria?
    1) by causing hemolysis of the cell
    2) by denaturing proteins in the cell
    3) by dissolving lipids in the cell
    4) by extracting water from the cell

11. In which form of radiation does the killing of cells result from inactivation of sensitive macromolecules by free radicals such as the hydroxyl radical (OH)?
    1) infrared
    2) ionizing
    3) ultraviolet
    4) visible

12. Why is the practice of adding antibiotics to animal feed controversial?
    The practice
    1) inflates the cost of meat.
    2) limits the supply of antibiotics for humans.
    3) lowers the natural resistance of the animal to disease.
    4) promotes development of bacterial resistance.

13. Which microorganism is a common, normal inhabitant of the human intestine?
    1) Escherichia coli
    2) Pseudomonas aeruginosa
    3) Staphylococcus aureus
    4) Vibrio cholerae

14. How do tears and saliva disrupt the cell walls of gram-positive bacteria?
    Tears and saliva
    1) contain lysozyme, which weakens the cell wall.
    2) are basic and hydrolyze the cell wall.
    3) deprive the bacteria of oxygen.
    4) lower the ionic strength of the fluid in which the bacteria are suspended.

15. What do high serum titers of IgM indicate?
    1) the typical primary response to an antigen
    2) a typical secondary response to an antigen
    3) the inability to produce IgG
    4) a disorder of the immune system

16. A child immunized with a polio vaccine will develop which type of immunity?
    1) artificially acquired, active
    2) artificially acquired, passive
    3) naturally acquired, active
    4) naturally acquired, passive
17. Why is streptococcus pneumoniae resistant to destruction by phagocytosis?
   Resistance is due largely to the
   1) presence of a streptococcal capsule.
   2) chemical nature of the streptococcal cell membrane.
   3) secretion of streptococcal exotoxin by the rough strain.
   4) secretion of streptococcal endotoxin by the smooth strain.

18. A newborn in an intensive care nursery has low birth weight and shows signs of cataracts and a heart murmur. A history reveals that the mother had contracted an undiagnosed upper respiratory tract infection with a low-grade fever and a mild skin rash during the third week of pregnancy. Which microbial agent would most likely be responsible for these occurrences in both mother and newborn?
   1) beta-hemolytic streptococci
   2) *Haemophilus influenzae*
   3) *Mycoplasma pneumoniae*
   4) rubella virus

19. A poultry processor comes to the clinic complaining of chronic cough and general malaise. Lung X rays show calcified nodules. A tuberculin test and acid-fast test are negative. Sputum samples show large fungus-like oval cells, often inside leukocytes. What is the most probable cause of the person's signs and symptoms?
   1) an adenovirus
   2) *Histoplasma capsulatum*
   3) *Mycobacterium tuberculosis*
   4) *Treponema pallidum*

20. What is the mechanism that leads to death in patients with cholera?
   1) cardiomyopathy
   2) endotoxin poisoning
   3) fluid and electrolyte losses
   4) renal failure

21. Why are there more female than male carriers of gonorrhea in the United States?
   1) Acidity of the female reproductive tract enhances infectivity and growth of the gonococcus.
   2) Females are often asymptomatic and therefore fail to seek treatment.
   3) Increased use of condoms usually prevents male exposure.
   4) Males are more easily treated and cured than are females.

22. What does the presence of coliform bacteria in a drinking water supply indicate?
   The water is
   1) safe to drink, because coliform bacteria are not usually pathogenic.
   2) potentially dangerous to drink, because the water is contaminated with bacteriophage.
   3) potentially dangerous to drink, because the water is contaminated with soil or sewage.
   4) dangerous to drink, because coliform bacteria cause fatal intestinal disease.

23. Which disease may be prevented by immunizing with a toxoid?
   1) smallpox
   2) tetanus
   3) tuberculosis
   4) typhoid fever

24. A microorganism used in an industrial setting to produce antibiotics should ideally exhibit which characteristic?
   The microorganism should
   1) be a small, slowly growing microbe.
   2) grow at low temperatures.
   3) excrete the secondary metabolite.
   4) produce large amounts of polysaccharide.
25. The conversion of ethanol in wine to acetic acid occurs under which circumstance?

1) Organisms are present in the wine that carry out malolactic fermentation.

2) The ethanol concentration of the wine is too low to inhibit the growth of acetic acid bacteria.

3) Too much fermentable carbohydrate is present in the wine.

4) The wine has been exposed to aerobic conditions for too long.
Rationales

1.(IB3)
1) Algae are classified as eukaryotes.

2) The archaeobacteria are classified as prokaryotes because they lack a nucleus, nuclear membrane, and organelles. Archaeobacteria also have other properties consistent with the prokaryotes.

3) Protozoans are classified as eukaryotes.

4) Yeasts are classified as eukaryotes.

2.(IC2)
1) The Gram stain is a differential stain because it stains separate parts of a cell differently. It is used to distinguish between gram-positive and gram-negative bacterial populations based on the distinctive staining characteristics of their cell walls.

2) The lipid granule stain does not separate bacteria into groups. It allows viewing of the structures within the cells.

3) The negative stain does not separate bacteria into groups. It is used to show clear bacteria on a dark background.

4) Although it is used to stain bacteria, the simple stain does not separate bacteria into groups.

3.(IIA)
1) Spore formation in the bacteria is limited almost exclusively to members of the genera *Bacillus* and *Clostridium*.

2) Bacteria of the *Envinia* genus do not produce spores.

3) Bacteria of the *Pseudomonas* genus do not produce spores.

4) Bacteria of the *Salmonella* genus do not produce spores.

4.(IIB1)
1) *Euglena gracilis* is considered autotrophic because it uses its photosynthetic pigments to synthesize its own food materials.

2) Heterotrophic refers to an organism that uses preformed organic matter for food.

3) Parasitic refers to an organism that uses living preformed organic matter.

4) Saprophytic refers to an organism that uses nonliving preformed organic matter.

5.(IIB3)
1) The pour plate method would be inappropriate because the organism of interest is too rare.

2) This is an inappropriate method because not all species grow on minimal media.

3) *The enrichment medium increases the relative percentage of the organism of interest when the population streak plate method is used afterward.*

4) The organism of interest is too rare for the streak plate method to be used directly.

*correct answer
6. (IID3)

*1) Conjugation requires cell-to-cell contact and would be blocked by the barrier.
2) Generalized transduction utilizes phage that can pass through the barrier.
3) Specialized transduction utilizes phage that can pass through the barrier.
4) Transformation uses DNA that can pass through the barrier.

7. (IID4c)

*1) The RNA polymerase would always find an open promoter/operon region.
2) The repressor never binds to DNA.
3) The repressor never binds to DNA under the conditions described.
4) Operons are turned off when the repressor is bound. This cannot happen because the repressor is a mutant.

8. (IIE2a)

1) Information about the extent of recombination is not required.
2) The curve gives no indication of the location of virion particles.
*3) The curve indicates the number of phage particles.
4) The curve shows the number of viruses released, but provides no information on the phylogeny of viruses.

9. (IIIB3b)

1) Desiccation is not a reliable form of sterilization because it has low sporidical activity.
2) Pasteurization is not a reliable form of sterilization because it has virtually no sporidical activity.
*3) Pressurized steam is used for sterilization in the autoclave where it penetrates tough bacterial spores and destroys them quickly.
4) Ultraviolet light is not a reliable form of sterilization because it has low sporidical activity.

10. (IIIB3)

1) Bacteria cells are not blood, so hemolysis does not occur.
*2) Small temperature increases lead to denaturation of some proteins.
3) Lipids are more resistant to moist heat than are proteins.
4) Water remains within a cell until driven off at increasingly higher temperatures.

11. (IIIB4b)

1) Infrared radiation is not strong enough to induce the production of oxygen radicals.
*2) Ionizing radiation is powerful enough to ionize water by causing atoms to change to ions.
3) Ultraviolet light is not strong enough to induce the production of oxygen radicals.
4) Visible radiation is not strong enough to induce the production of oxygen radicals.

12. (IID3a)

1) The practice of adding antibiotics to animal feed may actually reduce the cost of feed as animals gain weight faster.
2) The practice may lead to an oversupply of antibiotics needed for human beings.
3) The practice lowers the antibiotic resistance of the animals to disease.
*4) The practice preferentially allows the growth of bacteria strains that are resistant to drugs used to treat human infections.

13. (IVA1b)

*1) The intestine of most human beings contains a population of nonpathogenic Escherichia coli as part of its normal flora.
2) Pseudomonas aeruginosa is not commonly located in the intestine. It is a possible pathogen in individuals who are immunocompromised.
3) Staphylococcus aureus is not commonly located in the intestine. It is found in the nose and on the skin.
4) Vibrio cholerae is not commonly located in the intestine. It is a pathogen and the agent of cholera.

*correct answer
14.(IVB1d)
1) Lysozyme in tears and saliva weakens the cell wall by rupturing peptidoglycan layers.
2) The pH of tears and saliva is not basic enough to break the cell wall.
3) Oxygen is diffused, not deprived, through tears.
4) The ionic strength is increased due to NaCl in tears.

15.(IVC2e)
1) IgM antibodies are the primary response to exposure to an antigen.
2) IgG antibodies appear 24 to 48 hours after the primary response to exposure to an antigen.
3) Recent exposure to antigens does not induce the production of IgG.
4) There is no known disorder that only produces IgM.

16.(IVC3b)
1) Vaccination is an artificial means of introducing antigens to the body, and since the body produces its own antibodies, the immunity is active.
2) Artificially acquired, passive immunity results from an injection of antibodies.
3) Naturally acquired, active immunity results from an episode of disease, even if the disease is subclinical.
4) Naturally acquired, passive immunity results from antibodies passed from mother to child across the placenta.

17.(VA1d)
1) The large capsule of *Streptococcus pneumoniae* prevents the phagocyte from adhering to the cell.
2) The cell membrane of *Streptococcus pneumoniae* is not involved in resistance to phagocytosis.
3) The rough strain of *Streptococcus pneumoniae* is nonvirulent.
4) Endotoxins are only produced by gram-negative bacteria and *Streptococcus pneumoniae* is gram-positive.

18.(VA2b)
1) A beta-hemolytic infection is commonly associated with high-grade fever.
2) This organism, which can inhabit the mucous membranes of the upper respiratory tract, is not characterized by skin rashes.
3) This organism is the causative agent of “walking pneumonia,” and generally does not produce the signs described in the newborn.
4) Rubella often goes undetected and can produce the signs described in the newborn if contracted in the first trimester of pregnancy.

19.(VA3f)
1) Adenoviruses generally cause the common cold, characterized by swelling of the lymph nodes, or meningitis.
2) This causative organism is a dimorphic fungus that can appear in yeastlike form in macrophages, where it can multiply.
3) Both the tuberculin and acid-fast tests were negative, so this organism is not the causative agent.
4) This bacterium is the spirochete that causes syphilis and does not produce the signs described.

20.(VB1)
1) Cardiomyopathy is a disorder of the heart muscle and is often of unknown etiology.
2) Endotoxin is associated with typhoid fever, meningitis, and urinary tract infections, not cholera.
3) Because of the loss of fluids in persons with cholera, the blood becomes so viscous that vital organs cannot function properly.
4) In renal failure, abrupt reduction of renal function is accompanied by progressive retention of waste compounds and is not associated with cholera.

*correct answer*
21. (VC1a)
1) The acidity of the female reproductive tract inhibits infectivity, it does not enhance it.
*2) The disease in females is more insidious than in males.
3) The use of condoms would help prevent disease transmission to either sex.
4) Treatment is the same for both females and males.

22. (VIA2c)
1) Coliforms may be pathogenic and can cause diarrhea and opportunistic urinary tract infections.
2) Bacteriophages do not affect human beings.
*3) Coliforms are indicator organisms for the presence of human waste in water.
4) Although coliforms can cause disease, the disease is not usually fatal.

23. (VD1a)
1) Smallpox vaccination develops after an injection of cowpox viruses.
*2) Tetanus toxoid is used in the DPT vaccine to produce immunity against tetanus.
3) A toxoid is not used to render immunity to tuberculosis. A preparation of live bacteria called BCG is used.
4) A toxoid is not used to render immunity to typhoid fever. Instead, treated bacteria are used.

24. (VIC2)
1) A small, slowly growing microbe would slow the antibiotic process and provide greater likelihood of contamination.
2) Low temperatures would cause the microorganism to grow more slowly. [See 1) above].
*3) Antibiotics are secondary metabolites that are easy to retrieve if in an appropriate growth medium.
4) Polysaccharide makes purification of a compound difficult.

25. (VIC2)
1) Malolactic fermentation is not involved in the conversion of ethanol in wine to acetic acid.
2) This condition does not lead to acetic acid production.
3) See 2).
*4) When wine is exposed to the air (under aerobic conditions), acid-forming bacteria use the oxygen to convert the ethanol in wine to acetic acid.
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