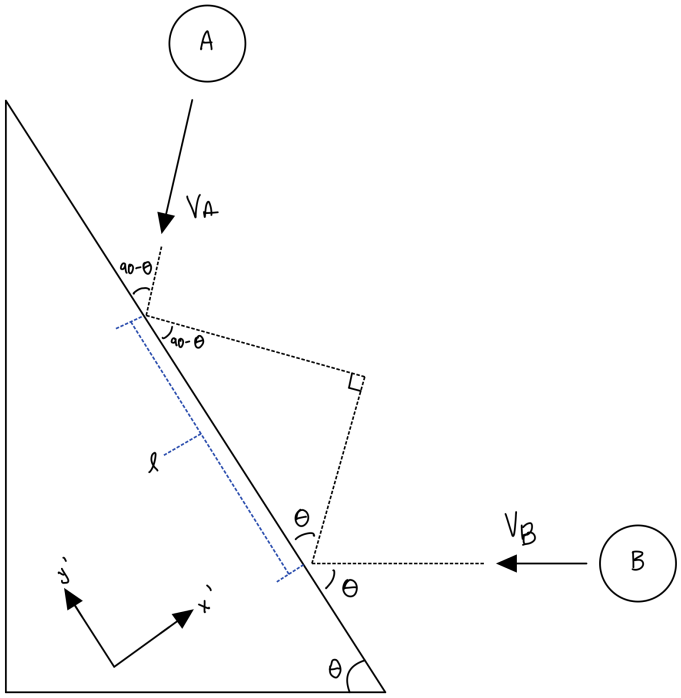
21-R-IM-ZA-50 Solution

Question: Ball A is moving at a velocity of $v_A\ m/s$ towards a block. Ball B is moving at a velocity $v_B\ m/s$ towards the same block that is angled at θ° with the horizontal. If the coefficient of restitution for ball A is e_A, and the distance between the points where each collision occurs is $l\ m$, find the coefficient for ball B in order for the balls to intersect after rebounding.

Solution:



Using the coefficient of restitution for ball A, we can find the velocity after the collision.

$v_{Ax'i} = v_{Ai}sin(90 - \theta)$

$e_A = v_{Ax'f}/v_{Ax'i} \Rightarrow v_{Ax'f} = e_A v_{Ax'i}$

$v_{Af} = v_{Ax'f}/sin(90 - \theta)$

Then, we use kinematics to find the time it takes ball A to reach the point where the balls will intersect.

$d_A = lcos(90 - \theta)$

$d_B = lcos(\theta)$

$v_{Af} = d_A/t \Rightarrow t = d_A/v_{Af}$

We can use this time to find the final velocity required from ball B, and use this to find the coefficient of restitution.

$v_{Bf} = d_B/t = d_B/(d_A/v_{Af})$

$e_B = v_{Bf}/v_{Bi}$