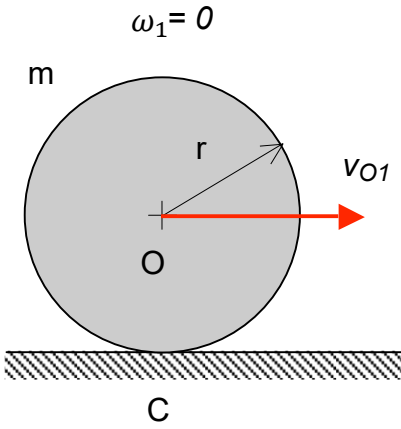
ME 274 – Summer 2009 ***Name _____***

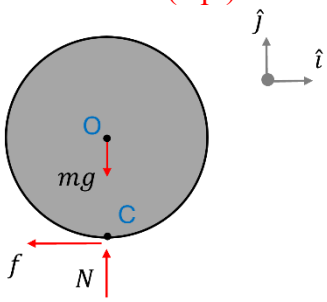
Final Examination PROBLEM NO. 4

Given: The homogeneous disk shown below has a mass of m and outer radius of r. The disk is placed on a rough horizontal surface (coefficients of static and kinetic friction of μ_s and μ_k, respectively) with a uniform speed (i.e., zero angular velocity) of v_{O1} to the right.

Find: Determine the elapsed time, Δt, during which the disk travels to the right before slipping ceases between the disk and the horizontal surface. Note that slipping ceases when the contact point C has zero velocity.



1. FBD (1 pt)



2. Kinetics

$\sum F_y = 0 = N - mg$ and $f = \mu_k N$ thus $f = \mu_k mg$ (1 pt)

LIM in x-dir: $mv_{O_2} - mv_{O_1} = \int_0^{\Delta t} \sum F_x dt = -\mu_k mg\Delta t$ (1 pt)

AIM about O: $\frac{1}{2}mr^2\omega_2 = \int_0^{\Delta t} \sum M_O dt = -\mu_k mgr\Delta t$ (1 pt)

3. Kinematics

In state 2 C is an instant center: $v_{O_2} = -\omega_2 r$ (1 pt)