Problem 1 (35 points): Two spheres of mass $m_s$ and radius $r_s$ are rigidly attached to a slender rod at the left-hand end (point A) and the right-hand end (point B). The mass of the rod is $m_r$ and the length of the rod is $L_r$. The system pivots about the left-hand end at A. The system is released from rest in a horizontal position and swings freely. Determine the angular velocity of the rod as it passes through a vertical position using the conservation of energy principle.

Problem 2: (30 points) The rod $AB$ has mass $m$ and length $L$. The rod is free to rotate in the vertical plane about a pin at A. Find the angular velocity, the acceleration of point B, and the reaction at the pin at A when the rod is released from rest.

Problem 3: (35 points) The uniform hoop of mass $m$ has a central radius of gyration of 220 mm. The hoop is launched on a horizontal surface with 3 m/s forward speed and 30 rad/s backspin. The kinetic coefficient of friction between the hoop and the surface is 0.2. Determine the final speed of the hoop and the time when the final speed is reached using the principle of impulse and momentum.