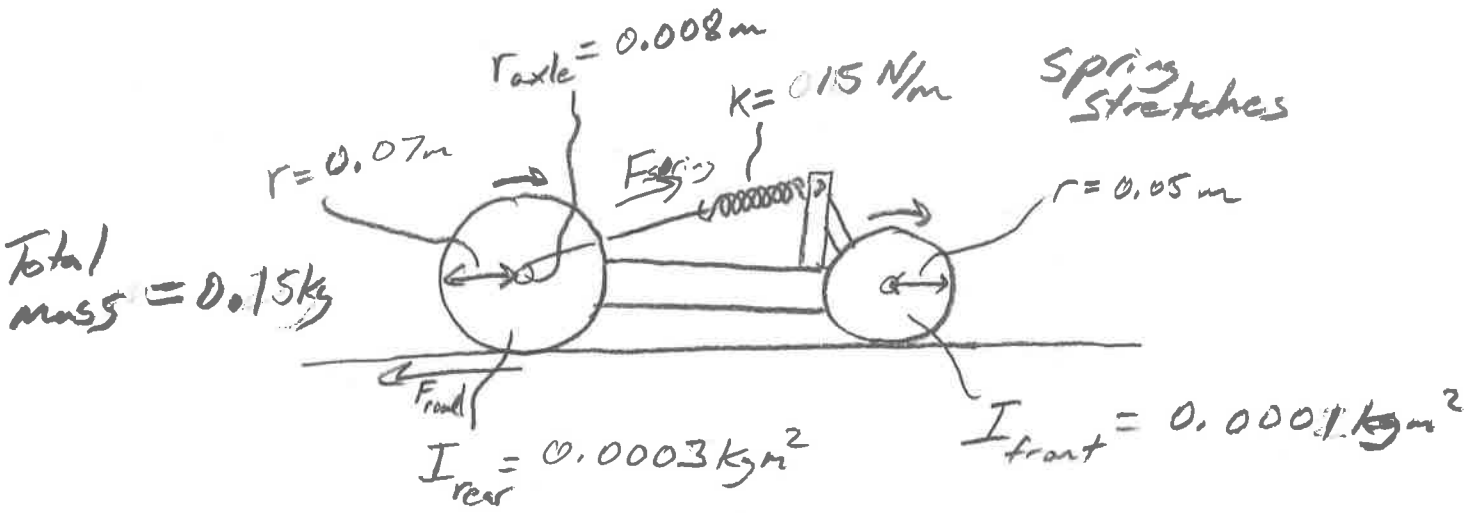

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1) $F_{spring} = Kx = 15 N/m\,(0.25m) = 3.75 N$

2) $\tau_{rear} = r_{axle} F_t = 0.008m\,(3.75N) = 0.030 N \cdot m$

3) $\tau_{rear} = r_{wheel} F_{road} \Rightarrow 0.030 N \cdot m = 0.07m\,(F_{road})$

$F_{road} = 0.429 N$

4) $PE_{spring} = \frac{1}{2} kx^2 = \frac{1}{2}\,(15 N/m)(0.25m)^2$

$= 0.469 J$

5) $Efficiency = \frac{Output}{Input} \Rightarrow 0.5 = \frac{Output}{0.469 J}$

$Output = 0.234 J$

6) $KE = \frac{1}{2}mv^2 + \frac{1}{2}I_{rear}\omega_{rear}^2 + \frac{1}{2}I_{Front}\omega_{Front}^2$

$KE = \frac{1}{2}mv^2 + \frac{1}{2}I_{rear}\frac{v^2}{r_{rear}^2} + \frac{1}{2}I_{Front}\frac{v^2}{r_{Front}^2}$

$2KE = v^2\left(m + \frac{I_{rear}}{r_{rear}^2} + \frac{I_{Front}}{r_{Front}^2}\right)$

$$V = \sqrt{\frac{2KE}{\left(m + \frac{I_{rear}}{r_{rear}^2} + \frac{I_{Front}}{r_{Front}^2}\right)}}$$

$$V = \sqrt{\frac{2(0.234\ J)}{0.15kg + \frac{0.0003\ kgm^2}{(0.07m)^2} + \frac{0.0001\ kgm^2}{(0.05m)^2}}}$$

$$V = \sqrt{\frac{0.469\ J}{0.15\ kg + 0.061\ kg + 0.04\ kg}}$$

$$V = \sqrt{\frac{4.45\ m^2}{52}} = 2.11\ m/s$$

7) Circumf. of rear axle $= 2\pi r = 2\pi(0.008\text{m}) = 0.0503\text{m}$

0.0503m of string = 1 rotation

$$\left(\frac{0.1 \text{ rotation}}{0.0503 \text{ m string}}\right)(0.25 \text{ m string}) = 4.97 \text{ rotations of rear axle}$$

8) Circumf of rear wheel $= 2\pi r = 2\pi(0.07\text{m}) = 0.440\text{m}$

$$\frac{0.44\text{m of travel}}{0.1 \text{ rotation of rear wheel}}\left(4.97 \text{ rotations of rear wheel}\right) = 2.19\text{m}$$