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

(a) We take the tangential acceleration of the bottom-most point on the (positively) accelerating disk to equal $R\alpha + a_{\text{com}}$. This in turn must equal the (forward) acceleration of the truck $a_{\text{truck}} = a > 0$. Since the disk is rolling toward the back of the truck, $a_{\text{com}} < a$ which implies that α is positive. If the forward direction is *rightward*, then this makes it consistent to choose counterclockwise as the positive rotational sense, which is the usual convention. Thus, $\sum \tau = I\alpha$ becomes

$$f_s R = I\alpha \qquad\qquad \text{where } I = \frac{1}{2}MR^2$$

and $\sum F_x = Ma_{\text{com}}$ becomes

$$f_s = M\,(a - R\alpha) \quad .$$

Combining these two equations, we find $R\alpha = \frac{2}{3}\,a$. From the previous discussion, we see acceleration of the disk relative to the truck bed is $a_{\text{com}} - a = -R\alpha$, so this has a magnitude of $\frac{2}{3}$ and is directed leftward.

(b) Returning to $R\alpha + a_{\text{com}} = a$ with our result that $R\alpha = \frac{2}{3}\,a$, we find $a_{\text{com}} = \frac{1}{3}\,a$. This is positive, hence rightward.