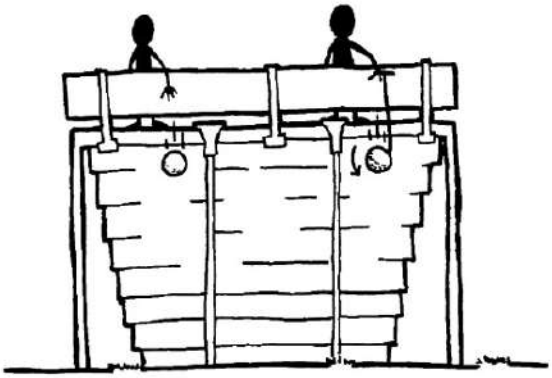
NAME _____ DATE _____

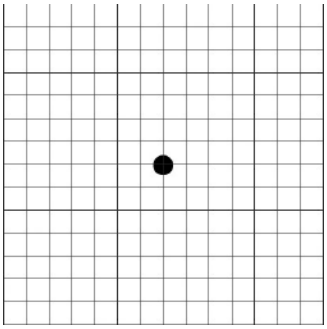
Scenario

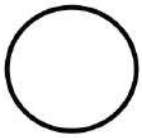
Carlos brings a pair of identical yo-yos (modeled as solid disks with rotational inertia $I = \frac{1}{2}MR^2$) to the top of the stadium bleachers of height H. The yo-yos both have a mass M and a radius R and are wound with a string so thin that the mass of the string can be ignored. Carlos simultaneously drops one yo-yo while he lets the other unwind.



Using Representations

PART A: Sketch a free-body diagram for the dropped yo-yo and a force diagram for the unwinding yo-yo while they are in the air. Draw the relative lengths of all vectors to reflect the relative magnitudes of all the forces. For the free-body diagram, each force must be represented by a distinct arrow starting on and pointing away from the dot. For the force diagram, each force must be represented by a distinct arrow positioned where the force is exerted.





Quantitative Analysis

PART B: Which yo-yo will land first, the dropped yo-yo or the unrolled yo-yo? Explain without deriving a mathematical expression.

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PART C: Derive an expression for the time for yo-yo 1 (dropped) to the time for yo-yo 2 (unwinding).

Yo-Yo 1	*Yo-Yo 2*

Argumentation

PART D: Each yo-yo lands on sticky tape and does not bounce upon landing. In a clear, coherent, paragraph-length response, explain which yo-yo experiences a greater impulse due to the normal force from the ground.

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