Problem 7

Write down everything we know, everything we can assume, and everything we need to find.

Given: m1=2.00 kg m2=6.00 kg θ=55.0o

Assumptions: frictionless conditions

Find: acceleration of the blocks and tension in the string

The important thing to know is that when dealing with pulleys the forces remain the same but change direction. Maybe a picture will help.

55.0o

Let’s also remember that ∑F=ma. So when we have 2 competing forces acting on a pulley you can treat them as though they are opposite in direction. The left side is easy. It’s just (2 kg)(9.81 m/s2) or 19.62N. The right side is harder. We need to break it into vectors.

mg cos(55.0o)

mg sin(55.0o)

55.0o

mg

So the force moving down the slope is sin(55.0o)(6.00 kg)(9.81 m/s2) or 48.22N. If the right side is pulling with 48.22 N and the left side is pulling with 19.62 N then the Net Force is (48.22 N – 19.62 N) or 28.60N down the slope. By realizing that the both blocks are being accelerated we can state the total mass being accelerated is (2 kg + 6 kg) or 8 kg. We don’t split up mass like we did force on the 6 kg block because mass is a scalar not a vector and therefore cannot be broken up into vectors. Now we just use ∑F=ma to find a. If ∑F= 28.60 N down the slope and m=8 kg, we can calculate a as equal to (28.60N)/(8kg) or 3.57 m/s2.

As for the tension it may be easier to show with a picture. Remember when two forces are acting on a pulley they can be considered to be in opposition .If the 6 kg mass is accelerating down the slope the 2 kg mass is accelerating straight up. We will look at the 2 kg mass for this.

Tension (T)

mg

ma

=

Once again we must use ∑F=ma and realize that ∑F is the summation of forces acting on the object. If we set upward forces as positive we have T-mg = ma. Rearranging terms means T=ma+mg = m(a+g).

If m=2kg, g=9.81 m/s2, and a = 3.57 m/s2 then T=(2 kg)(9.81 m/s2+3.57 m/s2)=(2 kg)(13.38 m/s2)= 26.76N