1. A uniform rod of mass $3M$ and length $2L$ is rotating clockwise in a vertical circle around a frictionless pivot $P$ that is located a distance $\frac{1}{2}L$ from one end. When the rod is exactly vertical, as shown in the drawing BEFORE, a point at its bottom end has a speed $V$. At that moment the rod is simultaneously struck by two putty balls, traveling as shown. The balls hit exactly at the ends of the rod. The lower ball has mass $M$ and speed $V$, while the upper ball has mass $2M$ and speed $2V$. Both balls stick to the rod AFTER the collision.

a) Derive an expression for the moment of inertia of the rod about $P$ in terms of $L$ and $M$.

b) Treating the balls as point particles, derive an expression, in terms of relevant system parameters, for the angular velocity (magnitude and direction) of the rod after the collision.

2. Two children, each of mass $m$, are riding on a merry-go-round of radius $R$ and moment of inertia $4mR^2$. One rides at the outer edge and the other sits half-way to the edge. The merry-go-round rotates counterclockwise with angular speed $\omega$. Their father whose mass is $7m/4$, decides to jump on and runs towards the merry-go-round tangentially with a speed $V$, as shown in the drawing.

Derive an expression in terms of relevant system parameters for the angular velocity of the merry-go-round after the father has hopped on.