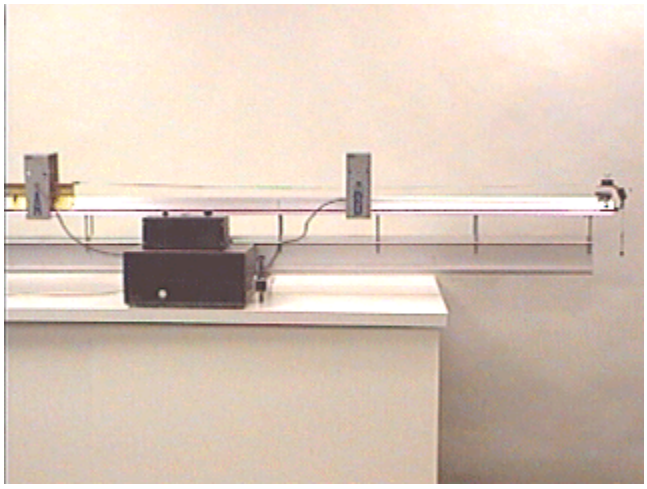
Answer #119

The answer is (b): 2.83 seconds, as can be seen by clicking your mouse on the photograph below.



The equation to determine how far an accelerated body moves as a function of time is:

$$x = (1/2)a\ t^2.$$

where a is the acceleration.

The time for the accelerating body *M* to move the distance *D* between the two photocell gates due to the gravitational force on *m* is given by:

$$t = \text{sqrt}\ [\ 2D\ (M+m)\ /\ mg] \sim \text{sqrt}\ [2\ DM\ /\ mg] = t_0,$$

where g is the acceleration of gravity. Substituting 2*M* for *M* yields approximately $t = \text{sqrt}(2)t_0$ or 2.83 seconds. Because M>>m, we have dropped the *m* from the numerator in the final relation for t_0 in the equation above.

What error will this make in the final calculated value? The calculated time taken for mass *m* to accelerate mass *M* will be too short by the small fraction:

$$\text{sqrt}\ [\ 1 + m/M\ ],$$

which is smaller than the experimental error in the apparatus.

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For questions and comments regarding the *Question of the Week* contact Dr. Richard E. Berg by e-mail or using phone number or regular mail address given on the Lecture-Demonstration Home Page.