PHYSICS OF MUSIC

PHY 102-Spring 2008

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MIDTERM 2

When you get this:

- **Do not turn the page until you are so instructed**
- **Put your name and student number on the answer sheet, *letters an dots***
- **Wait to start the test until you are so instructed**
- **You'll have until 11:50 to finish your test**

GOOD LUCK !

Choose the best option

1. The ossicles (“hammer, anvil and stirrup”) are connected to

   a) eardrum and cochlea
   b) pinna and middle ear
   c) cochlea and auditory nerve
   d) organ of Corti and the Eustachian tube
   e) scala tympani and scala vestibule

2. Most of the length of the cochlea is sensitive to

   a) lower frequencies
   b) higher frequencies
   c) lower and higher frequencies
   d) all frequencies equally
   e) middle frequencies

3. The eardrum is much larger than the area where the stapes (stirrup) connects to the cochlea (oval window). This is important because

   a) it prevents breaking of the ossicles
   b) it makes the pressure of the sound waves in the liquid in the cochlea larger
   c) it increases the amplitude of vibration of ossicles compared to the vibration of the eardrum
   d) it protects the hair cells
   e) it prevents leakage of the cochlea fluid

4. The interval (in pitch) between a 100Hz and a 150Hz tone is called a “fifth”. What can you say about the interval between a 200Hz and a 300Hz tone?

   a) It is also a fifth
   b) It is larger than a fifth
   c) It is smaller than a fifth
   d) Will appear larger or smaller than a fifth depending on volume
   e) There is no relation between these two intervals

5. A jump in frequency between two tones is called an “interval”. Two intervals will sound the same if

   a) their loudness is the same
   b) the difference in their frequencies is the same
   c) the ratio of their frequencies is the same
   d) the square of the frequency differences is the same
   e) the frequency of the higher sound is the same

6. A tone contains a mixture of three frequencies: 500Hz, 750Hz and 1000Hz. Its pitch will be perceived to be the same as a pure sine wave with frequency

   a) 500Hz
   b) 1000Hz
   c) 250Hz
   d) 2250Hz
   e) 100Hz

7. By what factor does the intensity of a sound have to increase so that the sound intensity level (SIL) increases by 10 dB?

   a) 10
   b) 1
   c) 1/10
   d) 100
   e) 0

8. What is the sound intensity level (SIL) of a sound wave with intensity equal to 10^{-6} W/m^2?

   a) 6dB
   b) 10^{-6}dB
   c) 80dB
   d) 60dB
   e) -6dB

9. What is the SIL at the threshold of pain?

   a) about 20dB
   b) about 120dB
   c) about 200dB
   d) about 0dB
   e) about -100dB

10. Which one appears louder: a sound with a SIL of 60dB and a frequency of 40Hz or a sound with a SIL of 60dB and a frequency of 1000Hz ?
    a) they both will appear to have the same loudness
    b) sound with a SIL of 60dB and a frequency of 40Hz
    c) sound with a SIL of 60dB and a frequency of 1000Hz
    d) whichever is sounded first
    e) whichever is sounded last

11. What is the SIL beyond which sustained exposure may result in hearing loss

    a) about 0dB
    b) about -100dB
    c) about 200dB
    d) about 50dB
    e) about 95dB

12. One effect we use to localize the source of a sound is the interaural level difference. It becomes ineffective

    a) at high frequencies because of diffraction around the head
    b) at low frequencies because of diffraction around the head
    c) at high frequencies because of reflection on the pinna (outer ear)
    d) at low frequencies because of reflection on the pinna (outer ear)
    e) at mid frequencies because of refraction through the head

13. One problem in using the interaural time difference for sound localization is the "phase ambiguity". It occurs, for a sound coming from the side, when

    a) the wavelength is much larger than the head
    b) the wavelength is comparable or shorter than the head
    c) the loudness is above 60dB
    d) the frequency is larger than 20 Hz
    e) the wavelength is exactly four times the width of the head

14. What is the change between a "aaah" and a "uuuh" sound with the same pitch and loudness ?

    a) the vocal chords vibrate with different frequencies
    b) the vocal chords open and close more completely during its vibration
    c) the position of the lips, etc., changes and that changes the frequencies of the resonances of the vocal tract
    d) the tongue vibrates with different frequencies
    e) the lungs push the air more strongly in the "uuuh" case

15. If the sound arriving at the left ear is louder than the one arriving at the right ear the brain concludes that

    a) the sound source is probably above the head
    b) the sound source is probably behind the head
    c) the sound source is probably on the left
    d) the sound source is probably on the right
    e) the sound source is probably straight ahead

16. How can we tell a sound source is directly behind us as opposed to directly in front of us?

    a) time difference in the sound arrival at the two ears
    b) sound intensity level difference between the ears
    c) Doppler effect
    d) reflection and diffraction from ears, head, chest, … alter the frequency composition of the sound
    e) we cannot distinguish these two directions

17. The resonances of the vocal tract (formants)

a) enhance some of the harmonics generated by the vocal chords
b) suppress some of the harmonics generated by the vocal chords
c) increase the volume of all harmonics generated by the vocal chords equally
d) are essential in producing sounds like “sh”
e) are dependent on the frequency of vibration of the vocal chords

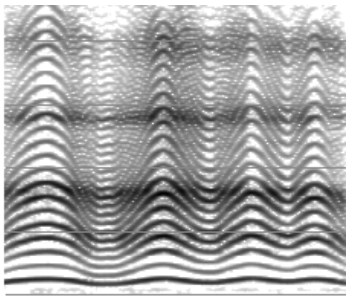
18. What is the wavelength of the fundamental mode of vibration of a string of 1m length?

a) 1 m
b) 2 m
c) 4 m
d) 50 cm
e) 25 cm

19. What is the largest wavelength of a standing wave inside a 40 cm long tube with one end closed and one end open?

a) 40 cm
b) 80 cm
c) 20 cm
d) 160 cm
e) 10 cm

20. The figure below shows a spectrograph (time on the horizontal direction and frequency, on a logarithmic scale, on the vertical axis). What is NOT true:



a) the dark horizontal bars correspond to formants
b) the sequence of parallel oscillating lines show the overtones
c) it corresponds to a voice oscillating in pitch
d) it corresponds to a voice holding the volume roughly constant
e) it corresponds to a voice reciting the vowels “ah-eh-eeh-oh-ouh”