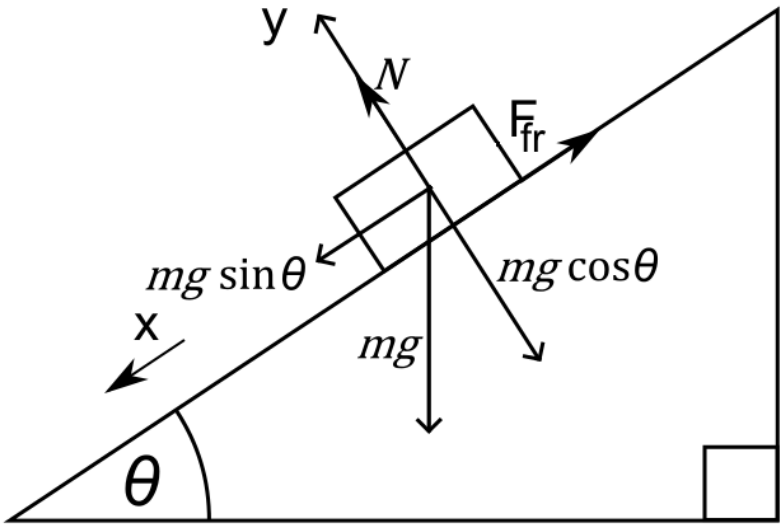
Answer on Question 65995, Physics, Mechanics, Relativity

Question:

A box of mass $50\ kg$ is placed on an inclined plane. When the angle of the plane is increased to 30°, the box begins to slide downwards. Calculate the coefficient of static friction between the plane and the box. Draw the free body diagram.

Solution:

There are three forces that act on the sliding box: the force of gravity mg directed downward and can be resolved into two perpendicular components ($F_{\parallel} = mgsin\theta$ and $F_{\perp} = mgcos\theta$), the force of reaction directed perpendicular to the surface and friction force F_{fr} directed opposite to the motion of the box. Let's draw a free-body diagram and write all forces that act on the box:



$$m\vec{g} + \vec{N} + \overrightarrow{F_{fr}} = m\vec{a} = 0.$$

Then projected the forces on axis x and y we get:

$$mgsin\theta - F_{fr} = 0, (1)$$

$$N - mgcos\theta = 0. (2)$$

Let's find the static friction force that acts on the box:

$$F_{fr} = \mu_s N = \mu_s mgcos\theta.$$

Substituting the friction force into the first equation we get:

$$mgsin\theta - \mu_s mgcos\theta = 0.$$

From this formula we can find the coefficient of static friction between the plane and the box:

$$mgsin\theta = \mu_s mgcos\theta,$$

$$\mu_s = \frac{sin\theta}{cos\theta} = tan\theta = tan30^\circ = 0.58.$$

Answer:

$\mu_s = 0.58.$