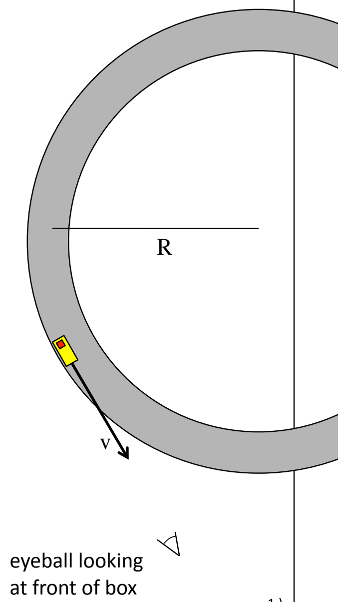
Problem 6.8

With the coefficient of friction between the flatbed truck and the crate of eggs being .600 and the roadway curve having a radius of 35.0 meters, finding the maximum velocity the truck can take the curve is a N.S.L. problem.

Again, as usual, you need to be able to see all the pertinent forces acting in the system when conjuring up your f.b.d. And again, as usual, for this kind of problem that f.b.d. should be as viewed in front of the box (see eyeball) as it's coming at you.

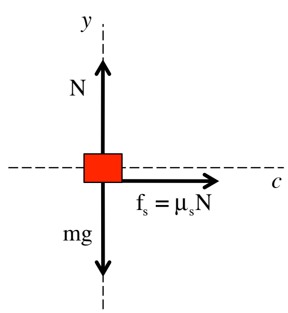
There is the additional hassle of deciding the direction of the frictional force in the system. There are, at minimum, two ways to decide:

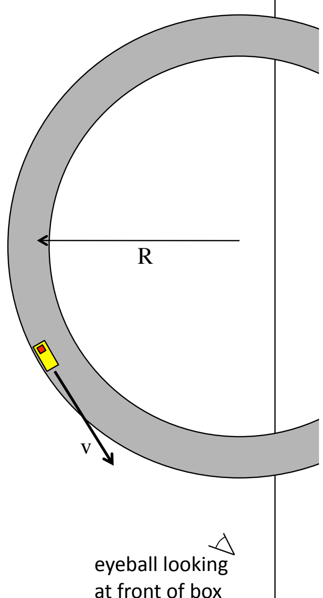


1.) If the box breaks free, it will (relative to the truck bed) appear to move outward. Apparently what kept it from doing that was the static frictional force *inward* toward the center.

2.) The box had to be pushed out of straight-line motion by *some* force. The only one available to do that is static friction. As the box is being pushed rightward toward the center of the arc, that must be the direction of the static frictional force.

In any case, the static frictional force must be center-seeking, and our f.b.d., with axes, will look like:





With the f.b.d., we can execute N.S.L.:

$$\underline{\sum F_y :}$$

$$\Rightarrow \quad N - mg = m\cancel{a_y}^{\,0}$$

$$\Rightarrow \quad N = mg$$

and

$$\underline{\sum F_c :}$$

$$\Rightarrow \quad \mu_s N = ma_c$$

$$\Rightarrow \quad \mu_s(mg) = m\left(\frac{v_{max}^2}{R}\right)$$

$$\Rightarrow \quad v_{max} = (\mu_s R g)^{1/2}$$

$$= \left[(.600)(35.0\text{ m})(9.80\text{ m/s}^2)\right]^{1/2}$$

$$= 14.3\text{ m/s}$$