## Scenario
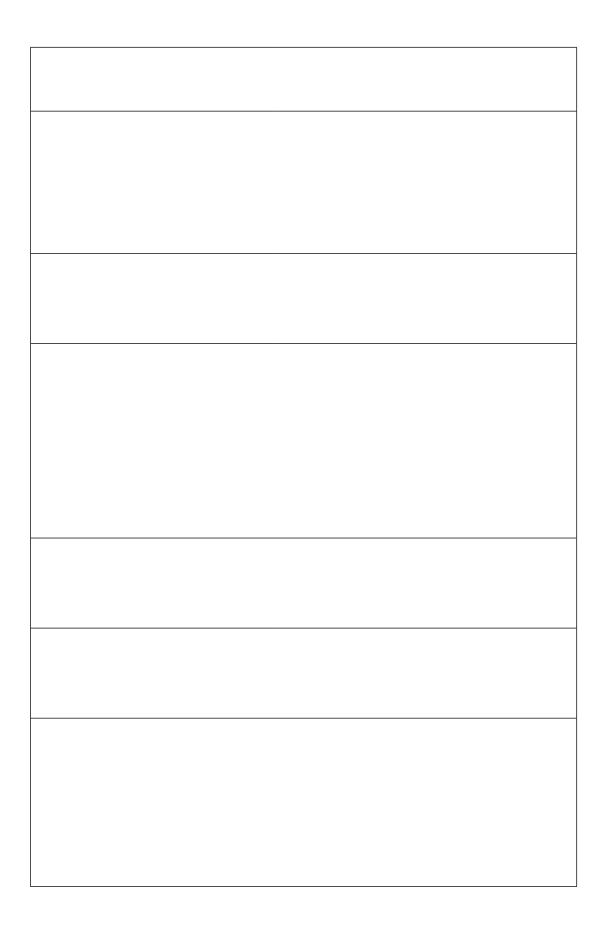
*Dominique is given a bowling ball and informed that the ball is solid (not hollow) and is made of the same material throughout. Her online research indicates, however, that most bowling balls have materials of different densities in their core. Further research indicates that a solid sphere of mass $M$ and radius $R$ having uniform density has a rotational inertia $I = 0.4MR^2$. Dominique decides to experimentally measure the bowling ball's rotational inertia.*

**PART A:** Dominique has access to a ramp, a meterstick, a stopwatch, an electronic balance, and several textbooks. In the space below, outline a procedure that she could follow to make measurements that can be used to determine the rotational inertia of the bowling ball. Give each measurement a meaningful algebraic symbol and be sure to explain how each piece of equipment is being used.

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**PART B:** Derive an expression that could be used to determine the rotational inertia of the ball in terms of the symbols and measurements chosen above. Once your equation has the accepted symbols and measurements, you may stop.

**PART C:** Identify one assumption that you made about the system in your derivation above.

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**PART D:** Dominique finds that the mass of the bowling ball is 7.0 kg and its radius is 0.1 m. Upon being released from the top of a ramp 0.05 m high, the ball reaches a speed of 0.75 m/s. Can she conclude that the ball is solid and made of uniformly dense material? Explain your reasoning and calculations.

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**PART E:** The surface of the ramp is now changed so that the coefficient of friction is smaller so that the ball both rotates and slips down the incline. Indicate whether the total kinetic energy at the bottom of the ramp is greater than, less than, or equal to the kinetic energy at the bottom of the other ramp.

Greater than _____    Less than _____    The same as _____

Justify your choice.

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**PART F:**   Indicate whether the translational speed at the bottom of the incline is greater than, less than, or equal to the translational speed of the ball at the bottom of the other ramp.

Greater than _____    Less than _____    The same as _____

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