Yea Friction Lab
AP Physics 1

Objective: I can explain the cause of contact forces and their directions by relating the coefficient of friction with the angle of an inclined plane.

http://www.thephysicsaviary.com/Physics/Programs/Labs/ForcesOnInclineLab/

In this lab, you will be working with a simulation to determine how the force of friction can be used to prevent an object from sliding down the ramp. There are two types of friction that can be present:

1. Static friction (prevents an object from sliding relative to the surface)
2. Kinetic friction (tries to stop any sliding that is occurring).

While kinetic friction always has a fixed value for a given system, static friction varies in order to keep the net forces of the object and surface equal (commonly, but not always, 0 N). The normal force between an object and the surface are important in determining the maximum static friction and value of kinetic friction. In this lab, you will be exploring how changing the coefficient of friction (essentially tells you how "large" the frictional force is) and the mass of the object can change the minimum angle at which the block begins to slide down the ramp. You will also be asked to briefly experiment with changing the gravitational field (aka acceleration due to gravity).

Procedure and Data

Part 1 – Varying the friction coefficients only

1. Before you start to run the simulation, note that you can change the friction coefficients, mass of the block, and/or the gravitational field. You *cannot* change these once you begin raising the ramp. For now, do not change anything.
2. Click "Click to change angle".
3. Click "Click to freeze angle" as soon as you see the block move.
4. Record the angle and friction coefficient in the table below.
5. Reset the system.
6. Change the friction coefficients.
7. Repeat steps 3-7.

Table 1. Data representing how the friction coefficients and angles change with constant mass.

Static friction coefficient	**Ramp angle (degrees) Trial 1**	**Ramp angle Trial 2 (deg)**	**Average Ramp angle from Trials (deg)**
0.27	16.3	16.6	16.45
0.35	20.5	20.4	20.45
0.42	23.9	24.1	24.0
0.46	26	26.2	26.1

0.54	29.5	29.7	29.6
0.63	33.3	33.3	33.3

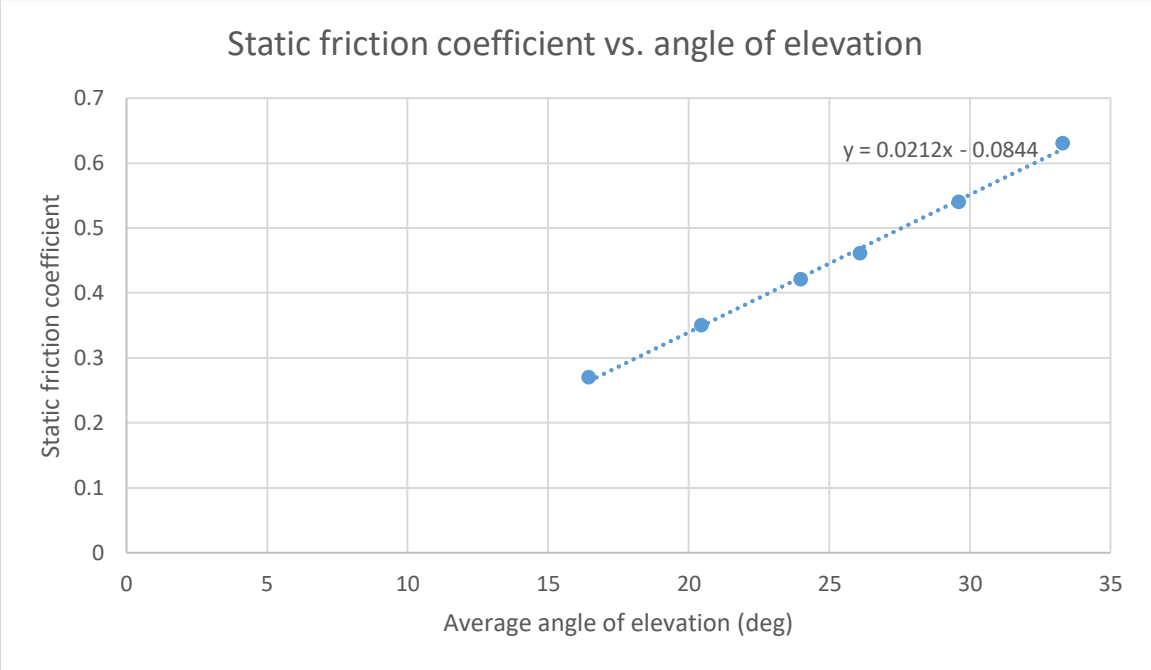

Figure 1. A graph showing the relation between the static friction coefficient and the angle of elevation for the ramp.

In the graph above, plot your data (note which data are on which axes) and fit it with a polynomial trendline of order 3. Does the graph look linear? Do the coefficients give you confidence that the data are approximately linear?

Part 2 – Varying the mass only

1. Reset the system if you have not already done so.
2. Choose a set of friction coefficients and leave them constant for this entire part.
3. Repeat your procedure from Part 1, but change only the mass between Trials.
4. Record your data in the table below.
5. Summarize the trend in a statement after graphing it.

Table 2. Data representing the mass of the block and angle at which the block starts sliding.

Mass of the block (kg)	**Ramp angle (degrees) Trial 1**	**Ramp angle Trial 2 (deg)**	**Average Ramp angle from Trials (deg)**
.509	20.4	20.5	20.45
.574	20.5	20.7	20.6
.655	20.5	20.6	20.55
.701	20.4	20.5	20.45

	20.3	20.3	20.3

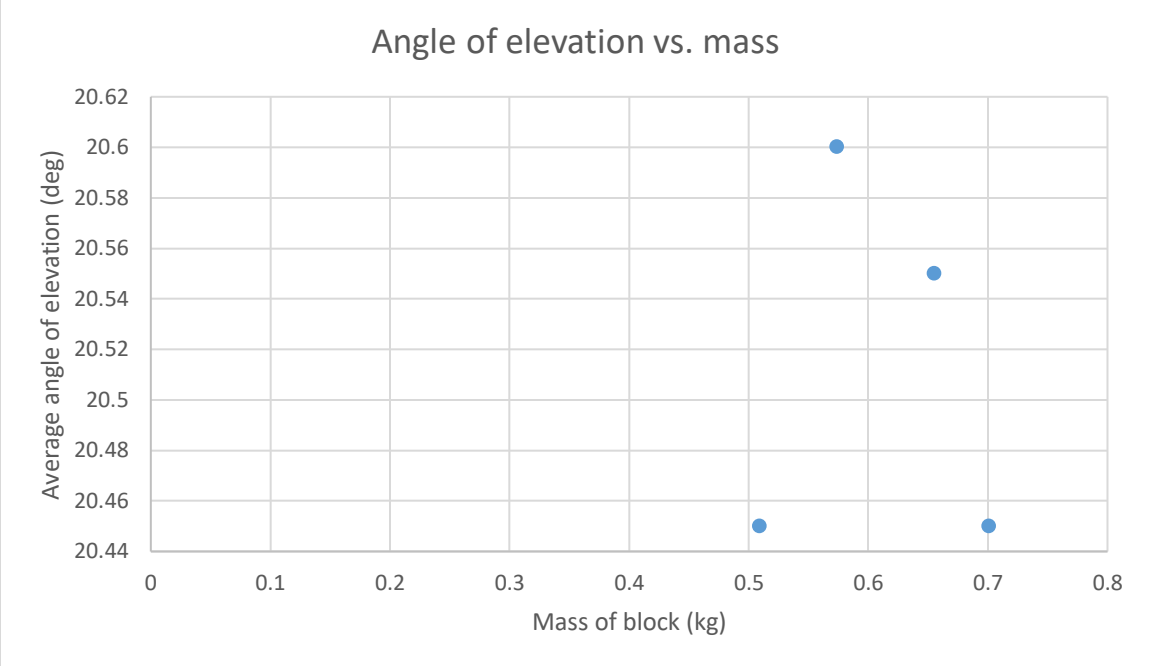

Figure 2. A graph showing the relation between mass of the block and the angle of elevation for the ramp at which the block starts to move, for constant coefficients of friction.

Summarize: *Delete this italicized text and answer: What is the trend between angle of elevation and mass, for constant coefficient of friction? Speculate on why the trend may make physical sense.*

Before you take the quiz, you should be comfortable with the following:

- Analyzing and justifying the trend between coefficient of static friction and the angle at which the block begins sliding
- Analyzing and justifying the trend between block mass and the angle at which the block begins sliding
- Analyzing and justifying the trend between gravitational field and the angle at which the block begins sliding (just roughly)
- Identifying Newton's 3rd Law Action/Reaction Pairs of forces
- Deriving expressions for different forces
- Interpolating function for Figure 1 to estimate coefficient required for the block to start sliding at a different angle.