www.simiode.org
SIMIODE
A SYSTEMIC INITIATIVE FOR MODELING INVESTIGATIONS
& OPPORTUNITIES WITH DIFFERENTIAL EQUATIONS

STUDENT VERSION
BALL BOUNCE OFF INCLINED RAMP

Brian Winkel, Director SIMIODE
Chardon OH 44024 USA
BrianWinkel@simiode.org

Abstract: Students build two projectile motion models (1) a one-dimensional model for a vertically falling ball from a fixed distance until it hits an inclined ramp and (2) a two-dimensional projectile motion model of the ball bouncing off the ramp. The purpose of the activity is to determine the angle of the ramp which permits the ball to bounce OUT the farthest.

SCENARIO DESCRIPTION

We drop a ball onto an inclined plane (ramp) of slope m and watch it bounce. Suppose the coefficient of restitution is 0.5, applied only to the component of the velocity which is perpendicular to the plane of the ramp. We wonder what angle the ramp should be to give the bounce the maximum horizontal distance along the level ground.

We keep the action in a vertical plane in which the first coordinate (x) represents horizontal distance of the ball in meters from the pivot point of the flat inclined ramp (along the direction of the ramp) and the second coordinate (y) represents the height of the ball in meters. Place the ball at position $(10, 40)$ with the ramp's base at $(0, 0)$ and assume the slope of the ramp is a positive value, m. Thus the ramp has equation $y = mx$. For a drop from a height of 40 meters above the ground (not necessarily above the ramp though) we seek the slope m of the ramp which will permit the ball to bounce farthest along the ground, i.e. maximize horizontal range.