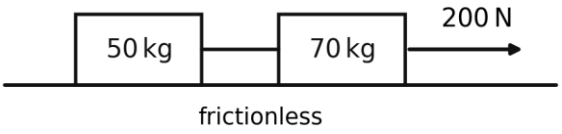
Two-Body Systems — Acceleration, Tension & Friction

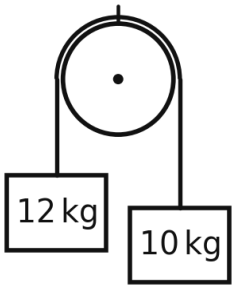
For each problem, draw a free-body diagram for each object. Show your force equations and calculations. Give the magnitude, direction, and units of each answer. Assume massless, inextensible ropes and frictionless pulleys.

Mild

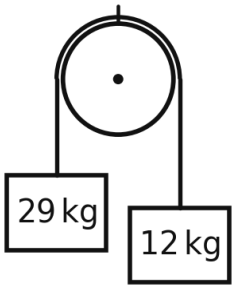
1. Two blocks of masses 50 kg and 70 kg are connected by a rope on a frictionless horizontal surface. A person pulls the 70 kg block to the right with a force of 200 N.
   a) Determine the magnitude and direction of the system's acceleration.
   b) Determine the tension in the connecting rope.



2. A 12 kg mass and a 10 kg mass are connected by a rope passing over a pulley. The system is released from rest.
   a) Determine the magnitude and direction of the acceleration of each mass.
   b) Determine the tension in the rope.

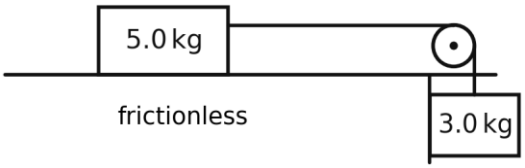


3. Two hanging masses, 29 kg and 12 kg, are connected over a pulley and released from
   a) Determine the magnitude and direction of the system's acceleration.
   b) Determine the tension in the rope.
   c) Compare the acceleration with Problem 2. Explain the difference.

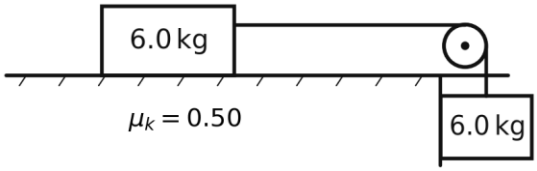


Medium

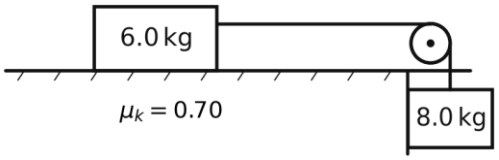
4. A 5.0 kg block rests on a frictionless horizontal table and is conn block. The system is released from rest.
   a) Determine the magnitude and direction of the system's accele
   b) Determine the tension in the rope.



5. A 6.0 kg block is sliding right across a rough horizontal surface with a coefficient of kinetic friction $\mu_k = 0.50$. It is connected by a rope over a pulley to a hanging 6.0 kg mass.
   a) Determine the magnitude and direction of the system's acceleration.
   b) Determine the tension in the rope.

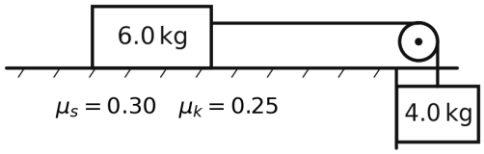


6. A 6.0 kg block is already sliding right across a rough horizontal surface with $\mu_k = 0.70$. It is connected by a rope over a pulley to a hanging 8.0 kg mass.
   a) Determine the magnitude and direction of the system's acceleration.
   b) Determine the tension in the rope.



Spicy

7. A 6.0 kg block rests on a rough horizontal table and is connected to a hanging 4.0 kg mass. The coefficients of friction are $\mu_s = 0.30$ and $\mu_k = 0.25$. The system is initially at rest.
   a) Will the system begin moving? Justify quantitatively.
   b) If it begins moving, determine the magnitude and direction of its acceleration.
   c) Determine the tension in the rope while the blocks slide.



Extra-Spicy

8. A 40 kg block is already sliding right on a rough horizontal table with $\mu_k = 0.70$. It is connected over a pulley to a hanging 25 kg mass.
   a) Determine the magnitude and direction of the system's acceleration.
   b) Determine the tension in the rope.
   c) Is the 40 kg block speeding up or slowing down? Explain.

