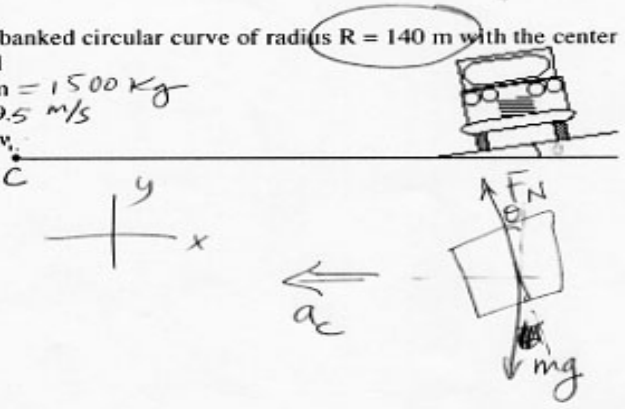
9. [pts] A jeep is traveling around a banked circular curve of radius R = 140 m with the center of the circle at C. The road is covered rain (i.e. frictionless), and the jeep (m = 1500 kg traveling with a constant speed v = 19.5 m/s shows the front of the jeep coming tov



(a) Draw the free-body diagram.

(b) Determine the minimum angle θ at which the road must be banked in order that the jeep not slide off the road.

$\Sigma F_x = ma_x$

$F_N \sin\theta = \frac{mv^2}{R}$ (1)

$\Sigma F_y = ma_y$

$F_N \cos\theta - mg \cancel{\cos\theta} = 0$

$F_N \cos\theta = mg$ (2)

divide (1) by (2)

$\tan\theta = \frac{\cancel{F_N}\sin\theta}{\cancel{F_N}\cos\theta} = \frac{\frac{\cancel{m}v^2}{R}}{\cancel{mg}} = \frac{v^2}{Rg} = \frac{(19.5\frac{m}{s})^2}{140m(9.8\frac{m}{s^2})} = 0.277$

$\theta = 15.5^\circ$

(c) As the jeep is rounding the curve, it travels 110 m. What is the work done by the normal force as it travels that distance?

0. $\vec{F}_N \perp \vec{v}$ so no motion parallel to force

(d) After rounding the curve, the jeep travels along a straight strech of road and accelerates from its original speed to 28.0 m/s in 30.0 sec. Calculate the work done by the engine during this acceleration. Ignore air resistance.

$K_i + W_{eng} = K_f$

$W_{eng} = K_f - K_i = \frac{1}{2}m(v_f^2 - v_i^2) = \frac{1}{2}(1500\,kg)\left[(28\frac{m}{s})^2 - (19.5\frac{m}{s})^2\right]$

$= 3.03 \times 10^5\,J$