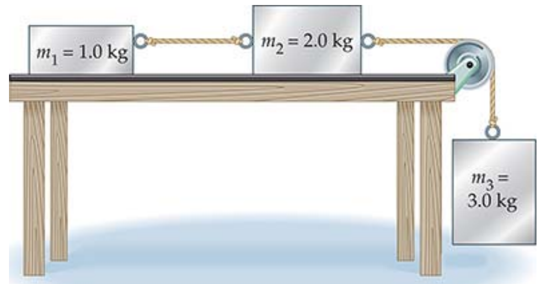
Physics 135-1, Quiz 2, Spring 2018 **Name:________________________________**

1) (12 points) Two masses of 1.0 kg and 2.0 kg are setting on a table, as shown at right. Both masses have $\mu = 0.25$ for their coefficient of kinetic friction. A hanging mass of 3 kg is attached to them by a cord. What are the tensions in the two cords?

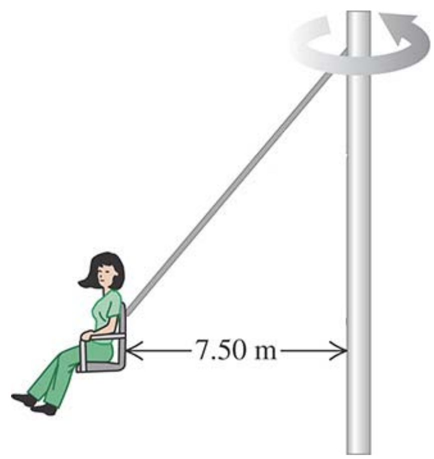


Solution
The total frictional force acting on the two masses is just $F = \mu N = (0.25)(1 + 2)(9.8) = 7.35$ N. This will oppose the force being applied by the 3 kg mass, so the acceleration of the system is given by: $(3)(9.8) - 7.35 = (1 + 2 + 3)a$, or $a = 3.675$ m/s^2.

The first string (the one on the left) only has to accelerate the first mass. So, it will supply a tension of $ma + \mu N = (1)(3.675) + (0.25)(1)(9.8) =$ 6.125 N.

The second string must accelerate both masses, so it will supply a tension of $ma + \mu N =$ $(3)(3.675) + (0.25)(3)(9.8) =$ 18.375 N.

2) (8 points) The girl at right is sitting on a seat at the end of a rope. She rotating around a pole on a carnival ride at a rate of one revolution every 4 seconds. She has a mass of 50 kg. What is the tension in the rope?



Solution
There are two "forces" acting on her. One is gravity, which acts straight down. This is $mg = (50)(9.8) = 490$ N. The other "force" is the centrifugal force of her rotation, which is acting directly outwards from the pole, i.e., at 90° to the gravity. Since she is rotating once every four seconds, her rotation frequency is 0.25 cycles per second. This gives us $F = m\omega^2 r = m(2\pi f)^2 r =$ $(50)(2\pi \frac{1}{4})^2(7.5) = 925$ N. The Pythagorean Theorem then gives us the total force acting on her, which must also be the tension in the rope: $(490^2 + 925^2)^{1/2} =$ 1047 N.