Final Exam Notes

8am   WednesdayDecember 16, 2015

Physics 1320   Music & Physics   Prof. Tunks & Olness

1)This contains review material for the Final exam. It consists of review sheets for exams 1 and 2, as well as the formula sheets and tables. The latter part of the course reviewed the instrument families; here we suggest you review the quizzes as that is indicative of what we expect you to know.

2) The grade sheets are updated on-line. Please check for errrrors, and inform us no later than Monday 7 December. (That's when we process the grade sheets.) There will be a final update by Friday 4 December when we process the grades from the projects.

3) There will be a review session on either Tuesday 15 December at 2pm in Room 60.

Notes: 1) onlines grades are updated; 2) Final Review Sheet is online; 3) Review TBD

Review	Exam 1	2013
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

Exam #2 Study Sheet 2013

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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 (10 log I1/I2), intensity ratio, sound pressure level , 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

$x = v\,t$

$F = ma$ *Newton's 2nd Law*

$P = F/A$

$W = F\,x$

$F = -k\,x$ *Hooke's Law*

$W = \frac{1}{2} k\,x^2$ (for spring)

$$f = \frac{1}{T} = \frac{1}{2\pi}\sqrt{\frac{k}{m}} = \frac{1}{2\pi}\sqrt{\frac{g}{L}}$$

$x(t) = A \ \mathrm{Sin}(2\pi f t + \phi)$

$$v = c = f\lambda$$

$c = 332\ (\mathrm{m/s}) \pm 0.6\ (\mathrm{m/s/\ °C})$

$c = 1087\ (\mathrm{ft/s}) \pm 1.1\ (\mathrm{ft/s/\ °F})$

$f_{AVERAGE} = (f_1 + f_2)/2$

$f_{BEATS} = f_1 - f_2$

$I = P/A = P/(4\pi r^2)$ *(P=Power)*

$SIL = 10\ \mathrm{Log}(I/I_0)$

$I = I_0 \times 10^{L/10}$ $I_0 = 10^{-12}\ \mathrm{W/m^2}$

Conversions:

$1\ \lambda = 360° = 2\pi$ radians

$1\ \mathrm{Hz} = 1$ cycles/sec $= 2\pi$ rad/s $= 360°$/s

PHYSICAL CONSTANTS

$\rho = 1.21\ \mathrm{kg/m^3}$ (density of air)

$\rho = 10^3\ \mathrm{kg/m^3}$ (density of water)

BASIC FORMULAS

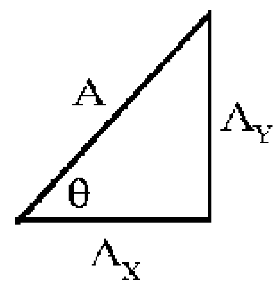
Sphere: $A = 4\pi r^2$, $V = \pi r^3$

Cylinder: $A = 2\pi r L$, $V = \pi r^2 L$

$A_X = A\cos(\theta)$;

$A_Y = A\sin(\theta)$;

$\tan(\theta) = A_Y / A_X$;



CAUTION:

- pressure is "P", density is rho "ρ"
  ... and sometimes power is "P"
- acceleration is "a", Area is "A"
- force is "F", frequency is "f",
  ... and Fahrenheit is "F"

	+0 dB	+1 dB	+ 2 dB	+ 3 dB	+ 4 dB	+ 5 dB	+ 6 dB	+ 7 dB	+ 8 dB	+ 9 dB	+ 10 dB		
120 dB	1.0	1.3	1.6	2.0	2.5	3.2	4.0	5.0	6.3	7.9	10.0	$\times 10^{-0}$	W/m^2
110 dB	1.0	1.3	1.6	2.0	2.5	3.2	4.0	5.0	6.3	7.9	10.0	$\times 10^{-1}$	W/m^2
100 dB	1.0	1.3	1.6	2.0	2.5	3.2	4.0	5.0	6.3	7.9	10.0	$\times 10^{-2}$	W/m^2
90 dB	1.0	1.3	1.6	2.0	2.5	3.2	4.0	5.0	6.3	7.9	10.0	$\times 10^{-3}$	W/m^2
80 dB	1.0	1.3	1.6	2.0	2.5	3.2	4.0	5.0	6.3	7.9	10.0	$\times 10^{-4}$	W/m^2
70 dB	1.0	1.3	1.6	2.0	2.5	3.2	4.0	5.0	6.3	7.9	10.0	$\times 10^{-5}$	W/m^2
60 dB	1.0	1.3	1.6	2.0	2.5	3.2	4.0	5.0	6.3	7.9	10.0	$\times 10^{-6}$	W/m^2
50 dB	1.0	1.3	1.6	2.0	2.5	3.2	4.0	5.0	6.3	7.9	10.0	$\times 10^{-7}$	W/m^2
40 dB	1.0	1.3	1.6	2.0	2.5	3.2	4.0	5.0	6.3	7.9	10.0	$\times 10^{-8}$	W/m^2
30 dB	1.0	1.3	1.6	2.0	2.5	3.2	4.0	5.0	6.3	7.9	10.0	$\times 10^{-9}$	W/m^2
20 dB	1.0	1.3	1.6	2.0	2.5	3.2	4.0	5.0	6.3	7.9	10.0	$\times 10^{-10}$	W/m^2
10 dB	1.0	1.3	1.6	2.0	2.5	3.2	4.0	5.0	6.3	7.9	10.0	$\times 10^{-11}$	W/m^2
0 dB	1.0	1.3	1.6	2.0	2.5	3.2	4.0	5.0	6.3	7.9	10.0	$\times 10^{-12}$	W/m^2

Level Difference	**Intensity Ratio**
SIL_1-SIL_2=	**I_1 / I_2**
0 dB	1.0
1 dB	1.3
2 dB	1.6
3 dB	2.0
4 dB	2.5
5 dB	3.2
6 dB	4.0
7 dB	5.0
8 dB	6.3
9 dB	7.9
10 dB	10.0
20 dB	10^2
30 dB	10^3
40 dB	10^4
50 dB	10^5
60 dB	10^6
70 dB	10^7
80 dB	10^8
90 dB	10^9
100 dB	10^{10}
$(10 \times n)$ dB	10^n

Sound Level dBA	**Max 24hr Exposure Occupational**	**Max 24hr Exposure Non-occupational**
80		4 hr
85		2 hr
90	8 hr	1 hr
95	4 hr	30 min
100	2 hr	15 min
105	1 hr	8 min
110	30 min	4 min
115	15 min	2 min
120	0 min	0 min

	Pythagorean	Just	Mean Tone*	Equal
C	0	0	0	0
C#	114	92	76	100
D	204	204	193	200
Eb	294	316	310	300
E	408	386	386	400
F	498	498	503	500
F#	612	590	579	600
G	702	702	696.5	700
G#	816	816	772	800
A	906	884	890	900
Bb	996	996	1007	1000
B	1110	1088	1083	1100
C	1200	1200	1200	1200

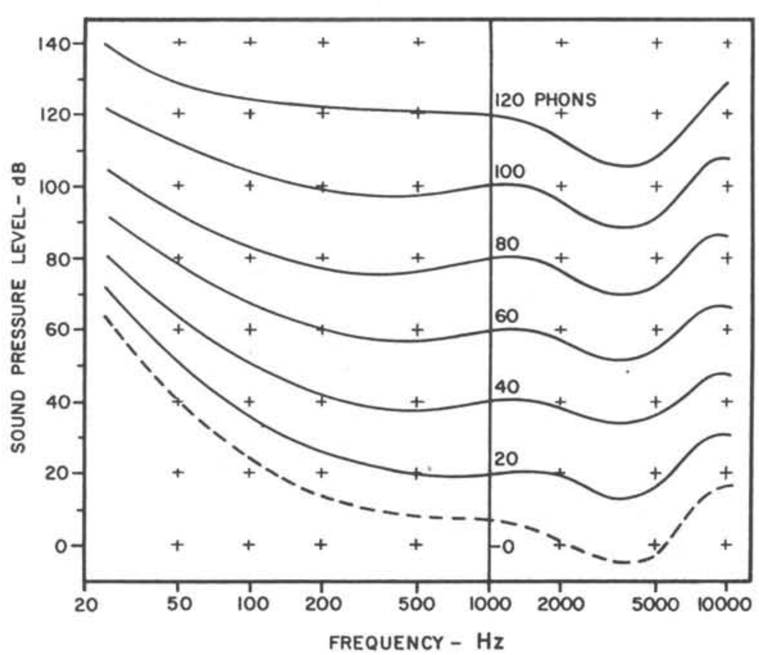


FIG. 3. Sensitivity of the ear as a function of frequency; equal loudness curves relating loudness level in phons to sound pressure level in decibels.

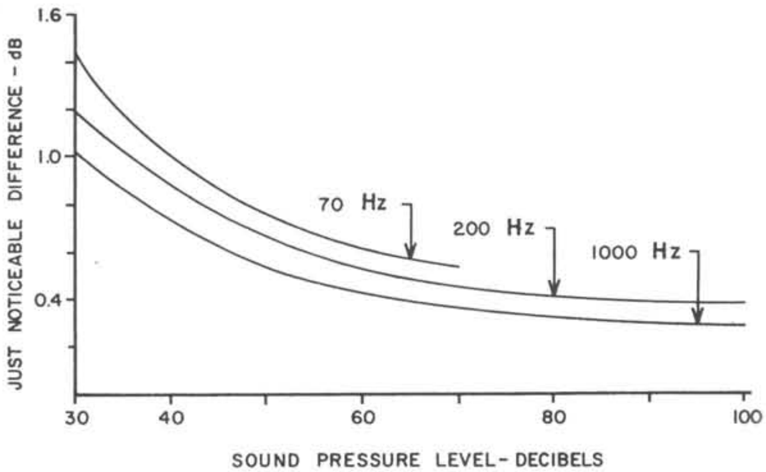
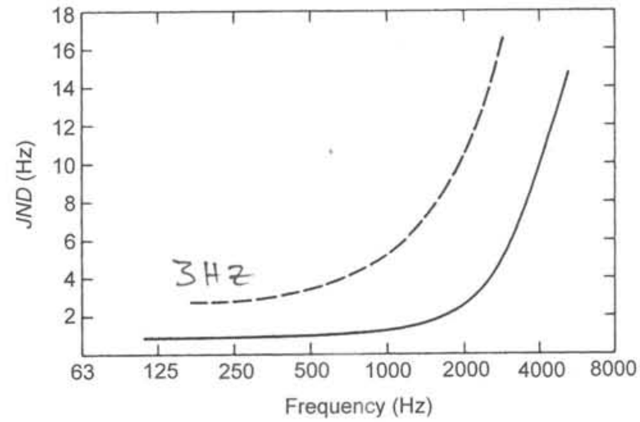


FIG. 2. Just noticeable difference in sound pressure level for three frequencies.



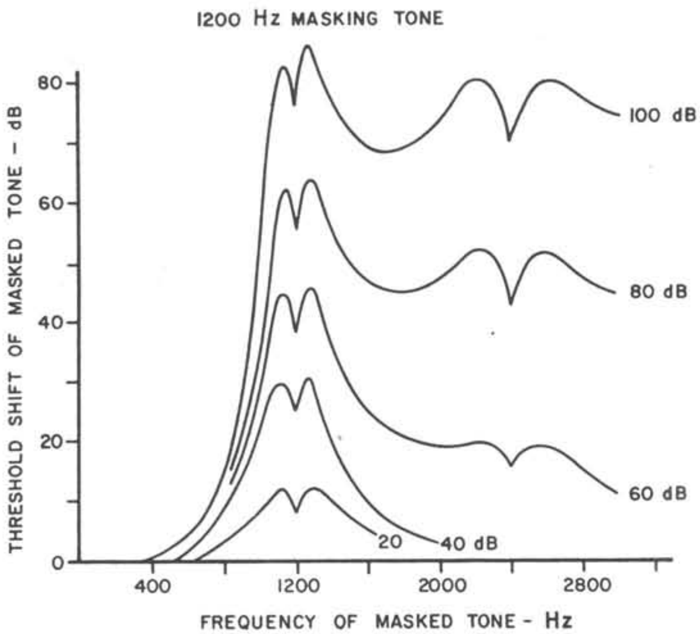


FIG. 5. Masking curves for a masking tone of 1200 hertz.

Sound Level (dBA)	Maximum 24-Hour Exposure	
	Occupational	Nonoccupational
80		4 hr
85		2 hr
90	8 hr	1 hr
95	4 hr	30 min
100	2 hr	15 min
105	1 hr	8 min
110	30 min	4 min
115	15 min	2 min
120	0 min	0 min

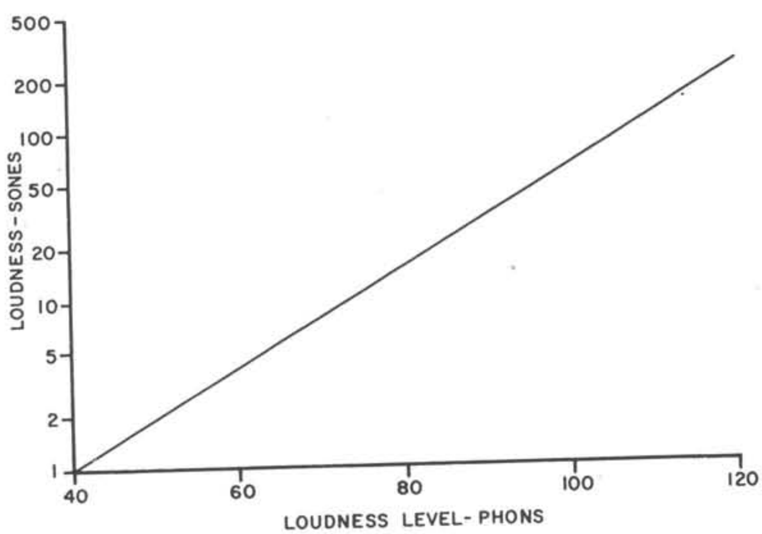


FIG. 4. Relation between loudness in sones and loudness level in phons.

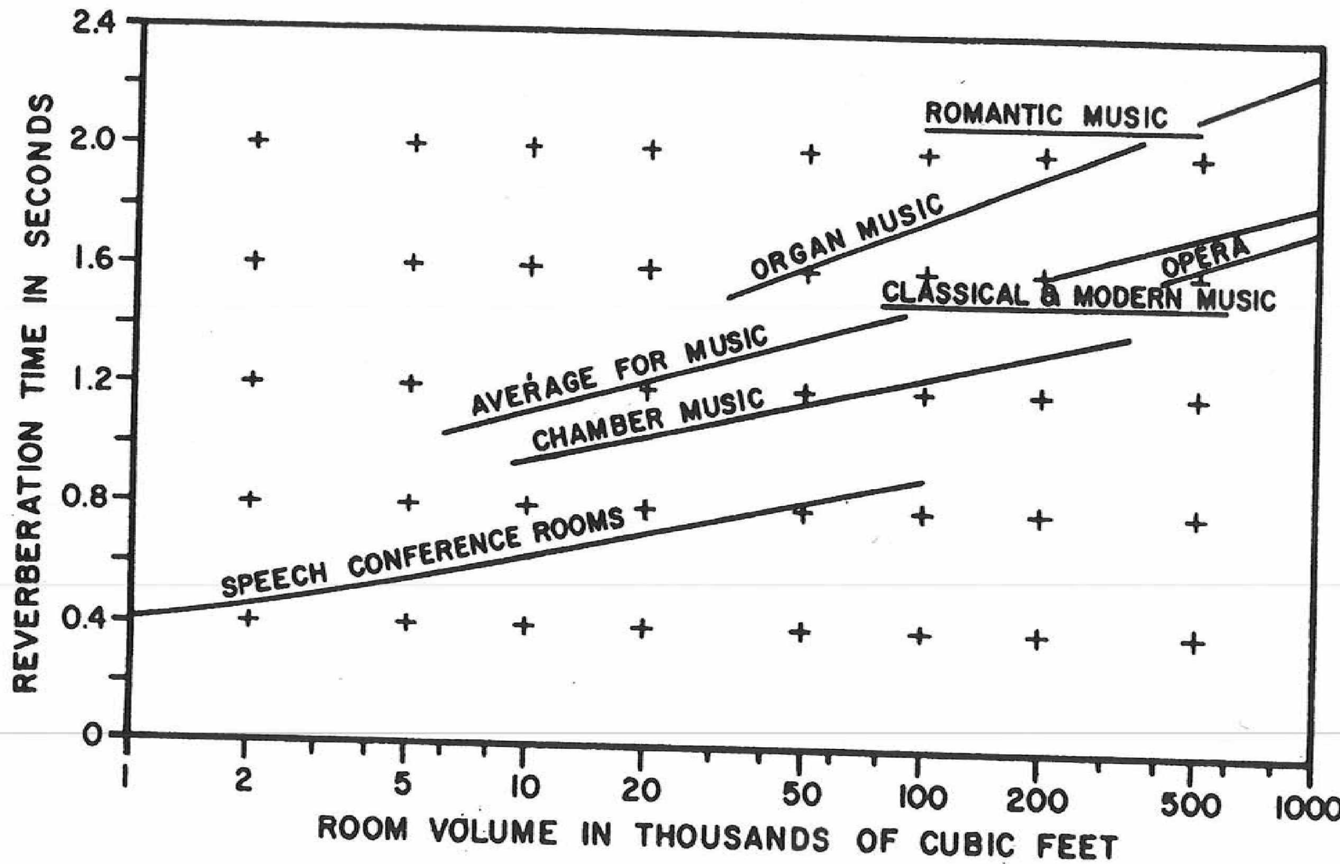


FIG. 5. Optimum reverberation time for auditoriums of various sizes and functions at a frequency of 500 hertz.

	FREQUENCY—HERTZ					
	125	250	500	1000	2000	4000
Marble or glazed tile	.01	.01	.01	.01	.02	.02
Concrete, unpainted	.01	.01	.01	.02	.02	.03
Asphalt tile on concrete	.02	.03	.03	.03	.03	.02
Heavy carpets on concrete	.02	.06	.14	.37	.60	.65
Heavy carpets on felt	.08	.27	.39	.34	.48	.63
Plate glass	.18	.06	.04	.03	.02	.02
Plaster on lath on studs	.30	.15	.10	.05	.04	.05
Acoustical plaster, 1″	.25	.45	.78	.92	.89	.87
Plywood on studs, ¼″	.60	.30	.10	.09	.09	.09
Perforated cane fiber tile, cemented to concrete, ½″ thick	.14	.20	.76	.79	.58	.37
Perforated cane fiber tile, cemented to concrete, 1″ thick	.22	.47	.70	.77	.70	.48
Perforated cane fiber tile, 1″ thick, in metal frame supports	.48	.67	.61	.68	.75	.50