

Exam II Key

Physics 0082

October 29, 2013

Your Name _____ Key _____

Instructions: Answer the multiple-choice by circling the letter next to the correct answer. For the true false section, circle either True or False. Each multiple choice question is worth 3 points and each true false question is worth 2 points for a total of 100pts. THE CORRECT ANSWER IS INDENTED.

Multiple Choice (Circle the correct answer)

1. The limit of frequency discrimination Δf_D is
 - (a) the smallest frequency difference that we can perceive when two pure tones are sounded in succession, first one and then the other, rather than played together.
 - (b) the largest frequency difference that we can still hear individual beats from the amplitude modulation of two pure tones played together very close in frequency.
 - (c) the smallest frequency difference such that two pure tones sound as distinct tones rather than a single fused tone when played together.
 - (d) the smallest frequency difference at which two pure tones sound smooth rather than rough when played together.
 - (e) the same thing as the beat frequency.
2. The critical band Δf_{CB} is
 - (a) the smallest frequency difference that we can perceive when two pure tones are sounded in succession, first one and then the other, rather than played together.
 - (b) the largest frequency difference that we can still hear individual beats from the amplitude modulation of two pure tones played together very close in frequency.
 - (c) the smallest frequency difference such that two pure tones sound as distinct tones rather than a single fused tone when played together.
 - (d) the smallest frequency difference at which two pure tones sound smooth rather than rough when played together.
 - (e) the same thing as the beat frequency.

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3. If two oboes play a concert A at pitches of 440 and 442 Hz respectively, how many beats per second will you hear?
- (a) 4
 - (b) 2
 - (c) 1
 - (d) 0
 - (e) 8
4. Two pure tones having frequencies 440 and 660 Hz are played together softly. The following is likely to be perceived:
- (a) 220 Hz in addition to the 440 and 660 Hz.
 - (b) 220 Hz, 880Hz, 1320 Hz in addition to the 440 and 660 Hz
 - (c) just the 440 and 660 Hz
 - (d) 110 and 220 Hz in addition to the 440 and 660 Hz
 - (e) 110 Hz, 220 Hz, 880 Hz, 1320 Hz in addition to the 440 and 660 Hz
5. Two pure tones having frequencies 440 and 660 Hz are played together loudly. The following is likely to be perceived:
- (a) 220 Hz in addition to the 440 and 660 Hz
 - (b) 220 Hz, 880Hz, 1320 Hz in addition to the 440 and 660 Hz
 - (c) just the 440 and 660 Hz
 - (d) 110 and 220 Hz in addition to the 440 and 660 Hz
 - (e) 110 Hz, 220 Hz, 880 Hz, 1320 Hz in addition to the 440 and 660 Hz
6. 4. A string fixed at both ends is resonating at the 9th harmonic. The standing wave pattern has
- (a) an equal number of nodes and antinodes.
 - (b) one more antinode than node.
 - (c) nine nodes and ten antinodes.
 - (d) ten nodes and nine antinodes.
 - (e) eleven nodes and ten antinodes

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7. A string fixed at both ends is 63 cm in length. The wavelength of the 7th harmonic is
- (a) 9 cm.
 - (b) 18 cm.
 - (c) 27 cm.
 - (d) 36 cm.
 - (e) 7 cm.
8. The tension in a string fixed at both ends is multiplied by 4. The fundamental frequency will be
- (a) multiplied by 2.
 - (b) multiplied by 4.
 - (c) divided by 2.
 - (d) divided by 4.
 - (e) none of the above.
9. A vibrating cylindrical column of air which is closed at one end has a spectrum of frequencies that
- (a) includes only the even harmonics.
 - (b) includes all the integer harmonics.
 - (c) is identical to a cylindrical column of the same length open at both ends.
 - (d) includes only the odd harmonics.
 - (e) is not harmonic.
10. The amplitudes of the successive harmonics in a plucked string fall as $\frac{1}{n^2}$. For a string plucked at the midpoint, the ratio of the amplitude of the 7th harmonic to the first harmonic is
- (a) 49.
 - (b) 25.
 - (c) 0.
 - (d) $1/25$.
 - (e) $1/49$.

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11. The amplitudes of the successive harmonics in a plucked string fall as $\frac{1}{n^2}$. For a string plucked at the midpoint, the ratio of the amplitude of the 2nd harmonic to the 5th harmonic is
- (a) 49.
 - (b) 25.
 - (c) 0.
 - (d) 1/25.
 - (e) 1/49.
12. If we compare the frequency spectrum of a struck string with that of a string plucked in the same place we see that
- (a) the amplitudes of the struck string fall as $\frac{1}{n^3}$ compared with $\frac{1}{n^2}$ for the plucked string.
 - (b) the amplitudes of the struck string fall as $\frac{1}{n}$ compared with $\frac{1}{n^2}$ for the plucked string.
 - (c) a string struck at its midpoint supports all of the harmonics while a string plucked at its midpoint supports only the odd harmonics.
 - (d) a string struck at its midpoint supports only the even harmonics while a string plucked at its midpoint supports only the odd harmonics.
 - (e) the amplitudes of both the struck and plucked string fall as $\frac{1}{n^2}$.
13. If we compare the harmonic spectrum of the flute with that of the clarinet, we see that
- (a) the clarinet behaves like cylindrical column that is open at both ends while the flute behave like a cylindrical column closed at one end.
 - (b) the flute supports only the odd harmonics while the clarinet supports all of the harmonics.
 - (c) the flute embouchure hole behaves like a pressure node and the clarinet reed mouthpiece combination behaves like a pressure antinode.
 - (d) both instruments support the full harmonic spectrum even though the methods of exciting the air resonance inside the instruments are different.
 - (e) none of the above.

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14. When a string is plucked parts of the string remain stationary over substantial parts of the resulting cycle of oscillation. For example the point of the string $1/8$ of the distance from its fixed end will remain stationary for approximately what fraction of the cycle if the string is started by plucking it at its midpoint?
- (a) $7/8$
 - (b) $3/4$
 - (c) $1/2$
 - (d) $1/4$
 - (e) $1/8$
15. A stretched string 32 cm in length is up-bowed at a point 4 cm from one end. What fraction of the time does it spend slipping or falling down with respect to the bow? a)
- (a) $7/8$
 - (b) $4/5$
 - (c) $3/4$
 - (d) $1/5$
 - (e) $1/8$
16. The overall length of the basilar membrane is about
- (a) 15 mm
 - (b) 25 mm
 - (c) 35 mm
 - (d) 45 mm
 - (e) none of the above
17. A trumpet with no valves pressed down has a length of 140 cm. The trumpet player lowers the pitch by four semitones by pressing valves 2 and 3 together. The ideal length of the trumpet for this configuration is
- (a) 148.4 cm.
 - (b) 157.3 cm.
 - (c) 166.7 cm.
 - (d) 176.7 cm.
 - (e) 187.3 cm.

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18. 13. A trombone in 1st position has a length of 270 cm. The trombone player lowers the pitch of the trombone by four semitones by moving the slide out from 1st position to 5th position. The distance the slide is moved out is closest to
- (a) 35.4 cm.
 - (b) 25.8 cm.
 - (c) 45.7 cm.
 - (d) 16.7 cm.
 - (e) 56.5 cm.
19. 14. The frequency of a Helmholtz resonator with a volume of 500 cm^3 , an area of 3 cm^2 , and a length of 1 cm is closest to
- (a) 125 Hz.
 - (b) 250 Hz.
 - (c) 375 Hz.
 - (d) 425 Hz.
 - (e) 550 Hz.
20. For the resonator in question 14 in order to double the frequency of the resonator we could
- (a) increase its area by a factor of 2.
 - (b) decrease its length by a factor of 2.
 - (c) decrease the volume by a factor of 8.
 - (d) increase the area by a factor of 4.
 - (e) none of the above.

True False Section (Circle the Correct Answer)

1. If a simple sine wave of frequency f is distorted, the resulting complex wave may have frequencies that are integral multiples of the original frequency.
- (a) True
 - (b) False
2. In chapter 9 of your text book, the author frequently confuses intensity with amplitude in discussing the sound spectrum of a plucked or struck string.
- (a) True
 - (b) False

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3. A plucked string is released from rest and initially has only kinetic energy.
- (a) True
 - (b) False
4. A struck string starts with an initial velocity from its equilibrium position and has both potential and kinetic energy.
- (a) True
 - (b) False
5. A stretched string plucked at a point $\frac{1}{4}$ of its length from a fixed end would have missing harmonics 2, 4, 8, 12, etc.
- (a) True
 - (b) False
6. The pressure nodes of a cylindrical air column open at both ends are not located exactly at the ends of the air column, but rather at a small distance outside the ends of the cylinder defining the air column that increases as the radius of the cylinder increases.
- (a) True
 - (b) False
7. The range of frequencies 20-4000Hz covers about $\frac{2}{3}$ of the length of the basilar membrane.
- (a) True
 - (b) False
8. The basilar membrane is approximately a logarithmic spectrum analyzer. The distance between resonant points separated in frequency by one octave increases by a factor of 2 for each successive octave.
- (a) True
 - (b) False
9. The pressure nodes of a cylindrical air column open at both ends are not located exactly at the ends of the air column, but rather at a small distance outside the ends of the cylinder defining the air column that increases as the radius of the cylinder increases.
- (a) True
 - (b) False

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10. A good violin must have the tap tones of the wood in the top and back at exactly the same frequencies.
- (a) True
 - (b) False
11. A good violin has the MAR and MWR frequencies exactly a musical third apart..
- (a) True
 - (b) False
12. Because the 1st overtone of the clarinet is the 3rd harmonic of the fundamental rather than the 2nd harmonic, it requires 7 side holes rather than 6 to play a basic diatonic scale.
- (a) True
 - (b) False
13. The A clarinet which plays a semitone lower than the B-flat clarinet with identical fingerings is approximately 6 % longer than the B-flat clarinet.
- (a) True
 - (b) False
14. A trumpet with valves one and two depressed plays approximately 2 semitones below the pitch with no valves depressed.
- (a) True
 - (b) False
15. For a string plucked in its middle the points along the string near the ends are at rest for a substantial fraction of each period.
- (a) True
 - (b) False
16. For a string bowed at its middle the points along the string near the ends are at rest for a substantial fraction of each period.
- (a) True
 - (b) False

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17. A jet-stream playing over an edge may produce a sound of definite pitch, but it must be carefully directed because on one side of the edge it will produce a sound while on the other side it will not.
- (a) True
 - (b) False
18. The pitch of an edge tone is inversely proportional to the velocity of the jet-stream playing over the edge.
- (a) True
 - (b) False
19. The sound from a clarinet is started by the vibration of the reed, but the pitch is controlled by the frequency of the resonance setup in the air column of the clarinet that then also controls the frequency of opening and closing the reed on the mouthpiece.
- (a) True
 - (b) False
20. A bell is necessary on brass instruments to insure the efficient radiation of the sound, but its addition has no effect on the pitches of the resonances inside the instrument.
- (a) True
 - (b) False