A golf ball strikes a hard, smooth floor at an angle of 26.3 ° and, as the drawing shows, rebounds at the same angle. The mass of the ball is 0.0457 kg, and its speed is 58.7 m/s just before and after striking the floor. What is the magnitude of the impulse applied to the golf ball by the floor? (Hint: Note that only the vertical component of the ball's momentum changes during impact with the floor, and ignore the weight of the ball.)

Solution

Impulse = Change in momentum

Resolve the velocity vector into its rectangular components. Now, since speed before and after striking the floor remains the same, hence the horizontal component ($v\cos\theta$) doesn't change. Hence, only the vertical components come into play.

Therefore, Initial momentum = $mv\sin\theta$.

And, final momentum = $-mv\sin\theta$.

Thus, Impulse = $-mv\sin\theta\ -mv\sin\theta = -2mv\sin\theta$.

The magnitude of the impulse applied to the golf ball by the floor

$$\Delta P = 2mv\sin\theta = 2 * 0.0457 * 58.7 * \sin 26.3\,^\circ = 2.38\frac{\text{kg} * \text{m}}{\text{s}}.$$

Answer: $2.38\frac{\text{kg}*\text{m}}{\text{s}}$.