82. (Fourth problem in **Cluster 1**)

A useful diagram (where some of these forces are analyzed) is Fig. 6-5 in the textbook; however, since the block is about to move uphill, one must imagine $\vec{f}_s$ turned around (so that it points downhill). Using that figure for this problem, W is the weight (equal to $mg = 98$ N), and $\theta = 25°$.

(a) If there is *no* motion, then $\sum \vec{F} = 0$ along the incline, so $F - f_s - W \sin\theta = 0$ (if uphill is positive). And if the system verges on motion, then $f_s = f_{s,\,\max} = \mu_s W \cos\theta = 53$ N. Therefore, in that case we find $F = 95$ N.

(b) With the block sliding, and the applied force F still equal to the value found in part (a), then Newton's second law yields $F - f_k - W \sin\theta = ma$ (if uphill is positive) where $f_k = \mu_k N = (0.20) W \cos\theta = 18$ N. We thus obtain $a = 3.6$ m/s^2. Therefore, the magnitude of $\vec{a}$ is 3.6 m/s^2 and the direction is uphill.

(c) With the block sliding uphill, but with no applied force F, then Newton's second law yields $-f_k - W \sin\theta = ma$ (if uphill is positive) where $f_k = 18$ N. We thus obtain $a = -5.9$ m/s^2. Therefore, the magnitude of $\vec{a}$ is 5.9 m/s^2 and the direction is downhill. It is decelerating and will ultimately come to a stop and remain at there at equilibrium.