

## **CONSTRAINTS**

**CONCEPT** In kinematics, constraints are limitations or conditions that affect the motion of objects. Constraints can be either external, such as obstacles or boundaries, or internal, such as physical characteristics of the object itself.

External constraints can limit the motion of an object by restricting its range of motion or changing its direction of motion. For example, a ball thrown in a room may be constrained by the walls and ceiling, which limit its trajectory and cause it to bounce off at certain angles.

Internal constraints refer to limitations that arise from the physical properties of the object itself. For example, a rigid body cannot deform or change shape, while a flexible body may bend or twist under certain conditions. These constraints affect the way the object moves, as well as the forces and energies involved in its motion.

## **REAL WORLD CONNECTIONS**

One example of constraints in kinematics could be the motion of a car traveling along a curvy and hilly road. The shape of the road and the presence of obstacles like trees or other vehicles impose external constraints on the car's motion, limiting its range of motion and changing its direction of travel. Additionally, the car itself may have internal constraints, such as a limited turning radius or a maximum speed, that further restrict its motion. By analyzing the forces and energies involved in the car's motion, we can better understand how these constraints affect its behavior and predict its trajectory along the road.







