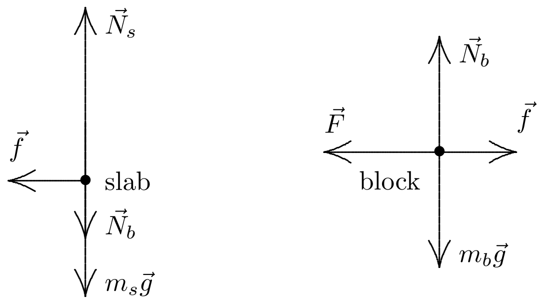
27. The free-body diagrams for the slab and block are shown below. $\vec{F}$ is the 100 N force applied to the block, $\vec{N}_s$ is the normal force of the floor on the slab, N_b is the magnitude of the normal force between the slab and the block, $\vec{f}$ is the force of friction between the slab and the block, m_s is the mass of the slab, and m_b is the mass of the block. For both objects, we take the $+x$ direction to be to the left and the $+y$ direction to be up.



Applying Newton's second law for the x and y axes for (first) the slab and (second) the block results in four equations:

$$\begin{aligned} f &= m_s a_s \\ N_s - N_b - m_s g &= 0 \\ F - f &= m_b a_b \\ N_b - m_b g &= 0 \end{aligned}$$

from which we note that the maximum possible static friction magnitude would be

$$\mu_s N_b = \mu_s m_b g = (0.60)(10\,\text{kg})(9.8\,\text{m/s}^2) = 59\ \text{N}\ .$$

We check to see if the block slides on the slab. Assuming it does not, then $a_s = a_b$ (which we denote simply as a) and we solve for f:

$$f = \frac{m_s F}{m_s + m_b} = \frac{(40\,\text{kg})(100\,\text{N})}{40\,\text{kg} + 10\,\text{kg}} = 80\ \text{N}$$

which is greater than $f_{s,\max}$ so that we conclude the block is sliding across the slab (their accelerations are different).

(a) Using $f = \mu_k N_b$ the above equations yield

$$a_b = \frac{F - \mu_k m_b g}{m_b} = \frac{100\,\text{N} - (0.40)(10\,\text{kg})(9.8\,\text{m/s}^2)}{10\,\text{kg}} = 6.1\ \text{m/s}^2\ .$$

The result is positive which means (recalling our choice of $+x$ direction) that it accelerates leftward.

(b) We also obtain

$$a_s = \frac{\mu_k m_b g}{m_s} = \frac{(0.40)(10\,\text{kg})(9.8\,\text{m/s}^2)}{40\,\text{kg}} = 0.98\ \text{m/s}^2\ .$$

As mentioned above, this means it accelerates to the left.