The Doppler Effect

When a source of sound waves and a listener approach one another, the **pitch** of the sound is increased as compared to the frequency heard if they remain at rest. If the source and the listener recede from one another, the frequency is decreased.

$$f_L = f_S \frac{v + v_L}{v - v_S}$$ Units: **Hz**

f_L. Frequency of the listener, f_S: frequency of the source
v: velocity of sound, v_L: velocity of listener, v_S: velocity of source

Sign Convention: velocity: (+) approaching and (-) receding

1. A train whistle emits sound at a frequency of 400 Hz. The speed of sound is 340 m/s
a. What is the pitch of the sound heard when the train is moving toward a stationary observer at a speed of 20 m/s.

b. What is the pitch heard when the train is moving away from the observer at this speed?

2. A stationary source of sound has a frequency of 800 Hz on a day when the speed of sound is 340 m/s. What frequency is heard by a person who is moving from the source at 30 m/s?

3. An auto with a siren having a frequency of 365 Hz is approaching a stationary detector at a speed of 75 km/h. What will the frequency of the siren appear to be if sound travels at 345 m/s?

4. The whistle of a train has a frequency of 440 Hz. The train is moving at 35 m/s toward a person standing on the platform. If sound travels at 345 m/s, what is the wavelength of the sound heard by the person?