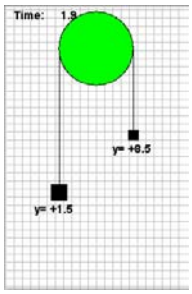
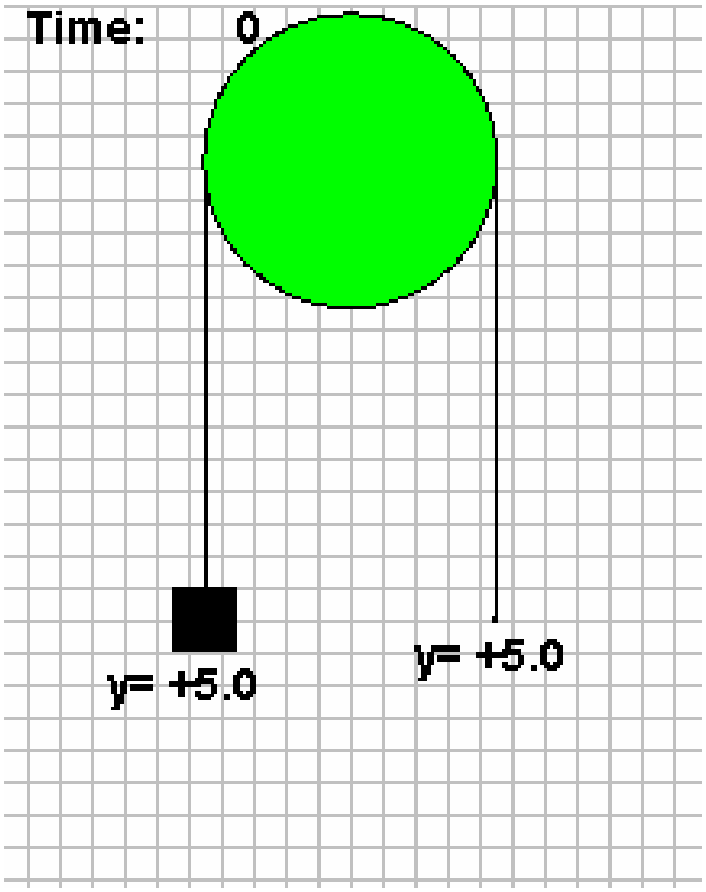
Worksheet for Exploration 4.7: Atwood's Machine



A 10-kg mass, M, is attached via a massless pulley to another variable mass m **(position is given in meters and time is given in seconds)**. You can test the limits of the formula for the acceleration of the Atwood's machine (not shown to scale) by changing the ratio of the masses above. Restart.

a. Draw a free-body diagram for each mass.

   i. Use symbols F_{Tm}, F_{TM}, F_{gm}, F_{gM} a_m,a_M, for the tension forces, gravitational forces, and accelerations (write the "m's" neatly so you can tell which is which)..



b. Solve for the acceleration of m in terms of g, M, and m.

i. To do this you will need to write out four equations (most books skip two easy ones and start you in the middle). You need two Newton's second law equations (one for each object)

2^{nd} Law for M:

2^{nd} Law for m:

ii. Now the other two equations relate the two accelerations and tension forces. How do the accelerations relate to each other (careful on directions)? How do the tensions relate (careful with directions…sketch)?

Accelerations:

Tensions:

iii. Now get out some paper and solve. You should use the acceleration equation to eliminate a_M since you want to find a_m.

c. Which, if any, of the following statements regarding the motion of the masses are true?

- when M = m then: a = g.
- when M = m then: a = 0.
- when M >> m then: a = g.
- when M >> m then: a = 0.
- when M < m then: a = 0.
- when M < m then: a = g.
- when M < m then: a < 0.

Verify your answer(s) to (c) by using the animation and your answer for (b).