Chapter 6: Applications of Newton's Laws of Motion

$F_{min} = \frac{\sin\theta - \mu_s \cos\theta}{\cos\theta + \mu_s \sin\theta} mg$

1. A block of mass m is pushed by a horizontal force $\vec{F}$ against an inclined plane of angle θ with the horizontal. The coefficient of static friction between the block and the plane is μs. Determine the minimum force F that allows the block to remain stationary.

2.A crate of weight Fg is pushed by a force $\vec{P}$ on a horizontal floor. The coefficient of static friction is μs, and P is directed at angle θ below the horizontal. Show that the minimum value of P that will move the crate is given by P = μs*Fg***sec θ /(1-μs***tan θ)

3. A large box of mass M is pulled across a horizontal, frictionless surface by a horizontal rope with tension $\vec{T}$. A small box of mass m sits on the top of the large box. The coefficient of static and kinetic friction between the two boxes are μs and μk, respectively. Find an expression for the maximum tension **T**max for which the small box rides on top of the large box without slipping. $T_{max} = (M+m)\mu_s g$

4. A block of mass m rests on the inclined surface of wedge of mass M. The wedge is acted on by a horizontal force $\vec{F}$ and slides on a frictionless surface. The coefficient of static friction between the wedge and the mass is μs. Find the minimum applied force $\vec{F}$ on the wedge such that the mass would not slip on the wedge.

5. Block B, with mass m_2 , rests on block A, with mass m_1 , which in turn is on a horizontal tabletop. There is no friction between block A and tabletop, but the coefficient of static friction between block A and block B is μs. A light string attached to block A passes over a frictionless, massless pulley, and block C is suspended from the other end of the string. What is the largest mass that block C can have so that blocks A and B still slide together when the system is released from rest?

6. A small bead can slide without friction on a circular hoop that is in a vertical plane and has a radius of r. The hoop rotates at a constant rate about a vertical diameter. At angle β the bead remains stationary relative to the rotating hoop. Find the time for one revolution.

7. A small block with mass m is placed inside an inverted cone that is rotating about a vertical axis such that the time for one revolution of the cone is T. The walls and the cone make an angle β with the vertical. The coefficient of static friction between the block and the cone is μs. If the block is to remain stationary relative to the rotating cone at a constant height h, what is the maximum value of T?

8. A ball of mass m is attached to a vertical rod by two strings. The strings are separated a distance d on the rod and both strings are length d. When the system rotates about the axis of the rod, the strings are extended and the tension in the upper string is twice the tension in the lower string. Find (a) the velocity of the ball and (b) the minimum velocity of the ball.