

Chapter 17 End-of-Chapter Problems

Halliday & Resnick, 10th Edition

Donald Aingworth IV

Hit me where it Matters

Where needed in the problems, use
speed of sound in air = 343 m/s
and
density of air = 1.21 kg/m³
unless otherwise specified.

1 Problem 1

Two spectators at a soccer game see, and a moment later hear, the ball being kicked on the playing field. The time delay for spectator A is 0.23 s, and for spectator B it is 0.12 s. Sight lines from the two spectators to the player kicking the ball meet at an angle of 90° . How far are (a) spectator A and (b) spectator B from the player? (c) How far are the spectators from each other?

1.1 Solution (a)

This is a simple question to answer. The distance traveled to A would be equal to the speed of sound times the time taken to travel the distance.

$$x = vt = (343 \text{ m/s})(0.23 \text{ s}) = \boxed{78.89 \text{ m}} \quad (1)$$

1.2 Solution (b)

The is calculatable the same way.

$$y = vt = (343 \text{ m/s})(0.12 \text{ s}) = \boxed{41.16 \text{ m}} \quad (2)$$

1.3 Solution (c)

The 90 degree angle of their sight lines makes the triangle of the two spectators and the ball a right triangle, so we can use the Pythagorean theorem to find the distance between the spectators.

$$h = \sqrt{x^2 + y^2} = \sqrt{(78.89 \text{ m})^2 + (41.16 \text{ m})^2} = \boxed{88.98 \text{ m}} \quad (3)$$

2 Problem 3

When the door of the Chapel of the Mausoleum in Hamilton, Scotland, is slammed shut, the last echo heard by someone standing just inside the door reportedly comes 15 s later. (a) If that echo were due to a single reflection off a wall opposite the door, how far from the door is the wall? (b) If, instead, the wall is 25.7 m away, how many reflections (back and forth) occur?

2.1 Solution

3 Problem 5

Earthquakes generate sound waves inside Earth. Unlike a gas, Earth can experience both transverse (S) and longitudinal (P) sound waves. Typically, the speed of S waves is about 4.5 km/s, and that of P waves 8.0 km/s. A seismograph records P and S waves from an earthquake. The first P waves arrive 3.0 min before the first S waves. If the waves travel in a straight line, how far away did the earthquake occur?

3.1 Solution

4 Problem 7

A stone is dropped into a well. The splash is heard 3.00 s later. What is the depth of the well?

4.1 Solution

5 Problem 11

Diagnostic ultrasound of frequency 4.50 MHz is used to examine tumors in soft tissue. (a) What is the wavelength in air of such a sound wave? (b) If the speed of sound in tissue is 1500 m/s, what is the wavelength of this wave in tissue?

5.1 Solution

6 Problem 15

6.1 Solution

7 Problem 17

7.1 Solution

8 Problem 19

8.1 Solution

9 Problem 20

9.1 Solution

10 Problem 25

10.1 Solution

11 Problem 27

11.1 Solution

12 Problem 29

12.1 Solution

13 Problem 35

13.1 Solution

14 Problem 39

14.1 Solution

15 Problem 41

15.1 Solution

16 Problem 47

16.1 Solution

17 Problem 49

17.1 Solution

18 Problem 51

18.1 Solution

19 Problem 53

19.1 Solution

20 Problem 55

20.1 Solution

21 Problem 57

21.1 Solution

22 Problem 61

22.1 Solution

23 Problem 63

23.1 Solution

24 Problem 71

24.1 Solution

25 Problem 81

25.1 Solution

26 Problem 87

26.1 Solution

27 Problem 99

27.1 Solution

28 Problem 107

28.1 Solution

Contents

1	Problem 1	2
1.1	Solution (a)	2
1.2	Solution (b)	2
1.3	Solution (c)	2
2	Problem 3	3
2.1	Solution	3
3	Problem 5	4
3.1	Solution	4
4	Problem 7	5
4.1	Solution	5
5	Problem 11	6
5.1	Solution	6
6	Problem 15	7
6.1	Solution	7
7	Problem 17	8
7.1	Solution	8
8	Problem 19	9
8.1	Solution	9
9	Problem 20	10
9.1	Solution	10
10	Problem 25	11
10.1	Solution	11
11	Problem 27	12
11.1	Solution	12
12	Problem 29	13
12.1	Solution	13

13 Problem 35	14
13.1 Solution	14
14 Problem 39	15
14.1 Solution	15
15 Problem 41	16
15.1 Solution	16
16 Problem 47	17
16.1 Solution	17
17 Problem 49	18
17.1 Solution	18
18 Problem 51	19
18.1 Solution	19
19 Problem 53	20
19.1 Solution	20
20 Problem 55	21
20.1 Solution	21
21 Problem 57	22
21.1 Solution	22
22 Problem 61	23
22.1 Solution	23
23 Problem 63	24
23.1 Solution	24
24 Problem 71	25
24.1 Solution	25
25 Problem 81	26
25.1 Solution	26

26 Problem 87	27
26.1 Solution	27
27 Problem 99	28
27.1 Solution	28
28 Problem 107	29
28.1 Solution	29