NYU Physics I—friction

In lecture we did a problem of a block on an inclined plane. Here we consider the same "block on plane" problem but with friction. When we "switch on" friction, the contact force between the block and the plane is no longer purely normal but has both normal and transverse (frictional) components. For definiteness, imagine a plane inclined at about 20 deg to the horizontal in what follows. Work with a partner!

1 Following lecture, or whatever method you like, work out the problem of a block on an inclined plane in the *absence of friction.* That is, compute the magnitude of the normal force and the magnitude and direction of the acceleration of the block.

2 Make dimensional and scaling arguments that it makes sense for the frictional force magnitude to be some dimensionless constant μ times the normal force magnitude. What typical values of μ do you find in the world? Are there limits on the possible values of μ? (Hint: Cars used in motorsports can pull 6 lateral gs. What does that imply about friction?)

3 There are two kinds of friction, sliding (or kinetic) and static. What is the difference between them? You might want to use the internet or a book to find this out.

4 Imagine that between the block and the plane there is a coefficient of friction $\mu = 0.05$. Draw the forces on the block, separating the contact force into its normal and transverse components.

5 Write down the kinematic constraint, and solve for the magnitude of the normal force and the magnitude of the frictional (transverse) component of the contact force. Which way does the frictional force point, and why?

6 What is the acceleration of the block in this case?

7 Describe a situation in which the frictional force would point *down* the plane. When you answered the previous questions, you made an assumption. What was it?

8 Now imagine that $\mu = 0.9$. What is the magnitude of the frictional force? Give a simple argument that it *cannot* be $\mu\,m\,g\,\cos\theta$.