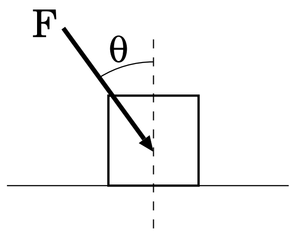
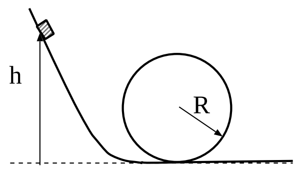
Exercise

1. Given two vectors $\vec{a} = (2, 1, 4)$ and $\vec{b} = (-1, -3, 2)$, calculate by vector methods;
   (a) The length of each
   (b) The scalar product $\vec{a} \cdot \vec{b}$
   (c) The cosine of the angle between them
   (d) The vector product $\vec{a} \times \vec{b}$
2. Show that $\vec{a}$ is perpendicular to $\vec{b}$ if $|\vec{a} + \vec{b}| = |\vec{a} - \vec{b}|$.
3. Figure shows a force $\boldsymbol{F}$ acting on a block of mass M resting on a horizontal rough surface with coefficient of friction μ.
   (a) Assuming $|\boldsymbol{F}| \gg Mg$, find the maximum angle θ at which the force $\boldsymbol{F}$ cannot make the block slip, no matter how large it is.
   (b) Find the ratio $|\boldsymbol{F}|/Mg$ in terms of θ and μ such that the block will just slip. Show that the answer reduces to that of (a) in the limit $|\boldsymbol{F}| \gg Mg$.



4. In the collision of two particles, the reference frame in which one is initially at rest and the other moving with velocity v is called the *laboratory frame*. Suppose the moving mass is m and the stationary one is $2m$
   (a) What is the velocity of the center-of-mass frame with respect to the laboratory frame?
   (b) How much kinetic energy is lost in both the laboratory and center-of-mass frames in a completely inelastic collision, i.e., one in which the particles stick together?
5. A mass m slides down a frictionless track and from the bottom rises up to travel in a vertical circle of radius R. Find the height h from which it must be started from rest in order just to traverse the complete circle without falling off under the force of gravity.



6. Express the kinetic, potential and total energy of a satellite of mass M in a circular orbit of radius r in terms of the angular momentum J.

Mechanics, Berkeley Physics Course. vol1. 2nd ed.