Exam #2 Study Sheet 2024

Physics 1320 Music & Physics Prof. Baker & Olness

IMPORTANT: Review Term Sheets:
Harmonic series
Musical Ratios/Intervals: 5th, 4th, Major/Minor 3rd, 2nd
Middle C=C_4, and US conventions

Inverse square law
Chorus effect
Formant region.
Subjectives tones: Difference tones.
Loudness difference Limen:
Frequency difference Limen:
Pitch vs. loudness
implied fundamental
phon: Loudness level
sone: Loudness
sound intensity level: dB
intensity level: W/m^2
Masking
Critical Band:
Scales: {P,J,M,E}
time-domain/frequency-domain graphs
human ear
Pythagorean / Just (de Caus) /Meantone (¼ comma)/Equal Temperament
A speaker outputs 100 W/m^2 at a distance of 1m. Compute the intensity at a distance of 10m.
Understand the dB scale, and be able to add SIL.
intensity (I) in Watts per squared meter, intensity level (IL) in dB
intensity ratio, sound pressure level (SIL), threshold of audibility,
Fletcher-Munson curves, equal loudness contours, loudness level (LL) in phons,
threshold of feeling (pain), loudness (L) in sones, sound level meter, dB(A),
OSHA standard

Review Exam 1 2017

Physics 1320 Music & Physics Prof. Tunks & Olness

Understand units. Recall the 3 fundamental units, and be able to reduce terms to basic units. Example: which of the following do not have units of acceleration.
Use the basic formula: d= s t, or equivalently: x= v t. Example, sound travels x distance in t seconds. Find v.
Perform problems from lab. Example: Which of the following do not have 4 significant figures. Example: Galileo measures a wave covers a round trip of 20 miles in 30 seconds, and 40 miles in 50 seconds. Find the reaction time of his assistant, and the true speed of the wave.
Examine a graph of a wave and determine amplitude, phase, period, frequency, etc.
Given K and M, compute the f for a mass on a spring.
Given g and L, , compute the f for a mass on a string.
Two tones sound together. Compute the average frequency, and the beat frequency.
For both and open and closed organ pipe, sketch the first 5 resonances. Find the frequency and wavelength in terms of the length of the pipe, and the speed of sound.
Understand and know how to use the inverse square law Know about wave properties: Reflection, Refraction, Interference, Diffraction, Doppler effect.

VARIOUS TERMS:
Length, time, mass, speed, velocity, area, acceleration, volume,
force, work, pressure, power,vector, momentum, equilibrium,

vibration - oscillation, periodic motion, period, T, cycle, frequency, f, Hz, simple harmonic motion, SHM, amplitude, displacement, restoring force, momentum, phase, sine curve, pure tone, sinusoid, fundamental frequency, mass - stiffness, natural frequencies, damping, driving force, f=1/T, T=1/f, envelope, wave history, time domain/frequency domain graphs,

medium, propagation, compression, expansion (rarefaction), density, elasticity, longitudinal wave, transverse wave, tension, displacement-time, pressure-time curves, pressure/displacement phase relationship (90 degrees), wavelength, speed of sound, reflection, refraction, diffraction, phase, constructive interference, destructive interference, beats (fb=f1-f2), Doppler effect, efficiency, intensity, inverse square law,

standing wave, node, antinode, vibratory modes, harmonics, partials, overtones, open tube function (open pipe), stopped (closed) tube function (stopped pipe), conical pipe function, resonance, sympathetic vibration, Helmholtz resonator

NAME:

Quiz #1 August 27, 2024

Physics 1320 Music & Physics Prof. Baker & Olness

1)True or False:

a. T / F : It is not necessary to do a pre-lab before the lab session.

b. T / F : Class will always be in Fondren Science and never in Perkins Chapel or the Meadows building for special presentations.

c. T / F : The quiz grading scheme is as follows:

# Correct	Score
3	3
2	3
1	2
0	1
absent	0

... so that you can always miss one question without penalty.

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2) True / False:

In lab, there is plenty of time to carefully read the lab procedure and workout the pre-lab problems during the start of the lab period; therefore, you don't have to begin the experiments until the last 5 minutes of the period.

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3) Identify the 3 fundamental physical quantities from which all other are built up.

a. length, distance, breadth
b. speed, velocity, motion
c. mass, weight, slugs
d. money, power, mass-media
e. earth, wind, fire
f. length, time, mass

Hints for Quiz #2: This will be on the video (online linked from the webpage). What was the point of the Tchaikovsky demonstration? What is the trick to reproducing the Stradovarious? When you change the shape of the bells, what happens?

NAME:

Quiz #2 August 29, 2024

Physics 1320 Music & Physics Prof. Baker & Olness

Circle the correct answer for each problem.

1) The revolutionary breakthrough described in the video that allows us to make violins that sound like antique Stradivarius violins came from the observation that the wood was aged in water, therefore ... *(what was the key difference???)*

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2) What was the point of the demonstration of the orhestra playing Symphony No.6 of Tchaikovsky??? *(Just convince us you got it.)*

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3) What is different about the "new bells" demonstrated in the video???
(Just convince us you got it; there could be multiple answers.)

NAME:

Quiz #3 September 3, 2024

Physics 1320 Music & Physics Prof. Baker & Olness

Circle the correct answer for each problem.

1) 2) SMU installs a speaking tube 70,000 meters long so the students can listen to the lecture without leaving their dorms. How long does it take a sound wave to travel the length of the tube? (Assume v=350m/s)
Useful formula: $x = v\,t$

2) What is the wavelength (λ) of the note A=440 Hz. (Assume v=350m/s)
Useful formla: $v = f\ \lambda$. Take v=350m/s and f= 440. Compute λ.

3) The speed of sound is aproximately 350 meter/second. Convert into miles/hour.
(Remember, 2 out of 3 correct answers gives you full credit on the quiz.)
The following might be useful: 1,000 meters = 1 km, 1 mile = 1.6 km,
1 minute = 60 seconds, 1 hour = 60 minutes.

I suggest you fill in the blanks [???] below

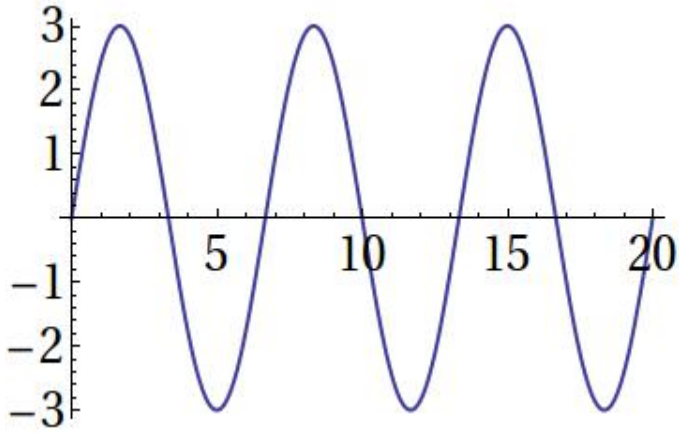
$$340\frac{meters}{second} \times \frac{???}{???}\frac{seconds}{minutes} \times \frac{???}{???}\frac{minutes}{hours} \times \frac{???}{???}\frac{kilometers}{meters} \times \frac{???}{???}\frac{miles}{kilometers} = \frac{???}{???}\frac{miles}{hr}$$

NAME:

Quiz #4 September 5, 2024

Physics 1320 Music & Physics Prof. Baker & Olness

1) The figure represents a sound wave as displayed on an oscilloscope. The horizontal axis is in **seconds**, and the vertical axis is in **feet**. From the figure, find the following, AND INDICATE UNITS!!!
Hint: T=1/f



a) period

b) frequency

c) amplitude
(careful!!!)

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2) For a vibrating mass—spring system, the book shows: $f = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$

thus:

a) when the mass **m** increases the frequency goes: UP / DOWN / No Change

b) when the spring **k** increases the frequency goes: UP / DOWN / No Change

c) when the amplitude **A** increases the frequency goes: UP / DOWN / No Change

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3) a) For a pendulum, the frequency $\frac{1}{2\pi}\sqrt{\frac{g}{L}}$ is independent of two quantities:

_____ and _____

b) For a mass on a spring, the frequency $\frac{1}{2\pi}\sqrt{\frac{k}{m}}$ is independent of:

_____

c) Why is $\frac{1}{2\pi}\sqrt{\frac{k}{m}}$ important for music???

NAME:

Quiz #4 September 10, 2024

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Circle the correct answer for each problem.

1)For a TRANSVERSE wave the displacement is _____ relative to the motion of the wave

For a LONGITUDINAL wave the displacement is _____ relative to the motion of the wave

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2) Sound waves are (chose one) TRANSVERSE / LONGITUDINAL

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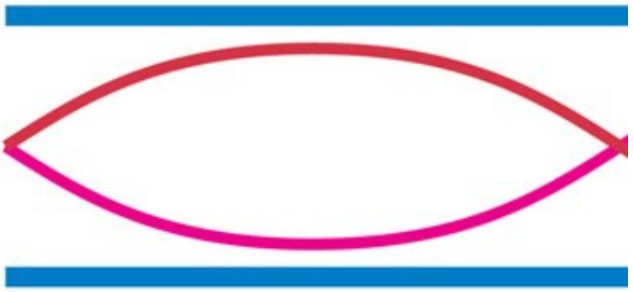
3) For an open organ pipe, sketch the wave pattern for the lowest frequencies is shown.



a) The length of the organ pipe is L=1 meter, find the wavelength of the sound.

$\lambda =$

b) Given v=340m/s, and using $v=f\lambda$, find the frequency $f=v/\lambda$.

f =

NAME:

Quiz #6 Sept 12, 2024

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Waves do 4 things. Describe each and give an example. *(Pictures help.)*

R_____

R_____

I_____

D_____

NAME:

Quiz #7 Sept 17, 2024

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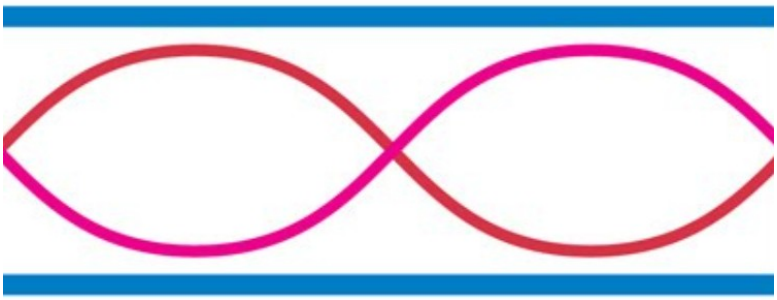
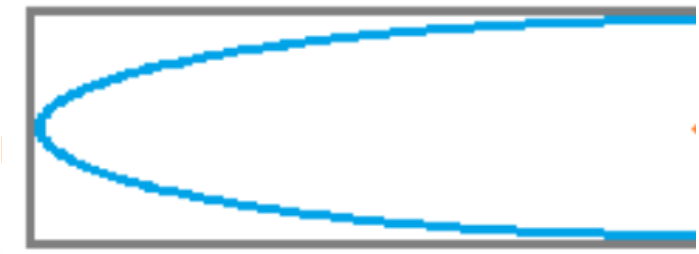
1) For an open organ pipe, the wave pattern for the 2nd harmonic is displayed. If f=440 Hz, and v=340m/s, compute the wavelength λ. Recall: v=f λ.



2) For an closed organ pipe, the wave pattern for the lowest frequencies is shown. If L=1 meter, v=340m/s, find the frequency f in Hz. Recall: v=f λ.



3) The speed of sound is 332m/s ± 0.6m/s/°C or 1087ft/s ± 1.1ft/s/°F

Hint: on the exam you will need to calculat the inverse problem. Hint: Water freezes at 32 F

a) What is the speed of sound at +40 degrees C

b) What is the speed of sound at 42 degrees F. *(Think, why did I pick 42???)*

NAME:

Quiz #8 Sept 19, 2024

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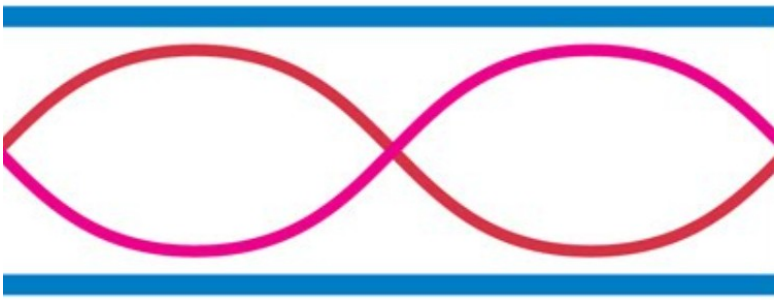
1) For an open organ pipe, the wave pattern for the 2nd harmonic is displayed. If L=1.5m, and v=340m/s, compute the frequncy f. Recall: $v=f\lambda$.



2) The speed of sound is 332m/s ± 0.6m/s/°C or 1087ft/s ± 1.1ft/s/°F

Hint: on the exam you will need to calculat the inverse problem. Hint: Water freezes at 32 F

a) What is the speed of sound at -40 degrees C

b) What is the speed of sound at 52 degrees F. *(Think, why did I pick 42???)*

3a) 400Hz and 600Hz are <u>adjacent</u> harmonics. What is the fundamental f?

b) Holding elasticity constant, an increase in density of a medium produces an increase in sound velocity? **TRUE OR FALSE:**

c) (Hooke's Law) For oscillation to be termed SHM, _____ must be proportional to_____.

Quiz #9 Sept 24, 2024

Physics 1320 Music & Physics Prof. Baker & Olness

Name:	Last 4 of ID	Signature

NAME:

Quiz #10 October 3, 2024

Physics 1320 Music & Physics Prof. Baker & Olness

1a) If 1 clarinet player has SIL of 60dB, what is the SIL of 2 players?

1b) If 1 clarinet player has SIL of 60dB, what is the SIL of10 players?

1c) At the quad concert, the dB level 1.0 meter from the speakers is 100dB. If I double my distance to 2.0 meters, applying the inverse-square law, my distance goes up by a factor of 2,

so my intensity goes down by a factor of _____,

and thus my dB level goes down by _____ dB

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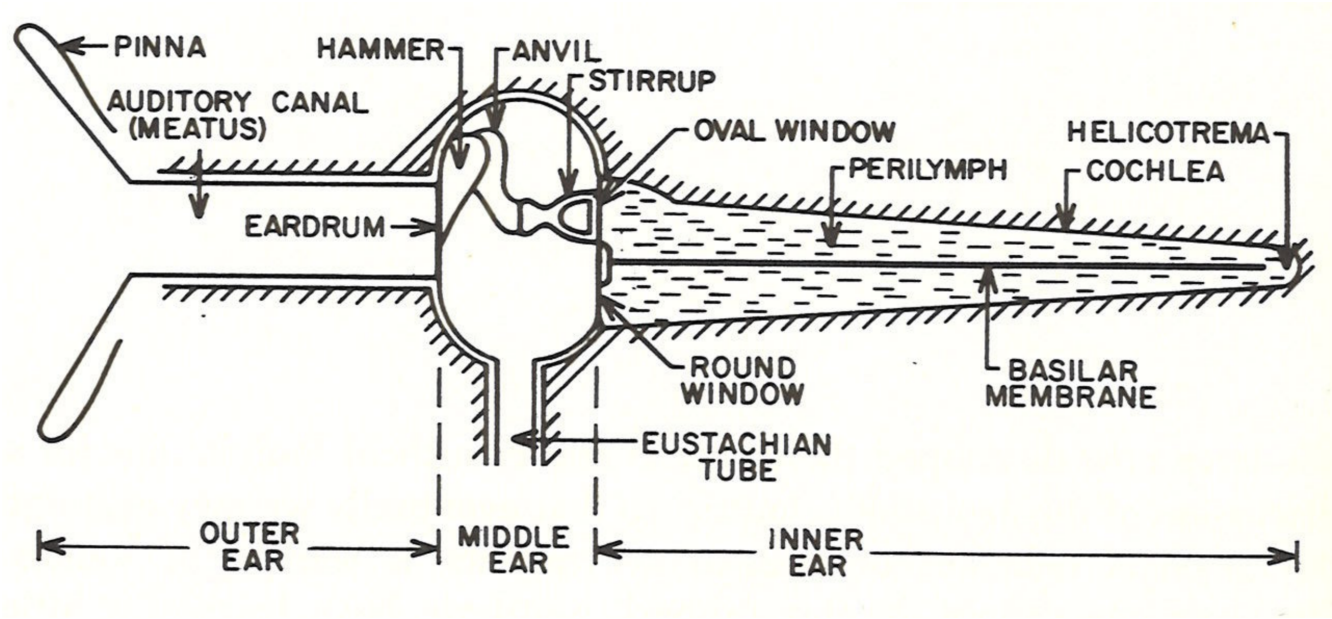
2 & 3) On the back of page:

2& 3)

For the ear, discuss what happens from the point at which a sound wave enters the outer ear to the point at which the sound "message" leaves the inner ear and heads to the brain.



Outer ear:

Middle ear:

Inner ear:

NAME: KEY

Quiz #11 October 10, 2024

Physics 1320 Music & Physics Prof. Baker & Olness

1b) If D/C=9/8 and E/D=9/8 what is the interval E/C?

Important: get the fractions in the correct order; higher note ⇒ larger number

Hint: $\frac{E}{C} = \frac{E}{D} \times \frac{D}{C} = \frac{9}{8} \times \frac{9}{8} = \frac{81}{64}$

1b) If D/C=9/8 and E/C= 5/4 what is the interval E/D?

Hint: $\frac{E}{D} = \frac{E}{C} \times \frac{C}{D} = \frac{5}{4} \times \frac{8}{9} = \frac{10}{9}$

1a) If E/C=5/4 and F/C= 4/3 what is the interval F/E?

Hint: $\frac{F}{E} = \frac{F}{C} \times \frac{C}{E} = \frac{4}{3} \times \frac{4}{5} = \frac{16}{15}$

2) What are the ideal ratios for

Octave	1:2
Fifth	2:3
Fourth	3:4

3) For the Pythagorean sytem:

a) What interval is this based on???
(Hint: what interval is perfect in this system) 5th 2:3

b) Name a problem with this system:
(Hint: there are many to choose from)

3rd = $\frac{81}{64}$

Pyth. Comma

m2 = $\frac{256}{243}$

24¢ B# ≠ C

NAME:

Quiz #12 October 15, 2024

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1a) Psycho-acoustics has to do with human perception of sound (including music), judgments, comparisons and reactions to various sounds.

TRUE or FALSE:

1b) Vibrato is a periodic variation of the frequency of the tone about its average value. It is also known as frequency modulation.

TRUE or FALSE:

1c) Higher pitches involve higher frequencies and thus smaller wavelengths than lower frequencies.

TRUE or FALSE:

1d) We listened to excerpts of two songs in the key of D Major (Alan Jackson and Jimmy Buffett). Both songs used the I, IV and V chords extensively in the chorus. These three chords (the I, IV and V chords) are the principal chords of a Major key, because they are closely related by fifths on the circle of fifths.

TRUE or FALSE:

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2) If you were to tune a piano in one-quarter comma Meantone, playing a piece in the key of F# Major (six sharps) would not sound as "in tune" as if you played it in C Major. Briefly explain why this is.

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3) Timbre (tone color) helps us determine whether a guitar, piano or flute is playing. Fourier analysis (determining the amplitudes of the various harmonics) helps to explain why this is so.

NAME:

Quiz #13 October 17, 2024

Physics 1320 Music & Physics Prof. Baker & Olness

1) Define Formants

Define Periodicity Pitch

Define the Chorus Effect

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2) *Circle th*e 4 (of 8) properties of sound that are **psychological** rather than **physical**.

Waveform	Loudness
Pitch	Frequencey
Perceived Duration	Intensity
Physical Duration	Timber

3a) I play a 10,00Hz tone at 80dB. Refer to the chart of "equal loudness."

a) If I want to play a 3000Hz tone so it apparently sounds the same, what is the necessary dB level?

b) If I want to play a 100Hz tone so it apparently sounds the same, what is the necessary dB level?

Quiz #14 October 24, 2024

Physics 1320 Music & Physics Prof. Baker & Olness

Name:	Last 4 of ID	Signature

NAME:

Quiz #15 October 31, 2024

Physics 1320 Music & Physics Prof. Baker & Olness

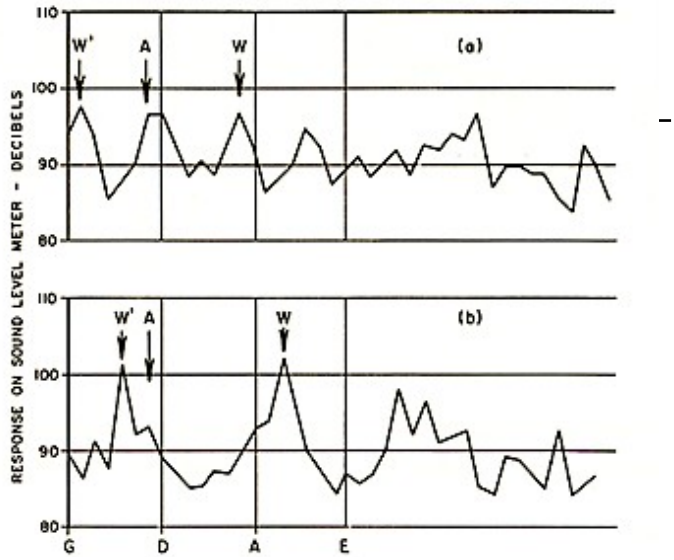
1) In brief, what is the purpose of: the bridge:

the bass bar:

the sound post:

2a) What is Wolf Tone with respect to string instrument behavior.
(Note, this is different from the "Wolf Interval which is the A-sharp, B-flat problem)

3b) The figure shows the SIL response for two violins. Which is the better quality instrument???



3) Match each instrument with its classification: *(Draw line: one line per instrument.)*

Aerophone	Violin
Cordophone	Bell
Electrophones	Bass Drum
Idiophone	Electric piano
Membranophone	Trumpet

NAME:

Quiz #16 November 5, 2024

Physics 1320 Music & Physics Prof. Baker & Olness

1) A **flute** (L=0.60m) functions as an **<u>open</u>** pipe.

a) Compute the lowest (fundamental) frequency f_1. (v=340m/s)

b) Draw the second harmonic f_2. *(Careful, NOT the first/lowest harmonic).*

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2) A **clarinet** (L=0.60m) functions as an **<u>closed</u>** pipe.

a) Compute the lowest (fundamental) frequency f_1. (v=340m/s)

b) Draw the second harmonic f_2. *(Careful, NOT the first/lowest harmonic).*

---

3) A sax has an "octave" key, but the clarinet has a "register" key.

What fundamental property of the instruments causes these difference?

NAME:

Quiz #17 November 7, 2024

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1) When a singer sings with helium instead of air, what changes and what stays the same? (Careful, think this through.)

2) Why is it physically impossible for sopranos to get diferent vowels in their highest range?

3a) In a simplifed case, approximately where shoule the register key be located on a **flute** if it is playing the lowest note of the register??? *[Measure relative to the mouthpiece.]*

3a) In a simplifed case, approximately where shoule the register key be located on a **clarinet** if it is playing the lowest note of the register??? *[Measure relative to the mouthpiece.]*

NAME:

Quiz #18 November 12, 2024

Physics 1320 Music & Physics Prof. Baker & Olness

1) To lower a trumpet a half-step, I increase the length by 6%; thus, if I multiply the length by (1.06), I get the correct length.
If I want to lower the pitch by FOUR half-steps, by what percent should I increase the length??? (Hint: it is NOT 24%)

2) Most instruments do NOT use the 7^{th} harmonic. But, the trombone can.
a) What is the general problem with the 7^{th} harmonic, and b) what feature of the trombone allows the trombone to use this harmonic while a trumpet cannot.

3a) Musically speaking, what is the fundamental improvement of the piano compared to the harpsichord.

b) For a piano, why are octaves NOT tuned to an exact 1:2 ratio???

c) For a piano, why do we wrap the bass strings?

NAME:

Quiz #18 November 14, 2017

Physics 1320 Music & Physics Prof. Tunks & Olness

$T = K\,V/(S\,a)$ $K = 0.049$ s/ft

Assume Perkins Chapel measures: 40x60x80 ft, and assume $a=0.25$

1+2) Compute the reverberation time of Perkins Chapel, T

3) Describe 3 (three) properties that are important for acoustics *besides reverberation time*.

Bonus: Where is Perkins Chapel located, and why is this important???

NAME:

Quiz #19 November 16, 2017

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$T = K V/(S a)$ $K = 0.049$ s/ft $= 0.16$ s/m

1) Assume Notre Dame Cathedral measures: 100x50x50 meters, and assume the reverberation time is t=8.0sec. Compute the absorption coefficient a and comment if this the value is realistic.

CAREFUL: USE METRIC!!! (Hint: Take it to be shaped like a box and use: side A x side B; get all 6 sides.)

2) Give one example from the SMU campus of how a room can be improved acoustically. Explain acoustically.

3) If a C-trumpet has a fundamental of f=130Hz. If v=1126ft/s, compute the length of this trumpet.