A man throws a stone over a cliff and hears it strike at the bottom in 8 sec. The temperature is 25 °C. What are the two times; the time that the stone travels and the time that sound travels? What is the height of the cliff in meters?

Solution:

Let us denote by h - the height, by v – the sound velocity, by t_1 – the time that the stone travels and by t_2 – the time that sound travels. Thus

$$h = \frac{gt_1^2}{2},$$

$$h = vt_2.$$

Because total time

$$t_1 + t_2 = 8 \text{ s},$$

we find

$$\sqrt{\frac{2h}{g}} + \frac{h}{v} = 8.$$

After some algebra we obtain equation

$$h^2 - v^2\left(\frac{16}{v} + \frac{2}{g}\right)h + 64v^2 = 0.$$

Since $v = 346\frac{\text{m}}{\text{s}}, g = 10\frac{\text{m}}{\text{s}^2}$ we get

$$h^2 - 29479h + 7661824 = 0.$$

Root

$$h = 262 \text{ m}.$$

$$t_1 = \sqrt{\frac{2h}{g}} = 7.24 \text{ s}$$

$$t_2 = \frac{h}{v} = 0.76 \text{ s}$$

Answers:

7.24 s,

0.76 s,

262 m.