SI Workshop Problems #6: Newton's 2nd Law (2 or more bodies)

1. A force F is pulling three blocks horizontally as shown in figure 1. Each block has a mass of 2 kg. If the system is to accelerate at the rate of 10 m/s^2, what is the value of F and the tension in the ropes between the blocks:

figure 1

   a. assuming there is no friction? [T_3=20N, T_2=40N, T=60N]

   b. if μ_k = 0.4 between the blocks and the table? [T_3=27.8N, T_2=55.6N, T=83.4N]

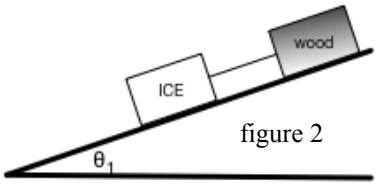


figure 2

2. A block of ice (10 kg, μ_k = 0.1) is pulling a block of wood (5 kg, μ_k = 0.4) down a 30° incline. What is the acceleration of the system and the tension in the rope connecting the blocks? [a=3.20 m/s^2]

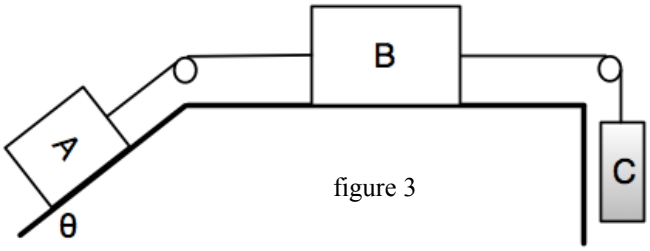


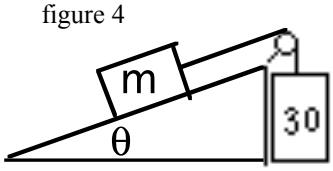
figure 3

3. If μ_k is 0.2 everywhere, what are the tensions in the ropes and the acceleration of the system shown in figure 2 if the masses of A, B, and C are 10, 20, and 30 kg respectively, and θ = 27°.

4. a. Refer to figure 4. If the angle of inclination, θ is 15°, μ_k = 0.25, and the acceleration is 3.0 m/s^2 up the incline what is the mass of block m? [going up incline M_B=25.8 kg]

   b. If m = 100 kg, μ_k = 0.25, and the acceleration is 3.0 m/s^2 down the incline, what is θ? [θ=56.6°]

figure 4



5. A block is on a 30° incline, which can itself slide on a horizontal surface as shown below.

   a. If everything is frictionless, what horizontal acceleration must you give to the incline to prevent the block from sliding down? [a=5.658 m/s^2]

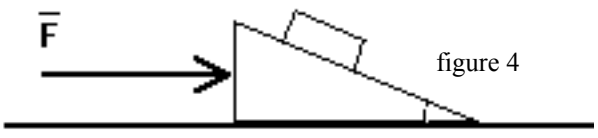


figure 4

   b. If the block and the wedge weigh 2 and 5 kg respectively, what horizontal force F must you apply on the wedge to produce this acceleration? [F=39.6 N]