QUES 04:-

A train, standing in a station-yard, blows a whistle of frequency 400 Hz in still air. The wind starts blowing in the direction from the yard to the station with a speed of 10 ms^{-1}. What are the frequency, wavelength, and speed of sound for an observer standing on the station's platform? Is the situation exactly identical to the case when the air is still and the observer runs towards the yard at a speed of 10 ms^{-1}? The speed of sound in still air can be taken as 340 ms^{-1}.

Sol. Here the actual frequency of whistle of train v = 400 Hz, speed of sound in still air v = 340 ms^{-1}.

As the wind is blowing in the direction from the yard to the station with a speed of v_m = 10 ms^{-1}

∴ For an observer standing on the platform, the effective speed of sound

$v' = v + v_m = 340 + 10 = 350$ ms^{-1}

As there is no relative motion between the sound source (rail engine) and the observer, the frequency of sound for the observer, v = 400 Hz

∴ The wavelength of sound heard by the observer $\lambda' = \frac{v'}{v} = \frac{350}{400}$ = 0.875 m.

The situation is not identical to the case when the air is still and observer runs towards the yard at a speed of v_0 = 10 ms^{-1}. In this situation as medium is at rest. Hence v' = v = 340 ms^{-1}.

$v' = \frac{v+v_0}{v} v = \frac{340+10}{340} \times 400 = 412$ Hz

and $\lambda' = \lambda = \frac{v}{v} = \frac{340}{400} = 0.85$ m