Instructor's Manual and Test Bank

for

Carole T. Ferrand

Speech Science
An Integrated Approach to Theory and Clinical Practice

Fourth Edition

prepared by

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PREFACE

This instructor's manual and test bank is designed to accompany the fourth edition of *Speech Science: An Integrated Approach to Theory and Clinical Practice.* The purpose of this manual is to provide instructional and testing material to support classroom lectures. Suggestions for teaching methods are offered, but may be adjusted according to each instructor's preference of style and key emphases. Each chapter provides the following: (1) a chapter overview; (2) key concepts; (3) a list of emphases; (4) suggested discussion topics and instructional activities; (5) test bank. The test bank includes multiple choice questions, true-false questions, short answer questions, and essay questions. The answer key for multiple choice and true-false questions is provided at the end of the manual.

CHAPTER OVERVIEW AND SUMMARY

The chapter overview and narrative summary provide a guideline that the instructor can use to construct class lectures, or to determine which information he or she would like to focus on. Information presented in these sections may also be provided to students in order to familiarize them with material that will be introduced, and give them a foundation for the upcoming concepts.

KEY CONCEPTS

The key concepts focus attention on important material covered in each chapter. These pages may be photo-copied and distributed to students. Instructors may provide the key concepts at the beginning of a chapter, prompting students to complete the definitions. This allows students to become familiar with the information and helps to develop a framework to follow the instructor's presentation of the material. Instructors may also choose to provide the concepts before an exam, as a means of reviewing information. Additionally, key concepts may be used as pre- and post-tests to assess student knowledge.

EMPHASES AND INSTRUCTIONAL ACTIVITIES

This section offers suggestions for topics to be introduced and discussed by the instructor. Some ideas for manner of presentation are included, such as using graphs, charts, or diagrams to acquaint students with more complex information. Within each section there are various discussion topics and instructional activities that may be used to demonstrate more elusive concepts and further support classroom lectures.

TEST BANK

A series of test questions are presented at the conclusion of each chapter. Instructors may select specific questions as a supplement to their own prepared examination, distribute the test bank in its entirety, or use the test bank as a general review before administering their own examination.

CHAPTER ONE
THE NATURE OF SOUND

CHAPTER OVERVIEW

I. THE NATURE OF SOUND
- Defining Science and Its Relationship to Human Speech
- International System of Units

II. BASIC PHYSICS CONCEPTS
- Mass, Force, Weight, Volume, and Density
- Speed, Velocity, Momentum, Acceleration, and Inertia
- Elasticity and Stiffness
- Work, Energy, Power, and Intensity
- Pressure

III. SOUND: CHANGES IN AIR PRESSURE
- Behavior of Air
- Air Pressure
- Airflow
- Relationship between Air Pressure, Air Volume, and Air Density
- The Nature of Sound
- Why Molecules Keep Vibrating: Elasticity, Inertia, and Friction
- Sound Propagation
- Wave Motion of Sound
- Longitudinal Versus Transverse Waves
- Mass/Spring System
- Simple Harmonic Motion
- Frequency, Period, Wavelength, Velocity, and Amplitude
- Visually Depicting Sound Waves: Waveforms

IV. PURE TONES AND COMPLEX SOUNDS
- Pure Tones
- Complex Sounds
- Periodic Versus Aperiodic Complex Waves
- Visually Depicting Sound Waves: Spectra

V. SOUND ABSORPTION, REFLECTION, REFRACTION, AND DIFFRACTION

VI. CONSTRUCTIVE AND DESTRUCTIVE INTERFERENCE

VII. ATTRIBUTES OF SOUNDS
- Frequency and Pitch
- Frequency: Human Range of Hearing
- Amplitude, Intensity, and Loudness

VIII. DECIBEL SCALE
- Logarithms and Ratios
- Perception on the dB Scale
- Advantages of the Decibel Scale
- Application of the dB Scale

IX. RESONANCE
- Acoustic Resonance
- Tube Resonance and Standing Waves
- Acoustic Resonators as Filters
- Bandwidth
- Cutoff Frequencies
- Resonance Curves
- Parameters of a Filter
- Types of Filters

KEY CONCEPTS

ABSORPTION

ACCELERATION

AIR

AIR FLOW

AIR PRESSURE

AMBIENT PRESSURE

AMPLITUDE

AUDIOGRAMS

BANDWIDTH

BOYLE'S LAW

BROWNIAN MOTION

CHANGES IN PRESSURE

COMPLEX SOUNDS

COMPRESSION

CONSTRUCTIVE INTEREFERENCE

CUROFF FREQUENCY

DAMPING

DECIBEL SCALE

DEFORMATION

DENSITY

DESTRUCTIVE INTEREFERENCE

DIFFRACTION

DRIVING PRESSURE

ELASTICITY

ENERGY

FILTERS

FORCE

FREQUENCY

FUNDAMENTAL FREQUENCY

HARMONIC FREQUENCIES

HERTZ

HOOKE'S LAW

INCIDENT WAVE

INERTIA

INTENSITY

LAMINAR FLOW

LINEAR SCALE

LOGARITHMIC SCALE

LONGITUDINAL WAVES

MASS

MOMENTUM

NODES

PERIOD

PERIODIC

PHASE

PITCH

POWER

PRESSURE

PURE TONE

RAREFACTION

RATIO SCALE

REFLECTION

REFRACTION

RESONANCE

RESONANCE CURVE

REVERBERATION

SIMPLE HARMONIC MOTION

SPECTRA

SPEED

STANDING WAVES

THRESHOLD OF HEARING

THRESHOLD OF PAIN

TRANSVERSE WAVES

TURBULENT FLOW

VELOCITY

VOLUME

WAVEFORMS

WAVELENGTH

WEIGHT

WORK

EMPHASES AND INSTRUCTIONAL ACTIVITIES

1. Review basic terms and concepts, such as mass, density, volume, pressure, etc.

2. Explain the relationship between air pressure and sound.

3. Students will understand the power of air pressure as well as changes in pressure with this simple demonstration. Use a peeled hard-boiled egg, a jar with an opening that is slightly smaller than the diameter of the egg, a piece of paper, and a lighter. Light the piece of paper and drop it into the bottle. Place the hard-boiled egg on the opening of the bottle. Increasing the temperature of air inside the bottle increases the pressure. Once the flame goes out, the pressure inside the bottle decreases relative to atmospheric pressure, and the positive atmospheric pressure pushes the egg into the bottle.

4. Describe simple harmonic motion (SHM), frequency, period, wavelength, velocity, and

amplitude.

5. Simple harmonic motion, frequency, and amplitude can be shown by using strings of different lengths with hex nuts attached to one end of each string. When swung, the string acts like a pendulum, and makes it easy for students to visualize the smooth back and forth motion that is characteristic of SHM, as well as the relationship between frequency and amplitude.

6. You can also demonstrate simple harmonic motion by using a hanging spring with a mass attached to the end. As you pull the mass down and release it, the spring will continue to move up and down in a repetitive motion. This will continue until the motion gradually fades away. On page 16 of the text, an illustration demonstrates what would occur if a marker was attached to the spring as it moves up and down.

7. Frequency, amplitude, and constructive/destructive interference can be demonstrated using a long slinky. Have two students stand across from one another with a slinky placed on a table between them. One student gives the slinky a push, generating a wave that travels along the length of the slinky. Pushing the slinky more forcefully increases the amplitude; pushing it more quickly increases the frequency. When the students push the slinky at either end, waves are generated from each end and travel toward each other. These waves will interfere either constructively, increasing the amplitude, or destructively, decreasing the amplitude.

8. Introduce pure tones versus complex sounds and waveforms versus spectra. Discuss the types of information that can be obtained from each type of graph. Prepare a variety of waveforms and spectra of pure tones and complex periodic and aperiodic sounds and have students interpret the graphs in terms of their perceptual and acoustic characteristics.

9. Describe the decibel scale and its relevance to an audiogram.

10. Many apps are available that analyze frequency and amplitude. Students can download these onto their smartphones or tablets and they provide a fun and easy way of becoming familiar with these concepts.

CHAPTER ONE TEST BANK

MULTIPLE CHOICE QUESTIONS

1. An object's resistance to changing its state of motion or rest is known as
    a. Inertia
    b. Momentum
    c. Newton's Second Law of Motion
    d. Acceleration

2. Compression occurs when
    a. Air molecules collide, creating an area of positive pressure.
    b. Air molecules return to their equilibrium position.
    c. Air molecules collide, creating an area of negative pressure.
    d. Air molecules overshoot their equilibrium position.

3. If the tympanic membrane (TM) is in the path of shifting molecules, then
    a. Compression moves the TM inward
    b. Rarefaction moves the TM outward
    c. A & B
    d. None of the above

4. The three forces that interact to keep molecules swinging back and forth around their equilibrium positions before they settle down again are
    a. Elasticity, friction and propagation
    b. Friction, damping, and simple harmonic motion
    c. Driving pressure, elasticity, and inertia
    d. Elasticity, inertia and friction

5. Which law states that a volume varies inversely with pressure, given a constant temperature?
    a. Boyle's Law
    b. Hooke's Law
    c. Newton's Second Law of Motion
    d. None of the above

6. All of the following influence the frequency of a vibrating object **EXCEPT**
    a. Length
    b. Pitch
    c. Density
    d. Tension

7. The frequency range that that humans tend to hear best is
    a. 1 kHz to 4 kHz
    b. 500 Hz to 8 kHz
    c. 0 to 140 dB
    d. 10 to 130 dB

8. Sound occurs when a disturbance creates alternating increases and decreases in
    a. Oral pressure
    b. Tympanic membrane pressure
    c. Ambient pressure
    d. Tracheal pressure

9. What is the frequency and period of a tuning fork vibrating at 500 cycles per second?
    a. F = 500Hz, t = 0.004s
    b. F = 250 Hz, t = 0.004s
    c. F = 250 Hz, t = 0.002s
    d. F = 500 Hz, t = 0.002s

10. During Brownian motion,
    a. Molecules move around in systematic pathways.
    b. Molecules move around at extremely high speeds and in random patterns.
    c. A&B
    d. None of the above

TRUE AND FALSE QUESTIONS

1. Waveforms are graphs with time on the horizontal axis and amplitude on the vertical axis.

    A) TRUE B) FALSE

2. Pure tones have more than one frequency and are graphed as sinusoidal waves.

   A) TRUE B) FALSE

3. Frequency is the subjective perception of how high or low a sound is on a musical scale.

   A) TRUE B) FALSE

4. The decibel scale is a linear scale that compares any target sound with a standard reference sound.

   A) TRUE B) FALSE

5. Natural frequency is the frequency at which an object vibrates when struck and is determined by the force of the strike.

   A) TRUE B) FALSE

6. An auditory area graph is used to represent an individual's hearing by measuring his or her threshold at selected frequency levels.

   A) TRUE B) FALSE

7. Vibration of a source in simple harmonic motion results in a pure tone with only one frequency.

   A) TRUE B) FALSE

8. Increasing the density of a vibrating object will decrease its rate of vibration.

   A) TRUE B) FALSE

9. Resonators that are less complex and more regular in shape tend to have wider bandwidths.

   A) TRUE B) FALSE

10. During constructive interference, two areas of low pressure combine. The amplitude of the resulting wave will be doubled.

    A) TRUE B) FALSE

SHORT ANSWER QUESTIONS

1. Explain the terms absorption, reflection, and diffraction.

2. Define Hooke's Law and explain its relationship to the vibration of a tuning fork.

3. Explain the relationship between the predictable movement of air molecules and driving pressure.

4. Describe how the decibel scale is a logarithmic ratio scale and provide an example of how the scale works.

5. Define the following concepts and label each concept as a subjective or objective phenomenon: frequency, pitch, amplitude, intensity, loudness.

ESSAY QUESTIONS

1. Air flow may be turbulent or laminar. Define these two terms and relate each type of air flow to speech production. Provide examples of phonemes that are produced with relatively laminar or relatively turbulent flow.

2. Discuss the movement of molecules when a tuning fork is struck. Include the terms compression, rarefaction, elasticity, inertia, and friction in your discussion.

3. Explain how resonators act as filters. In your explanation, be sure to include a description of the four types of filters and contrast their different functions.

4. Compare and contrast pure tones and complex sounds.

5. Compare and contrast waveforms and spectra. Be sure to include the type of information that each provides. Use diagrams to illustrate your response.