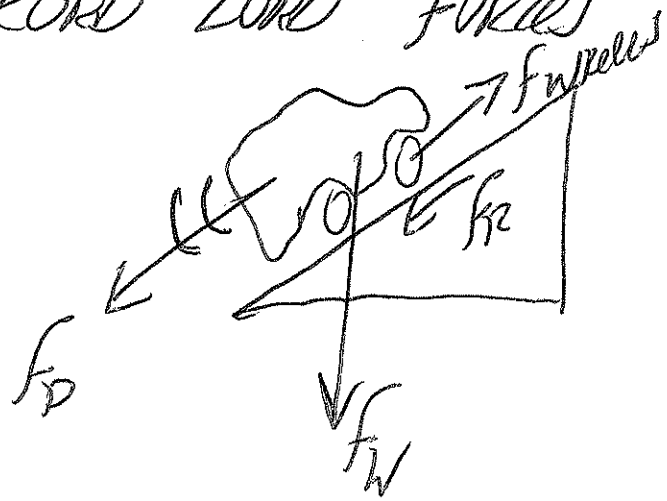
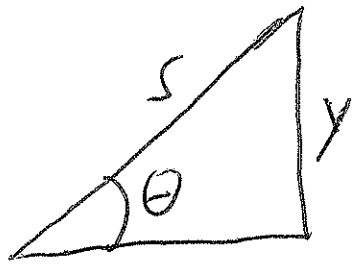
ROAD LOAD FORCES



$\%\ grade = (Y/S) \times 100$

$SIN\ \theta = Y/S$



AT STEADY-STATE SPEED

$$f_{wheels} = f_D + f_R + f_g$$

f_D ← AERO DRAG; f_R ← ROLLING RESISTANCE; f_g ← GRAVITATIONAL FORCE ALONG ROAD SURFACE

$f_D = \frac{1}{2} C_D S_{area} \rho_f V^2 \quad , 3 < C_D < .5$

$f_R = C_R f_N = C_R mg \cos\theta \quad .01 < C_R < .035$

$f_g = mg \sin\theta$

$P_{ROAD\ LOAD}$ = POWER REQUIREMENT = $f_{WHEELS} \cdot V_{VEHICLE}$

SPORT UTILITY VEHICLE CLIMBING LONDON GRADE

$v = 55 mph = 24.6 m/s$

7% GRADE $\rightarrow \theta = \arcsin(7/100) = 4^\circ$

$m = 2725 kg$ $\quad \rho = 1.2 kg/m^3$

$C_R = .032$ $\quad C_D = .41$

$A_f = 29 ft^2 = 2.7 m^2$

$$F_D = \tfrac{1}{2} C_D A_f \rho v^2 = \tfrac{1}{2}(.41)(2.7 m^2)(1.2 kg/m^3)(24.6 m/s)^2$$

$\hookrightarrow \underline{401 N} \Rightarrow 13\%$

$$F_R = C_R m g \cos\theta = (.032)(2725 kg)(9.81 m/s^2)\cos(4^\circ)$$

$\hookrightarrow \underline{853 N} \Rightarrow 27\%$

$$F_g = m g \sin\theta = (2725 kg)(9.81 m/s^2)(7/100)$$

$\hookrightarrow \underline{1865 N} \Rightarrow 60\%$

$$F_{WHEELS} = 401 N + 853 N + 1865 N = 3119 N$$

$$P_{\substack{ROAD \\ LOAD}} = (3119 N)(24.6 m/s) = \underline{\underline{77 kW}}$$

$\hookrightarrow$ ON THE FLAT IT IS 31 kW!