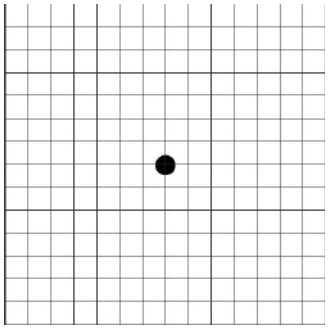
NAME _____ DATE _____

Scenario

A police car of mass m moves with constant speed around a curve of radius R. *(The car is, from your point of view, coming out of the page and is in the process of turning towards the left side of the page.) The car is moving as fast as it can without sliding out of control on the flat roadway to respond to an emergency. This maximum safe speed is* v_0. *The coefficient of static friction between the car's tires and the roadway is* μ_s.

Using Representations

PART A: The dot at right represents the car. Draw a free-body diagram showing and labeling the forces (not components) exerted on the car as it rounds the corner. 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.



Argumentation

PART B: i. Suppose that the car encounters a wet section of the curved roadway so that this section of the curve has a coefficient of friction less than μ_s. The maximum safe speed to make this turn is v_1. Mark the correct relationship between v_0 and v_1.

_____ $v_1 < v_0$ _____ $v_1 = v_0$ _____ $v_1 > v_0$

Explain your reasoning using physical principles without manipulating equations. (This means you may reference equations from the equation sheet but should not derive an equation for the relationship between μ and F_N.)

ii. Suppose that the police car arrives at another section of roadway that also curves but has a radius of curvature greater than R. The maximum safe speed to make this turn is v_2. Mark the correct relationship between v_0 and v_2.

_____ $v_2 < v_0$ _____ $v_2 = v_0$ _____ $v_2 > v_0$

Explain your reasoning using physical principles without manipulating equations. (This means you may reference equations from the equation sheet but should not derive an equation for the relationship.)

Quantitative Analysis

PART C: Derive an expression for the maximum safe speed that the car can take the turn in terms of μ and R.

PART D: i. Explain how your expression in Part C supports your answer for Part B (i).

ii. Explain how your expression in Part C supports your answer for Part B (ii).