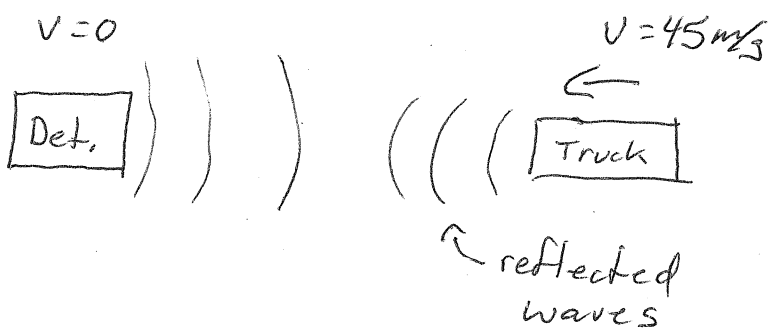


A stationary motion detector sends a sound wave of frequency 0.150 MHz toward a truck traveling at 45.0 m/s toward the detector.

- (1) Determine the frequency of the reflected waves as measured by the motion detector.
- (2) What was the change in wavelength observed by the motion detector?



Strategy

- 1) Determine frequency observed by truck.
- 2) Now using 1) and the truck as the source determine the frequency observed by the detector

(1)

Step 1

$$v_{0(\text{truck})} = 45 \text{ m/s} \quad f_0 = ?$$

$$v_s(\text{detector}) = 0 \quad f_s = 0.150 \text{ MHz}$$

$$f_0 = f_s \left(\frac{v + v_0}{v \pm \cancel{v_s}^{\rightarrow 0}} \right)$$

← moving toward source

$$= \frac{f_s}{v} (v + v_0)$$

$$= \frac{0.150 \text{ MHz}}{343 \text{ m/s}} (343 \text{ m/s} + 45 \text{ m/s})$$

$$= \underline{0.1697 \text{ MHz}}$$

Step 2

$$V_0 (\text{detector}) = 0$$

$$f_0 = ?$$

$$V_s (\text{truck}) = 45 \text{ m/s}$$

$$f_s = 0.1697 \text{ MHz}$$

$$f_0 = f_s \left(\frac{v \pm v_0}{v \pm v_s} \right)$$

Toward observer

$$= f_s \left(\frac{v}{v - v_s} \right)$$

$$= 0.1697 \text{ MHz} \left(\frac{343 \text{ m/s}}{343 \text{ m/s} - 45 \text{ m/s}} \right)$$

$$= 0.1953 \text{ MHz}$$

~~$$0.20 \text{ MHz}$$~~

$$0.195 \text{ MHz}$$