

Exam III

Physics 0082

November 26, 2013

Your Name _____ KEY _____

Instructions: Do the four questions in building scales by filling in the table. Answer the multiple-choice by circling the letter next to the correct answer. For the true false section, circle either True or False. Building scales is worth 30 points. Each multiple choice question is worth 3 points for 36 points, and each true false question is worth 2 points for 34 points. There are 100 points in total.

Building Scales

1. Starting on “do” which we will assume is middle C, generate the notes G, D, A, E, and B by going up a perfect fifth at a time and then moving the note into the octave between middle C and one octave above middle C by dividing by an appropriate power of 2. Assume that middle C has a frequency of 1 for purposes of this exercise. Indicate your work to me by filling in the table below with the correct frequencies relative to middle C. Express the numbers as 1.xxxxx where the x’s represent the number of digits after the decimal place. Finally insert the note F into the table by going down a perfect fifth from middle C and then moving the note into the correct octave. (6 points)
2. Now generate the missing notes in the diatonic scale for D major in the Pythagorean tuning. (9 points)
3. To the right of the your Pythagorean D major scale, enter the correct tunings for the C major even tempered scale. In making your entries use a semitone ratio of 1.0594631. Keep seven figures after the decimal point for all calculations and only round the answers when entering them in the table below with five figures after the decimal point. (6 points)
4. Enter the note ratios described in the Ratio column for both the even tempered and Pythagorean scales. (9 points)

C major	Pythag.	D major	Pythag.	C major	even temp	Ratios	even temp	Pythag.
C	1.00000	D	1.12500	C	1.00000	D/C	1.12246	1.12500
D	1.12500	E	1.26563	D	1.12246	E/C	1.25992	1.26562
E	1.26563	F#	1.42383	E	1.25992	F/C	1.33484	1.33333
F	1.33333	G	1.50000	F	1.33484	F/E	1.05946	1.05350
G	1.50000	A	1.68750	G	1.49831	G/E	1.18921	1.18519
A	1.68750	B	1.89844	A	1.68179	G/C	1.49831	1.50000
B	1.89844	C#	2.13574	B	1.88775	B/E	1.49831	1.50000
C	2.00000	D	2.25000	C	2.00000	C/B	1.05946	1.05350

Multiple Choice (Circle the correct answer)-3pts each

1. If we start on middle C(C_4) and go up a perfect fourth and down a perfect minor third we land on D_4 a whole tone above middle C, What is the frequency ratio of this whole tone compared with middle C?
 - (a) $25/24$
 - (b) $16/15$
 - (c) $27/25$
 - (d) _____ $10/9$
 - (e) $9/8$

2. If we use the whole tone ratio computed in question 1, what is the frequency ratio for the seventh necessary to complete the octave?
 - (a) $48/25$
 - (b) $15/8$
 - (c) $50/27$
 - (d) _____ $9/5$
 - (e) $16/9$

3. The main advantage of the even-tempered scale over all of the other scales we studied is that
 - (a) _____it permits all of the instruments of the orchestra to play together in different musical keys.
 - (b) it has a truer intonation.
 - (c) it has perfect fifths and fourths.
 - (d) it has perfect major and minor thirds.
 - (e) none of the above.

4. Plomp and co-workers concluded that the point of maximum dissonance between two pure tones occurred at approximately what percentage of the critical band frequency
 - (a) 10%
 - (b) _____25%
 - (c) 40%
 - (d) 50%
 - (e) 100%

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5. If two complex tones a major third apart are played together, what are the lowest harmonics of each note which are in unison?
- (a) 3 and 2
 - (b) 4 and 3
 - (c) _____ 5 and 4
 - (d) 6 and 5
 - (e) none of the above
6. An open window in an otherwise enclosed space has an area of 2.5 m^2 . The sound absorption of the window is closest to
- (a) 5 sabins.
 - (b) _____ 2.5 sabins.
 - (c) 1.25 sabins.
 - (d) 0 sabins.
 - (e) none of the above.
7. Consider a space 10 m wide by 8 m deep by 4 m high. The floor is indoor-outdoor carpet. The walls are painted concrete, and the ceiling is plaster on lath. At 1000 Hz the total absorption of the room is closest to
- (a) 50 sabins.
 - (b) 46 sabins.
 - (c) 40 sabins.
 - (d) _____ 30 sabins.
 - (e) 25 sabins.
8. Ignoring the absorption of the air in the room in question 7, the reverberation time for the room is closest to
- (a) 1.62 s.
 - (b) _____ 1.70 s.
 - (c) 1.81 s
 - (d) 1.88 s.
 - (e) 2.10 s.

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9. For the room in question 7 the lowest resonant frequency of the room is closest to
- (a) 15 Hz.
 - (b) _____17 Hz.
 - (c) 22 Hz.
 - (d) 28 Hz.
 - (e) 34 Hz.
10. For the room in question 7 if the ceiling is covered with suspended acoustical tile and the walls are covered with heavy weight drapery, the noise reduction at 1000 Hz is closest to
- (a) 4.5 db.
 - (b) 5.4 db.
 - (c) 6.3 db.
 - (d) 7.6 db.
 - (e) _____8.2 db.
11. After the change in the absorption of the room in question 7 given in question 10, the reverberation time of the room is closest to
- (a) 0.14 s.
 - (b) 0.19 s.
 - (c) _____0.26 s.
 - (d) 0.31 s.
 - (e) 0.35 s.
12. For the room in question 7 the absorption of the air of the room at 1000 Hz that we ignored above is closest to
- (a) _____1.0 sabin
 - (b) 2.5 sabins
 - (c) 2.8 sabins.
 - (d) 3.2 sabins.
 - (e) 4.3 sabins.

True False Section (Circle the Correct Answer)-2 pts each

1. If two complex tones a perfect fifth apart are played together, the third harmonic of the lower tone will be in unison with the second harmonic of the upper tone.

(a) _____ True
(b) False
2. The Plomp criterion states that when two pure tones are played together they will be perceived as consonant if their difference in frequencies is less than 50% of the critical band frequency difference at the average frequency of the two pure tones.

(a) True
(b) _____ False
3. There are no dissonant harmonics for two musical notes an octave apart.

(a) _____ True
(b) False
4. Apart from the octave, all other intervals have some dissonant harmonics.

(a) _____ True
(b) False
5. An interval which is consonant may sound dissonant when played at lower frequencies.

(a) _____ True
(b) False
6. The Pythagorean scale is built around the idea of keeping the fifths and fourths of the diatonic scale at the correct integer ratios.

(a) _____ True
(b) False
7. Just as the octave can be thought of as a perfect fifth followed by a perfect fourth, a major sixth is a perfect fourth followed by a perfect major third and has a frequency ratio of $5/3$.

(a) _____ True
(b) False

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8. The just scale which is based on the major triad allows all of the instruments of the orchestra to play together with out regard to the major key.
- (a) True
(b) _____False
9. The major third in the Pythagorean scale is sharp compared with the ideal interval, but it is less sharp than the even tempered scale
- (a) True
(b) _____False
10. The whole tone in the even tempered scale is a larger interval than in the Pythagorean scale.
- (a) True
(b) _____False
11. The discrepancy between the frequency ratio for 12 perfect fifths and 7 octaves is sometimes referred to as the Pythagorean comma.
- (a) _____True
(b) False
12. There is one perfect fifth in the even tempered scale for each major key.
- (a) True
(b) _____False
13. A long reverberation time in a concert hall is desirable both because it gives the instruments a large full tone quality and also improves the clarity of music played at a fast tempo.
- (a) True
(b) _____False
14. A sense of spaciousness with respect to the orchestra in a concert hall depends primarily on sound reflected from the ceiling rather than from the side walls.
- (a) True
(b) _____False

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15. In order for the reflected sound to enhance the listening experience it is important that the initial time delay gap between the direct sound and the first reflected sound is not too great.
- (a) _____ True
- (b) False
16. The reverberation time of a room is defined to be the time it takes the sound level in the room to decrease by a factor of 1000 after the source of sound is stopped.
- (a) True
- (b) _____ False
17. A concert hall is said to have acoustical intimacy if music played in it gives the impression of being played in a small hall.
- (a) _____ True
- (b) False