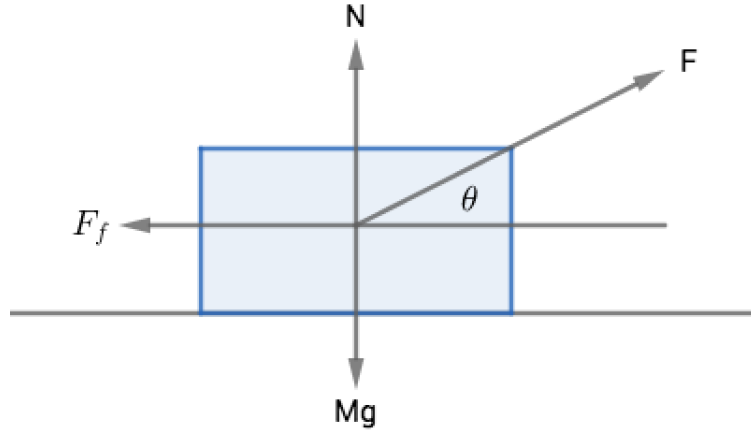


Exercise 2.21

Kevin S. Huang



In the vertical direction:

$$N + F \sin \theta = Mg$$

In the horizontal direction:

$$F \cos \theta = F_f$$

If the coefficient of static friction is μ , we know that $F_f \leq \mu N$.

$$F \cos \theta \leq \mu(Mg - F \sin \theta)$$

$$F(\cos \theta + \mu \sin \theta) \leq \mu Mg$$

$$F \leq \frac{\mu Mg}{\cos \theta + \mu \sin \theta}$$

Thus, the critical force required to make the block slip is given by

$$F(\theta) = \frac{\mu Mg}{\cos \theta + \mu \sin \theta}$$

At F_{min} ,

$$\frac{d}{d\theta}(\cos \theta + \mu \sin \theta) = -\sin \theta + \mu \cos \theta = 0$$

$$\tan \theta = \mu$$

$$\theta = \arctan \mu$$

$$F_{min} = \frac{\mu Mg}{\sqrt{1 + \mu^2}}$$