Answer on Question 58222, Physics, Mechanics, Relativity

Question:

A fisherman has caught a very large, $5.0\ kg$ fish from a dock that is $2.0\ m$ above the water. He is using lightweight fishing line that will break under a tension of $54\ N$ or more. He is eager to get the fish to the dock in the shortest possible time. If the fish is at rest at the water's surface, what's the least amount of time in which the fisherman can rise the fish to the dock without losing it?

Solution:

Let's first find the acceleration of the system of fishing line and a fish weight. By the Newton's second law of motion we have:

$$\sum \vec{F} = m\vec{a},$$

$$T - mg = ma.$$

From this formula we can obtain the acceleration of the system of fishing line and a fish weight:

$$a = \frac{T - mg}{m} = \frac{54\ N - 5.0\ kg \cdot 9.8\ \frac{m}{s^2}}{5.0\ kg} = \frac{54\ N - 49\ N}{5.0\ kg} = \frac{5.0\ N}{5.0\ kg} = 1.0\ \frac{m}{s^2}.$$

We can find the least amount of time from the kinematic equation:

$$h = \frac{1}{2}at^2,$$

where, h is the height of the dock above the water, a is the acceleration of the system of fishing line and a fish weight, and t is the time. Finally, from this formula we get t:

$$t = \sqrt{\frac{2h}{a}} = \sqrt{\frac{2 \cdot 2.0\ m}{1.0\ \frac{m}{s^2}}} = \sqrt{\frac{4.0\ m}{1.0\ \frac{m}{s^2}}} = 2.0\ s.$$

Answer:

$t = 2.0\ s.$