SAMPLE 2.19 **Stacked blocks at rest on an inclined plane.** Blocks A and B with masses m and M, respectively, rest on a frictionless inclined surface with the help of force T as shown in Fig. 2.75. There is friction between the two blocks. Draw free-body diagrams of each of the two blocks separately and a free-body diagram of the two blocks as one system.

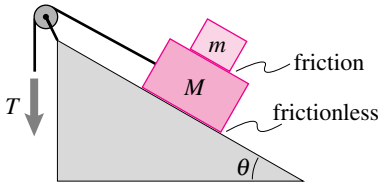

Figure 2.75: Two blocks held in place on an inclined surface

Solution The three free-body diagrams are shown in Fig. 2.76 (a) and (b). Note the action and reaction pairs between the two blocks; the normal force N_A and the friction force F_f between the two bodies A and B. If we consider the two blocks together as a system, then the forces N_A and F_f do not show on the free-body diagram of the system (See Fig. 2.76(b)), because now they are internal to the system.

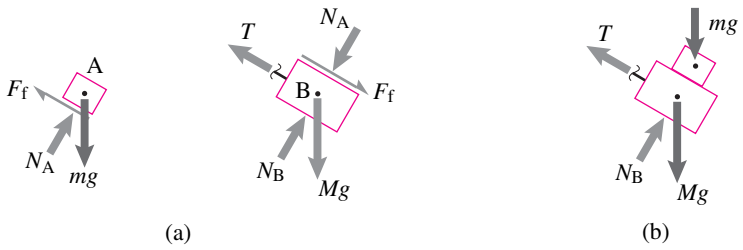

Figure 2.76: Free-body diagrams of (a) block A and block B separately and (b) blocks A and B together.

SAMPLE 2.20 **Two blocks slide down a frictional inclined plane.** Two blocks of identical mass but different material properties are connected by a massless rigid rod. The system slides down an inclined plane which provides different friction to the two blocks. Draw free-body diagrams of the two blocks separately and of the system (two blocks with the rod).

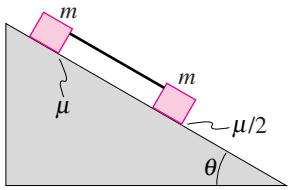

Figure 2.77: Two blocks slide down a frictional inclined plane. The blocks are connected by a light rigid rod.

Solution The Free-body diagrams are shown in Fig. 2.78. Note that the friction forces on the two blocks are different because the coefficients of friction are different for the two blocks. The normal reaction of the plane, however, is the same for each block (why?).

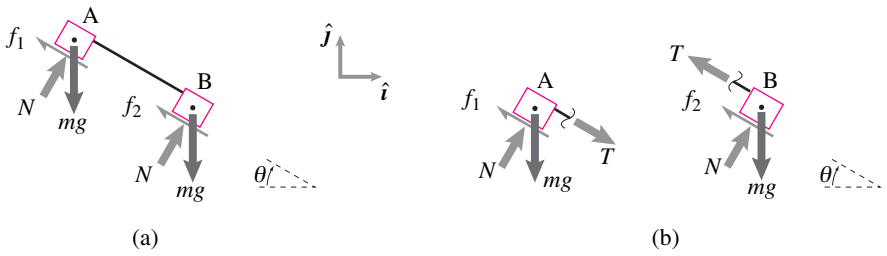

Figure 2.78: Free-body diagrams of (a) the two blocks and the rod as a system and (b) the two blocks separately.

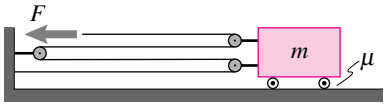

Figure 2.79: A cart with pulleys

SAMPLE 2.21 **Massless pulleys.** A force F is applied to the pulley arrangement connected to the cart of mass m shown in Fig. 2.79. All the pulleys are massless and frictionless. The wheels of the cart are also massless but there is friction between the wheels and the horizontal surface. Draw a free-body diagram of the cart, its wheels, and the two pulleys attached to the cart, all as one system.

Solution The free-body diagram of the cart system is shown in Fig. 2.80. The force in each part of the string is the same because it is the same string that passes over all the pulleys.

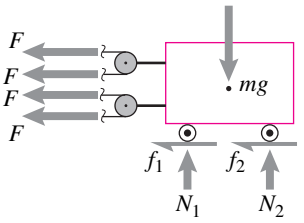

Figure 2.80: Free-body diagram of the cart.

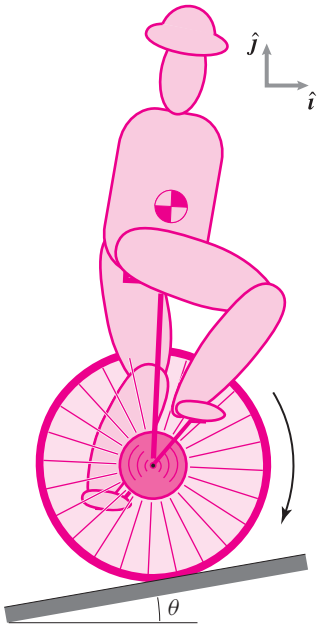

Figure 2.81: The unicyclist

SAMPLE 2.22 **A unicyclist in action.** A unicyclist weighing 160 lbs exerts a force on the front pedal with a vertical component of 30 lbf at the instant shown in figure 2.81. The rear pedal barely touches the other foot. Assume the wheel and the frame are massless. Draw free-body diagrams of the cyclist and the cycle. Make other reasonable assumptions if required.

Solution Let us assume, there is friction between the seat and the cyclist and between the pedal and the cyclist's foot. Let's also assume a 2-D analysis. The free-body diagrams of the cyclist and the cycle are shown in Fig. 2.82. We assume no couple interaction at the seat.

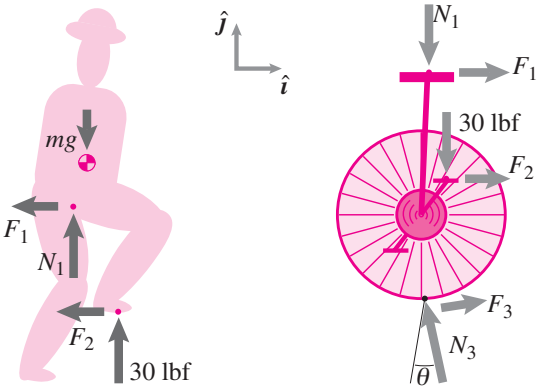

Figure 2.82: Free-body diagram of the cyclist and the cycle.