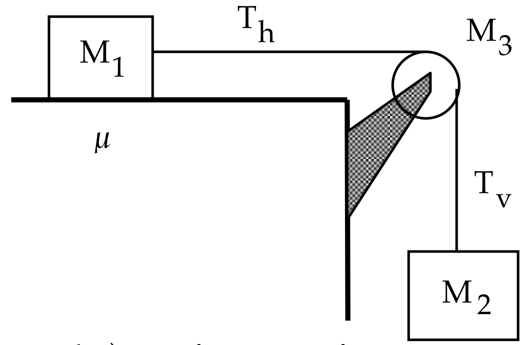
A half-Atwood machine (pictured at right) consists of two masses (M_1 = 2.0 kg and M_2 = variable) and a real pulley ($I = \beta MR^2$; M_3 = 0.0, 5.0, 50.0 kg; R = 0.1 meters; β = 0.4). The coefficient of friction between Block 1 and the horizontal surface is 0.5. Block 2 is released from rest. Determine and plot:



1. the acceleration of the system (for M_3 = 0, 5.0, 50.0 kg) as a function of mass ratio M_2/M_1 as M_2/M_1 is increased from 0.5:1 to (at least) 100:1.
2. the tensions (T_h and T_v) in the rope (for M_3 = 0.0, 5.0, 50.0 kg) as a function of mass ratio M_2/M_1 as M_2/M_1 is increased from 0.5:1 to (at least) 100:1.

Procedure — Mathematical Methods and Physical Models

In an embedded Word document (or series of embedded Word documents) *on a separate worksheet*, you are expected to include a thorough, step-by-step discussion/description of the physics, including a clear statement of how (and why) you derived/calculated all values. Clear, well-labeled diagrams should be included as part of that discussion. This is your opportunity to demonstrate your depth of insight and understanding and to discuss what you learned by completing this exercise. You should use the drawing tools in Microsoft Word or Excel to produce annotated diagrams.

Analysis of Results + Questions, Answers and Annotations

As a part of your analysis, you should discuss and explain the following:

1. *For a given value of M_3*, discuss/explain the observed trend in the acceleration of the system as the mass ratio increases.
2. *For each value of M_3*, compare the values for the acceleration of the system. Explain the observed trend as M_3 increases from 0.0 to 50.0 kg.
3. *For a given value of M_3*, discuss/explain the observed trend in the tensions as the mass ratio increases.
4. *For each value of M_3*, compare the values for the tensions. Explain the observed trend as M_3 increases from 0.0 to 50.0 kg.
5. Plot T_v as a function of the corresponding acceleration (for each of the three values of M_3). Include an appropriate trendline and algebraically derive a relationship for T_v as a function of acceleration (in terms M_1, M_3 and other constants) that is consistent with this trendline. Account for the observed trends. Compare this set of plots to those for T_h as a function of acceleration. Discuss and account for differences and similarities.

For the questions below, consider how to visualize and present answers to these questions graphically.

1. What would you expect to happen to the acceleration of the system as β increases? Why?
2. What affect would you expect μ to have on the acceleration of the system? Explain.

In addition to the questions above, be sure to address other general questions (as appropriate) found in the document ***Description of XL Lab Content—Format+Grading*** **found on the website.** As with the procedure, this analysis should be on a separate worksheet ***as an embedded Word document.***

REMEMBER: All XL labs have "required elements" of content and style. Be sure to refer to the *Grading Rubric for Advanced Physics XL Labs*, *Description of XL Lab Content—Format+Grading* and the *Reference and Style Guide for Microsoft Excel* in order to acquaint yourself fully with these requirements.