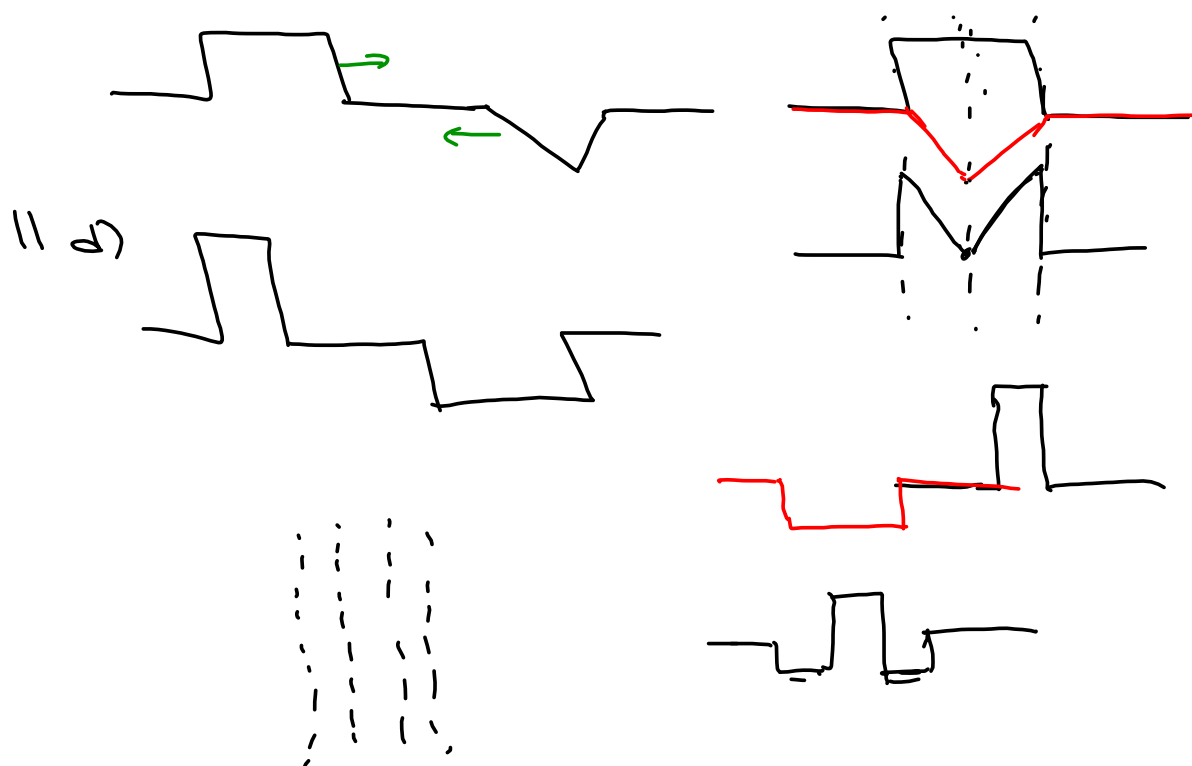


Homework

3. p 362.



Introduction to Sound

Frequency (pitch) - how high or low a sound is

20 - 20000 Hz for human hearing

Dogs - up to about 50,000 Hz

Bats - up to $\sim 100\,000$ Hz

Sounds over 20,000 Hz are called
ultrasounds

Amplitude (volume, loudness) - change in pressure

Decibel scale (non-linear scale)

0 dB \neq no sound.

0 dB \approx lower limit of human hearing

10 dB = 10x amplitude (~ 3 x volume) of 0 dB

20 dB = 10x 10 dB = 100x 0 dB \rightarrow rustling of leaves in trees.

50 - 60 dB \Rightarrow normal speech.

65 dB \Rightarrow road noise.

80 dB \Rightarrow heavy traffic

Prolonged exposure to sounds over 80 dB is known to cause permanent hearing loss.

100 - 120+ dB Indoor Rock Concert.

140 dB - Jet plane (outside).

Musical Notes

Concert

256 Hz

440 Hz

Middle C

A above Middle C

Piano

261.6 Hz

440 Hz

Doubling of $f \Rightarrow$ up one octaveHalving of $f \Rightarrow$ down one octavePiano \approx 28 - 8200 Hz

Speed of Sound

Substance	Speed (m/s) (at 20°C)	
Air	343	gases
CO ₂	259	
O ₂	316	
Water	1500	liquids
→ Mercury	1407	
Ethanol	1162	
Wood (along fibre)	3300-4700	solids
Brick	3652	
Glass	5000-6000	
Iron	5130	

Speed of Sound in Air

↑ pressure \Rightarrow ↑ v

↑ altitude \Rightarrow ↓ v

pollutants, humidity, etc.


Temperature is the biggest factor

Speed of sound $\rightarrow v_s = 331 \text{ m/s} + 0.6 \text{ m/s}^\circ\text{C} T$ ← T is temp in $^\circ\text{C}$

$$\begin{aligned} \text{at } 20^\circ\text{C} \quad v_s &= 331 + 0.6(20) \\ &= 343 \text{ m/s} \end{aligned}$$

$$\begin{aligned} \text{at } -10^\circ\text{C} \quad v_s &= 331 + 0.6(-10) \\ &= 325 \text{ m/s} \end{aligned}$$

Homework: Sheet #3 - 5

 <http://www.youtube.com/watch?v=ASd0t3n8Bnc&feature=related>

