Problem A

Context-Rich Problems: Solutions Outline

FOCUS the PROBLEM
Draw a picture of the situation including ALL the information given in the problem.

1 rev / 3 sec

Push for 1 sec
with a force of 150 lbs = 668 N

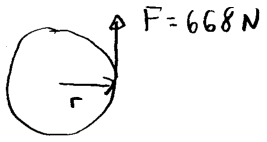
Question(s): What is the problem asking you to find?

What is the mass of the merry-go-round

Approach: Outline the approach you will use.

Use Newton's second Law for angular quantities, assuming the merry-go-round is a disk. Also use Angular kinematics to determine angular acceleration

DESCRIBE the PHYSICS
Draw physics diagram(s) and define ALL quantities uniquely.



$r = 1.98\,m$

$I = \frac{1}{2}mr^2$

$\omega_0 = 0$

$\omega_1 = \frac{1\,rev}{3\,sec} \times \frac{2\pi\,rad}{rev} = \frac{2\pi}{3}\,\frac{rad}{sec}$

$t_1 - t_0 = 1.0\,sec$ $\quad t_0 = 0\,sec$

Which of your defined quantities is your Target variable(s)? m

Quantitative Relationships: Write equations you will use to solve this problem.

$\Sigma \vec{\tau} = I\vec{\alpha}$ $\quad \omega_1 = \omega_0 + \alpha\Delta t$

PLAN the SOLUTION

Construct Specific Equations (Same Number as Unknowns)

$\Sigma \tau = I\alpha$

$Fr = \frac{1}{2} m r^2 \alpha$

$m = \frac{2F}{r\alpha}$ ①

α, m

Solve for α

$\omega_1 = \omega_0 + \alpha(t_1 - t_0)$

$\alpha = \frac{\omega_1 - \omega_0}{t_1 - t_0} = \frac{\omega_1}{t_1}$ ②

Plug ② into ①

$m = \frac{2 F t_1}{r \omega_1}$

Check Units

$$\frac{\frac{[m][L][T]}{[T]^2}}{[L]\frac{1}{[T]}} = [m] \text{ ok}$$

EXECUTE the PLAN

Calculate Target Quantity(ies)

$$m = \frac{2(668\,N)(1.0\,s)}{(1.98\,m)\left(\frac{2\pi}{3}\frac{rad}{sec}\right)} = 322\,kg$$

$(\sim 700\ lbs)$

EVALUATE the ANSWER

Is Answer Properly Stated?

Yes in kg

Is Answer Unreasonable?

No, it is quite heavy, though

Is Answer Complete?

Yes

(extra space if needed)