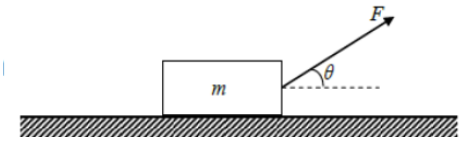
Tutorial 4

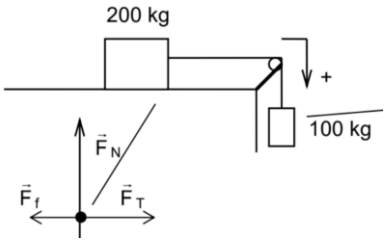
Monsoon 2024, PHY-101

Q1: A block is placed at rest on horizontal surface. The coefficient of friction between the block and the surface is μ_s. It is pulled with a force F at an angle θ with the horizontal plane as shown. Find the value of θ at which minimum force is required to move the block.



Q2: Consider an automobile moving along a straight horizontal road with a speed v_0. If the coefficient of static friction between the tires and the road is μ_s, what is the shortest distance in which the automobile can be stopped?

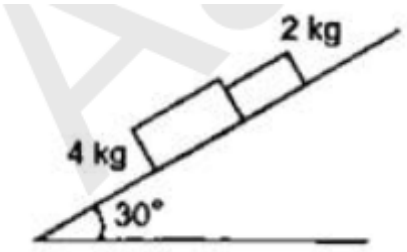
Q3: A 200 kg mass rests on a surface which has a coefficient of friction of 0.25. It is connected to a 100 kg mass over a pulley as shown in the diagram below. When the masses are released what is the resulting tension in the rope?



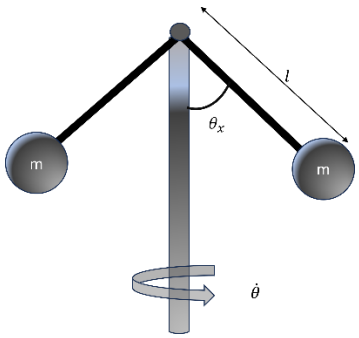
Q4: Figure shows two blocks in contact sliding down an inclined surface of inclination 30°. The friction coefficient between the block of mass 2.0 kg and the incline is μ_1 and that between the block of mass 4.0 kg and the incline is μ_2. Calculate the acceleration of the 2.0 kg block if,

(a)$\mu_1 = 0.20$ and $\mu_2 = 0.30$,

(b) $\mu_1 = 0.30$ and $\mu_2 = 0.20$. Take g =10 ms^{-2}



Q5: A device consists of mass of equal magnitude m tethered to a central shaft as shown in the figure. At a constant rotational speed of the central shaft the masses will be at a constant angle θ_x wrt to the central shaft. Considering length of the tethers are l and acceleration due to gravity g.



(a) Rate of spinning of the shaft is $\omega = \dot{\theta} = \sqrt{\frac{g}{l\,Cos\theta_x}}$

(b) If we want to spin it exactly at 60 rpm, what will be the angle θ_x if m=0.5kg and l=1m

Q6: 2. In the arrangement of Fig. 1 the masses m_0, m_1 and m_2 of bodies are equal, the masses of the pulley and the threads are negligible, and there is no friction in the pulley. Find the acceleration a with which the body m_0 comes down, and the tension of the thread binding together the bodies m_1 and m_2, if the coefficient of friction between these bodies and the horizontal surface is equal to k.

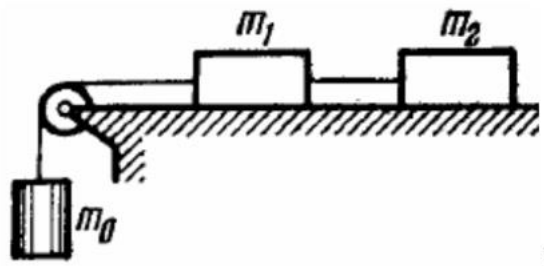


Fig. 1