Solution to HW 7

1. Wavefronts

a) Key idea here is that the time delay \( \Delta t \) is due to the distance \( d \) that each wavefront must travel to reach your left ear \((L)\) after it reach your right ear \((R)\). From figure, we see
\[
\Delta t = \frac{d}{v} = \frac{D \sin \theta}{v}.
\]

b) Key idea: Now the speed of sound substituted by \( v_w \).
\[
\Delta t_w = \frac{D \sin \theta}{v_w}
\]

"Wavefront arrives from directly left to the right. \( \theta = 90^\circ \)
\[
\Delta t_w = \frac{D}{v_w}.
\]
Therefore, if \( \Delta t = \Delta t_w \).

We have \( \frac{D}{v_w} = \frac{D \sin \theta}{v} \Rightarrow \sin \theta = \frac{v}{v_w} = \frac{393}{1482} = 0.23 \)
\[\theta = 13^\circ.\]

2. a) Let \( v \) represent the emitted frequency, \( 1/v \) represent the sound speed, and \( 1/v_s \) represent the source speed. Since the bird is flying directly away from the observer, the received frequency