

# **Instructors' Manual and Test Bank**


*For*

## **Introduction to Audiology** **13<sup>th</sup> Edition**

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## Preface

This book was originally designed as a primary text for a single-term instructional course in audiology. A variety of pedagogical features were incorporated within the first edition of the text to facilitate student mastery of new concepts in the study of hearing diagnostics and treatment. Each edition has seen an increase in coverage of this evolving field of study and the expanding scope of practice of its practitioners. And as coverage has expanded, so have the pedagogical aides provided within the text to support student learning. These include:

- Learning objectives at the beginning of each chapter to direct students' attention to the material to be introduced.
- Bold facing of all new terms that are fully defined in the glossary at the end of the book.
- A comprehensive glossary that serves as a full dictionary of audiologic terms.
- A large number of illustrative figures with instructional captions throughout the text.
- Summary tables at the end of each chapter.
- An expansion of the instructive "Evolving Case Studies" that are followed from chapter to chapter.
- Twenty demonstrative videos that can be accessed by clicking the video box on the margins of select pages in the e-text.
- A list of frequently-asked questions for each chapter derived from students' actual queries in class and during office hours.
- Brief examinations following each major section within chapters for self-assessment of learning with immediate feedback on selected answers
- Interactive activities at the conclusion of most chapters that include diagram labeling and matching exercises.

This instructors' manual and accompanying PowerPoint slides have been created to further facilitate student learning by making the task of teaching audiology courses easier. The provision of examination questions and other materials can serve to free course instructors from some of the more mundane tasks, allowing them to devote their time to other aspects of their teaching.

Instructors are encouraged to use all or any part of the materials in this instructors' manual to assist in offering audiology courses. Each chapter in this manual opens with a restatement of the chapter's learning outcomes. These learning outcomes are numbered as they are in the text with numbers corresponding to the major heading within the chapter in which the learning outcome is addressed. Learning outcomes are followed by a listing of vocabulary items to which students will be introduced within the corresponding book chapter. Extrapolation of these vocabulary lists from the text facilitates instructors' development of study sheets or vocabulary quizzes pertinent to select chapters. For more in-depth assessment of student learning, essay questions, short answer questions and multiple choice questions are provided. A large sampling of case studies is provided for class discussion. Each includes a background history, expected audiometric findings, the diagnosis of the case based on the findings, the probable etiology, discussion of case management and reasons for the decisions drawn. Any portion of any material in this manual may be used in its entirety, edited, substituted, or augmented with other materials.

# Table of Contents

<b>Chapter</b>	<b>Title</b>	<b><u>Page</u></b>
1	The Profession of Audiology .....	1
2	Sound and Its Measurement .....	6
3	The Human Ear, Hearing Loss and Pure-Tone Hearing tests .....	13
4	Speech Audiometry .....	22
5	Masking .....	29
6	Physiological Tests of the Auditory System .....	36
7	Pediatric Hearing Loss Identification and Assessment .....	43
8	The Outer Ear .....	50
9	The Middle Ear .....	57
10	The Inner Ear .....	65
11	The Auditory Nerve and Central Auditory Pathways .....	73
12	Nonorganic Hearing Loss .....	82
13	Beyond Hearing: Management of Balance Disorders, Tinnitus, and Decreased Sound Tolerance .....	88
14	Amplification/Sensory Systems .....	95
15	Patient Management .....	102
	Case Studies .....	112

# Chapter 1

## The Profession of Audiology

Compared to other professions in the health arena, audiology is a relative newcomer, emerging from the combined efforts of otology and speech pathology during World War II. Following the war, this new area of study and practice grew rapidly within the civilian sector because of the high prevalence of hearing loss in the general population and the devastating effects on individuals and families when hearing loss remains untreated. To support the needs of those served fully, especially the pediatric population, audiologists often maintain close working relationships with speech-language pathologists and educators of people with hearing impairment. A mutual respect for what each profession brings to auditory (re)habilitation leads to the highest level of remediation for those served.

Today the profession of audiology supports a variety of specialty areas and is transitioning toward a professional doctorate as the entry-level degree. Given projected population demographics, students choosing to enter this profession will find themselves well placed for professional growth and security.

## Learning Objectives

The purpose of this opening chapter is to introduce the profession of audiology, from its origins through its course of development to its present position in the hearing-healthcare delivery system. At the completion of this chapter, the reader should be able to

- 1.1** Describe the evolution of audiology as a profession.
- 1.1** Discuss the differences between licensure and certification and why an audiologist might choose to become certified.
- 1.1** Describe the reasons that speech-language pathologists may interact closely with audiologists as they provide services within their chosen professions.
- 1.2** Discuss the impact of hearing impairment on individuals and society.
- 1.2** List specialty areas within audiology and the employment settings within which audiologists may find themselves.

## Vocabulary Items

Aural rehabilitation	Otology
Prevalence	Speech-language pathology

# Chapter 1 Test Items

## Essay Question

1. Discuss the economic burden hearing loss presents to society.

## Short Answer Questions

1. Audiology developed from the professions of \_\_\_\_\_ and \_\_\_\_\_.
2. A founder of audiology, often called the “father of audiology,” is \_\_\_\_\_.
3. Two professional documents that govern the practice of audiology are \_\_\_\_\_ and \_\_\_\_\_.
4. The entry-level degree for the profession of audiology is the \_\_\_\_\_.
5. The credential required for the practice of audiology in the United States is \_\_\_\_\_.
6. The two organizations most closely associated with audiology are \_\_\_\_\_ and \_\_\_\_\_.
7. List three areas that are impacted by hearing loss in adults besides hearing sensitivity.
8. The work of audiologists in areas of noise is sometimes called \_\_\_\_\_.

## Multiple Choice Questions

1. Audiology developed from the professions of
  - a. Education, and psychiatry
  - b. Social work and speech pathology
  - c. Otology and speech pathology
  - d. Speech pathology and education

2. A founder of audiology, often called the “father of audiology,” is
  - a. Raymond Carhart
  - b. David Goldstein
  - c. Jack Katz
  - d. Jerry Northern
  
3. Two professional documents that govern the practice of audiology are
  - a. Organizational chart and business plan
  - b. Scope of practice and code of ethics
  - c. Statement of professional purpose and rules and regulations document
  
4. The entry-level degree for the profession of audiology is the
  - a. Master’s degree
  - b. Ed.D.
  - c. Ph.D.
  - d. Au.D.
  
5. The credential required for the practice of audiology in the United States is
  - a. State license
  - b. ASHA CCC-A
  - c. Department of Education registration
  
6. The two organizations most closely associated with audiology are
  - a. Academy of Rehabilitative Audiology and American Academy of Audiology
  - b. Academy of Doctors of Audiology and the American Speech-Language-Hearing Association
  - c. International Hearing Society and American Auditory Society
  - d. American Academy of Audiology and American Speech-Language-Hearing Association
  
7. Audiology had its beginnings during World War II within
  - a. Community-based speech and hearing centers serving the hearing needs of returning veterans
  - b. Military-based aural rehabilitation centers
  - c. France following the Battle of Verdun and quickly migrated to the United States military hospitals where it blossomed over the next 25 years
  - d. Hospital speech pathology departments



8. A speech-language pathologist's scope of practice
  - a. Is clearly delineated from that of audiology with no overlap
  - b. Allows for the speech pathologist to provide therapeutic aspects of aural rehabilitation and basic checks of hearing aid performance
  - c. Is limited beyond work with speech, language and voice disorders to the provision of therapeutic aspects of aural rehabilitation
  
9. A life time economic burden of hearing loss computed on an average life expectancy of seventy-one years, the economic burden of hearing loss can exceed
  - a. \$ 250,000
  - b. \$ 500,000
  - c. \$ 750,000
  - d. \$1,000,000
  
10. The majority of audiologists find employment within
  - a. Hospitals
  - b. Community speech and hearing centers
  - c. Private practice
  - d. Physicians' offices

## Chapter 1 Test Item Answer Key

### Essay Item

1. The student's answer should include the high costs for treatment of transitory ear infections as well as the rehabilitation and educational costs for those with permanent hearing loss. In addition, the later costs of lost income potential for adults with hearing loss should be included in the answer. The astute student may also recognize that there is a national impact from reduced taxes when a person with hearing loss is either not gainfully employed or is working in a position beneath the earning potential that might have been present if he or she had normal hearing.

### Short Answer Items

1. otology, speech-language pathology
2. Dr. Raymond Carhart
3. scope of practice, code of ethics
4. Doctor of Audiology (Au.D.)
5. state license
6. American Academy of Audiology, American Speech-Language-Hearing Association
7. general health, psychosocial well-being, generated income
8. industrial audiology

### Multiple Choice Items

1. c
2. a
3. b
4. d
5. a
6. d
7. b
8. b
9. d
10. c

# Chapter 2

## Sound and Its Measurement

Sound may be regarded objectively if we consider its waves in terms of their frequency, intensity, phase, and spectrum. Sounds may also be studied subjectively, in terms of pitch, loudness, or the interactions of signals producing masking or localization. In discussing sound energy it is always important to specify precisely the various aspects and appropriate measurement references, such as hertz, decibels (IL, SPL, HL, or SL), mels, sones, or phons.

### LEARNING OBJECTIVES

Understanding this chapter requires no special knowledge of mathematics or physics, although a background in either or both of these disciplines is surely helpful. From this chapter, readers should be able to

- 2.1 Describe sound waves and their common attributes, and express the way these characteristics are measured.
- 2.1 Discuss the basic interrelationships among the measurements of sound and demonstrate the ability to perform simple calculations (although at this point it is more important to grasp the physical concepts of sound than to gain skill in working equations).
- 2.2 Understand the different references for the decibel and when they are used.
- 2.3 State the difference between physical acoustics and psychoacoustics.
- 2.4 Discuss the reasons for audiometer calibration and what this may entail in general terms.

### Vocabulary Items

American National Standards Institute	Amplitude
Aperiodic	Artificial ear
Artificial mastoid	Beats
Bel	Brownian motion
Cancellation	Complex wave
Components	Compression

Cosine wave	Damping
Decibel	Dyne
Elasticity	Erg
Force	Forced vibration
Formant	Fourier analysis
Free vibration	Frequency
Fundamental frequency	Harmonics
Hearing level	Hertz
Intensity	Intensity level
International Organization for Standardization	Inverse square law
Joule	Kinetic energy
Localization	Logarithm
Longitudinal waves	Loudness
Loudness level	Mass
Mass reactance	Microbar
Newton	Octave
Ohm	Oscillation
Overtones	Period
Phase	Phon
Pitch	Potential
Power	Pressure
Quality	Rarefaction
Ratio	Reactance
Resonance	Resonant frequency
Sensation level	Sinewaves
Sinusoidal	Sound level meter
Sound pressure level	Spectrum
Stiffness	Stiffness reactance
Threshold	Transverse wave
Velocity	Vibration
Watts	Wavelength
Waves	Work

## Chapter 2 Test Items

### Essay Questions

1. Describe what is meant by Sound Pressure Level, Hearing Level and Sensation Level and how these are used.
2. How would you calibrate an audiometer for air conduction and bone conduction, both with and without electroacoustic equipment?

### Short Answer Questions

1. Sound travels through air in the form of \_\_\_\_.
2. Three types of waves discussed in this book are \_\_\_\_, \_\_\_\_, and \_\_\_\_.
3. Waves are described as a series of \_\_\_\_ and \_\_\_\_.
4. Two types of vibration described above are \_\_\_\_ and \_\_\_\_.
5. The two major effects on frequency are \_\_\_\_ and \_\_\_\_.
6. The velocity of sound is its \_\_\_\_.
7. The formula for wavelength is \_\_\_\_.
8. The number of beats per second is determined by the difference between two \_\_\_\_.
9. The lowest frequency of vibration in a complex sound is called the \_\_\_\_.
10. Formant frequencies of the human voice are determined by the \_\_\_\_.
11. Two sine waves may be contrasted by their differences in \_\_\_\_, \_\_\_\_, and \_\_\_\_.
12. Decibels cannot be simply added or subtracted because they are \_\_\_\_.

13. The decibel reference on audiometers is \_\_\_\_\_.
14. Any discussion of decibels must include their \_\_\_\_\_.
15. The psychological correlate of frequency is \_\_\_\_\_.
16. The ability to localize sound requires that the individual have \_\_\_\_\_.
17. The threshold shift of one sound that is caused by the introduction of a second sound is called \_\_\_\_\_.
18. Audiometer earphones are used to test hearing by \_\_\_\_\_.
19. An oscillator is placed on the forehead or mastoid to test hearing by \_\_\_\_\_.
20. The decibel reference used in sound-level meters is \_\_\_\_\_.

### Multiple Choice Questions

1. The zero dB reference level for most sound level meters is
  - a. 20 dynes per cm squared
  - b. 20 micropascals
  - c. 0 dB
  - d. 40 watts
2. One parameter not looked at in electroacoustic calibration of audiometers is
  - a. frequency
  - b. intensity
  - c. duration of tonal presentation
  - d. attenuator linearity
3. The alternating regions of low pressure and high pressure produced by an object's vibration are called, respectively:
  - a. constructive, destructive
  - b. rarefactions, condensations
  - c. condensations, compressions
  - d. troughs, valleys

4. When a sound source produces energy at more than one frequency, the result is a \_\_\_\_\_ sound.
  - a. sinusoidal
  - b. simple
  - c. loud
  - d. complex
  
5. The reference value for sound power is:
  - a.  $10^{-16}$  watt/cm<sup>2</sup>
  - b.  $10^{-4}$  watts/cm<sup>2</sup>
  - c. 20μPa
  - d.  $10^{-12}$  dynes/cm<sup>2</sup>
  
6. A complex sound is found to have the following frequency components: 100 Hz, 200 Hz, 300 Hz, 400 Hz, and 500 Hz. Its fundamental frequency is:
  - a. 50 Hz
  - b. 100 Hz
  - c. 300 Hz
  - d. 500 Hz
  
7. Complete cancellation of a sound may occur when a \_\_\_\_\_ encounters a \_\_\_\_\_.
  - a. rarefaction, rarefaction
  - b. condensation, condensation
  - c. rarefaction, condensation
  - d. deflection, reflection
  
8. An object has one frequency at which it will vibrate at its greatest amplitude. This frequency is known as the \_\_\_\_\_.
  - a. peak amplitude
  - b. resonant frequency
  - c. octave frequency
  - d. harmonic frequency
  
9. Frequency and intensity are \_\_\_\_\_ measurements of sound.
  - a. physical
  - b. perceptual
  - c. intuitive
  - d. reflective
  
10. Pitch and Loudness are \_\_\_\_\_ measurements of sound.
  - a. physical

- b. reflective
  - c. intuitive
  - d. perceptual
11. The amount of time it takes a waveform to complete one cycle is called its \_\_\_\_\_
- a. wavelength
  - b. phase
  - c. period
  - d. duration
12. The \_\_\_\_\_ of a sine wave is determined by the number of cycles completed in one second.
- a. phase
  - b. frequency
  - c. duration
  - d. wavelength
13. An increase of \_\_\_\_\_ dB corresponds to a doubling of sound pressure.
- a. 2
  - b. 4
  - c. 6
  - d. 12
14. At its resonant frequency, a mass vibrates
- a. With the least amount of applied energy
  - b. With the greatest amount of applied energy
  - c. At its least possible amplitude
  - d. As a free vibration
15. The velocity of sound in air is said to be
- a. 20 mph
  - b. 1130 ft/sec
  - c. 5286 ft/sec
  - d. 14.7 mph
16. The period of a sound can be calculated as
- a. Period = 1/frequency
  - b. Period = frequency/1
  - c. Period =  $1/\pi$
  - d. Period = frequency/20 $\mu$ Pa
17. Masking may take place when
- a. The masker precedes the signal



- b. The signal precedes the masker
  - c. The masker and signal coexist in time
  - d. All of the above
18. If the fifth harmonic of a sound is 500 HZ, the fundamental frequency is
- a. Indeterminable from the above information
  - b. Determined by wavelength
  - c. 100 Hz
  - d. 250 Hz
19. The unit of measurement in equal loudness contours is
- a. mel
  - b. sone
  - c. decibel
  - d. phon
20. The period of a 100 Hz tone is
- a. 1/1000 sec
  - b. 1/100 sec
  - c. 1/10 sec
  - d. 1 sec

## Chapter 2 Test Item Answer Key

### Essay Items

1. In addition to defining SPL, HL and SL, the student's answer should show an understanding how these relate for audiometric testing.
2. A complete response should include discussion of the different purposes between an artificial ear and artificial mastoid and the need for intensity level calibration as well as frequency and attenuator linearity calibration. The response should include mention of the different couplers for supra-aural earphones and insert receivers as well as acknowledgement that the SPL to reach audiometric zero differs for these two transducers and what this means clinically. Finally, recognition of the difference between electroacoustic calibration and biologic calibration and the need for both should be demonstrated in the answer.

### Short Answer Items

- |                                   |  |
|-----------------------------------|--|
| 1. waves                          | 12. logarithmic                              |
| 2. transverse, longitudinal, sine | 13. Hearing Level (HL)                       |
| 3. compressions, rarefactions     | 14. references                               |
| 4. forced, free                   | 15. pitch                                    |
| 5. mass, stiffness                | 16. similar hearing sensitivity in both ears |
| 6. speed                          | 17. masking                                  |
| 7. $w=v/f$                        | 18. air conduction                           |
| 8. frequencies                    | 19. bone conduction                          |
| 9. fundamental frequency          | 20. sound-pressure level                     |
| 10. vocal tract                   |  |
| 11. frequency, intensity, phase   |  |

### Multiple Choice Items

1. b
2. c
3. b
4. d
5. a
6. b
7. c
8. b
9. a
10. d
11. c
12. b
13. c
14. a