Iona Physics Lab: The Doppler Effect Br. R.W.Harris	

The **Doppler effect** (or the **Doppler shift**) is the change in frequency of a wave in relation to an observer who is moving relative to the wave source. It is named after the Austrian physicist Christian Doppler, who described the phenomenon in 1842.[1]

The Doppler effect is used to measure speeds. For example, the shift in the wavelength of light coming from distant stars is used to determine the speed at which the stars are moving with respect to us. Police use the Doppler effect to determine the speed of automobiles.

Problem: To determine the maximum speed of the hand-held phone as it is moved.

Procedure:
1. Set up a constant frequency sound generator. There are several ways you can do that. Phyphox can generate tones, so if two people work together, one can generate the tone and the other can make the measurement. However, your computer can also generate a constant frequency tone. Here is a link to an Iona Prep Physics tone generator: https://ionaphysics.org/classroom/Physlets2/IonaPuzzles/ToneGenerator/Beats.htm This page actually has two tone generators. Set the frequency of one of them to 2000 Hz and ignore the other one.
2. On Phyphox, go to the Doppler effect experiment. On the SETUP tab set the base frequency to 2000 Hz, the frequency range to 30 Hz, the time step to 50. ms and the speed of sound to 346 m/s.
3. Go to the Results tab and click the little arrow to start detection. While holding the phone firmly in your hand (you do not want to throw it!) move it quickly toward the source of the sound.
4. Click the two parallel lines to pause detection.
5. You can expand the Frequency display by tapping on the two small arrows to the left of the word Frequency.

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[1] "Doppler effect - Wikipedia." https://en.wikipedia.org/wiki/Doppler_effect. Accessed 14 Jul. 2020.

6. With the large display, click on the PICK DATA button and then touch the screen at a place where the frequency is the highest. It will display the time and frequency. Record it.
7. Touch the screen at a place where the frequency is the lowest. Record that frequency.

Formula $f = f_o (V + V_o)/(V-V_s)$

V = v sound (taken to be 343 m/s in this case
V_o = v observer
V_s = v source - taken to be zero

$F = F_o (V + V_o)/V$
$F/F_o = (V + V_o)/V$
$F * V/F_o = V + V_o$
$(F*V/F_o) - V = V_o$

In one case the measured frequencies were 2019 and 1981 so $\Delta f = 19$ hz

For this experiment:
$((2019*346)/2000) - 346 = V_o$

V_o= 3.29 m/s
Consequently, for this set of data the phone was moving at 3.29 m/s. You should use your own data, not mine, to do the experiment.