$x = v\,t$

$F = ma$ *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)

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

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

$$v = c = f\lambda$$

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

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

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

$f_{BEATS} = f_1 - f_2$

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

$1\ \lambda = 360^\circ = 2\pi$ radians

1 Hz = 1 cycles/sec = 2π 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

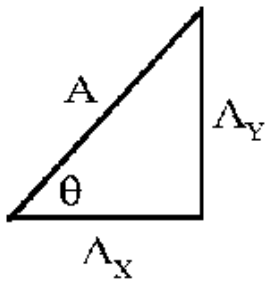
Sphere: $A = 4\pi r^2$, $V = \pi r^3$

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	**Max 24hr Exposure**	**Max 24hr Exposure**
dBA	**Occupational**	**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

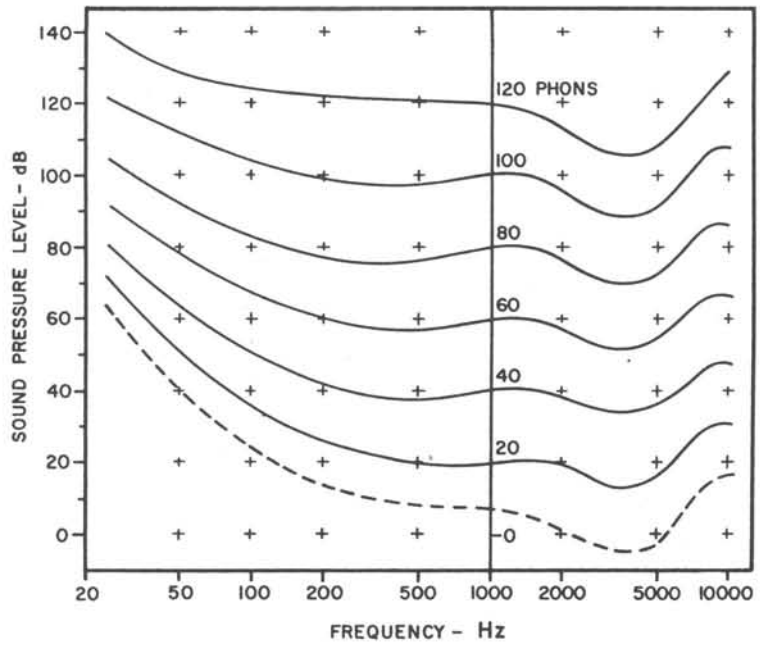


FIG. 3. Sensitivity of the ear as a function of frequency; equal loudness curves relating loudness level in phons to sound pressure level in decibels.

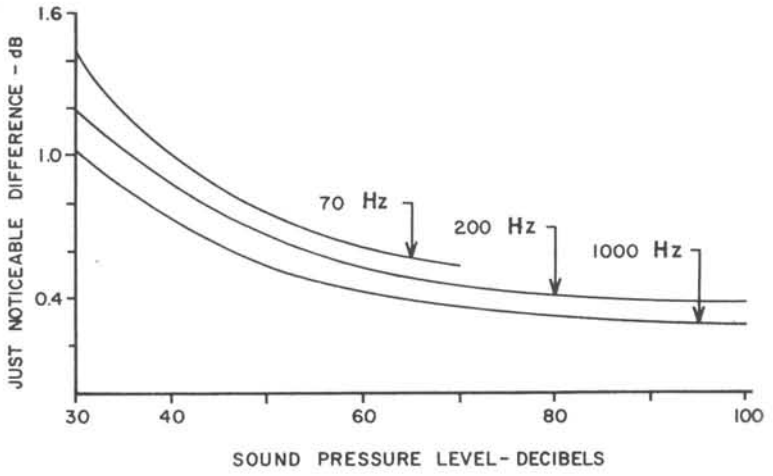
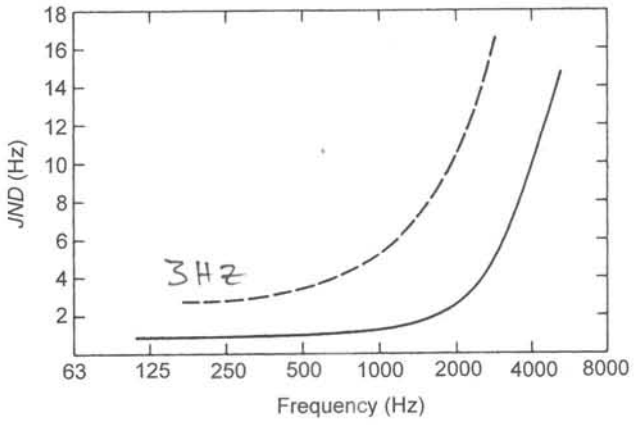


FIG. 2. Just noticeable difference in sound pressure level for three frequencies.



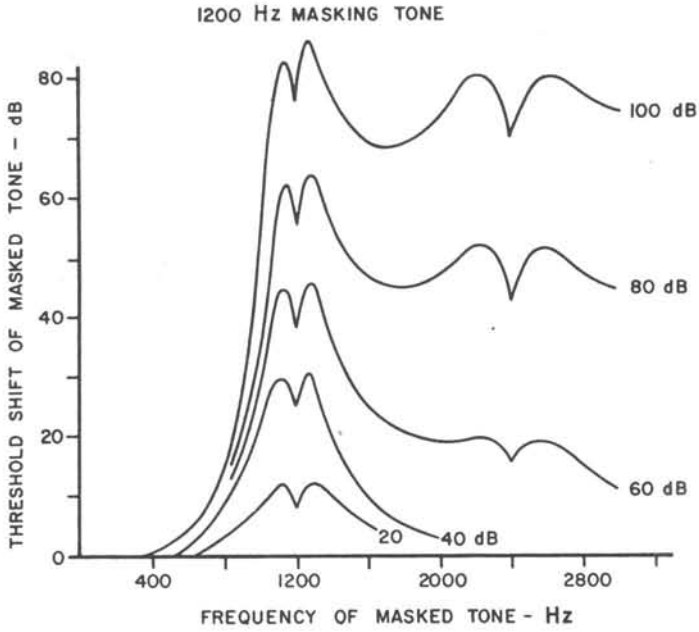


FIG. 5. Masking curves for a masking tone of 1200 hertz.

	Maximum 24-Hour Exposure	
Sound Level (dBA)	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

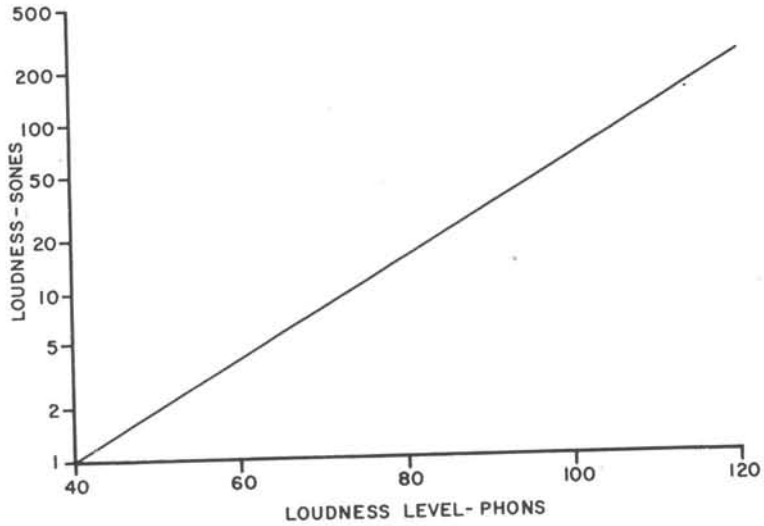


FIG. 4. Relation between loudness in sones and loudness level in phons.