Midterm Review Practice Exam

IMPORTANT NOTE: *These "practice" exam questions are intended to help you review some of the basic concepts covered in class. The actual exam will include "show work" problems similar to those in the written homework assignments, so be sure to review the posted solutions.*

The class meeting on Thursday, February 27 will be devoted to exam review, and be focused on going through the solution to the questions on this practice exam. Be sure to bring your iClicker to class in order to participate in the review. The solution to this practice exam will NOT be publically posted, so be sure to make it a priority to attend this class session.

Multiple Choice – Select the <u>single</u> most appropriate response for each question.
Note that "none of the above" MAY be a VALID ANSWER.

Equations and constants:

c = 1130 feet/sec (speed of sound at ambient conditions)

$\lambda = c/f$

$f_n = nc/4L$ *where f_n is a resonance mode of an undamped pipe of length L, for n = 1,3,5…*

$$\Sigma_{dB\text{-}SPLa+b} = 20 \log_{10} [\text{sqrt} \{ (10^{dB\text{-}SPLa/20})^2 + (10^{dB\text{-}SPLb/20})^2 + 2(10^{dB\text{-}SPLa/20}) (10^{dB\text{-}SPLb/20})(\cos(\theta_a - \theta_b))\}]$$

$\Sigma_{dB\text{-}SPLa+b} = 20 \log_{10} [1 + 10^{dB\text{-}SPLb/20}]$ *two sources in phase, dB-SPLa = 0 dB*

$\Sigma_{dB\text{-}SPLa+b} = 20 \log_{10} [\text{sqrt} \{ 2 + 2\cos(-\theta_b) \}]$ *both sources 0 dB, $\theta_a = 0$*

1. The head-related transfer function (HRTF) provides us with our sense of:
   (A) spaciousness
   (B) horizontal localization
   (C) vertical localization
   (D) tonal quality
   (E) none of the above

2. The effect of a 1.5 ms offset between loudspeakers in a cluster that cover adjacent areas, with some overlap in coverage, is:
   (A) an echo
   (B) pseudo stereo effect
   (C) destructive interference at certain frequencies
   (D) power addition
   (E) none of the above

3. The crest factor of an audio signal is:
   (A) the peak compression ratio
   (B) the peak clipping ratio
   (C) the peak to RMS level ratio
   (D) the peak limiting ratio
   (E) none of the above

4. For typical speech/musical program material, the crest factor is:
   (A) 0 dB
   (B) 3-5 dB
   (C) 6-8 dB
   (D) 10-12 dB
   (E) none of the above

5. If two 0 dB sine waves of the same frequency but 120º out of phase are summed, the resulting level will be:
   (A) -6 dB
   (B) 0 dB
   (C) +3 dB
   (D) +6 dB
   (E) none of the above

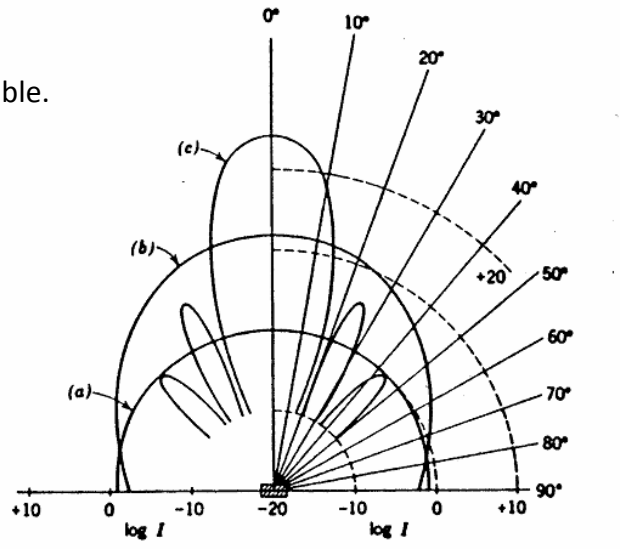
6. If two 0 dB sine waves of the same frequency but 90º out of phase are summed, the resulting level will be:
   (A) -6 dB
   (B) 0 dB
   (C) +3 dB
   (D) +6 dB
   (E) none of the above

7. In the __ zone, sources must remain within ± 1/3 wavelength:
   (A) coupling
   (B) cancellation
   (C) combing
   (D) combining
   (E) isolation

8. In the __ zone, there is 10 dB or more of level offset:
   (A) coupling
   (B) cancellation
   (C) combing
   (D) combining
   (E) isolation

9. Filters narrower than __ are generally not perceptible.
   (A) λ/2
   (B) λ/3
   (C) λ/4
   (D) λ/6
   (E) none of the above

10. Based on the polar plots shown in Figure 1, the frequency of operation that would produce directivity pattern (b) for a 12-inch woofer is approximately:
   (A) 141 Hz
   (B) 283 Hz
   (C) 1130 Hz
   (D) 4520 Hz
   (E) none of the above



(a) λ=8a, (b) λ=2a, (c) λ=a/2

Figure 1. Directivity patterns produced by a piston of radius a.

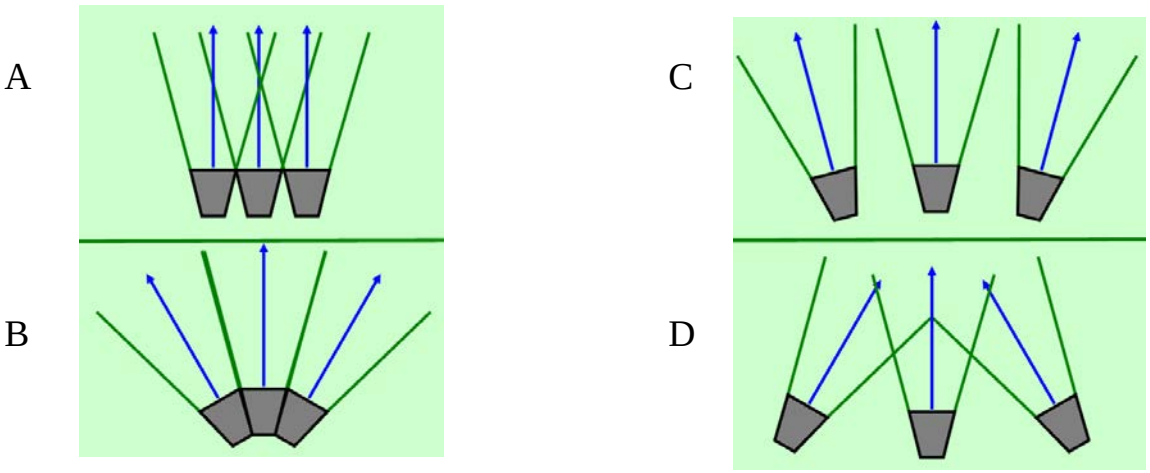


Figure 2. Standard array configurations.

11. The illustration in Figure 2 that depicts a *coupled point destination array* is:
    (A) A
    (B) B
    (C) C
    (D) D
    (E) none of the above

12. The illustration in Figure 2 that depicts a *coupled line source array* is:
    (A) A
    (B) B
    (C) C
    (D) D
    (E) none of the above

13. The *horizontal beamwidth* of the loudspeaker in Figure 3 at 5 KHz is approximately:
    (A) 30º
    (B) 60º
    (C) 90º
    (D) 120º
    (E) none of the above

14. Based on the trends depicted in the polars of Figure 3, one would expect the *directivity index* D_I (also called "Q") of this loudspeaker to:
    (A) increase with frequency
    (B) decrease with frequency
    (C) remain constant
    (D) none of the above

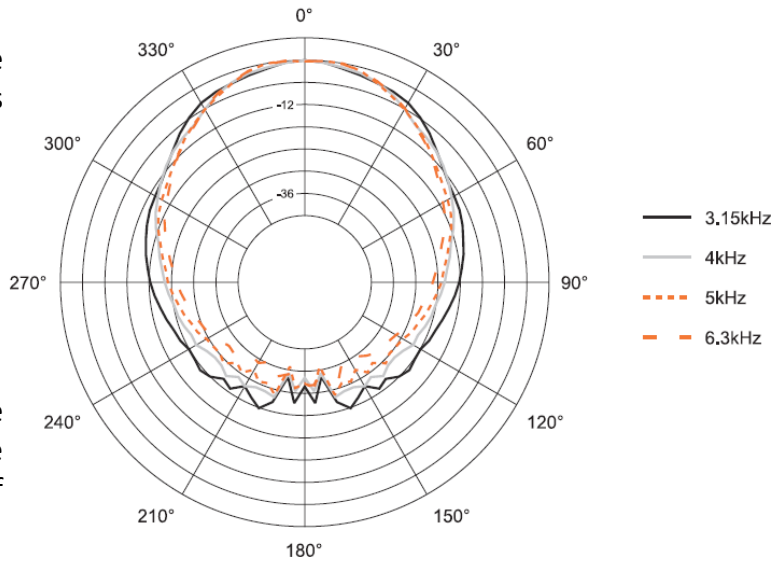


Figure 3. Horizontal polar directivity patterns for a commercial loudspeaker.

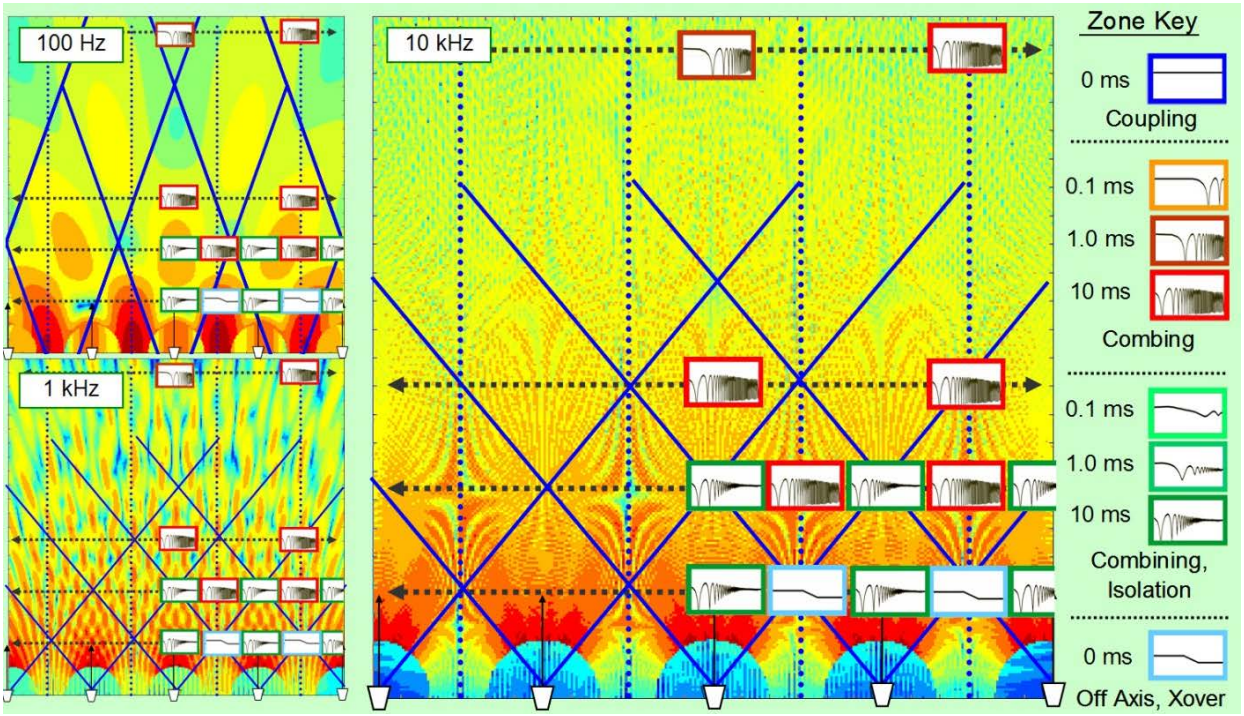


Figure 4. Summation zone progression factors.

15. The type of array depicted in Figure 4 is:
    (A) a coupled line source
    (B) an uncoupled line source
    (C) a coupled point source
    (D) an uncoupled point source
    (E) none of the above

16. The speaker order depicted in Figure 4 is:
    (A) first
    (B) second
    (C) third
    (D) none of the above

17. The presence of __ crossover activity is evident in the high frequency response shown in Figure 4.
    (A) unity
    (B) overlap
    (C) gap
    (D) none of the above

18. If the displacement between elements in Figure 4 is increased, the gap distance moves:
    (A) proportionally forward
    (B) proportionally backward
    (C) not at all
    (D) none of the above

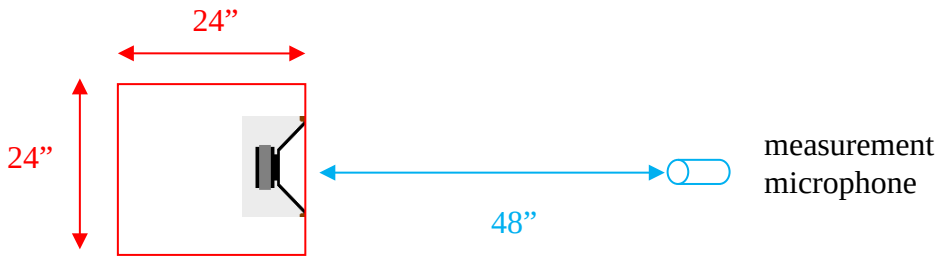


Figure 5. A 12-inch loudspeaker is suspended <u>outdoors</u> in a free standing cabinet that is 24”x24”x24”’ (HWD). The loudspeaker produces a level of 90 dB SPL at 100 Hz measured on-axis at a distance of 12” with one electrical watt of input.

19. If the cabinet is sealed (and sufficiently stuffed with damping material), the level measured at the microphone when the speaker is operated at 100 Hz with one electrical watt of input will be approximately:

    (A) 72 dB (B) 78 dB (C) 84 dB (D) 90 dB (E) none of these

20. To obtain a level of 100 dB SPL at the measurement microphone, the electrical power required will be approximately:

    (A) 80 watts (B) 100 watts (C) 160 watts (D) 320 watts (E) none of these

21. If the rear panel of the cabinet is opened (and the stuffing material removed), the contribution reaching the measurement microphone from the *rear vibrating surface* of the loudspeaker (when operated at 100 Hz with one electrical watt of input) will be approximately:

    (A) 72.0 dB
    (B) 74.4 dB
    (C) 76.2 dB
    (D) 78.0 dB
    (E) none of the above

    Note: Assume the rear radiation can be completely isolated from the front radiation (for measurement purposes), and that wave propagation within the cabinet is <u>planar</u>.

22. When operated at 100 Hz with the back of the cabinet open, the relative phase angle between the rear radiation and front radiation of the loudspeaker at the measurement microphone location will be approximately:

    (A) 64º (B) 128º (C) 244º (D) 307º (E) none of these

23. When operated at 100 Hz with the back of the cabinet open and one electrical watt of input, the summed level of the rear radiation and front radiation of the loudspeaker at the measurement microphone location will be approximately:

    (A) 75 dB (B) 77 dB (C) 79 dB (D) 81 dB (E) none of these

24. A measure of "stiffness" of a loudspeaker's suspension when suspended in free air is:
    (A) V_{as} (equivalent compliance volume)
    (B) F_s (free air resonance frequency)
    (C) Q_{ms} (mechanical Q of driver at Fs)
    (D) Q_{es} (electrical Q of driver at Fs)
    (E) none of the above

25. The value of Q_{TC} (total Q) that results in optimum efficiency alignment for a sealed box loudspeaker system is:
    (A) 0.5
    (B) 0.7
    (C) 1.0
    (D) 1.1
    (E) none of the above

26. Spatial aspect of reverberation (sound arriving from all directions):
    (A) intimacy
    (B) warmth
    (C) texture
    (D) diffusion
    (E) none of the above

27. The "fine grain" of the listening experience:
    (A) intimacy
    (B) warmth
    (C) texture
    (D) diffusion
    (E) none of the above

28. The "bending" of sound transmission over distance is:
    (A) refraction
    (B) rarefaction
    (C) diffraction
    (D) deflection
    (E) none of the above

29. The "bending" of sound transmission around a structure or surface is:
    (A) refraction
    (B) rarefaction
    (C) diffraction
    (D) deflection
    (E) none of the above