

# **Instructor's Resource Manual**

*for*

## **Acoustics in Hearing, Speech and Language Sciences: An Introduction** First Edition

Ian R. A. Mackay  
University of Ottawa

**PEARSON**

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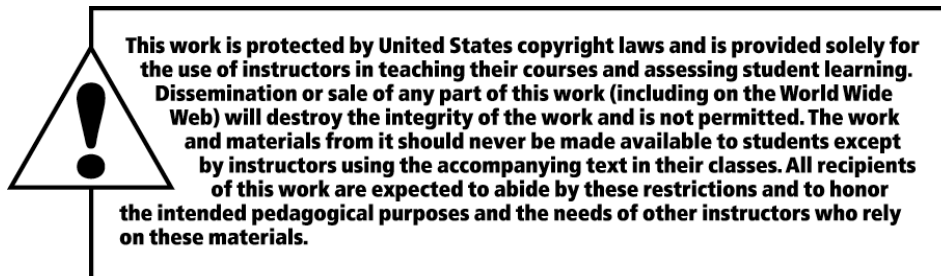
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## Introduction

**General note about the Questions & Problems sets:** In many textbooks, the questions or problems are for further thought or more in-depth study. In this book, the questions and problems are designed to ensure basic understanding of the material. Some have been devised to focus on points where there are common misunderstandings. In this sense, I consider them to be an essential part of students' study, not an optional extra.

Here is how I use the exercises pedagogically. In order to encourage learning of the concepts as the course progresses — this being a topic that resists cramming — the Q&P's are assigned at the end of the study of a chapter. Oftentimes, it is the act of doing the exercises that brings students' attention to the necessity of mastering certain concepts.

The Q&Ps count towards students' grades, but they count very little, just enough so that they are worth doing, but little enough that a few errors provide a positive motivation for learning. Thus, the exercises are a positive learning experience (encouraged by a small number of points as the carrot on the stick), rather than a negative one (loss of many points for making an error the first time a new type of problem is tried).

I count each individual set of exercises equally towards the total, and I drop each individual student's lowest Q&P grade (easy to program into an Excel spreadsheet). This seems to reduce a sense of frustration over a single poor set of problems, in order that motivation be maintained despite poor performance on one set of exercises.

An addition wrinkle is that I divide the class into small groups. The students are assigned doing all the questions in the set of exercises individually. Only then do they compare answers with their group. The group attempts to resolve differences in answers through discussion. The group submits a group set of answers (with all group members' copies attached in order to demonstrate that all individuals did indeed attempt all questions). My experience is that the resulting peer consultation deals with many initial misunderstandings in a non-threatening environment and leads to better understanding.

## 1. About the Tables of Q&P Answers in this Instructor's Manual

### 1.1 Format of the Tables of Answers in this Instructors' Manual

The answer keys are set up as tables, with **Suggested Points**, **Question Number**, and **Suggested Answer** as column headings.

Suggested answers and problem solutions are given **in red**. Additional material that might be part of the answer is shown in black type. For instance, the problems do not ask for the calculation to be shown step by step, but the answer key shows those steps. They are not in red because the text of the question in the book does not require that information. (Instructors should decide whether to require the steps in mathematical calculations and let students know their policy.)

Some additional material, plus commentary, suggestions, and so on may be added for the benefit of the instructor. When relevant to a specific question, this information is included within the table cell for the answer to the question. However, it is distinguished from the answers by *black italic* type and square brackets.

**Thus, in the answer tables:**

**Red Roman:** suggested answers

**Black Roman:** a more expansive answer; in particular, mathematical steps in a calculation of the answer, not required in the phrasing of the question.

**[Black Italic in square Brackets]:** Additional material, not called for by the specific wording of the question, or comments directed to the instructor.

### 1.2 Suggested Point Values

In the tables, I have suggested a number of points for each question. You may or may not wish to use these. If you use them, you will see that no effort has been made to ensure that the overall set of exercises has a nice round number total. If a spreadsheet is used for grades and grade calculations, then it does not matter if an exercise is out of a total of (for instance) 91; percentages can be calculated directly. My rationale is not to include unnecessary questions or to delete important questions just to make the exercise total a round number. The Q&P's are designed to focus on important issues, and in some instances provide multiple problems of the same type for practice; the number of questions is determined by those criteria, not by a round number of total points for the exercise.

If, on the other hand, you wish to have exercise totals that are round numbers, please modify the individual question values accordingly or add or subtract questions.

The point values assigned to the individual questions are designed to give relative weightings based on importance and difficulty. But the values of individual questions are balanced only with respect to other questions *in the same chapter*. No attempt has been made to equalize the point value of individual questions from chapter to chapter.



## Chapter 2

### 1. Erratum:

In the first printing, in Table B.2 on page 29, the figure for atmospheric pressure in kilograms/m<sup>2</sup> is given as ~~1,0332.3~~ rather than 10,332.3.

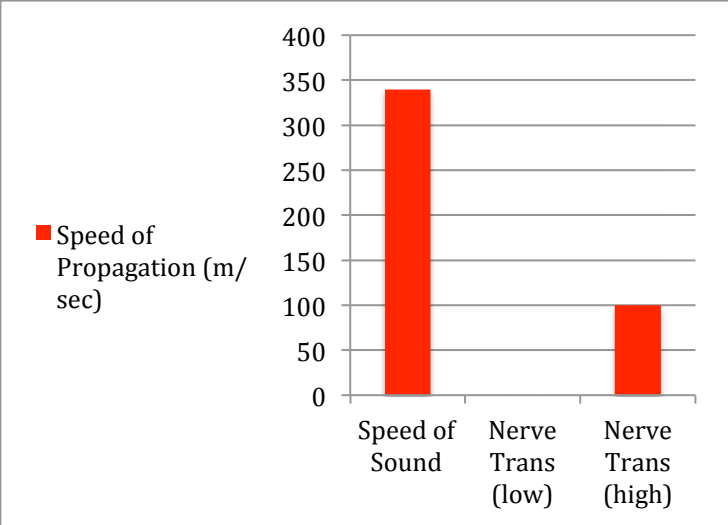
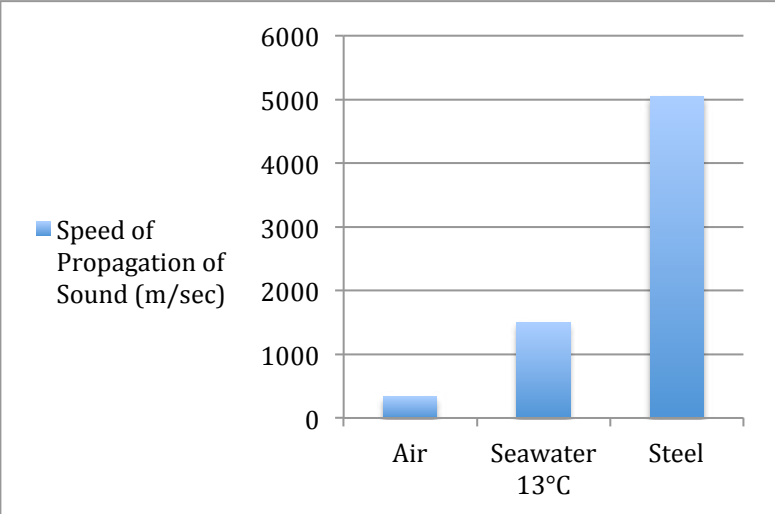
### 2. Comment on the exercises:

Significant digits are not introduced until Chapter 3 (in Refresher C). Therefore, close attention has not been paid to significant digits in the answers below.

### 3. Questions & Problems, pp 21-22

Sugg. Points	Q #	Suggested answer. [ <i>Additional material, not called for by the nature of the question, or comments directed to the instructor, are shown in italics.</i> ]
1	1	Source-filter Theory
1	2	A medium through which to propagate
1	3a	The word “travel” doesn’t clearly express how sound energy is displaced from its point of origin
1	3b	“Sound propagates from Point A to Point B.”
1	3c	The corrected sentence gives a more accurate view of how energy is transmitted through a medium. Sound is energy that interacts with its medium in order to propagate; it isn’t a “thing” that “moves” or “travels.”
1	4a	340 m/sec or $3.4 \times 10^2$ m/sec
1	4b	The first two digits are significant, but not the last one; this is an approximation. [Actual speed of propagation will depend on such factors as temperature, humidity, atmospheric pressure, and so on.]
1	5	Mach 1



Sugg. Points	Q #	<b>Suggested answer.</b> <i>[Additional material, not called for by the nature of the question, or comments directed to the instructor, are shown in italics.]</i>								
3	6	<p><i>[data to be found on page 10]</i></p>  <table border="1" data-bbox="443 407 1167 928"> <caption>Speed of Propagation (m/sec)</caption> <thead> <tr> <th>Category</th> <th>Speed (m/sec)</th> </tr> </thead> <tbody> <tr> <td>Speed of Sound</td> <td>~340</td> </tr> <tr> <td>Nerve Trans (low)</td> <td>0</td> </tr> <tr> <td>Nerve Trans (high)</td> <td>100</td> </tr> </tbody> </table>	Category	Speed (m/sec)	Speed of Sound	~340	Nerve Trans (low)	0	Nerve Trans (high)	100
Category	Speed (m/sec)									
Speed of Sound	~340									
Nerve Trans (low)	0									
Nerve Trans (high)	100									
3	7	<p><i>[data to be found on page 9]</i></p>  <table border="1" data-bbox="443 1052 1214 1562"> <caption>Speed of Propagation of Sound (m/sec)</caption> <thead> <tr> <th>Medium</th> <th>Speed (m/sec)</th> </tr> </thead> <tbody> <tr> <td>Air</td> <td>~340</td> </tr> <tr> <td>Seawater 13°C</td> <td>~1500</td> </tr> <tr> <td>Steel</td> <td>5000</td> </tr> </tbody> </table>	Medium	Speed (m/sec)	Air	~340	Seawater 13°C	~1500	Steel	5000
Medium	Speed (m/sec)									
Air	~340									
Seawater 13°C	~1500									
Steel	5000									
2	8	<p><b>answer: 8.3 m/sec</b></p> $\frac{500 \text{ m}}{60 \text{ sec}} = 8.333 \text{ m/sec}$								

Sugg. Points	Q #	Suggested answer. [ <i>Additional material, not called for by the nature of the question, or comments directed to the instructor, are shown in italics.</i> ]
	9	
1	9a	Slower from A to B than from B to C.
1	9b	Slower from B to C than from C to D.
1	9c	Slower from C to D than from D to E.
1	10a	supersonic
1	10b	infrasonic
1	10c	subsonic
1	10d	Mach 1
2	11	Normal atmospheric air pressure pushes the liquid up the straw.
	12	<i>[This question refers to material in Refresher B. It assumes the knowledge that pressure within the middle ear is equivalent to atmospheric pressure – the Instructor may wish to provide this information ahead of time depending on the background of the class members.]</i>
1	12a	101.3 kPa
1	12b	1 atmosphere
1	12c	14.7 pounds per square inch
	13	<i>[This problem relies on the knowledge that the upward pressure on the bottom of the table is equal to the downward pressure on the top: Refresher B]</i>
2	13	Metric version
		<p>area of table:</p> $0.750m \times 0.750m = 0.5625m^2$ <p>pressure:</p> $0.5625 m^2 \times 10,332.3 \frac{kg}{m^2} = 5811.9 \text{ kilograms}$
	13	Imperial version [ <i>note that metric and Imperial versions are NOT equivalent</i> ]

Sugg. Points	Q #	<b>Suggested answer.</b> [ <i>Additional material, not called for by the nature of the question, or comments directed to the instructor, are shown in italics.</i> ]
		<p>area of table:</p> $2ft \times 2ft = 4 sq. ft.$ <p>conversion:</p> $4 sq. ft. \times 144 \frac{sq. in.}{sq. ft.} = 576 sq. in.$ <p>pressure:</p> $576 sq. in. \times 14.7 \frac{pounds}{sq. in} = 8467.2 pounds$