40. The situation is somewhat similar to that shown in the "loop-the-loop" example done in the textbook (see Figure 6-10) except that, instead of a downward normal force, we are dealing with the force of the boom $\vec{F}_B$ on the car – which is capable of pointing any direction. We will assume it to be upward as we apply Newton's second law to the car (of total weight 5000 N):

$$F_B - W = ma \quad \text{where} \quad m = \frac{W}{g} \ , \quad \text{and } a = -\frac{v^2}{r}$$

Note that the centripetal acceleration is downward (our choice for negative direction) for a body at the top of its circular trajectory.

(a) If $r = 10$ m and $v = 5.0$ m/s, we obtain $F_B = 3.7 \times 10^3$ N = 3.7 kN (up).

(b) If $r = 10$ m and $v = 12$ m/s, we obtain $F_B = -2.3 \times 10^3$ N = -2.3 kN where the minus sign indicates that $\vec{F}_B$ points downward.