1. The mass \( m = 1 \text{ Kg} \), the spring constant \( k = 200 \text{ N/m} \) and the unstretched length of the spring is \( 0.1 \text{ m} \). When the system is released from rest in the position shown (position 1), the spring contracts, pulling the mass to the right. Use conservation of energy to determine the magnitude of the velocity of the mass when the string and the spring are parallel (position 2). \{20 points\}
2. The 10 kg mass A is moving at 5 m/s when it is 1m from the stationary 10-kg mass B. The coefficient of kinetic fiction between floor and the two masses is \( \mu_k = 0.6 \), and the coefficient of restitution of the impact is \( e = 0.5 \). Determine how far B moves from its initial position as a result of the impact. {20 points}
3. (i). A bar of length 4m is observed to slide down an incline with magnitude of $V_B=2$ m/s. Determine $V_A$ {10 points}

3. (ii) In the figure below, use instantaneous centers to determine the horizontal velocity of B {10 points}
4. (i) Prove that when two objects of equal mass moving at different velocities, undergo a perfectly elastic direct central impact, their velocities interchange.
   i.e., \( V_A' = V_B \) and \( V_B' = V_A \). \{6 points\}

4. (ii) For an oblique impact of a body on a stationary surface, determine the post-impact angle, \( \alpha \) as a function of the pre-impact angle \( \theta \) and the coefficient of restitution, \( e \). \{14 points\}