

11. [points] A spring gun (like the one in the ballistic pendulum) is clamped onto a cart with wheels (assume frictionless bearings and ignore air resistance). The gun is clamped at an angle of 37.0° with the horizontal, and it fires a ball whose velocity as it leaves the incline = 4.88 m/s .

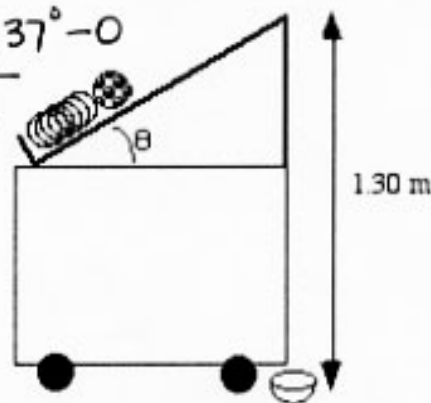
(a) What is the maximum height that the ball reaches?

$$v_y = v_{0y} - gt \rightarrow t = \frac{v_{0y} - v_y}{g} = \frac{4.88 \frac{\text{m}}{\text{s}} \sin 37^\circ - 0}{9.8 \frac{\text{m}}{\text{s}^2}} = 0.30 \text{ s}$$

$$y = y_0 + v_{0y}t - \frac{1}{2}gt^2$$

$$= 1.3 \text{ m} + 4.88 \sin 37^\circ (-0.3) - \frac{1}{2}(9.8)(0.3 \text{ s})^2$$

$$= 1.74 \text{ m}$$



(b) What is the speed of the ball at this height?

$$v = v_{x,0} = 4.88 \frac{\text{m}}{\text{s}} \cos 37^\circ = 3.90 \frac{\text{m}}{\text{s}}$$

(c) How fast and in what direction must the cart move in order for the ball to land in the bowl that is placed on the floor directly below the place where the ball leaves the incline?

Cart must be moving left @ same speed that ball is moving right so ball is not moving horizontally relative to bowl.

$$\text{i.e. } v_{\text{cart}} = -v_{x,\text{ball}} = -3.90 \frac{\text{m}}{\text{s}}$$

to left