Finally, we note that $n!$ can be replaced by the product $p_1p_2\ldots p_n$ where $p_1 < p_2 < \ldots < p_n$ denote the primes in ascending order of size. In each of the three examples above, this produces a run of consecutive composites for $|j| \leqslant p_{n+1} - 1$.

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Two quick observations about rough inclined planes

1. In Figure 1, two masses m_1 and m_2 are connected by a light rod and projected up (or down) a rough plane inclined at angle θ to the horizontal: θ could be zero!

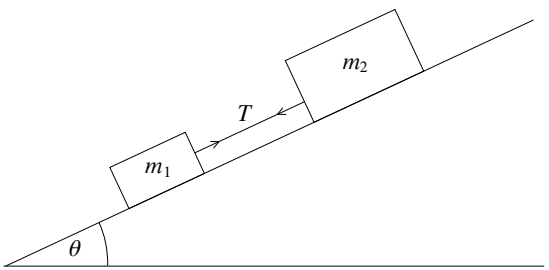


FIGURE 1

If a is the acceleration up the slope and T the force in the connecting rod, then resolving forces parallel to the slope shows that the equations of motion of the individual masses are

$$m_1a = T - m_1g\sin\theta - F_1 \tag{1}$$

and

$$m_2a = -T - m_2g\sin\theta - F_2 \tag{2}$$

where F_1, F_2 are the friction forces on m_1, m_2 respectively. Eliminating a between (1) and (2) then gives

$$m_2\left(T - m_1g\sin\theta - F_1\right) = m_1\left(-T - m_2g\sin\theta - F_2\right)$$

so that $T = \dfrac{m_2F_1 - m_1F_2}{m_1 + m_2}$. (If the masses are moving down the slope, the sign of the terms is reversed.)

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Our first observation is simply this: T will be zero if $\frac{F_1}{m_1} = \frac{F_2}{m_2}$. This condition is satisfied by the usual (Coulomb) law of friction, $\frac{F_1}{m_1} = \frac{F_2}{m_2} = \mu g \cos\theta$. Conversely, absence of a force in the connecting rod would give supporting experimental evidence for such a law.

2. Although, from the time of Galileo onwards, the inclined plane has been used to 'dilute' gravity in order to make kinematical measurements easier, our second observation is that accelerations of magnitude greater than g are also possible. Consider a mass m projected up a slope of inclination θ to the horizontal where the angle of friction is λ, so that the coefficient of friction μ is given by $\mu = \tan\lambda$. Resolving forces parallel to the slope shows that a, the acceleration up the slope, is given by

$$ma = -mg \sin\theta - \mu mg \cos\theta$$

so that

$$a = -g(\sin\theta + \tan\lambda \cos\theta)$$

or

$$a = -g\frac{\sin(\theta + \lambda)}{\cos\lambda}.$$

The magnitude of a thus mimics g if $\sin(\theta + \lambda) = \cos\lambda = \sin(\frac{1}{2}\pi - \lambda)$ forcing $\theta = \frac{1}{2}\pi - 2\lambda$ or (unsurprisingly) $\theta = \frac{1}{2}\pi$. And it exceeds g if $\theta + \lambda > \frac{1}{2}\pi - \lambda$ (when $\theta + \lambda$ is acute) or if $\pi - (\theta + \lambda) > \frac{1}{2}\pi - \lambda$ (when $\theta + \lambda$ is obtuse). The former inequality requires $\theta > \frac{1}{2}\pi - 2\lambda$; the latter is vacuously true.

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