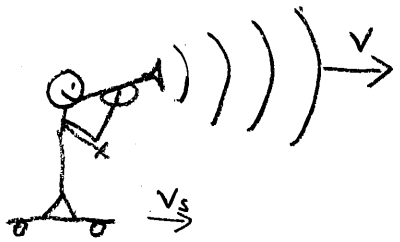
Worksheet on Doppler effect



Source: plays frequency f

observer: hears freq f'

speed of sound: v
speed of source: v_s
speed of observer: v_o

Goal: find f' in terms of f, v, v_o, v_s.

Part A: observer fixed.

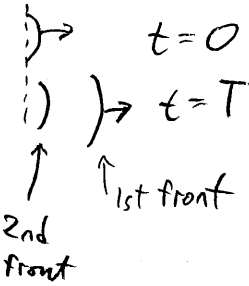
- The first wavefront is emitted at time $t=0$

1. After one period T, how far has first wavefront moved? (answer in v, f)

2. After one period T, how far has source moved? (answer in v_s, f)

- At time T, another wavefront is emitted.

3. What is the distance λ' between the first two wave fronts?

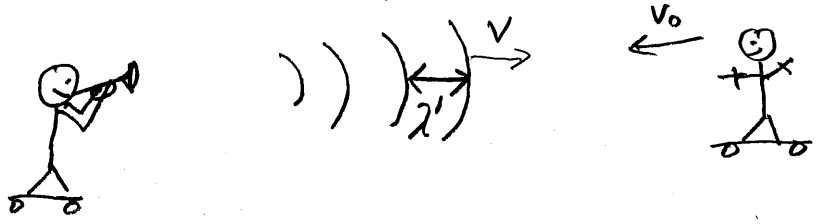


4. The observer sees a wave with speed v, and wavelength λ'. What frequency f' does the observer hear? (answer in v, v_s, f)

Doppler effect

Part B

- Now think about a moving observer.



5. What is the relative speed of the wave and the observer?

6. What is the time T' between observer hitting first wavefront and observer hitting second wavefront? (in terms of λ', v, v_o)

7. Rewrite T' in terms of v, v_o, v_s, and f, using result from #3

8. What frequency f' does the observer hear?

Note: positive v_o, v_s $\Rightarrow$ motion towards each other.
negative v_o, v_s $\Rightarrow$ motion away from each other.