81. (Third problem in **Cluster 1**)
A useful diagram (where some of these forces are analyzed) is Fig. 6-5 in the textbook. Using that figure for this problem, W is the weight (equal to $mg = 98$ N), and $\theta = 25°$.

(a) The maximum static friction is given by Eq. 6-1:

$$f_{s,\,\max} = \mu_s N = (0.60)W\cos\theta = 53 \text{ N} \quad .$$

(b) $W\sin\theta = 41$ N.

(c) If there is *no* motion, then $\sum \vec{F} = 0$ along the incline, so $f_s - W\sin\theta - F = 0$ (if uphill is positive). And if the system verges on motion, then $f_s = f_{s,\,\max}$. Therefore, in that case we find $F = 53 - 41 = 12$ N.

(d) With the block sliding, with no applied force F, then Newton's second law yields $f_k - W\sin\theta = ma$ (if uphill is positive) where $f_k = \mu_k N = (0.20)W\cos\theta = 18$ N. We thus obtain $a = -2.4$ m/s^2. Therefore, the magnitude of $\vec{a}$ is 2.4 m/s^2 and the direction is downhill.