CHAPTER OVERVIEW

17: N4) Motion from Forces

In this chapter, we are going to talk about how to determine the motion of an object from the forces that act on that object. This is a combination of dynamics (forces), and kinematics (acceleration, velocity, and position). This process is generally the primary thing we are interested in as physicists - both *why* things move, and *how* they move.

The first, and most important thing, to understand is the two sides of Newton's second law, $\Sigma\vec{F} = m\vec{a}$. The left hand side is the addition of all the forces, and the right hand side is simply the mass times the acceleration. You need both sides in order to determine the motion of the object - typically the best strategy for solving these problems is to carefully write down everything you know about the forces (which forces, which directions), and everything you know about the accelerations (do you know anything?). Then it is a matter of solving the set of equations in front of you, acknowledging that they generally *will be a set* - that is, multiple equations and multiple unknowns.

There a few things to watch out for, and a few new ideas we will have to develop:

The Normal Force: This is a contact force between surfaces, like a block and the floor. The word normal here does not mean "usual", but means normal in the mathematical sense - that is, perpendicular. It's the force that prevents blocks from going through floors, or you hand from going through the wall when you push on it. This is not a *fundamental force*, like gravity or electric, but just an effective force that actually arises from the electromagnetic interactions between the atoms in the solid.

Tension in Ropes: We will be dealing a lot with ropes in this part of the class. At a basic level, ropes are just a way to transmit pulling forces (since you cannot push things with ropes!). The force that ropes transmit is called "tension", but even that is a more general word that can refer to other kinds of forces as well. The key aspect of ropes in this class is that they will be ideal - massless and inelastic. Among other things, this means that the tension the rope delivers is constant over it's length. So if a rope is apply a 50 N force to an object, that tension in that rope is 50 N.

Pulleys: Pulleys are nice objects to have when you have ropes around, because they allow you to change the direction of the forces in the ropes. In this class, we were generally only deal with ideal pulleys - massless and frictionless. Specifically, what that means is that pulleys can only change the direction of the tension in ropes, they cannot change the magnitude of the tension.
