Questions on Chapter 7

Questions:

Q7-1. What is the position of the transmission media in the OSI or the Internet model?

The *transmission media* is located *beneath the physical layer* and controlled by the physical layer.

Q7-2. Name the two major categories of transmission media.

The two major categories are *guided* and *unguided* media.

Q7-3. How do guided media differ from unguided media?

Guided media have physical boundaries, while unguided media are unbounded.

Q7-4. What are the three major classes of guided media?

The three major categories of guided media are twisted-pair, coaxial, and fiberoptic cables.

Q7-5. What is the function of the twisting in twisted-pair cable?

Twisting ensures that both wires are equally, but inversely, affected by external influences such as noise.

Q7-6. What is refraction? What is reflection?

Refraction and reflection are two phenomena that occur when a beam of light travels into a less dense medium. When the angle of incidence is less than the critical angle, refraction occurs. The beam crosses the interface into the less dense medium. When the angle of incidence is greater than the critical angle, reflection occurs. The beam changes direction at the interface and goes back into the denser medium.

Q7-7. What is the purpose of cladding in an optical fiber?

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.

Q7-8. Name the advantages of optical fiber over twisted-pair and coaxial cable.

We can mention three advantages of optical fiber cable over twisted-pair and coaxial cables: noise resistance, less signal attenuation, and higher bandwidth.

Q7-9. How does sky propagation differ from line-of-sight propagation?

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.

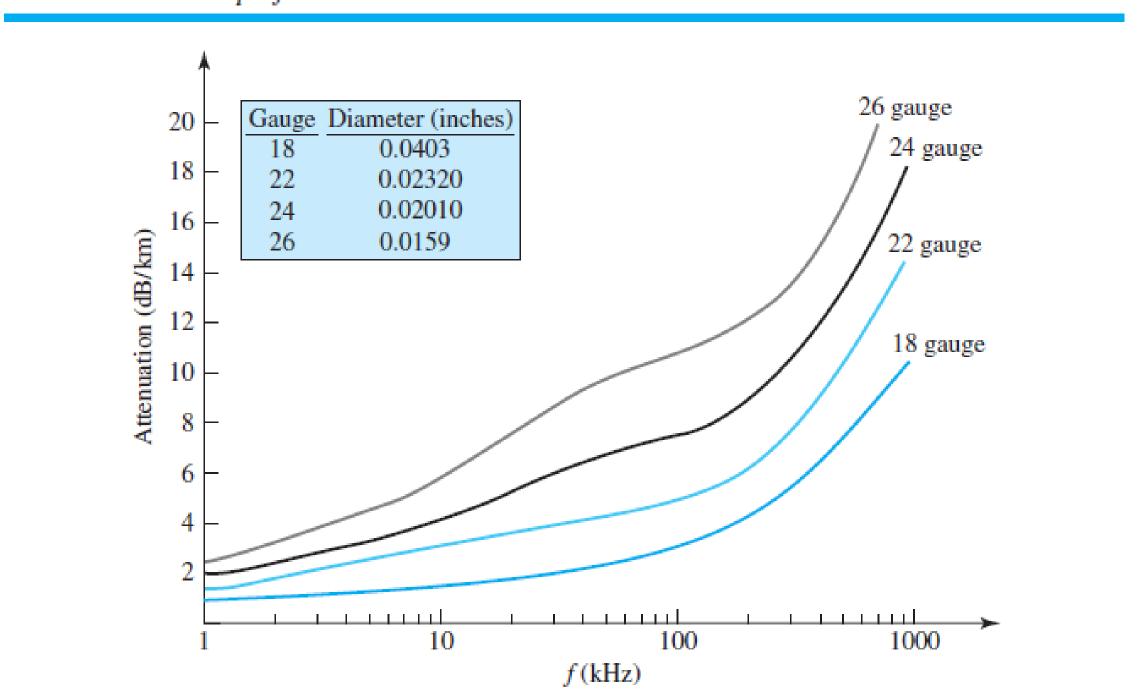
Q7-10. What is the difference between omnidirectional waves and unidirectional waves?

Omnidirectional waves are propagated in all directions; unidirectional waves are propagated in one direction.

Problems:

7-1) Tabulate the attenuation (in dB) of a 18-gauge UTP for the indicated frequencies and distances from the following figure.

UTP performance



Solution

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**

7-2) Use the results of Problem P7-1 to infer that the bandwidth of a UTP cable decreases with an increase in distance.

As the Table 7.1 shows, for a specific maximum value of attenuation, the highest frequency decreases with distance. 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	50 KHz
15 Km	1 KHz
20 Km	0 KHz

7-3) If the power at the beginning of a 1 Km 18-gauge UTP is 200 mw, what is the power at the end for frequencies 1 KHz, 10 KHz, and 100 KHz? Use the results of Problem P7-1.

Solution:

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**

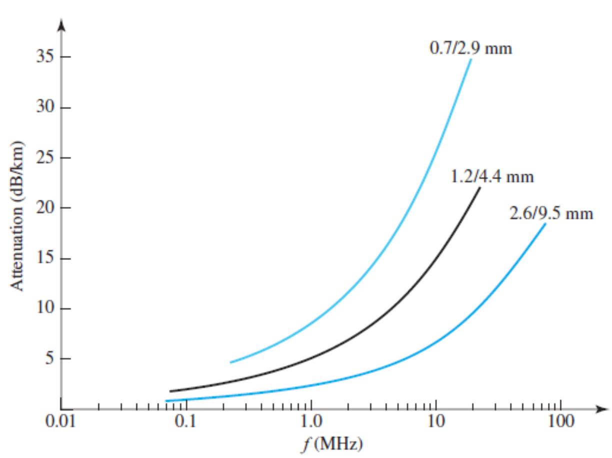
10 KHz dB = -5 $P_2 = P_1 \times 10^{-5/10}$ = **63.25 mw**

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

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

7-4) Using Figure 7.9, tabulate the attenuation (in dB) of a 2.6/9.5 mm coaxial cable for the indicated frequencies and distances.

Figure 7.9 *Coaxial cable performance*



Solution:

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**

7-5) Use the results of Problem P7-4 to infer that the bandwidth of a coaxial cable decreases with the increase in distance.

Solution:

As Table 7.2 shows, for a specific maximum value of attenuation, the highest frequency decreases with distance. 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

7-6) If the power at the beginning of a 1 Km 2.6/9.5 mm coaxial cable is 200 mw, what is the power at the end for frequencies 1 KHz, 10 KHz, and 100 KHz? Use the results of Problem P7-4.

We can use Table 7.2 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 = –7 $P_2 = P_1 \times 10^{-7/10}$ = **39.90 mw**

100 KHz dB = –20 $P_2 = P_1 \times 10^{-20/10}$ = **2.00 mw**

The table shows that power is decreased 100 times for 100 KHz, which is unacceptable for most applications.

7-7) Calculate the bandwidth of the light for the following wavelength ranges (assume a propagation speed of 2 × 108 m):

a. 1000 to 1200 nm **b. 1000 to 1400 nm**

Solution:

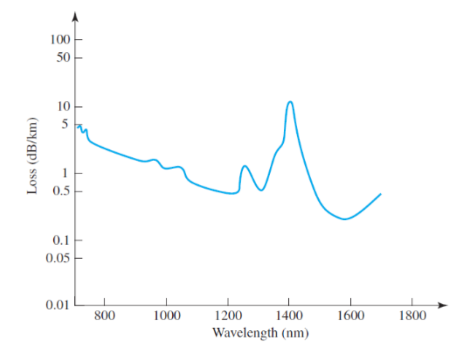
We can use the formula f = c / λ to find the corresponding frequency for each wave length as shown below (c is the speed of propagation):

a. B = [(2 × 108)/1000×10−9] − [(2 × 108)/ 1200 × 10−9] = **33 THz**

b. B = [(2 × 108)/1000×10−9] − [(2 × 108)/ 1400 × 10−9] = **57 THz**

7-8) The horizontal axes in the following figures represent frequencies. The horizontal axis in Figure 7.16 represents wavelength. Can you explain the reason? If the propagation speed in an optical fiber is 2 × 10^8 m, can you change the units in the horizontal axis to frequency? Should the vertical-axis units be changed too? Should the curve be changed too?

Figure 7.16 *Optical fiber performance*



UTP performance

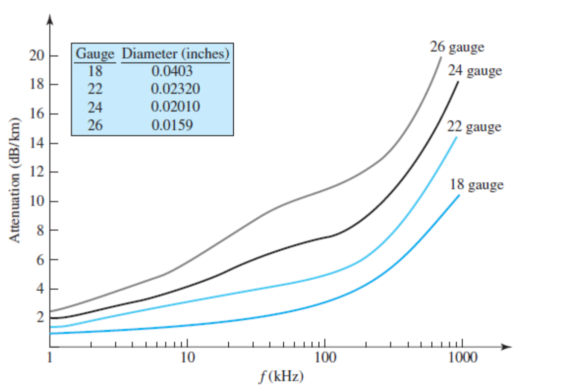
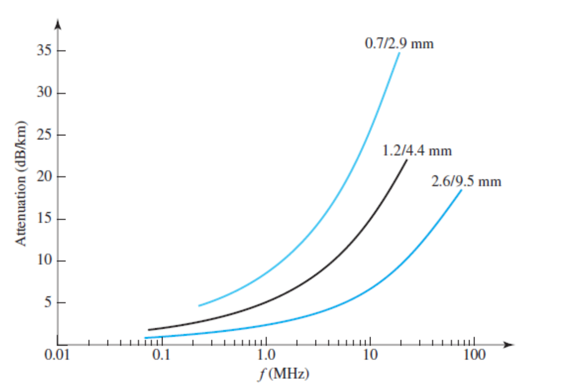


Figure 7.9 *Coax... ...*



Solution:

a. The wave length is the inverse of the frequency if the propagation speed is fixed (based on the formula λ = c / f). This means all three figures represent the same thing.

b. We can change the wave length to frequency. For example, the value 1000 nm can be written as 200 THz.

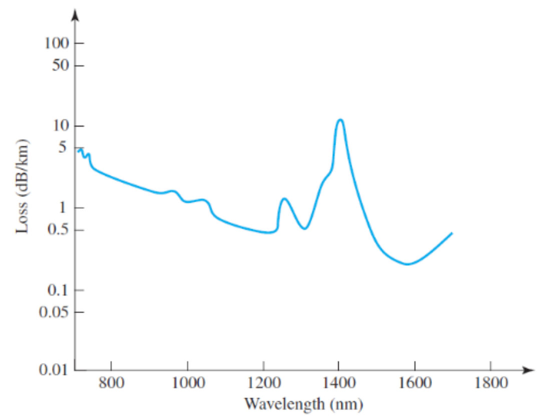
c. The vertical-axis units may not change because they represent dB/km.

d. The curve must be flipped horizontally.

7-9) Using Figure 7.16, tabulate the attenuation (in dB) of an optical fiber for the indicated wavelength and distances.

Distance	*dB at 800 nm*	*dB at 1000 nm*	*dB at 1200 nm*
1 Km			
10 Km			
15 Km			
20 Km			

Figure 7.16 *Optical fiber performance*



Solution:

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**

7-10) A light signal is travelling through a fiber. What is the delay in the signal if the length of the fiber-optic cable is 10 m, 100 m, and 1 Km (assume a propagation speed of 2×10^8 m)?

The delay = distance / (propagation speed). Therefore, we have:

a. Delay = $10/(2 \times 10^8)$ = **0.05 ms**

b. Delay = $100/(2 \times 10^8)$ = **0.5 ms**

c. Delay = $1000/(2 \times 10^8)$ = **5 ms**

7-11) A beam of light moves from one medium to another medium with less density. The critical angle is 60°. Do we have refraction or reflection for each of the following incident angles? Show the bending of the light ray in each case.

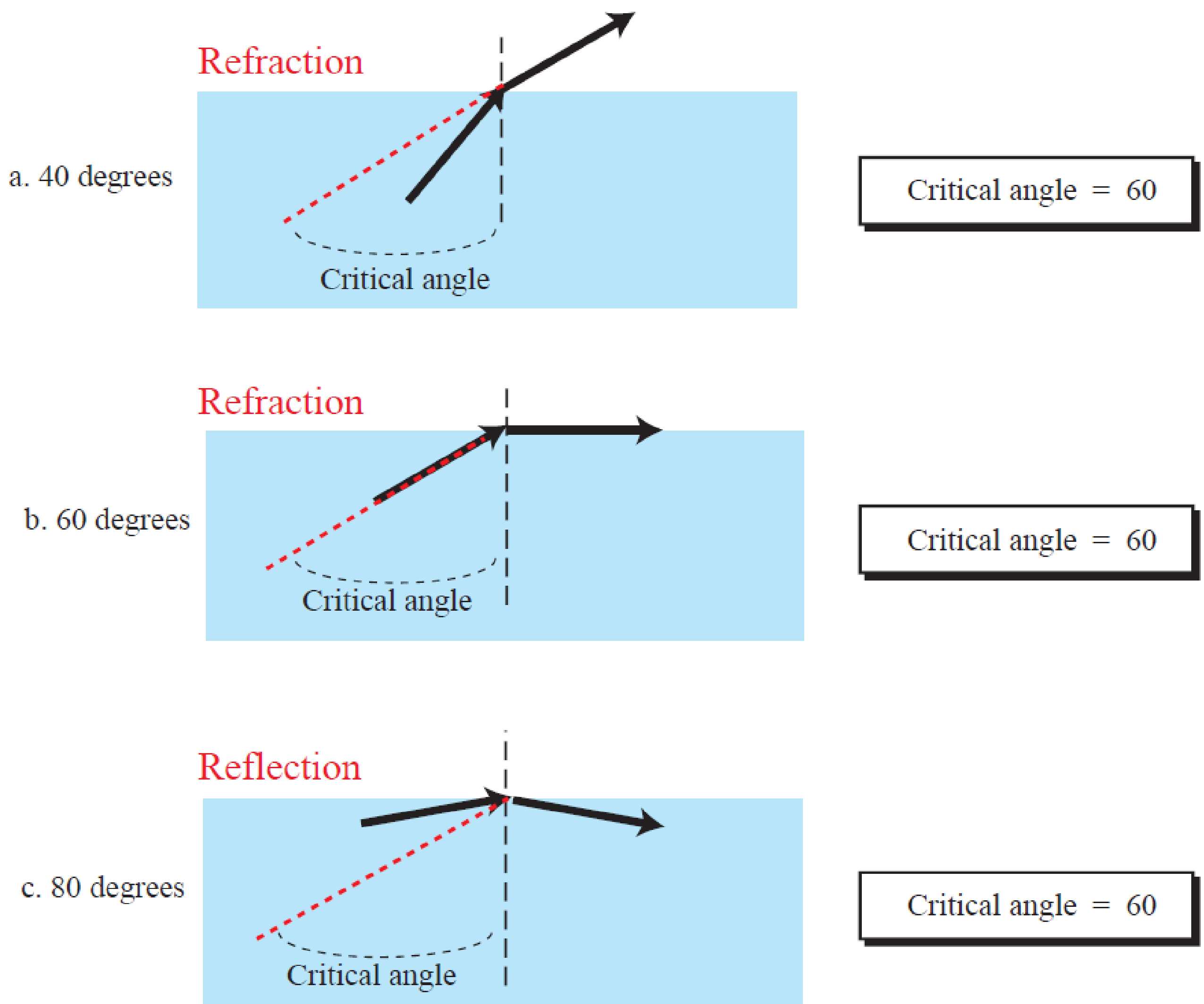
a. 40° **b.60°** **c.80°**

Solution:

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.

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



MCQ:

1)Transmission media are usually categorized as _______.

A) fixed or unfixed
B) guided or unguided
C) determinate or indeterminate
D) metallic or nonmetallic

Solution: **B**

2)Transmission media lie below the _______ layer.

A) physical
B) network
C) transport
D) application

Solution: **A**

3)_______ cable consists of an inner copper core and a second conducting outer sheath.

A) Twisted-pair
B) Coaxial
C) Fiber-optic
D) Shielded twisted-pair

Solution: **B**

4)In fiber optics, the signal is _______ waves.

A) light
B) radio
C) infrared
D) very low-frequency

Solution: **A**

5)Which of the following is not a guided medium?

A) twisted-pair cable
B) coaxial cable
C) fiber-optic cable
D) atmosphere

Solution: **D**

6)Which of the following is not an unguided medium?

A) twisted-pair cable
B) coaxial cable
C) fiber-optic cable
D) None of the choices are correct

Solution: **D**

7)Twisting in a twisted-pair help reduce the __________.

A) length
B) cost
C) noise
D) None of the choices are correct

Solution: **C**

8)Noise in a coaxial cable is reduced by ___________________.

A) twisting the cable
B) the outer conductor
C) the inner conductor
D) None of the choices are correct

Solution: **B**

9)UTP and STP are different implementations of ___________________ cable.

A) twisted-pair
B) coaxial
C) fiber-optic
D) None of the choices are correct

Solution: **A**

10)RJ-45 is a type of connectors used in _________ cabling.

A) twisted-pair
B) coaxial
C) fiber-optic
D) None of the choices are correct

Solution: **A**

11)RG rating is used in _________ cable.

A) twisted-pair
B) coaxial
C) fiber-optic
D) None of the choices are correct

Solution: **B**

12)SC and TP are two types of connectors used in _________ cabling.

A) twisted-pair
B) coaxial
C) fiber-optic
D) None of the choices are correct

Solution: **C**

13)The infrared wave has frequencies ________ microwave.

A) below
B) above
C) the same as
D) None of the choices are correct

Solution: **A**

14)BNC is a type of connectors used in _________ cabling.

A) twisted-pair
B) coaxial
C) fiber-optic
D) None of the choices are correct

Solution: **B**