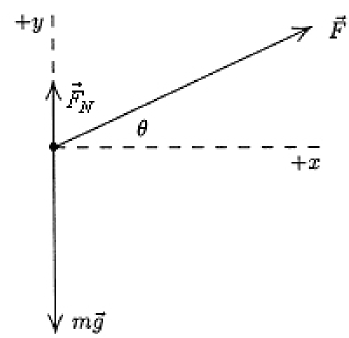
41. The force diagram (not to scale) for the block is shown below. $\vec{F}_N$ is the normal force exerted by the floor and $m\vec{g}$ is the force of gravity.




(a) The $x$ component of Newton's second law is $F\cos\theta = ma$, where $m$ is the mass of the block and $a$ is the $x$ component of its acceleration. We obtain

$$a = \frac{F\cos\theta}{m} = \frac{(12.0\,\text{N})\cos 25.0°}{5.00\,\text{kg}} = 2.18 \text{ m/s}^2.$$

This is its acceleration provided it remains in contact with the floor. Assuming it does, we find the value of $F_N$ (and if $F_N$ is positive, then the assumption is true but if $F_N$ is negative then the block leaves the floor). The $y$ component of Newton's second law becomes

$$F_N + F\sin\theta - mg = 0,$$

so

$$F_N = mg - F\sin\theta = (5.00)(9.80) - (12.0)\sin 25.0° = 43.9 \text{ N}.$$

Hence the block remains on the floor and its acceleration is $a = 2.18$ m/s$^2$.

(b) If $F$ is the minimum force for which the block leaves the floor, then $F_N = 0$ and the $y$ component of the acceleration vanishes. The $y$ component of the second law becomes

$$F\sin\theta - mg = 0 \quad \Rightarrow \quad F = \frac{mg}{\sin\theta} = \frac{(5.00)(9.80)}{\sin 25.0°} = 116\,\text{N}.$$

(c) The acceleration is still in the $x$ direction and is still given by the equation developed in part (a):

$$a = \frac{F\cos\theta}{m} = \frac{116\cos 25.0°}{5.00} = 21.0\,\text{m/s}^2.$$