MIE 200F - Quiz number 7 - November 16/98
quiz duration = 20 minutes

The 10-kg double wheel has a radius of gyration of 0.5 meters with respect to its centre of mass.
The outer radius is 2 meters, and the inner radius is 0.6 meters. A force P = 50 Newtons is applied as shown. What is frictional force, in x-y coordinates, between the wheel and the ground, when $\omega = 4$ s^{-1}? Assume the wheel rolls without slipping.
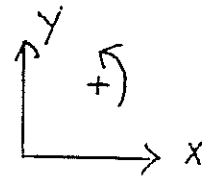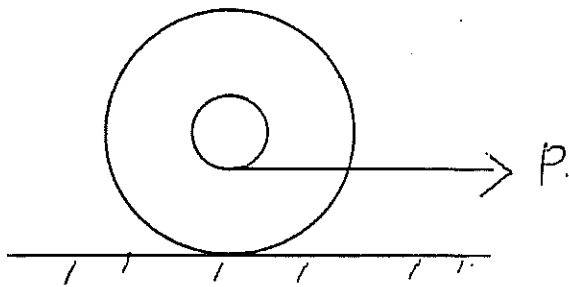
$\downarrow g = 9.81$ m/s^2

$$I_{cofg} = mk^2 = (10)(0.5)^2 = \boxed{2.5 \text{ kgm}^2}$$

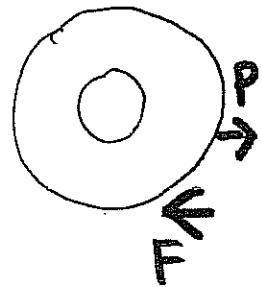$$(+ \, \Sigma M_{cofg} = I_{cofg}\alpha : \quad -(0.6)(P) + 2F = 2.5\alpha$$

$$\boxed{2F - 30 = 2.5\alpha} \; ①$$

$$\Sigma F_x = m(a_x)_{cofg}$$

$$P - F = 10\,a_x$$
$$P - F = (10)(2\alpha)$$
$$\boxed{P - F = 20\alpha} \; ②$$

Combine ① & ② $\Rightarrow$ $F = 17.1$

or $F = -17.1 \, \hat{i}$ Newtons

Note: the value of ω has no effect on our key equation in this problem.

$$\Sigma F = m\,a_{cofg}$$
$$\Sigma M_{cofg} = I_{cofg}\alpha$$

Note: wheel goes this way ! $\rightarrow$

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