Quiz 11 - Solutions

Make sure your name is on your quiz, and please box your final answer. Because we will be giving partial credit, be sure to attempt all the problems, even if you don’t finish them!

The figure shows a mobile consisting of four objects hanging on three rods of negligible mass. Find the values of the unknown masses of the objects if the mobile is to balance.

![Diagram of a mobile with objects and dimensions labeled]

Solution

In order for the mobile to balance, all of the torques have to be zero. So, we can start at the bottom and work our way up. On the bottom rod the sum of the torques is

\[ \sum \tau = \sum F_{Wi}r_i = (2)(3) - 4m_1g = 0 \Rightarrow m_1 = \frac{6}{4g} = 0.15 \text{ kg}. \]

So, that means that the total weight on the rod is \(2N + 0.15 \times 9.8 = 3.5\) N. Now, we move on to the next rod. In this case, the torques are

\[ \sum \tau = 2m_2g - 4(3.5) = 0 \Rightarrow m_2 = \frac{14}{2g} = 0.71 \text{ kg}. \]

Now this adds an extra weight of \(0.71 \times 9.8 = 7\) N to the hanging mass. This means that this rod, plus the bottom rod, have a total of weight of \(3.5 + 7 = 10.5\) N. Now we finally consider the top rod.

\[ \sum \tau = 2(10.5) - 6m_3g = 0 \Rightarrow m_3 = \frac{21}{6g} = 0.36 \text{ kg}. \]