

Two vehicles, each moving with speed u on the same horizontal straight road, are approaching each other. Wind blows along the road with velocity w . One of these vehicles blows a whistle of frequency f_1 . An observer in the other vehicle hears the frequency of the whistle to be f_2 . The speed of sound in still air is V . The correct statement(s) is (are)

- (A) If the wind blows from the observer to the source, $f_2 > f_1$.
- (B) If the wind blows from the source to the observer, $f_2 > f_1$.
- (C) If the wind blows from observer to the source, $f_2 < f_1$.
- (D) If the wind blows from the source to the observer, $f_2 < f_1$.

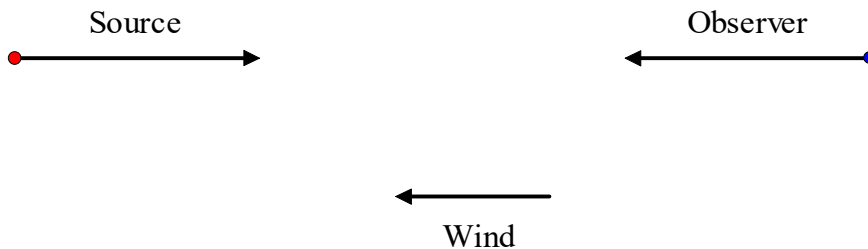
[JEE Advanced 2013]

Solution

We have, $f = f_0 \frac{v_{\text{sound}} + v_{\text{observer}}}{v_{\text{sound}} - v_{\text{source}}}$

Where, v_{source} and v_{observer} are with respect to the medium.

If wind blows from the observer to the source,



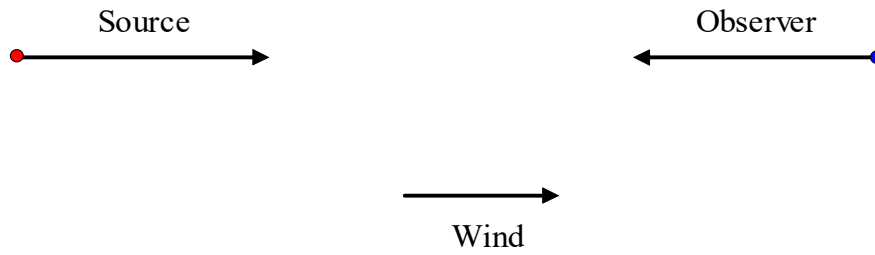
$$v_{\text{observer}} = u - w \quad \& \quad v_{\text{source}} = u + w$$

$$f_2 = f_1 \times \frac{V + (u - w)}{V - (u + w)} = f_1 \times \frac{(V - w) + u}{(V - w) - u} = f_1 \times \frac{\text{Large}}{\text{Small}}$$

$$\therefore f_2 > f_1$$

If wind blows from source to the observer,

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$$v_{observer} = u + w \quad \& \quad v_{source} = u - w$$

$$f_2 = f_1 \times \frac{V + (u + w)}{V - (u - w)} = f_1 \times \frac{(V + w) + u}{(V + w) - u} = f_1 \times \frac{\text{Large}}{\text{Small}}$$

$$\therefore f_2 > f_1$$

Hence, (A) & (B).