Pre-Lab: Friction [5 pts]

Directions: Read this sheet carefully and answer the questions to the best of your ability. It is essential that you understand the theory discussed here before you begin the associated experiment. Use your answers in the Theory section of your formal report.

A block of mass \( M \) sits along a board initially at rest. One end of the board is raised until the block slides on its own down the board at constant speed. Let the coefficient of kinetic friction between the block and the board equal \( \mu_k \).

Use Newton’s laws and error propagation formulas to answer the following questions:

1. Show that, when the block is sliding down the board at constant speed,
   \[
   \mu_k = \tan \theta = \frac{H}{L}
   \]

2. Given the error in measuring \( H \) and \( L \) to be equal to \( \delta L \), derive an expression for the propagated error in \( \mu_k \).

Now the block is tied to string that passes over a frictionless pulley. The other end of the string is tied to a mass \( m \). Mass \( m \) is increased until the block slides at constant speed.

3. Derive a new expression for \( \mu_k \) in terms of \( m \) and \( M \) alone. Show that this expression has the form: \( y = Ax + B \), where \( A = \mu_k \).