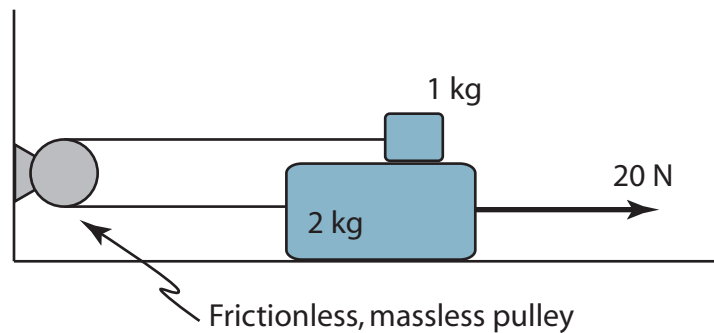


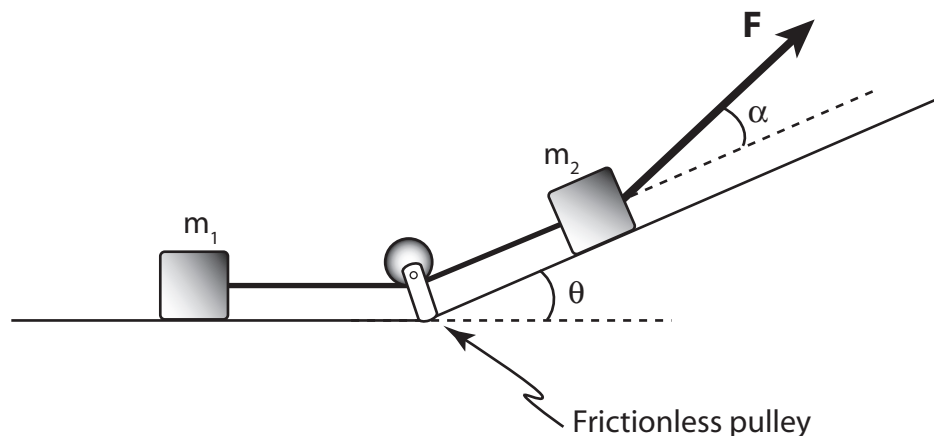
Problem Session

Dynamics

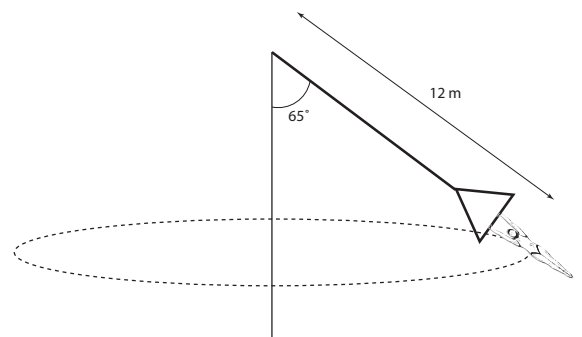
1. The lower block in the following figure is pulled by a force of 20 N. The coefficient of kinetic friction between the lower block and the surface is 0.30. The coefficient of kinetic friction between the lower block and the upper block is also 0.30. What is the acceleration of the 2.0 kg block?



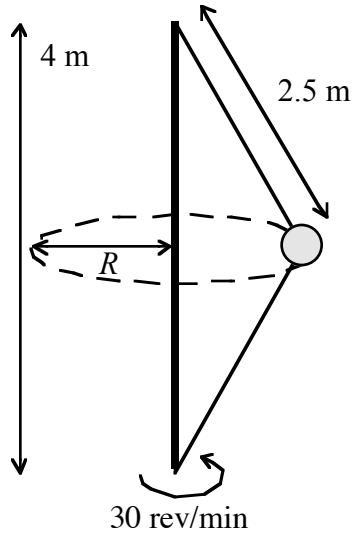
2. In the diagram below, two blocks, $m_1 = 2$ kg and $m_2 = 4$ kg, are tied together with a string passing over a massless, resistanceless pulley. The block m_2 is pulled up a 25° inclined plane with a 26 N force oriented at an angle $\alpha = 15^\circ$ from the surface. If the blocks are moving with a constant speed,



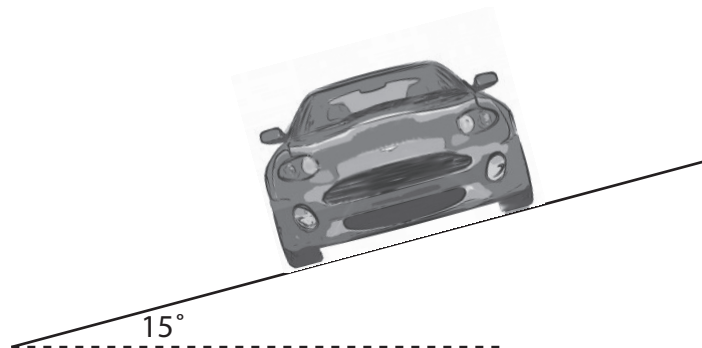
- a) determine the coefficient of kinetic friction between the blocks and the surface. Assume it is the same for both.
 b) Determine the tension in the string.
3. A gymnast in a circus show is swung in a circle by a 12-m cable attached to a vertical rotating pole, as the drawing shows. Suppose the mass of the gymnast is 65 kg.
- a) Determine the tension in the cable.
 b) Find the speed of the gymnast on its circular path.



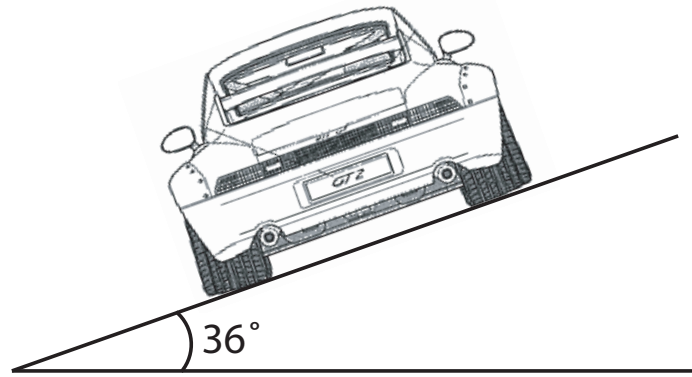
4. A 5 kg mass is attached to a vertical rotating rod 4 m in length, by two ropes of identical lengths ($L = 2.5$ m). When the rod rotates with an angular speed of 30 rev/min, the mass is held by the ropes in a horizontal circular motion as shown. Find the tensions T_1 and T_2 in each ropes.



5. A 1835 kg car takes an 80 m radius curb along a road inclined 15° with respect to the horizontal with a constant speed of 108 km/h. What must be the minimum friction coefficient between the tires and the road, so the car does not slide?



6. A specific race track has a banking angle of 36° in one of its turn with a 50 m radius of curvature. How fast can a pilot make this turn if he is driving a Porsche 911 of 1380 kg, equipped with Michelin tires with a coefficient of static friction of 0.5 in normal racing situations? Give your answer in km/h.



Answers

1. $T = 4.71 \text{ N}$ $a = 1.77 \text{ m/s}^2$
2. $T = 3.46 \text{ N}$ $\mu_k = 0.177$
3. $T = 1507 \text{ N}$ $v = 15.1 \text{ m/s}$
4. $T_1 = 92.3 \text{ N}$ $T_2 = 31.1 \text{ N}$
5. $\mu_s = 0.673$
6. 110.6 km/h