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Problem 20.63 (RHK)

A plane flies at 396 m s⁻¹at 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 m s⁻¹.



Solution:

The speed of the plane is $v_p = 396 \text{ m s}^{-1}$.

The speed of sound is $v_s = 330 \text{ m s}^{-1}$.

Angle θ of the sonic boom will be

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

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

Therefore, the altitude of the plane above the observer is

$$h = 4752 \times \tan 56.44^{\circ} = 4752 \times 1.507 \text{ m} = 7.16 \text{ km}.$$

