## 158.

## Problem 20.63(RHK)

A plane flies at $396 \mathrm{~m} \mathrm{~s}^{-1}$ at constant altitude. The sonic boom reaches an observer on the ground 12.0 s after the plane flies overhead. We have to find the altitude of the plane. The speed of sound is assumed to be $330 \mathrm{~m} \mathrm{~s}^{-1}$.


## Solution:

The speed of the plane is $v_{p}=396 \mathrm{~m} \mathrm{~s}^{-1}$.
The speed of sound is $v_{s}=330 \mathrm{~m} \mathrm{~s}^{-1}$.
Angle $\theta$ of the sonic boom will be

$$
\theta=\sin ^{-1} \frac{330}{396}=0.985 \mathrm{rad}=56.4^{0} .
$$

Distance travelled by the plane in 12 s is $396 \times 12 \mathrm{~m}=4,752 \mathrm{~m}$.

Therefore, the altitude of the plane above the observer is

$$
h=4752 \times \tan 56.44^{0}=4752 \times 1.507 \mathrm{~m}=7.16 \mathrm{~km} .
$$

