Names: Amy Chang, Akaash Kolluri

Pulleys: Unknown Masses and Atwood's Machine

AP Physics C – Mechanics

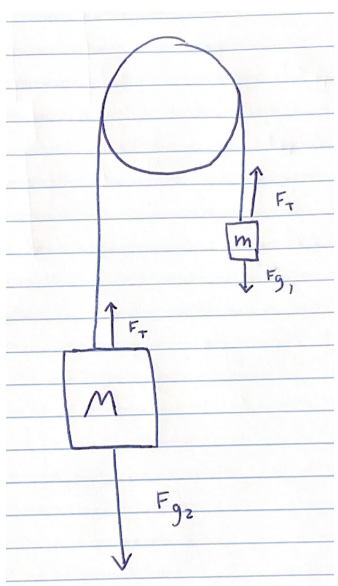
Objective: I will calculate the acceleration of a system moving in one dimension when a net constant force acts on the system during a known interval of time by deriving a complete Newton's second law statement and testing the theoretical prediction with empirical data.

Your goal is to answer the questions inside the Physlet below. Then, complete the Analysis Questions (See Analysis Question 1 to help understand Parts b and c).

https://www.compadre.org/Physlets/mechanics/ex4_7.cfm

Lab questions:

1)



2) $F_{net} = (M + m) \cdot a$

$F_{net} = F_{g2} - F_{g1} = gM - gm$

$a = \frac{g(M-m)}{M+m}$

3)

when M = m then: a = g. FASLE

when M = m then: a = 0. TRUE

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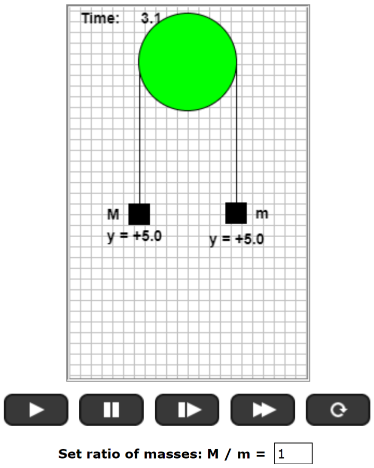
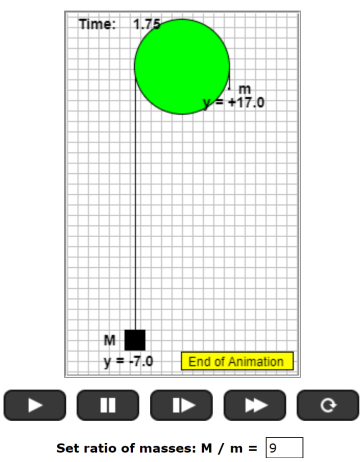


$$\Delta y = \lim_{t \to \infty} \left(\frac{1}{2} a t^2 \right)$$

$$0 = \lim_{t \to \infty} \left(\frac{1}{2} a t^2 \right)$$

$$a = 0$$

when M >> m then: a = g. TRUE



$$\Delta y = \frac{1}{2} a t^2$$

$$12 = \frac{1}{2} a * 1.75^2$$

$$a = 7.84\ m/s^2 \approx g$$

when M >> m then: a = 0. FASLE

when M < m then: a = 0. FALSE

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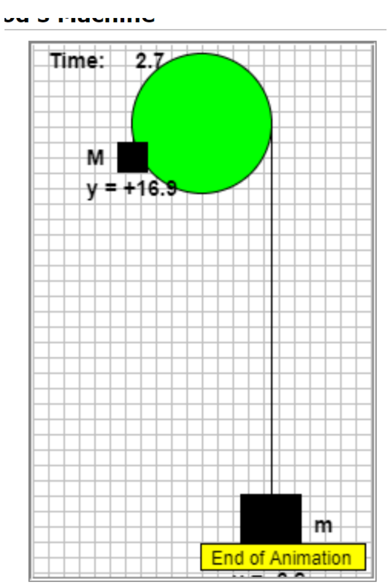
when M < m then: a = g.   FASLE

when M < m then: a < 0.   TRUE



$$\Delta y = \frac{1}{2} a t^2$$

$$-11.9 = \frac{1}{2} a * 2.7^2$$

$$a = -1.63\ m/s^2$$

Analysis Questions

1. This is listed as the last part of the questions on the website but just to elaborate and expand: collect data using kinematics quantities to verify that your formula for acceleration gives you the observed value for acceleration, for the 3 comparisons of *M* and *m* listed on the website. Calculate the percent difference between your measured values and the theoretical values (predicted by the formula you derived).
2. In a science laboratory, you set up an Atwood machine and notice that the measured acceleration is lower in magnitude than predicted by Newton's Second Law. List three reasons why this could be and justify why these reasons could be present (format it as follows: "The measured acceleration may be lower than the theoretical value because ______. This is feasible because _______."). How could we mitigate (reduce) these sources of error?
   The measured acceleration may be lower than the theoretical value because the pulley has friction and a mass, and air resistance as the blocks drop. This is feasible

because no pulley in the real world is massless and frictionless, and the air resistance exerts an force in the opposite direction in the real world. We can reduce error by using a light pulley.

3. Consider your theoretical expression for acceleration. You are provided with a table that details combinations of *m* and *M* (both quantities are listed separately), and measured values for acceleration for each combination. You wish to create a graph using these quantities to estimate the acceleration due to gravity *g*. Which quantities would you graph on each axis so that the straight line has a slope that approximates *g*?
   Acceleration vs. (M-m)/(M+m)