Phys 1240: Sound and Music

LAST: decibels

TODAY: decibels and hearing

NEXT: Midterm

(We'll finish up Ch 6 next Tues. Catch up on those readings if you haven't already done them)

Extra office hour today@4 (Vincent) (help room)

Earlier evening help session tomorrow 6 PM (here) (Jeff)

5.24a

A violin is playing at 60 dB. What happens to the SIL if there are 20 violins playing? It goes to...

A) 73 dB B) 76 dB C) 80 dB

D) 120 dB E) more than 120 dB

SIL difference (in decibels)	Intensity ratio
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

5.24a

A violin is playing at 60 dB. What happens to the SIL if there are 20 violins playing? It goes to...

A) 73 dB B) 76 dB C) 80 dB

D) 120 dB E) more than 120 dB

SIL difference (in decibels)	Intensity ratio
1 dB	1.3
2 dB	1.6
3 dB	2.0

20x intensity means 2*10,

From table that's +3+10 dB

Chorus effect

Adding instruments => add the intensities

(AND, nice, richer sound from the subtle beating...)

If sound from different sources is perfectly IN phase (or OUT of phase) (constructive or destructive interference) then it's not so simple...

Imagine sources with AMPLITUDE=1
=> INTENSITY ~ (Amp)^2 = 1^2 = 1

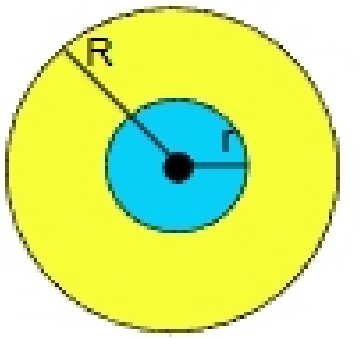
If have TWO such sources,
EXPECT total intensity = 1+1 = 2.

If DESTRUCTIVE interference:
AMP = 1-1 =0
=> INTENSITY ~ 0^2 = 0. Silence!

If CONSTRUCTIVE interference:
AMP = 1+1 =2
=> INTENSITY ~ $(2)^2$ = 4. Loud!!

Average of 0 and 4 is 2 (!!)

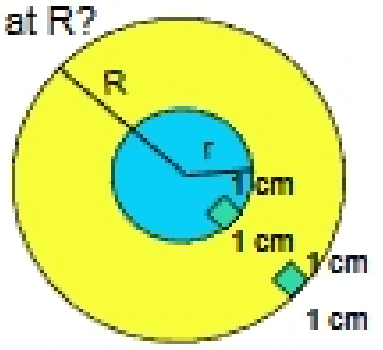
There is a source in the center emitting sound outward. How does intensity of the sound at r compare to that at R?



a) $I_{(at\ r)} > I_R$
b) $I_{(at\ r)} < I_R$
c) $I_{(at\ r)} = I_R$
d) Not enough information

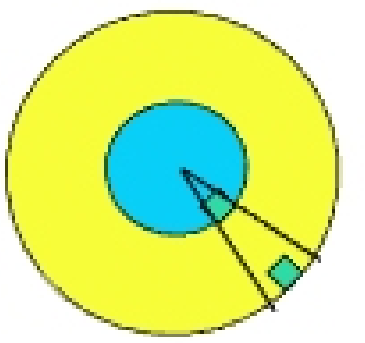
(Assuming no friction/losses, etc)
How does the total power (Energy/second) passing through the whole spherical surface at r compare to that at R?

A) $P_r > P_R$
B) $P_r < P_R$
C) $P_r = P_R$
D) ??



How does the power passing through a patch of 1 cm^2 at radius r compare to that at R?

Remember: I = power/area



The area of a sphere grows like (Radius)^2

Intensity = Power / area

So, intensity of sound decreases like 1/(Radius)^2.

If R=2r, what is I_R/I_r?

a) 1
b) 2
c) 4
d) .5
e) .25

DOUBLE distance to a sound source (outside) =>
sound intensity is 0.25 times as big
(you could say it decreases 4 times)

Table 5.1 says
6dB <=> 4x (look it up!)

Doubling distance lowers the SIL *by 6 dB.*

(Or even MORE, if some sound energy is lost to heat!...)

(Or LESS, if lots of sound reflects...)

Standing 10 meters from the speakers at an outdoor concert, the SIL is 100 dB.

Assuming "no losses", how loud is it at

20 meters? .... 80 meters?

A) 50 dB ..... 33 dB
B) 50 dB ..... 38 dB
C) 94 dB ..... 88 dB
D) 94 dB ..... 82 dB
E) Something totally different