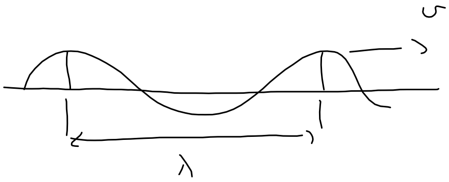
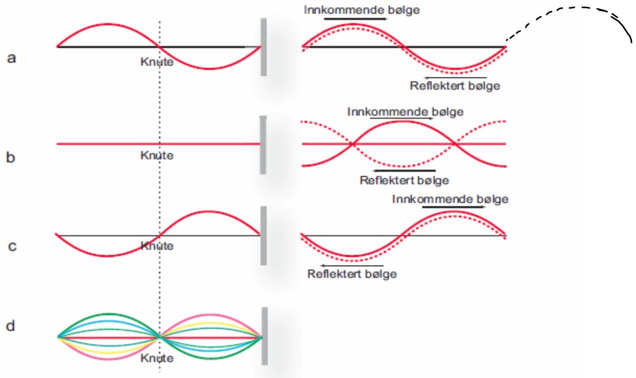


$v = \lambda f$

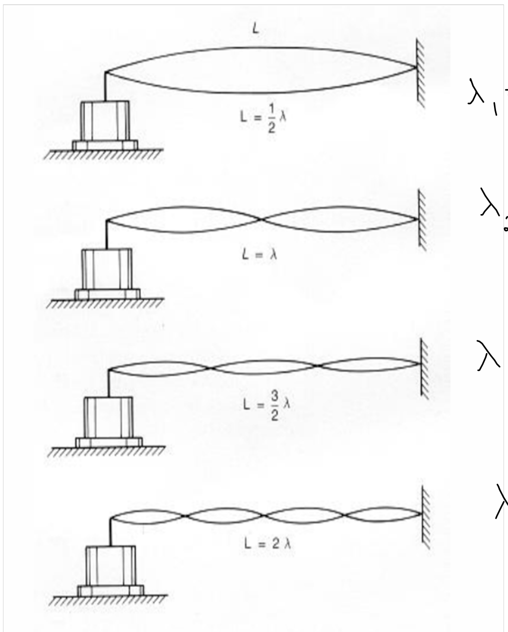
feb 16-08:13

Stående bølger

1 Den innkommende og den reflekterte bølgen *interfererer*. Resultatet blir en stående bølge.



mar 14-11:52



Grunntone og overtoner

$v = f \cdot \lambda$

$\lambda_1 = 2L$ $f_1 = \frac{v}{\lambda_1} = \frac{v}{2L}$

$\lambda_2 = L$ $f_2 = \frac{v}{\lambda_2} = \frac{v}{L} = 2\frac{v}{2L} = 2f_1$

$\lambda_8 = \frac{2}{3}L$ $f_3 = \frac{v}{\lambda_3} = \frac{v}{\frac{2}{3}L} = \frac{3v}{2L} = 3f_1$

$\lambda_4 = \frac{1}{2}L$ $f_4 = \frac{v}{\lambda_4} = \frac{v}{\frac{1}{2}L} = 4 \cdot \frac{v}{2L} = 4f_1$

mar 14-13:19

En gitarstreng svinger med grunntone 440 Hz. $= f_1$
Hva er frekvensen til de tre første overtonene?

$f_2 = 2f_1 = 880$ Hz $f_3 = 3f_1 = 1320$ Hz $f_4 = 4 \cdot f_1 = 1760$ H

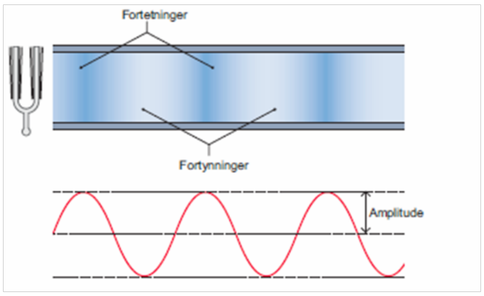
mar 14-14:01

Resonans

http://youtu.be/3mclp9QmCGs

mar 8-17:42

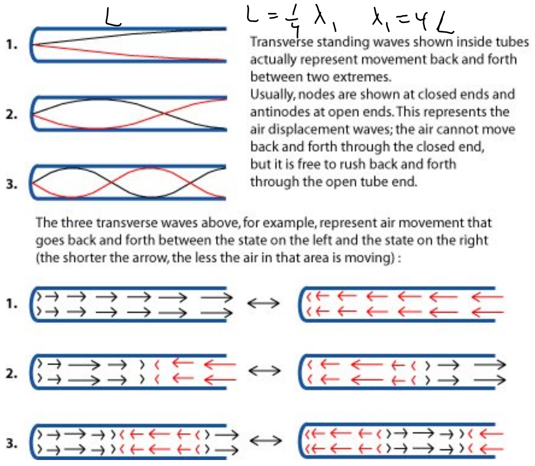
Lyd er langsbølger i luft. Vi tegner det ofte som tversbølger til tross for at det er langsbølger.



mar 14-10:07

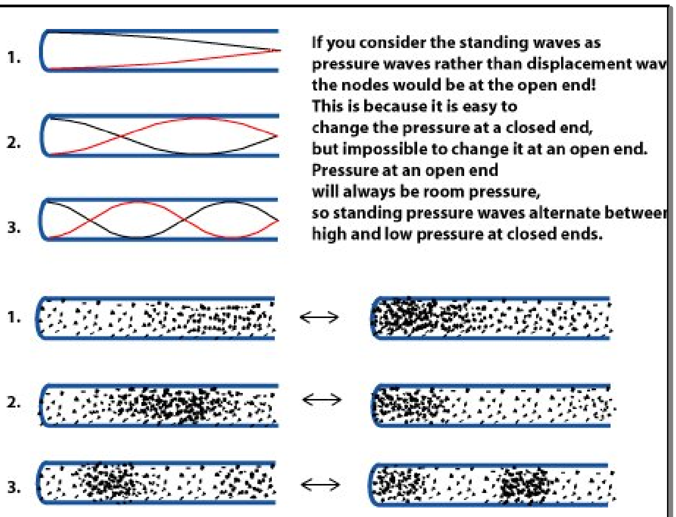
L

$L = \frac{1}{4}\lambda_1 \quad \lambda_1 = 4L$



Transverse standing waves shown inside tubes actually represent movement back and forth between two extremes. Usually, nodes are shown at closed ends and antinodes at open ends. This represents the air displacement waves; the air cannot move back and forth through the closed end, but it is free to rush back and forth through the open tube end.

The three transverse waves above, for example, represent air movement that goes back and forth between the state on the left and the state on the right (the shorter the arrow, the less the air in that area is moving):



If you consider the standing waves as pressure waves rather than displacement wav the nodes would be at the open end! This is because it is easy to change the pressure at a closed end, but impossible to change it at an open end. Pressure at an open end will always be room pressure, so standing pressure waves alternate betweer high and low pressure at closed ends.

$L = \frac{3}{4}\lambda_2$

$L = \frac{5}{4}\lambda_3$

$L = 22\ cm$

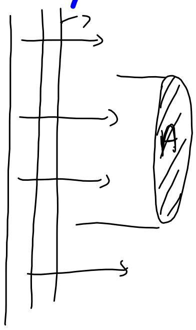
$\lambda_1 = 4L = 88\ cm$

$v = f\lambda \quad v = 340\ m/s$

$f_1 = \frac{v}{\lambda_1} = 386\ Hz$

Apr 5-1:34 PM

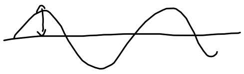
Lydintensitet



Effekt

$$I = \frac{P}{A}$$

Areal



4mm

$16 \cdot 10^{-6}\ m^2$

$\approx 10^{-6}\ m^2$

Lydintensitetsnivå

$$L = 10 \log\left(\frac{I}{I_0}\right) dB$$

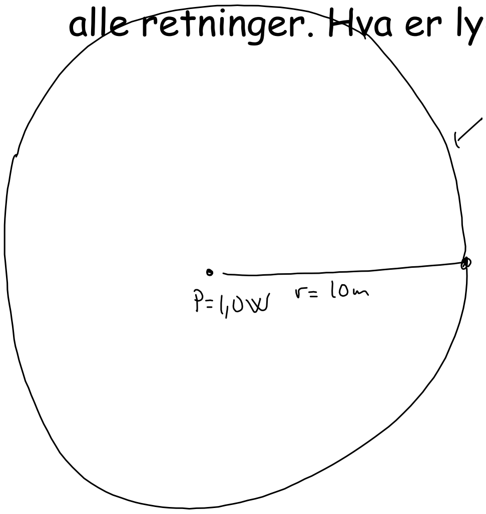
$10^{-12}\ W/m^2$

$P = I_0 \cdot 10^{-6}\ m^2 = 10^{-18}\ W$

Apr 5-1:42 PM

Eksempel

En høytaler har effekten 1,0 W og sender lyd like sterkt i alle retninger. Hva er lydintensitetsnivået 10 m borte?

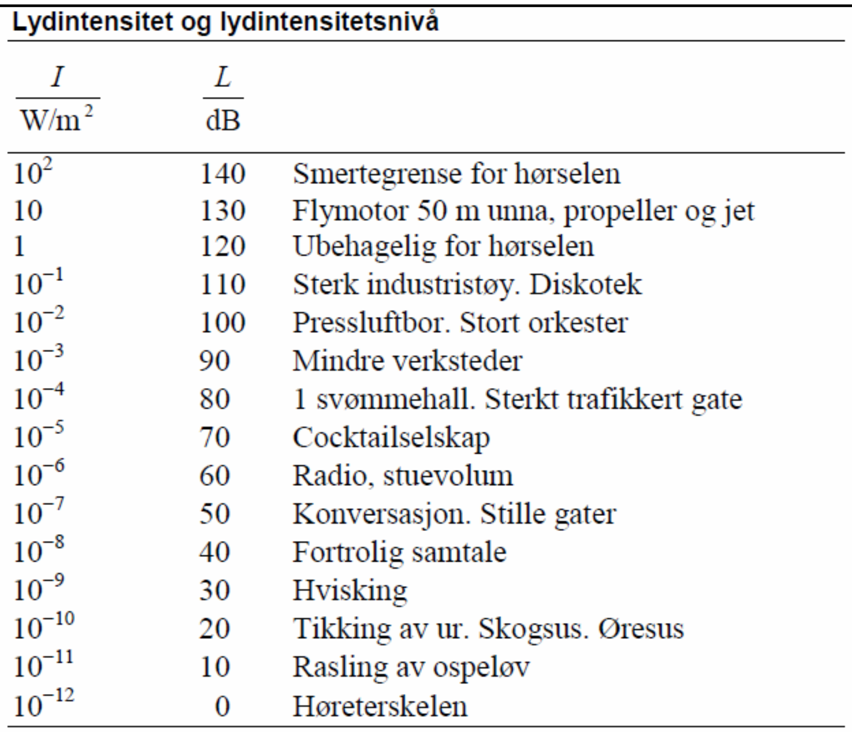


$A = 4\pi r^2$

$$I = \frac{P}{A} = \frac{1{,}0W}{4\cdot\pi\cdot(10m)^2} = 8{,}0\cdot10^{-4}\ W/m^2$$

$$L = 10\cdot\log\left(\frac{I}{I_0}\right)dB = 10\cdot\log\left(\frac{8{,}0\cdot10^{-4}}{10^{-12}}\right) = 89\ dB$$

Apr 5-1:42 PM

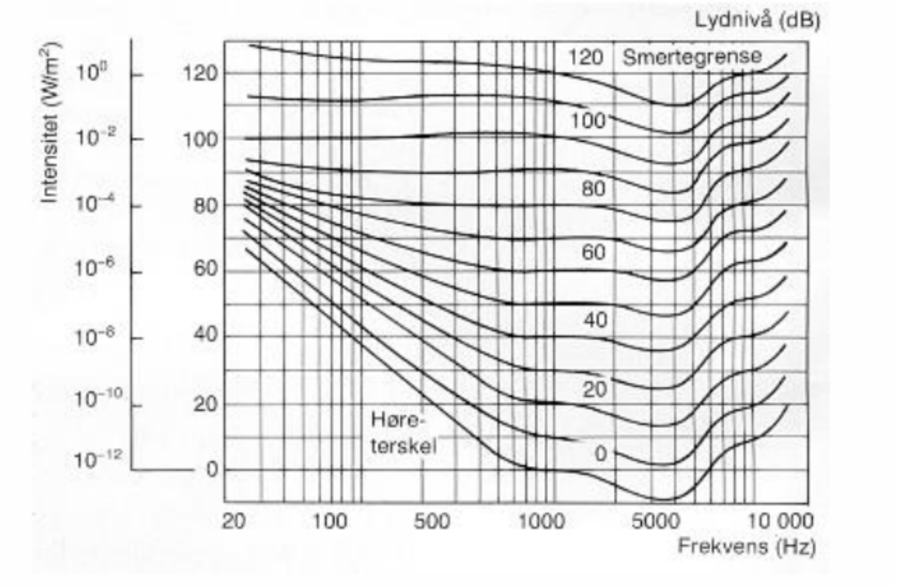


Lydintensitet og lydintensitetsnivå

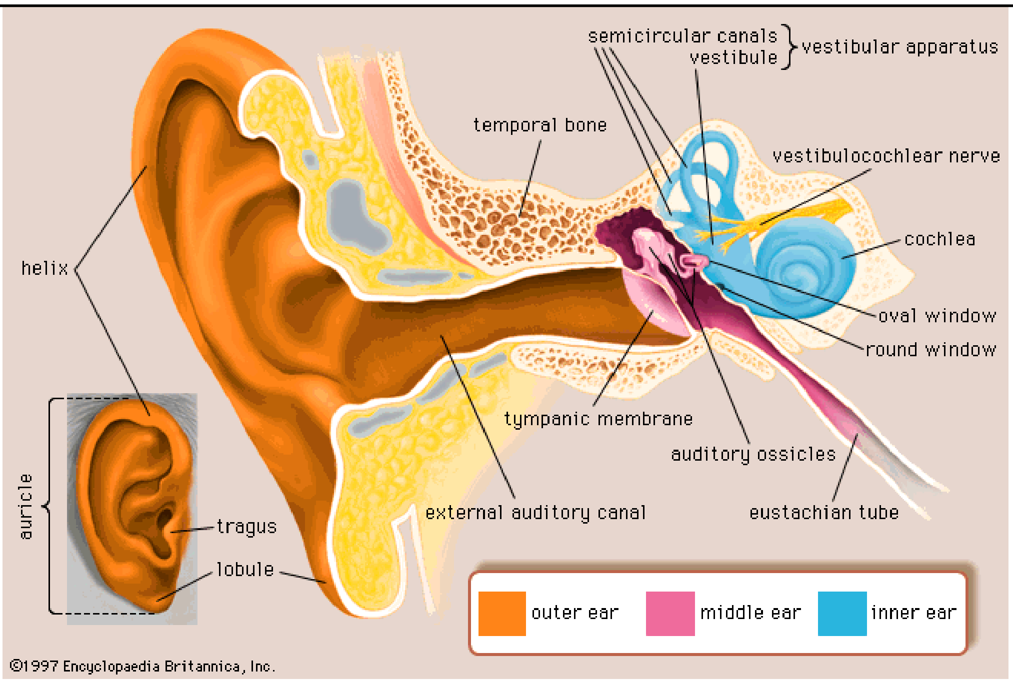
$\frac{I}{\mathrm{W/m^2}}$	$\frac{L}{\mathrm{dB}}$	
10^2	140	Smertegrense for hørselen
10	130	Flymotor 50 m unna, propeller og jet
1	120	Ubehagelig for hørselen
10^{-1}	110	Sterk industristøy. Diskotek
10^{-2}	100	Pressluftbor. Stort orkester
10^{-3}	90	Mindre verksteder
10^{-4}	80	1 svømmehall. Sterkt trafikkert gate
10^{-5}	70	Cocktailselskap
10^{-6}	60	Radio, stuevolum
10^{-7}	50	Konversasjon. Stille gater
10^{-8}	40	Fortrolig samtale
10^{-9}	30	Hvisking
10^{-10}	20	Tikking av ur. Skogsus. Øresus
10^{-11}	10	Rasling av ospeløv
10^{-12}	0	Høreterskelen

mar 14-15:34

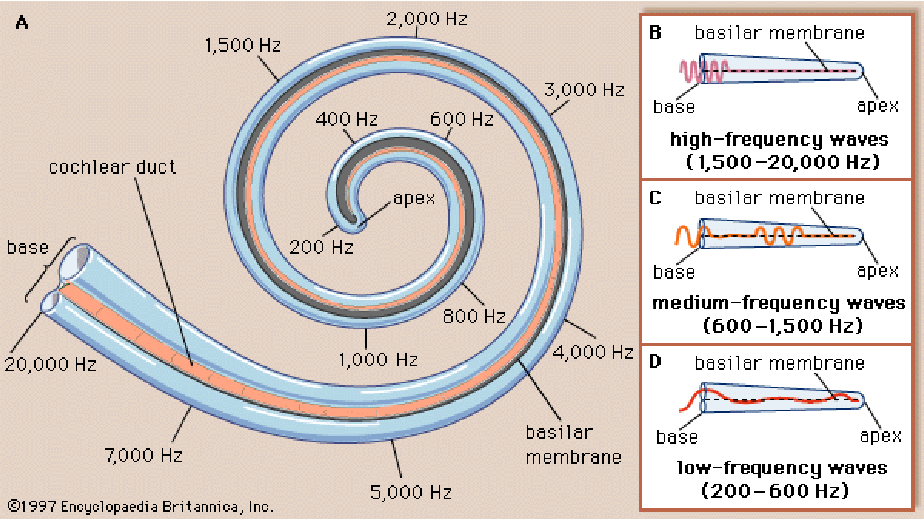
Lydintensitetsnivå og menneskeørets følsomhet:



mar 14-14:05



Apr 5-1:44 PM



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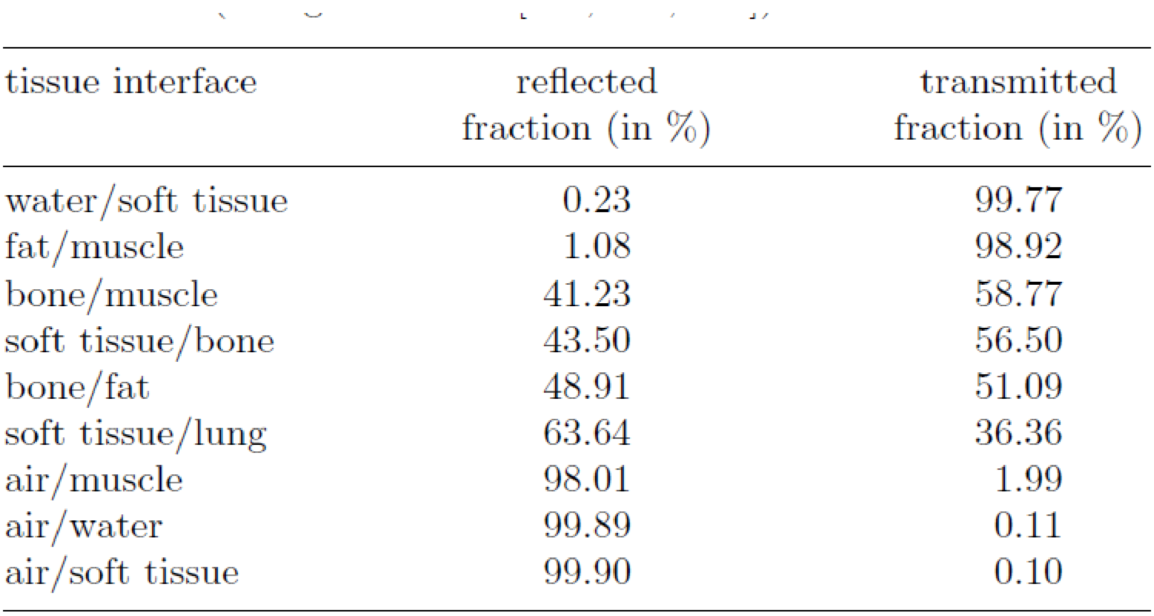
Apr 5-1:44 PM

BM_FMresponse.mpg

BMtocataAndFugue.mp4

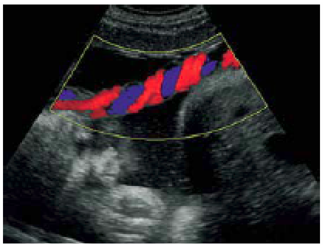
Apr 3-4:12 PM



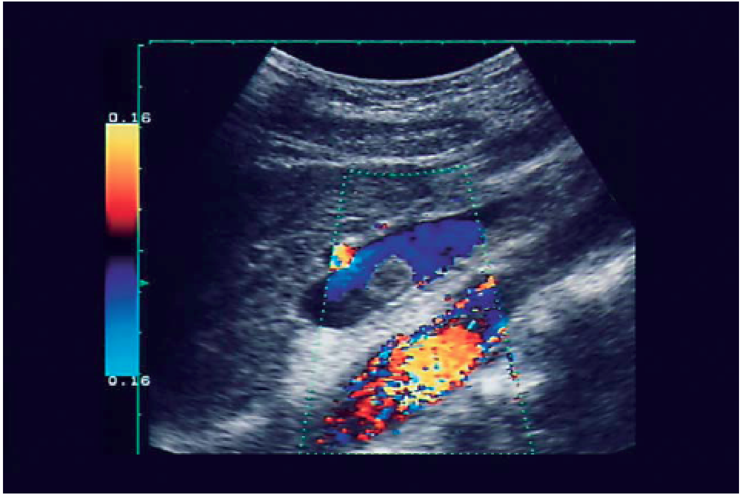
tissue interface	reflected fraction (in %)	transmitted fraction (in %)
water/soft tissue	0.23	99.77
fat/muscle	1.08	98.92
bone/muscle	41.23	58.77
soft tissue/bone	43.50	56.50
bone/fat	48.91	51.09
soft tissue/lung	63.64	36.36
air/muscle	98.01	1.99
air/water	99.89	0.11
air/soft tissue	99.90	0.10

Apr 3-4:14 PM

Dopplerultralyd



Her ser du Dopplerultralyd av en navlestreng. Blå farge indikerer at blodet beveger seg fra oss, og rød farge at det beveger seg mot oss.



Her ser du Dopplerultralyd av blodårene inn mot og ut fra leveren til en pasient.
Det blå området viser blod inn mot leveren. Det store grå området tyder på at en blodpropp hindrer blodtilstrømningen.
Blod ut fra leveren vises i det nedre området.
Det kreves høy kompetanse for å kunne tolke slike bilder.

mar 16-14:05

En annen viktig egenskap: Signalet blir svekket. **Det bør ikke gå mer enn 200 bølgelengder for å nå fram til organet.** Dette stiller også krav til frekvensen. Hvis vi vil se 10 cm inn i kroppen, hva bør frekvensen være?

I en hjerteundersøkelse brukes frekvenser fra 2 MHz til 5 MHz. Hvor dypt ser vi?

mar 16-14:19

Vedlegg

BMtocataAndFugue.mp4

BM_FMresponse.mpg