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.

For more information on exam availability and actual testing information, see the Exam Registration and Information Guide.

Examination Length and Scoring

The exam consists of approximately 130 single-answer, multiple-choice questions; see the sample questions at the back of this guide. You will have three (3) hours to complete the exam. Your score will be reported as a letter grade. Questions are scored either correct (1) or incorrect (0). There is no partial credit. Each credit-bearing exam contains pretest questions, which are embedded throughout the exam. They are indistinguishable from the scored questions. It is to your advantage to do your best on all the questions. Pretest questions are being tried out for use in future versions of the exam.

The UExcel exams do not have a fixed grading scale such as A = 90–100%, B = 80–90%, and so forth, as you might have seen on some exams in college courses. Each UExcel test has a scale that is set by a faculty committee and is different for each exam. The process, called standard setting, is described in more detail in the Technical Handbook. Excelsior puts each exam through a standard setting because different test questions have different levels of difficulty. To explain further, getting 70% of the questions right on the exam when the questions are easy does not show the same level of proficiency as getting 70% of questions correct when the questions are hard. Every form of a test (a form contains the test questions) has its own specific grading scale tailored to the particular questions on each exam form.

Please also note that on each form, some of the questions count toward the score and some do not; the grading scale applies only to those questions that count toward the score. The area with percentage ratings on the second page of your score report is intended to help identify relative strengths and weaknesses and which content areas to emphasize, should you decide to...
take the examination again. Your grade is based on both scored and pretest questions—pretest questions which are not scored. Therefore, the percentage ratings do not necessarily reflect the total percentage that counted toward your grade.

For the best view of the types of questions on this exam, see the sample questions in the back of this guide. Practice, practice, practice!

Score Reporting

For most of our examinations, based on performance, an examinee is awarded a letter grade of A, B, C, or F along with diagnostic information describing examinee performance in each of the major content areas in any given exam. A letter grade of D can be given, but credit is awarded for A, B, and C letter grades only. The letter grades reported to examinees indicate that their performance was equivalent to the performance of students who received the same letter grade in a comparable, on-campus course.

More specifically, the letter grade indicates the examinee’s proficiency relative to the learning outcomes specified in the exam content guide. Following are general descriptions of examinee performance at each level:

**Letter Grade Description**

**A** Highly Competent: Examinee’s performance demonstrates an advanced level of knowledge and skill, relative to the learning outcomes.

**B** Competent: Examinee’s performance demonstrates a good level of knowledge and skill, relative to the learning outcomes.

**C** Marginally Competent: Examinee’s performance demonstrates a satisfactory level of knowledge and skill relative to the learning outcomes.

**D** Not Competent (no credit recommended): Examinee’s performance demonstrates weak knowledge of the content and minimal skill relative to the learning outcomes.\(^1\)

**F** Fail (no credit recommended): Examinee’s performance demonstrates no knowledge of the content and no skill in the subject relative to the learning outcomes.

Credit is transcripted by Excelsior College for examinees who achieve letter grades of C or higher.

We encourage colleges and universities to use the Excelsior College letter grades of A, B, and C as acceptable standards for awarding credit.

See page 5 for a sample UExcel Grade Report for Examinations, at the back of this content guide.

### 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 (login required): www.excelsior.edu/bookstore

**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 SMARTTHINKING™ to connect with tutors who have been trained in a variety of academic subjects. To access SMARTTHINKING, go to www.excelsior.edu/smarthinking. Once there, you may download a copy of the SMARTTHINKING Student Handbook as a PDF.

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\(^1\) In general, two hour exams do not award a D letter grade.
Preparing for UExcel Exams

**Take Charge of Your Own Learning**

At Excelsior College, independent, self-directed study supported by resources we help you find is not a new concept. We have always stressed to exam takers that they are acting as their own teacher, and that they should spend as much time studying for an exam as they would spend in a classroom and on homework for a corresponding college course in the same subject area.

Begin by studying the content outline contained in this content guide, at its most detailed level. You will see exactly which topics are covered, and where chapters on those topics can be found in the Recommended Resources. You will see exactly where you might need to augment your knowledge or change your approach.

The content outline, along with the Learning Outcomes for this exam and recommended textbooks, will serve as your primary resources.

**How Long Will It Take Me to Study?**

Study for a UExcel exam is comparable to an equivalent college-level course. As an independent learner, you should study and review as much as you would for the same subject in a campus-based college course. If you already have a background in the subject, you may be able to pass the exam successfully with fewer hours of study. It depends upon the learner as well as the subject, the number of credits (for example, a 6- or 8-credit exam will require more hours of study than a 3-credit exam), and the length of the exam. We strongly encourage you to create a long-term action, or study plan, so that you have a systematic approach to prepare for the exam. We’ve included guidelines for creating such a plan.

**How Can I Create an Effective Long-Term Study Plan?**

1. **Determine the time you will require to complete your preparation for this exam.** As a rule, you should plan to budget approximately 150 hours of study time for this exam. About 135 of those hours should be spent on studying the content alone. Aside from the content review, you should then factor in time to search for and use other resources, and to complete any projects and assignments in the study materials that will clarify your understanding of the topics in the content outline (that part in the content guide where the specific areas of study are spelled out). Spend more time on concepts and areas in which you feel you are weak. Totaled, this is approximately the amount of time you should expect to devote to a three-credit, campus-based course. The actual amount of time you require depends on many factors, and will be approximate. If your background is weak, you may need to set aside substantially more than 135–150 hours. If your background is strong, you may budget less time.

   Take a few minutes to review the content outline to assess your familiarity with the content. Then, in the space below, write the number of hours you will allocate to complete preparing for the exam.

   Hours Required =

2. **Determine the time you will have available for study.**

   In self-study, you need structure, as well as motivation and persistence, and a methodical approach to preparation. There is no set class to keep you on task. You have to do that yourself. Construct a time-use chart to record your daily activities over a one-week period. The most accurate way to do this is to complete the chart on a daily basis to record the actual amount of time you spend eating, sleeping, commuting, working, watching television, caring for others and yourself, reading, and everything else in an adult’s life. However, if your schedule is regular, you might prefer to complete the chart in one sitting and, perhaps, by consulting your appointment book or planner.

   After you have recorded your activities, you will be ready to schedule study periods around these activities or, perhaps, instead of some of them. In the space below, write the number of hours you will be able to set aside for study each week.

   Hours Required =

3. **Divide the first number by the second number.**

   This will give you the number of weeks you will need to set aside for independent study. For example, if you think you will require 170 hours of study and you have 10 hours available to study each week, divide 170 hours by 10 hours and you will get 17. This means
that you will need about 17 weeks to complete this course of study. However, you will also need to allow about a week for review and self-testing. Moreover, to be on the safe side, you should also add two weeks to allow for unforeseen obstacles and times when you know you will not be able to study (e.g., during family illnesses or holidays). So, in this case, you should allot a total of 18 to 19 weeks to complete your study.

4. Schedule your examination to coincide with the end of your study period.

For example, if you plan to allow 18 weeks for study, identify a suitable examination date and begin study at least 18 weeks before that date. (The date you begin study assumes that you will have received all of your study materials, particularly textbooks, by that time.)

5. Format a long-term study plan.

You will need to use a calendar, planner, or some other tool to format and track your long-term study plan. Choose a method that is convenient and one that keeps you aware of your study habits on a daily basis. Identify the days and exact hours of each day that you will reserve for study throughout your whole independent study period. Check to see that the total number of hours you designate for study on your long-term study plan adds up to the number of hours you have determined you will need to complete this course of study (Step 1).

6. Record in your long-term study plan the content you plan to cover during each study period.

Enter the session numbers, review, and examination preparation activities you will complete during each study period. While it is suggested that approximately 160–170 hours of study is required for this exam, each and every student may require different timelines based on their comfort with, and comprehension of, the material.

You now have a tentative personal long-term study plan. Keep in mind that you will have to adjust your study plan, perhaps several times, as you study. It is only by actually beginning to work systematically through the material, using the content outline, that you will be able to determine accurately how long you should allow for each unit.

What Learning Strategy Should I Use?

The following guidelines are intended to help you acquire the grounding in the knowledge and skills required for successful completion of this examination.

1. Approach learning with a positive attitude.

Most students are capable of learning subject content if they devote enough time and effort to the task. This devotion will give you a positive edge and a feeling of control.

2. Diligently complete the exact work you specified in your study plan.

Your study plan is being designed for the specific purpose of helping you achieve the learning outcomes for this exam.

3. Be an active learner.

You should actively engage in the learning process. Read critically, take notes, and continuously monitor your comprehension. Keep a written record of your progress, highlight content you find difficult to grasp, and seek assistance from someone in your learning community who can help you if you have difficulty understanding a concept.

4. Be patient: you may not understand everything immediately.

When encountering difficulty with new material, be patient with yourself and don’t give up. Understanding will come with time and further study. Sometimes you may need to take a break and come back to difficult material. This is especially true for any primary source material (original letters, documents, and so forth) that you may be asked to read. The content outline will guide you through the material and help you focus on key points. You will find that many concepts introduced in earlier sessions will be explained in more detail in later sessions.

5. Apply your learning to your daily life.

Use insights you gain from your study to better understand the world in which you live. Apply the learning whenever you can. Look for instances that support or contradict your reading on the subject.
6. Accommodate your preferred way of learning.

How do you learn best? Common ways to learn are reading, taking notes and making diagrams, and by listening to someone (on video or live). Others learn by doing. Do any of these descriptions apply to you? Or does your learning style vary with the learning situation? Decide what works for you and try to create a learning environment to accommodate your preferences.

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.

Study smart for your UExcel exam, and succeed with our Student Success Guide.

Using UExcel Practice Exams

The Microbiology exam has a corresponding practice exam, which is delivered in the Canvas learning platform.

The official UExcel practice exams are highly recommended as part of your study plan. They can be taken using any computer with a supported Web browser such as Google Chrome.

A practice exam package containing two forms is available for this exam, for $75. To register for the practice exam, visit www.excelsior.edu and log into your MyExcelsior account. Please note: You must be registered for the corresponding credit-bearing exam first, before you can register for the practice exam.

Practice exams are not graded. Rather, they are intended to help you make sure you understand the subject and give you a sense of what the questions will be like on the exam for credit. Ideally, you would check any questions you got wrong, look at the explanations, and go back to the textbook to reinforce your understanding. After taking both forms of the practice exam, you should feel confident in your answers and confident that you know the material listed in the content outline.

Practice exams are one of the most popular study resources. Practice exams are typically shorter than the credit-bearing exam. Since the questions are drawn from the same pool of questions that appear on the credit-bearing exam, what you will see when you sit for the graded exam will be roughly the same. Used as intended, these practice exams will enable you to:

- Review the types of questions you may encounter on the actual exam.
- Practice testing on a computer in a timed environment.
- Practice whenever and wherever it is convenient for you.
- Take two different forms of a practice exam within a 180-day period. (We highly recommend that you take the first form of the practice exam as a pretest, early in the study period. Use the results to identify areas to further study and carry out a plan. Then take the second form as a post-test and see how much you have improved.)

Although there is no guarantee, our research suggests that exam takers who do well on the practice exams are more likely to pass the actual exam than those
who do not, or who do not take advantage of the opportunity. Note that since the practice exams are not graded (calibrated) the same way as the scores on the credit-bearing exam, it will be hard for you to use the practice exams as a way to predict your score on the credit-bearing exam. The main purpose of the practice exams is for you to check your knowledge and to become comfortable with the types of questions you are likely to see in the actual, credit-bearing exam.

**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](http://www.excelsior.edu/testprep).

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**Exam Preparation Strategies**

Each learner is different. However, all learners should read the content outline in the exam’s Content Guide and ensure that they have mastered the concepts. For someone with no prior knowledge of the subject, a rule of thumb is 135 hours of study for a three-credit exam—this number is just to give you an idea of the level of effort you will need, more or less.

**Content Guides**

This content guide is the most important resource. It lists the outcomes, a detailed content outline of what is covered, and textbooks and other study resources. It also has sample questions and suggestions for how to study. Content guides are updated periodically to correspond with changes in particular examinations and in textbook editions. Test-takers can download any of the latest free UExcel content guides by visiting the individual exam page or from the list at [www.excelsior.edu/contentguides](http://www.excelsior.edu/contentguides).

**Prior Knowledge**

A familiarity with precalculus topics including algebra, trigonometry, and functions is assumed.

**Using the Content Outline**

Each content area in the content outline includes 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 among textbook 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 resources listed below are recommended by the examination development committee for use preparing for this exam. Resources listed under “Exam Verification Resources” were used to verify all the questions on the exam. Please refer to the Content Outline to see which parts of the exam are covered by which of the Exam Verification Resources. Resources listed under “Supplemental Resources” provide additional material that may deepen or broaden your understanding of the subject, or that may provide an additional perspective. Textbook resources, both Exam Verification and Supplemental, are available for purchase at the Excelsior College Bookstore.

You should allow ample time to obtain resources and to study sufficiently before taking the exam, so plan appropriately and with care.

A word about textbook editions: Textbook editions listed in the UExcel content guides may not be the same as those listed in the bookstore. Textbook editions may not exactly match up in terms of table of contents and organization, depending upon the edition. However, our team of exam developers checks exam content against every new textbook edition to verify that all subject areas tested in the exam are still adequately available in the study materials. If needed, exam developers will list supplemental resources to ensure that all topics in the exam are still sufficiently covered. Public libraries may have the textbooks you need, or may be able to obtain them for you through interlibrary loan to reduce textbook costs. You may also consider financial aid, if you qualify, to further help defray the steep cost of textbooks. A section on OER has been included in this guide to help you locate additional resources to augment your study.

Exam Verification Resources

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


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.

A Word About Open Educational Resources
Open educational resources (OER) are educational materials available for study at no cost on the Web. Some OER are available for anyone to access any time. Others, such as Massive Open Online Courses (MOOCs), require sign-up and are only available during certain windows. Please note that some MOOC providers offer certificates of completion or other products or services for a fee. No MOOC or other OER is a complete substitute for the content guide and officially Recommended Resources listed here in this content guide. However, by definition, MOOCs are essentially free of charge and include access to a main body of learning materials that may help you in your learning.

Being an independent learner preparing for credit by exam, you may not need any of the fee-based options that are offered elsewhere online. But if you are looking for a coherent academic course for self-study, lectures on specific topics, or audio or visual materials that fit your learning style better than print materials alone, a MOOC or other type of OER may
be your answer. Keep in mind that none of these OER were designed by Excelsior, nor are they guaranteed to match the exam content outlines completely. They are simply another tool available in your study kit.

We highly encourage using the Recommended Resources. In the content outline, you will see that the topics in the exam are referenced to specific portions of recommended textbooks. Using OER alone will not ensure you’ve completely covered the content in the exam, or it may not cover some topics in sufficient-enough depth without the use of the formal, recommended textbooks.

If the OER course you choose does not include a textbook for reference and you do not have significant practical theory-based experience in the field of study, use a college textbook to ensure adequate preparation for the exam, and use the exam's content outline as a guide.

Combined with comparable college textbooks, OER provides you with a variety of choices in knowledge sources and learning experiences, to enhance your understanding of the subject matter.

**Choosing Open Educational Resources**

Most sites for university-based OER can be searched through [www.ocwconsortium.org](http://www.ocwconsortium.org) and/or [www.oercommons.org](http://www.oercommons.org).

Sites that specialize in Web courses designed by college professors under contract with the website sponsor, rather than in Web versions of existing college courses, include:

- [www.education-portal.com](http://www.education-portal.com)
- [www.opencourselibrary.org](http://www.opencourselibrary.org) (abbreviated as OCL)

We have included specific courses that cover material for one or more UEexcel® exams from the sites in the listings above. It’s worth checking these sites frequently to see if new courses have been added that may be more appropriate or may cover an exam topic not currently listed.

In addition, sites like Khan Academy ([www.khanacademy.com](http://www.khanacademy.com)) and iTunes U feature relatively brief lessons on very specific topics rather than full courses. Full courses are also available on iTunes U ([http://www.apple.com/education/ipad/itunes-u/](http://www.apple.com/education/ipad/itunes-u/)). We have chosen a few courses and collections for this listing.

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**Other Online Resources**

This section of the OER Guide is provided to allow learners to independently search for resources.

**Open Online Textbooks**

- BookBoon
- Flatworld Knowledge
  - [http://catalog.flatworldknowledge.com/#our-catalog](http://catalog.flatworldknowledge.com/#our-catalog)

**College Readiness**

- Khan Academy
- Hippocampus
  - [http://www.hippocampus.org/](http://www.hippocampus.org/)
- Open Course Library

**Study Aids**

- Education Portal
- Khan Academy
- Annenberg Learner
  - [http://www.learner.org/](http://www.learner.org/)
- OpenCourseWare
- OER Commons
  - [http://www.oercommons.org/](http://www.oercommons.org/)
- Open Course Library

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To achieve academic success, rate yourself at Excelsior College’s Self-Regulated Learning Lab. Visit the Diagnostic Assessment & Achievement of College Skills site at [https://srl.daacs.net/](https://srl.daacs.net/)

It’s free!
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. Summarize the basic concepts of microbiology and its historical development. (Aligns to GECC 2.1)
2. Examine microbial laboratory techniques. (Aligns to GECC 2.1)
3. Examine the anatomy, growth and nutrition, metabolism, and genetics of microorganisms. (Aligns to GECC 2.1)
4. Recognize the principles of microbial control. (Aligns to GECC 2.1)
5. Recognize diseases, resistance to diseases, and the role of the immune system. (Aligns to GECC 2.1)
6. Summarize the biology of infectious diseases. (Aligns to GECC 2.1)
7. Interpret environmental, food, and industrial microbiology. (Aligns to GECC 2.1)

General Education Career Competencies Addressed in this Exam

GECC-2: Mathematical and Scientific Problem Solving: Apply scientific knowledge and reasoning to make evidence-based decisions.
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>
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<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>
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</tbody>
</table>

*Approximate: For those test-takers who know the topic well, less time may be needed to learn the subject matter. For those who are new to the subject matter, more time may be required for study.

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.

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

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.

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

I. Introduction to Microbiology

5 PERCENT OF EXAM

Tortora

Ch. 1, The Microbial World and You
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

25 PERCENT OF EXAM

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

2. Eukaryotes
   a. Fungi
      1) Cellular and vegetative structures
      2) Reproductive structures
   b. Algae
      1) Cellular structures
      2) Photosynthetic apparatus
   c. Protozoa
      1) Structures for locomotion — flagella, cilia, pseudopodia
      2) Vacuoles

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 diplody
   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

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

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

25 PERCENT OF EXAM

Tortora

Ch. 19, Disorders Associated with the Immune System
Ch. 21, Microbial Diseases of the Skin and Eyes
Ch. 23, Microbial Diseases of the Cardiovascular and Lymphatic Systems
Ch. 24, Microbial Diseases of the Respiratory System
Ch. 25, Microbial Diseases of the Digestive System
Ch. 26, Microbial Diseases of the Urinary and Reproductive Systems

Parameters for the study of infectious disease:

• Recognition of the disease syndrome (symptoms)
• Etiology of the disease

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

10 PERCENT OF EXAM

Tortora

Ch. 27, Environmental Microbiology

Ch. 28, Applied Industrial Microbiology

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
Sample Questions

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 22−25 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.

You will be provided with an erasable white board to use during your exam, and you will have access to a basic 8-function calculator on the computer. The calculator button is located in the top left-hand corner of the screen, as each question is presented. A picture of a typical 8-function calculator is provided on page 26.

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.
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) Small temperature increases lead to denaturation of some proteins.
2) Generalized transduction utilizes phage that can pass through the barrier.
3) Lipids are more resistant to moist heat than are proteins.
3) Specialized transduction utilizes phage that can pass through the barrier.
4) Water remains within a cell until driven off at increasingly higher temperatures.
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) Ionizing radiation is powerful enough to ionize water by causing atoms to change to ions.
2) The repressor never binds to DNA.
3) Ultraviolet light is not strong enough to induce the production of oxygen radicals.
3) The repressor never binds to DNA under the conditions described.
4) Visible radiation is not strong enough to induce the production of oxygen radicals.
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.
1) The practice of adding antibiotics to animal feed may actually reduce the cost of feed as animals gain weight faster.
2) The curve gives no indication of the location of virion particles.
2) The practice may lead to an oversupply of antibiotics needed for human beings.
*3) The curve indicates the number of phage particles.
3) The practice lowers the antibiotic resistance of the animals to disease.
*4) The curve shows the number of viruses released, but provides no information on the phylogeny of viruses.
*4) The practice preferentially allows the growth of bacteria strains that are resistant to drugs used to treat human infections.

9. (IIIB3b)
1) Desiccation is not a reliable form of sterilization because it has low sporicidal activity.
1) The intestine of most human beings contains a population of nonpathogenic Escherichia coli as part of its normal flora.
2) Pasteurization is not a reliable form of sterilization because it has virtually no sporicidal activity.
2) Pseudomonas aeruginosa is not commonly located in the intestine. It is a possible pathogen in individuals who are immunocompromised.
*3) Pressurized steam is used for sterilization in the autoclave where it penetrates tough bacterial spores and destroys them quickly.
3) Staphylococcus aureus is not commonly located in the intestine. It is found in the nose and on the skin.
4) Ultraviolet light is not a reliable form of sterilization because it has low sporicidal activity.
4) Vibrio cholerae is not commonly located in the intestine. It is a pathogen and the agent of cholera.

10. (IIIB3b)
1) Bacteria cells are not blood, so hemolysis does not occur.
1) Bacteria cells are not blood, so hemolysis does not occur.

11. (IIIB4b)
1) Infrared radiation is not strong enough to induce the production of oxygen radicals.

12. (IIID3a)
1) The practice of adding antibiotics to animal feed may actually reduce the cost of feed as animals gain weight faster.
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.
2) The practice lowers the antibiotic resistance of the animals to disease.
*3) The practice lowers the antibiotic resistance of the animals to disease.
3) 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.
*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.

14. (IVB1d)
*1) Lysozyme in tears and saliva weakens the cell wall by rupturing peptidoglycan layers.
*1) Lysozyme in tears and saliva weakens the cell wall by rupturing peptidoglycan layers.

*Correct answer
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.
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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