Answer on Question #41992 – Physics – Other

Question.

A whistle with a frequency of 1100 Hz is travelling south at a velocity of 25.0 m/s. You are travelling north away from the whistle at a speed of 15.0 m/s. If the speed of sound is 340 m/s, what is the apparent frequency of the whistle as heard by you?

Given:

$\omega_0 = 1100\ Hz$ is an emitted frequency

$c = 340\ \frac{m}{s}$ is a velocity of waves in the medium

$v_1 = 25\ \frac{m}{s}$ is a velocity of the source relative to the medium

$v_2 = 15\ \frac{m}{s}$ is a velocity of the receiver relative to the medium

Find:

$\omega = ?$ is an observed (apparent) frequency

Solution.

The Doppler effect is the change in frequency of a wave (or other periodic event) for an observer moving relative to its source.

If the speeds of source and the receiver relative to the medium are lower than the velocity of waves in the medium, the relationship between observed frequency and emitted frequency is given by:

$$\omega = \omega_0 \frac{c + v_2}{c + v_1}$$

where v_1 is positive if the source is moving away from the receiver (and negative in the other direction) and v_2 is positive if the receiver is moving towards the source (and negative in the other direction).

Therefore,

$$\omega = \omega_0 \frac{c - v_2}{c + v_1}$$

Calculate:

$$\omega = 1100 \frac{340 - 15}{340 + 25} = 1100 \frac{325}{365} = 1100 \cdot 0.89 = 980\ Hz$$

Answer.

$$\omega = \omega_0 \frac{c - v_2}{c + v_1} = 980\ Hz$$