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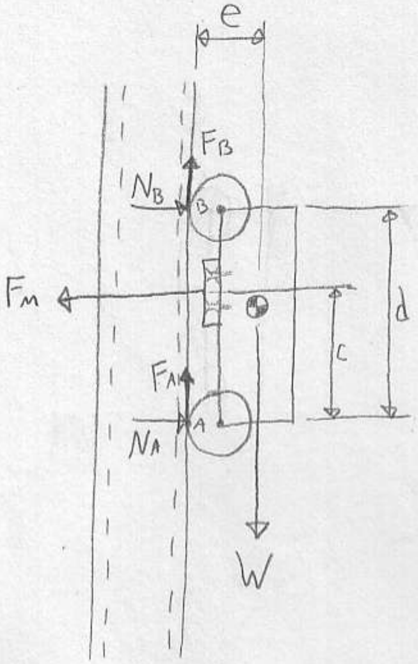
K&J Magnetics, Inc.



$$\Sigma F_x = 0$$
$$0 = N_A + N_B - F_M$$
$$F_M = N_A + N_B$$

$$\Sigma F_y = 0$$
$$0 = F_A + F_B - W$$
$$W = F_A + F_B$$

The sum of the forces in each direction is zero.

FRICTION: $F_A = \mu N_A \qquad F_B = \mu N_B$

...where μ is the coefficient of friction. $0 \leq \mu \leq 1$

The sum of the moments about point A is zero.

$$\circlearrowleft\!+\ \Sigma M_A = 0 = (F_M)(c) - (N_B)(d) - (W)(e)$$

$$F_M = \frac{(N_B)(d) + (W)(e)}{c}$$

SLIDING:

From ΣF_y: $W = F_A + F_B$

substitute from friction eqn.

$$W = \mu N_A + \mu N_B$$
$$W = \mu(N_A + N_B)$$

substitute from ΣF_x:

$$W = \mu F_M$$

$$F_M = \frac{W}{\mu}$$

If robot weighs 5 lb, and $\mu = 0.7$ (a guess)

$$F_M = \frac{W}{\mu} = \frac{5\text{ lb}}{0.7} \cong 7.14\text{ lb}$$

ROTATING:

At the moment of failure, the top wheels are just barely touching the pole. $N_B \to 0$.

From ΣM_A:

$$F_M = \frac{\cancelto{0}{N_B \cdot d} + W \cdot e}{c}$$

$$F_M = \frac{We}{c}$$

Solve for some values of e and c:

$$F_M = \frac{We}{c} = \frac{(5\text{ lb})(6'')}{4''}$$

$$F_M \cong 7.5\text{ lb}$$