Problem 2 (6 points)

A cart of mass $M_1$ has a pole on it from which a ball of mass $m \ll M_1, M_2$ hangs from a thin string of negligible mass and length $R$ attached at point $P$, as shown in the figure. The cart and ball have initial velocity $V$ (the ball is initially at rest with respect to the cart). The cart crashes into another cart of mass $M_2$ and sticks to it. All surfaces are frictionless, and you may ignore the mass of the wheels.

Before:

After:

(a) (2 points) Find the velocity of the two carts $V'$ after the collision.

(b) (2 points) Find the smallest initial velocity $V$ so that the ball will complete a circle around the point $P$ after the collision.

(c) (2 points) Now, instead of the two carts sticking together, assume an elastic collision and find the smallest initial velocity $V$ so that the ball will complete a circle around the point $P$ after the collision.