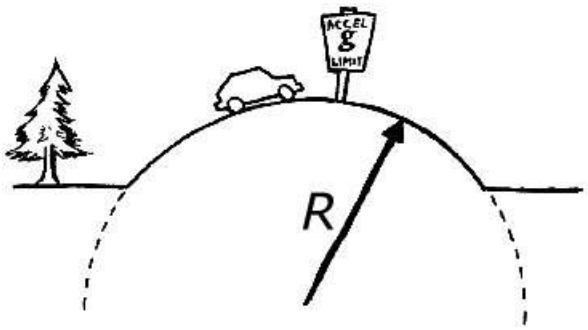
NAME _____ DATE _____

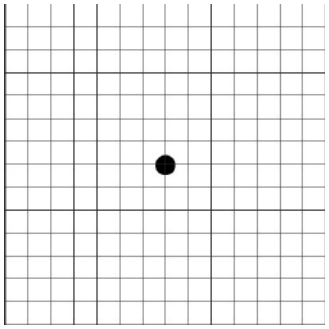
Scenario

A car of mass m *passes over a bump in a roadway that follows the arc of a circle of radius* R *as shown.*



Using Representations

PART A: The dot, at right below the picture, represents the car at the top of the hill. Draw a free-body diagram showing and labeling the forces (not components) exerted on the car. 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.



Quantitative Analysis

PART B: Starting with Newton's second law, derive an expression for the maximum speed v the car can have without losing contact with the road. For each line of the derivation, explain what was done mathematically (i.e., annotate your derivations). Your expression should be in terms of R and physical constants.

$\sum F = ma$	The net force on the car at the top of the hill is equal to the acceleration of the car times the mass of the car.

Argumentation

PART C: In your derivation, you set the normal force equal to zero. Explain why.

PART D: A truck of mass $2\ m$ passes over the same bump. Compared to the car, how many times bigger or smaller is its maximum speed without losing contact with the road? Justify your answer with reference to your expression in Part B.

Checklist:

_____ I answered the question directly.

_____ I stated a law of physics that is always true.

_____ I connected the law or laws of physics to the specific circumstances of the situation.

_____ I used physics vocabulary (force, mass, acceleration, centripetal, velocity, speed, time, radius).