156.

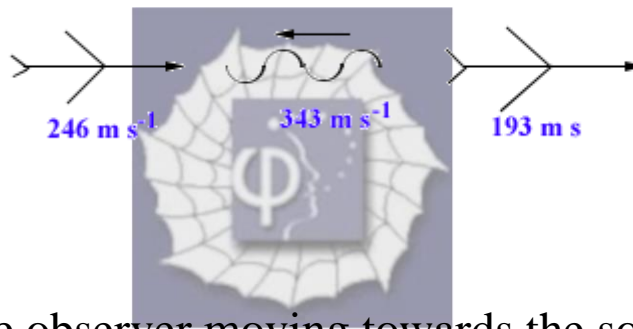## Problem 20.55 (RHK)

We have to find the frequency of a 15.8-kHz whine of the turbine in the jet engines of an aircraft moving with speed 193 m s^{-1} *heard by the pilot of a second aircraft which is trying to overtake the first at a speed of* 246 m s^{-1}.

Solution:

Speed of the observer moving towards the source of sound (second aircraft) is $v_{observer} = 246 \text{ m s}^{-1}$.

Speed of the source of sound (first aircraft) is

$v_{source} = 193 \text{ m s}^{-1}$.

Speed of sound is $v_s = 343 \text{ m s}^{-1}$.

The frequency, f', of the whine of the first aircraft observed by the second aircraft will be given by the Doppler shift relation

$$f' = \frac{f\left(v_s + v_{observer}\right)}{\left(v_s + v_{source}\right)}.$$

Therefore,

$$f' = 15.8 \times 10^3 \times \frac{\left(343 + 246\right)}{\left(343 + 193\right)} \text{ Hz} = 17.4 \times 10^3 \text{ Hz.}$$