

**Passage VII**

The *human threshold of hearing* is the minimum intensity at each sound frequency required for a sound to be heard by humans. The *human threshold of pain* is the maximum intensity at each sound frequency that humans can tolerate without pain.

The figure below displays, for sounds in water and in air, the human thresholds of hearing and of pain. The figure also shows  $S$ , the percent increase in air density and water density that accompanies the compression of air and water by sound waves of given intensities. Sound intensities are given in decibels (db) and frequencies are given in hertz [(Hz); 1 Hz = 1 cycle/sec].

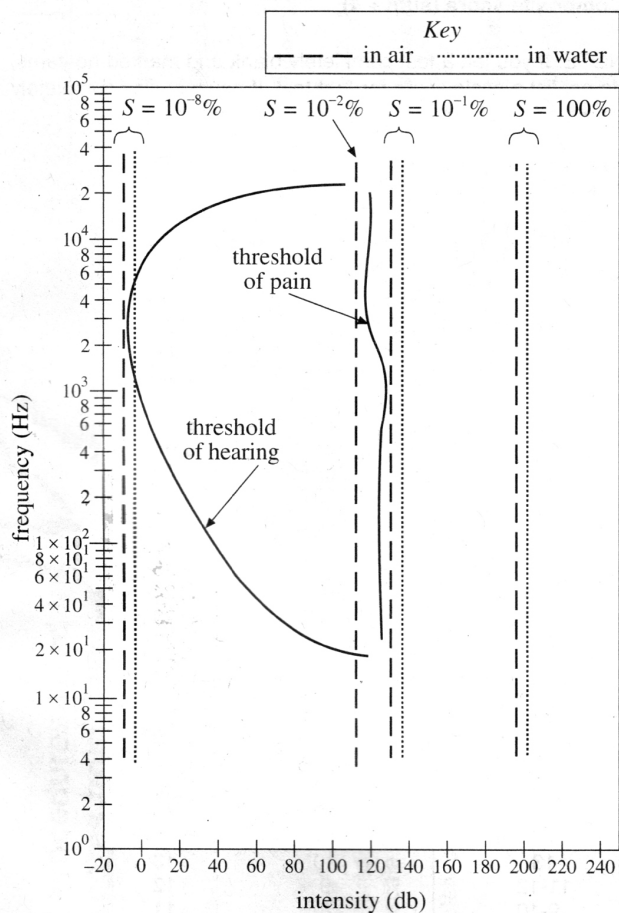
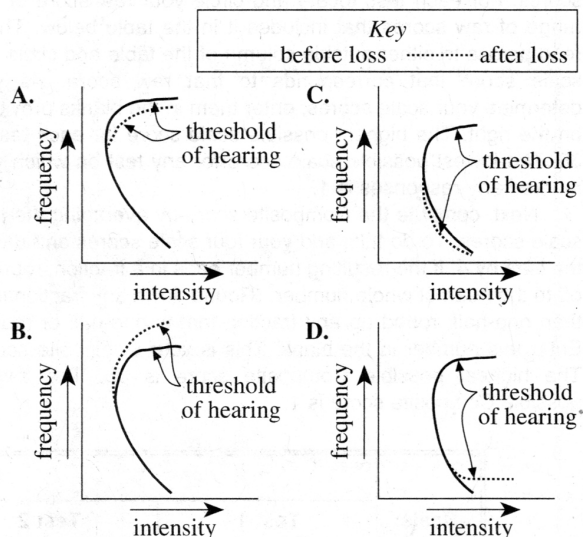


Figure adapted from Rita G. Lerner and George L. Trigg, eds., *Encyclopedia of Physics*, 2nd ed. ©1991 by VCH Publishers, Inc.

36. According to the figure, which of the following is closest to the lowest frequency that can be heard by a human being?
- F. 8 Hz  
 G. 20 Hz  
 H. 1,000 Hz  
 J. 20,000 Hz

37. As humans age, it is common for selective hearing loss to occur at high sound frequencies. Which of the following figures best illustrates this loss?



38. Based on the figure, a sound of a given frequency will have the highest intensity for which of the following sets of conditions?

Sound is passing through:	$S$
F. water	100%
G. water	$10^{-8}\%$
H. air	100%
J. air	$10^{-8}\%$

39. A student hypothesized that sounds of any intensity at a frequency of  $10^5$  Hz would be painful for humans to hear. Do the data in the figure support this hypothesis?
- A. Yes, because the threshold of pain is relatively constant with changes in frequency.  
 B. Yes, because as frequency increases above  $10^5$  Hz, the threshold of pain increases.  
 C. No, because humans cannot hear sounds at  $10^5$  Hz.  
 D. No, because the threshold of pain is relatively constant with changes in frequency.
40. Based on the figure, does  $S$  depend on the frequency of a sound wave of a given intensity?
- F. Yes, because as frequency increases,  $S$  increases.  
 G. Yes, because as frequency increases,  $S$  remains constant.  
 H. No, because as frequency increases,  $S$  increases.  
 J. No, because as frequency increases,  $S$  remains constant.