DOPPLER EFFECT

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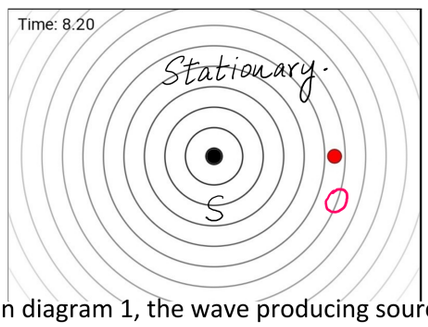
Doppler effect is defined as the apparent change in the frequency caused by the relative motion between the source of the wave and the observer. A common example is that of an ambulance with its siren blasting. You may recall that as the ambulance travels towards you, the pitch of the siren (or the frequency) of the siren appears to be **high** and then after the ambulance passes by and moves away from observer the pitch/frequency of the siren appears to be **low.** This **shift** in the apparent frequency for a wave produced by a moving source is the doppler effect. Another common experience is the shift in the apparent frequency of the sound of a train horn. As the train approaches, the sound of its horns is heard at a high pitch and as the train moves away, the sound of its horn is heard at a low pitch



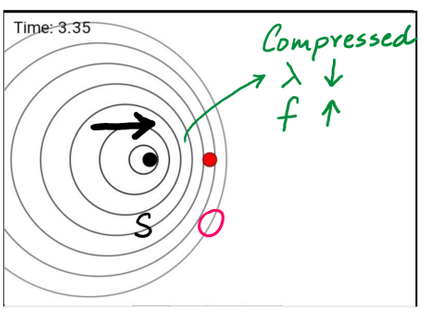
$f_s = 500\ Hz$

$f_o = 500\ Hz$

$f_o = f_s$

f_o = Observed freq.
f_s = freq. of Source

In diagram 1, the wave producing source is stationary. In this case, the observed frequency is equal to the actual frequency.



$f_o > f_s$

How to calculate this observed frequency ?

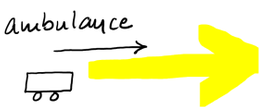
$$f_o = \frac{f_s \times V}{V - V_s}$$

V = Speed of Sound

V_s = Speed of the Source

f_s = freq of the Source

f_o = Observed freq.

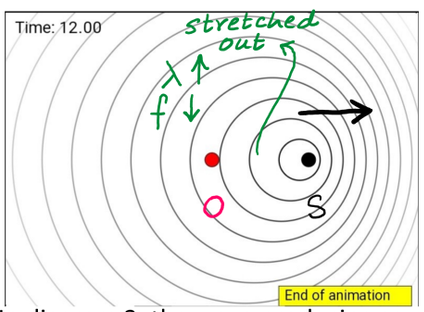


$f_o > f_s$.

Speed of Sound = 330 m/s (V)
freq of ambulance horn = 500Hz (f_s)
speed of ambulance = 45m/s (V_s)
find the Observed freq ? (f_o)

$$f_o = \frac{500 \times 330}{330 - 45} = 580\ Hz$$

In diagram 2 , the wave producing source is moving towards the stationary observer. In this case the observed frequency is higher than the actual frequency.



$f_o < f_s$

How to calculate this observed frequency.

$$f_o = \frac{f_s \times V}{V + V_s}$$

Same Symbol

$$f_o = \frac{500 \times 330}{330 + 45}$$

$$f_o = 440\ Hz$$

freq. of Sound produced by ambulance = 500 Hz (f_s)
Speed of Speed = 330 m/s (V)
Speed of ambulance = 45m/s (V_s)
Observed frequency (f_o)

In diagram 3, the wave producing source is receding away from the stationary observer hence the observed frequency is now lower than the actual frequency.

* The above formulas are only for the case when the Source is moving & the observer is stationary.
* Observer moving as well (NOT included).
* Doppler effect is also valid for other kind of waves eg. light waves. [same principle].