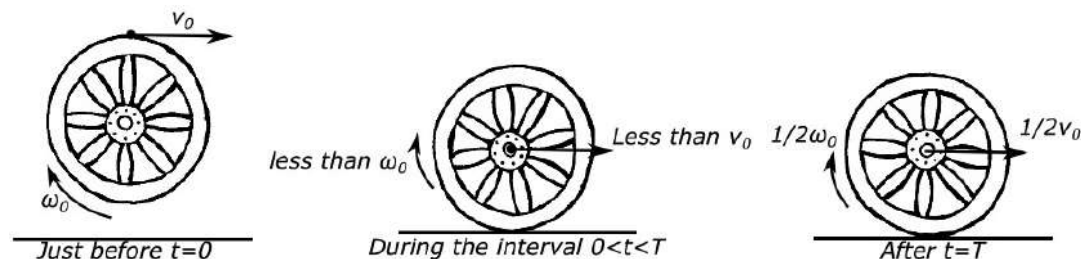


NAME _____

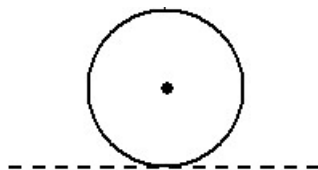
DATE _____

Scenario

A wheel of radius R and mass M is held at rest just above a rough table (coefficient of kinetic friction μ). The wheel spins with initial angular speed ω_0 so that all points on the edge of the wheel circle the wheel's center with speed v_0 . At time $t = 0$, the wheel is released from rest, lands on the table, and does not bounce. The wheel's rotational speed decreases while the linear speed of its center of mass increases until the wheel begins to roll without slipping at time $t = T$.



- PART A:** i. On the circle that represents the wheel, draw and label the forces exerted on the wheel during the interval $0 < t < T$. The dotted line represents the table. Each force should be represented by a single arrow that starts on and points away from the location on the wheel where that force is applied.



- ii. In terms of the forces you drew above, explain why the center of mass of the wheel increases in speed and the rotational speed of the wheel decreases during the interval $0 < t < T$.

Create Equation

PART B: Dominique derives an expression for T , makes a mistake, and obtains the incorrect expression $T = \frac{\mu\omega_0 R}{2g}$. Without deriving the correct expression, explain how one can know that this expression is not plausible.

Analyze Data

PART C: Dominique experiments with different wheels and surfaces and finds that, regardless of the values of R or μ , the final motion of the wheel is to roll without slipping with linear speed $\frac{1}{2}v_0$ and angular speed $\frac{1}{2}\omega_0$. On the grids below (linear speed on the left, angular speed on the right), draw graphs of the linear and angular speeds of the wheel from time $t = 0$ to a time after the wheel begins to roll without slipping for the two cases indicated below. Label the graphs as you are instructed.

- The table has a low coefficient of kinetic friction. Label these two graphs “low.”
- The table has a high coefficient of kinetic friction. Label these two graphs “high.”

