72. (a) Our $+x$ direction is horizontal and is chosen (as we also do with $+y$) so that the components of the 100 N force $\vec{F}$ are non-negative. Thus, $F_x = F\cos\theta = 100$ N, which the textbook denotes $F_h$ in this problem.

(b) Since there is no vertical acceleration, application of Newton's second law in the $y$ direction gives

$$N + F_y = mg \quad \Longrightarrow N = mg - F\sin\theta$$

where $m = 25$ kg. This yields $N = 245$ N in this case ($\theta = 0°$).

(c) Now, $F_x = F_h = F\cos\theta = 86.6$ N for $\theta = 30°$.

(d) And $N = mg - F\sin\theta = 195$ N.

(e) We find $F_x = F_h = F\cos\theta = 50$ N for $\theta = 60°$.

(f) And $N = mg - F\sin\theta = 158$ N.

(g) The condition for the chair to slide is

$$F_x > f_{s,\text{max}} = \mu_s N \quad \text{where} \quad \mu_s = 0.42\ .$$

For $\theta = 0°$, we have

$$F_x = 100\,\text{N} < f_{s,\text{max}} = (0.42)(245) = 103\,\text{N}$$

so the crate remains at rest.

(h) For $\theta = 30.0°$, we find

$$F_x = 86.6\,\text{N} > f_{s,\,\text{max}} = (0.42)(195) = 81.9\,\text{N}$$

so the crate slides.

(i) For $\theta = 60°$, we get

$$F_x = 50.0\,\text{N} < f_{s,\,\text{max}} = (0.42)(158) = 66.4\,\text{N}$$

which means the crate must remain at rest.