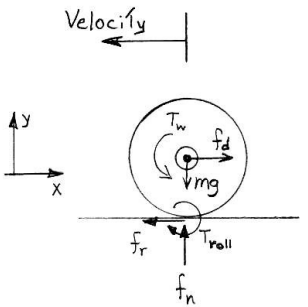
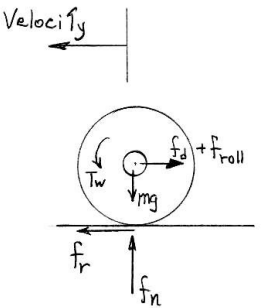
For the free body diagram there are 2 reasonable interpretations that will give a consistent force balance and the correct relationship between the axle torque, Tw, and the air drag and rolling forces. Of the two, "A" below is probably better as it gives a more realistic estimate of the required forward contact force, $f_r$.

A.




B.




Moments about contact:

$$\sum_{M_c} = T_w - f_d \cdot r_w - T_{roll} = 0$$

G

where $T_{roll} = f_{roll} \cdot r_w$

Moments about contact:

$$\sum_{M_c} = T_w - (f_d + f_{roll}) r_w$$

G

$f_{roll} = 0.05\,mg$

$f_d$ = air drag

$r_w$ = wheel radius

$f_r \leq \mu f_n$ = contact force for propulsion