Answer on Question #50223, Physics, Other

Police jeep moving towards cliffs sound its horn the driver that sound reflect from the cliffs has a pitch one octave higher than the actual sound of horn. If v is the velocity of sound then velocity of jeep is

Solution:

When wave energy like sound waves travels from two objects, the wavelength can seem to be changed if one or both of them are moving. This is called the Doppler effect.

In classical physics, where the speeds of source and the receiver relative to the medium are lower than the velocity of waves in the medium, the relationship between observed frequency f and emitted frequency f_0 is given by:

$$f = \left(\frac{v + v_r}{v + v_s}\right) f_0$$

where

v is the velocity of waves in the medium;

v_r is the velocity of the receiver relative to the medium; positive if the receiver is moving towards the source (and negative in the other direction);

v_s is the velocity of the source relative to the medium; positive if the source is moving away from the receiver (and negative in the other direction).

In our case,

$$f = \left(\frac{v + v_{jeep}}{v - v_{jeep}}\right) f_0$$

The Octave is a term used in music to indicate an interval between two notes, one having double (or half) the frequency of the other. For instance, a musical tone of 100 Hz is an octave higher than one with 50 Hz, and an octave lower than one with 200 Hz.

Thus,

$$f = 2f_0$$

Hence,

$$\frac{v + v_{jeep}}{v - v_{jeep}} = \frac{f}{f_0} = 2$$

$$v + v_{jeep} = 2(v - v_{jeep})$$

$$v + v_{jeep} = 2v - 2v_{jeep}$$

$$v_{jeep} = \frac{v}{3}$$

Answer: $v_{jeep} = \frac{v}{3}$