CHAPTER 7

Transmission Media

Solutions to Odd-Numbered Review Questions and Exercises

Review Questions

1. The ***transmission media*** is located ***beneath the physical layer*** and controlled by the physical layer.
3. ***Guided media*** have physical boundaries, while ***unguided media*** are unbounded.
5. ***Twisting*** ensures that both wires are equally, but ***inversely***, affected by external influences such as noise.
7. The ***inner core*** of an optical fiber is surrounded by ***cladding***. The core is denser than the cladding, so a light beam traveling through the core is reflected at the boundary between the core and the cladding if the incident angle is more than the critical angle.
9. In ***sky propagation*** radio waves radiate upward into the ionosphere and are then reflected back to earth. In ***line-of-sight propagation*** signals are transmitted in a straight line from antenna to antenna.

Exercises

11. See Table 7.1 (the values are approximate).

Table 7.1 *Solution to Exercise 11*

Distance	*dB at 1 KHz*	*dB at 10 KHz*	*dB at 100 KHz*
1 Km	**−3**	**−5**	**−7**
10 Km	**−30**	**−50**	**−70**
15 Km	**−45**	**−75**	**−105**
20 Km	**−60**	**−100**	**−140**

13. We can use Table 7.1 to find the power for different frequencies:

1 KHz	dB = −3	$P_2 = P_1 \times 10^{-3/10}$	= **100.23 mw**
10 KHz	dB = −5	$P_2 = P_1 \times 10^{-5/10}$	= **63.25 mw**

100 KHz   dB = –7 $P_2 = P_1 \times 10^{-7/10}$ = **39.90 mw**

The table shows that the power for 100 KHz is reduced almost 5 times, which may not be acceptable for some applications.

15. We first make Table 7.2 from Figure 7.9 (in the textbook).

Table 7.2 *Solution to Exercise 15*

Distance	*dB at 1 KHz*	*dB at 10 KHz*	*dB at 100 KHz*
1 Km	**–3**	**–7**	**–20**
10 Km	**–30**	**–70**	**–200**
15 Km	**–45**	**–105**	**–300**
20 Km	**–60**	**–140**	**–400**

If we consider the bandwidth to start from zero, we can say that the bandwidth decreases with distance. For example, if we can tolerate a maximum attenuation of –50 dB (loss), then we can give the following listing of distance versus bandwidth.

Distance	**Bandwidth**
1 Km	100 KHz
10 Km	1 KHz
15 Km	1 KHz
20 Km	0 KHz

17. We can use the formula f = c / λ to find the corresponding frequency for each wave length as shown below (c is the speed of propagation):

a. $B = [(2 \times 10^8)/1000\times10^{-9}] - [(2 \times 10^8)/ 1200 \times 10^{-9}]$ = **33 THz**

b. $B = [(2 \times 10^8)/1000\times10^{-9}] - [(2 \times 10^8)/ 1400 \times 10^{-9}]$ = **57 THz**

19. See Table 7.3 (The values are approximate).

Table 7.3 *Solution to Exercise 19*

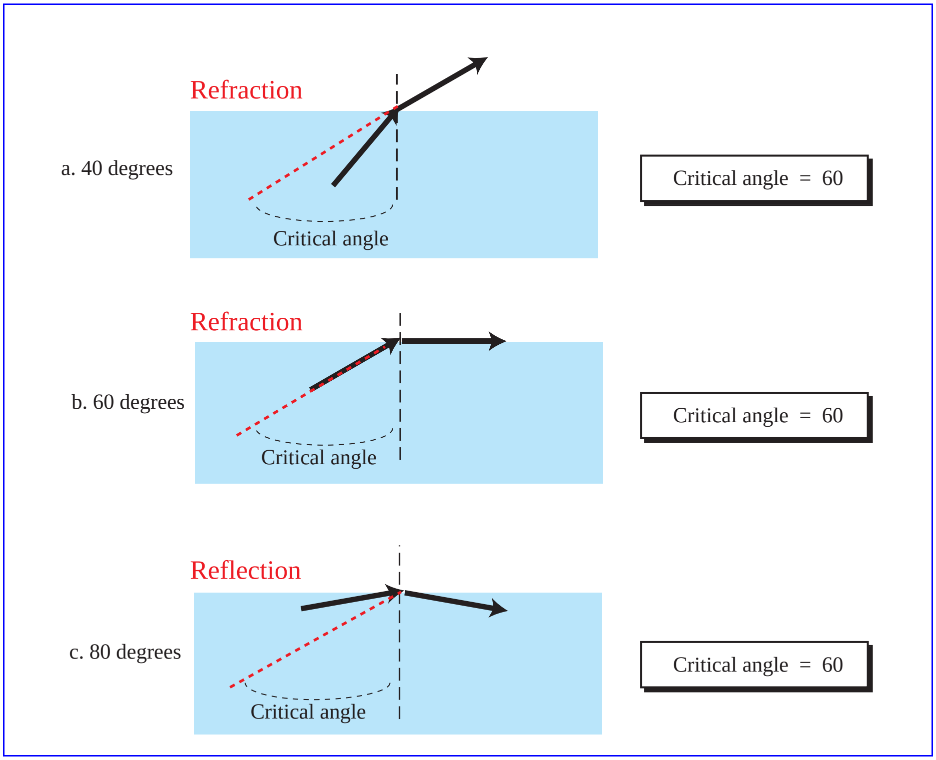
Distance	*dB at 800 nm*	*dB at 1000 nm*	*dB at 1200 nm*
1 Km	**–3**	**–1.1**	**–0.5**
10 Km	**–30**	**–11**	**–5**
15 Km	**–45**	**–16.5**	**–7.5**
20 Km	**–60**	**–22**	**–10**

21. See Figure 7.1.

a. The incident angle (40 degrees) is smaller than the critical angle (60 degrees). We have ***refraction***.The light ray enters into the less dense medium.

b. The incident angle (60 degrees) is the same as the critical angle (60 degrees). We have ***refraction***. The light ray travels along the interface.

Figure 7.1 *Solution to Exercise 21*



c. The incident angle (80 degrees) is greater than the critical angle (60 degrees). We have ***reflection***. The light ray returns back to the more dense medium.