Answer on Question 50138, Physics, Mechanics | Kinematics | Dynamics

Question:

A stone is dropped into a well. The splash is heard 2.95 seconds later. What is the depth of the well? Velocity of sound in air is 350 m/s.

Solution:

When stone is droped into the well, it needs time t to reach the water. Then time that sound of splash take to travel from water to top of the well is $t_{sound} = (2.95 - t)$. So, we can obtain the depth of the well (the initial velocity of the stone is zero):

$$h = \frac{1}{2} g t^2 . (1)$$

From the other hand:

$$v_{sound} = \frac{h}{t_{sound}},$$

We can write the formula for the depth of the well:

$$h = v_{sound} t_{sound} = v_{sound} (2.95 - t) . (2)$$

Therefore, we can equate formulas (1) and (2) for h and we obtain:

$$v_{sound} (2.95 - t) = \frac{1}{2} g t^2$$

Finally, we obtain the quadratic equation:

$$4.9t^2 + 350t - 1032.5 = 0.$$

This equation has two roots:

$$t_1 = \frac{-350 - \sqrt{142737}}{2 \cdot 4.9} = -74.265,$$
$$t_2 = \frac{-350 + \sqrt{142737}}{2 \cdot 4.9} = 2.84.$$

Because time can't be negative the correct answer is $t = 2.84s$.

Then, we can substitute time t into the formula (2) for h (but we can do this also for the formula (1), they both are equal):

$$h = v_{sound} t_{sound} = v_{sound} \left(2.95s - t\right) =$$

$$= 350\frac{m}{s}\left(2.95s - 2.84s\right) = 350\frac{m}{s} \cdot 0.11s = 39m.$$

Answer:

The depth of the well is $h = 39m.$