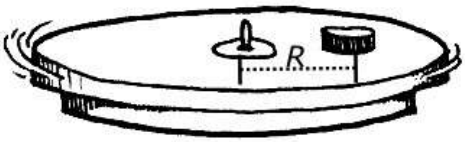
NAME _____ DATE _____

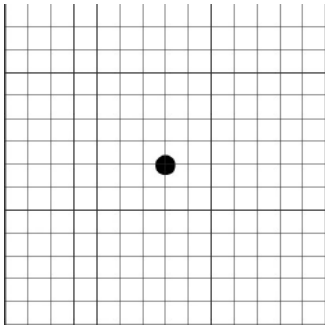
Scenario

Consider a coin of mass m *placed on a rotating surface a distance* R *from the axis of rotation. The surface rotates with a period* T. *There are some locations on the surface where the coin can be placed and the force of static friction will not allow the coin to slip. At other locations, the coin will slip because static friction is not strong enough to prevent the coin from slipping. The coefficient of static friction between the coin and the surface is* μ.



Using Representations

PART A: The dot at right represents the coin when the coin is at the location shown above in the diagram. Draw a free-body diagram showing and labeling the forces (not components) exerted on the coin. Draw the relative lengths of all vectors to reflect the relative magnitudes of all the forces. Each force must be represented by a distinct arrow starting on and pointing away from the dot.



Create an Equation

PART B: Starting from the equation $F_f \leq \mu F_N$, an inequality has been derived that must be satisfied at all times that the coin does not slip on the surface. The derivation has been done for you. You must fill in the annotations to explain each step.

$F_f \leq \mu F_N$	
$F_f \leq \mu mg$	
$\frac{mv^2}{R} \leq \mu mg$	
$\frac{v^2}{R} \leq \mu g$	
$v^2 \leq \mu gR$	
$v \leq \sqrt{\mu gR}$	
$\frac{4\pi^2 R}{T^2} \leq \mu g$	

Argumentation

Blake and Carlos are trying to predict whether the coin will slip if the coin is "too close" to or "too far" from the axis of rotation. The students reason as follows:

Blake: "I think that the coin will slip if it is too close to the axis. It is like if a car takes a turn too tightly, the car can slide out of control. There's not enough force if the radius is too small.

Carlos: "I think that the coin will slip if it is too far from the axis. It's like a merry-go-round; if I ride a merry-go-round near the center, then I don't feel much force pulling me to the outside, but if I ride near the outside, there is more force pulling me away from the axis.

PART C: For each student's statement, state whether the inequality written in Part B provides support for that statement. If so, explain how. If not, explain why not. Ignore whether the student's statement is correct or incorrect for this part.

Blake's Statement	*Carlos's Statement*

PART D: State whether the coin will slip when it is "too close" to or "too far" from the axis.

_____ too close _____ too far

PART E: Angela and Dominique are arguing over how the mass of the coin affects whether it will slip or not. Angela believes that a lighter coin is less likely to slip because a lighter coin requires less force. Dominique believes that a heavier coin is less likely to slip because a heavier coin can have a greater amount of friction. Using your equations along with other physical principles, explain how the coin's mass affects its likelihood of slipping.