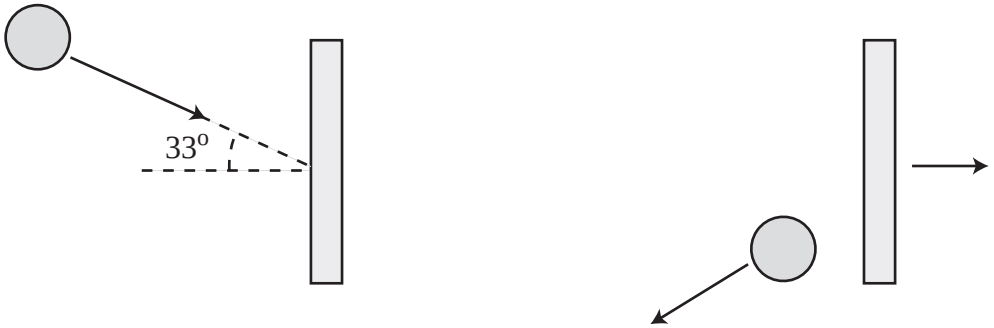
Sample Midterm #2

1. A tennis ball of mass 55 g hits a tennis racket of mass 0.34 kg with an initial speed of 5.3 m/s at an angle of 33° from the perpendicular. The racket is initially at rest, but after the collision is observed to be recoiling with a speed of 0.052 m/s as shown below.

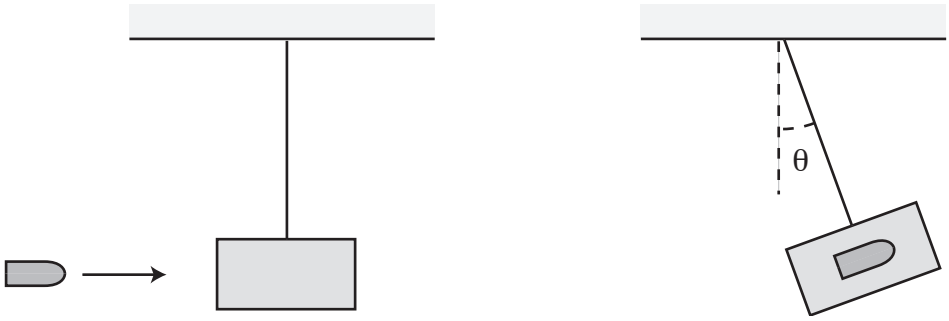


During the brief collision between the ball and the racket, neglect the force the player uses to hold the racket, and also neglect the force of friction between the racket and the ball. That is, assume the force exerted by the racket on the ball is perpendicular to the racket surface.

(a) (25 points) Find the final velocity vector of the tennis ball.

(b) (8 points) Is this collision elastic or inelastic?

2. (33 points) A bullet of mass 5.6 g is fired with an initial horizontal velocity of 53 m/s into a wood block of mass 0.89 kg suspended from the ceiling by a rope of length 0.50 m. The bullet becomes embedded in the block and the block. What is the angle of the rope at the maximum height of the block?



3. (33 points) Two blocks with masses $m_1 = 0.34$ kg and $m_2 = 0.65$ kg are connected by a spring with spring constant 530 N/m with unstretched length 0.30 m. The spring is stretched by 0.10 m and the blocks are released from rest. The spring pulls the two blocks toward each other, and they come momentarily to rest before being pushed back outward. Find the position of both blocks at the moment they are closest to each other.