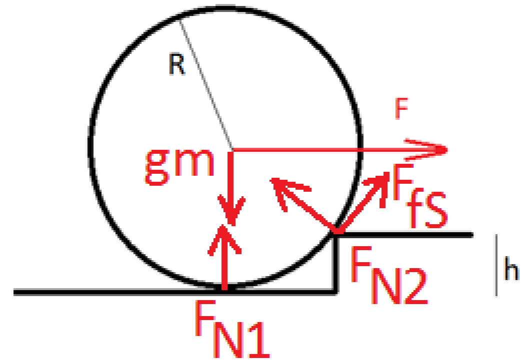
9-2)

a)

Let the pivot point be the point of contact between the wheel and the kerb.



The angle theta will be given by

$\sin\theta = (R - h)/R$

We'll use lever arms for this one.

τ: $0*F_{N2} + 0*F_{fS} - F_A(R - h) - F_{N1}[R^2 - (R - h)^2]^{1/2} + gm[R^2 - (R - h)^2]^{1/2} = 0$

Now if the wheel <u>just</u> lifts off from the ground, $F_{N1} \rightarrow 0$. Solve for F_A:

$F_A = gm[R^2 - (R - h)^2]^{1/2}/(R - h) = gm[2Rh - h^2]^{1/2}/(R - h)$

Careful. This is the force necessary to just barely lift the wheel. Will it be enough to lift the wheel the whole way over the kerb? As the wheel rises, the lever arm of F_A increases, while the lever arm of gm decreases, so the wheel will actually accelerate up and over the kerb.

b)

Now do for F_B instead:

τ: $0*F_{N2} - F_B(2R - h) - F_{N1}[R^2 - (R - h)^2]^{1/2} + gm[R^2 - (R - h)^2]^{1/2} = 0$

Now if the wheel <u>just</u> lifts off from the ground, $F_{N1} \rightarrow 0$. Solve for F_B:

$F_B = gm[R^2 - (R - h)^2]^{1/2}/(2R - h)$

$F_B = gm[2Rh - h^2]^{1/2}/(2R - h) = gmh^{1/2}[2R - h]^{1/2}/(2R - h) = gm[h/(2R - h)]^{1/2}$

Same argument as before; this is enough to just lift the wheel, and more than enough to lift it the whole way over the kerb.

c)

Which force is larger?

$F_A/F_B = [gm[2Rh - h^2]^{1/2}/(R - h)]/[gm[h/(2R - h)]^{1/2}] = (2R - h)]/(R - h) > 1$; $F_A > F_B$