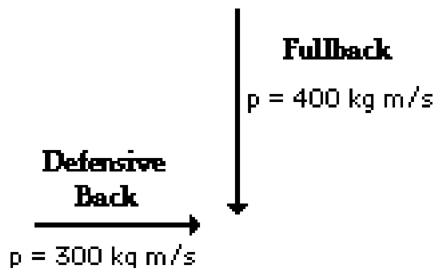
Collisions in Two-Dimensions

Technical Stuff

The Law of Momentum Conservation (2-Dimensions):
During a collision in an isolated system, momentum is conserved. The total momentum of all objects in the isolated system before the collision is equal to the total momentum of all objects after the collision. If the colliding objects are moving in 2-dimensions, then the momentum vectors must be resolved into horizontal and vertical components. In such instances, both the total horizontal momentum and total vertical momentum are conserved.

$$\Sigma p_{ix} = \Sigma p_{fx} \qquad \Sigma p_{iy} = \Sigma p_{fy}$$

1. A fullback (90 kg) and a defensive back (70 kg) collide in mid-air. The momenta of the two players are shown below. Use principles of vector addition and momentum conservation to determine the total momentum of the system before and after the collision.

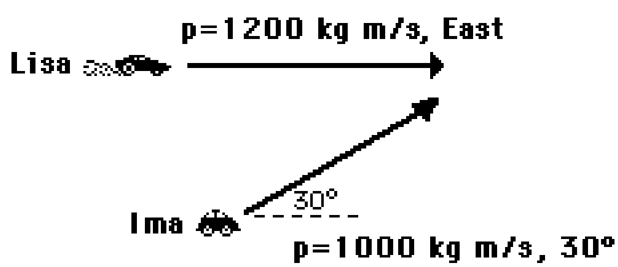


Total Momentum Before Collision:

Total Momentum After Collision:

Determine the post-collision speed and direction of the two players if the collision is completely inelastic.

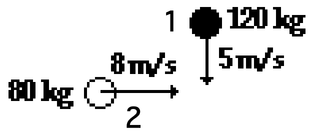
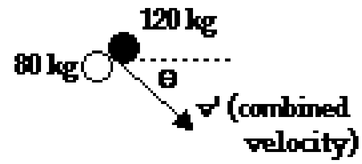
2. Ima Rilla Saari becomes careless in the GBS parking lot. As she cuts across lanes on an icy December morning, her car collides with Lisa Honda's car. The before-collision momenta of the two cars are shown below. After collision the two cars travel together as "a single object." Use principles of vector resolution and momentum conservation to fill in the table below.



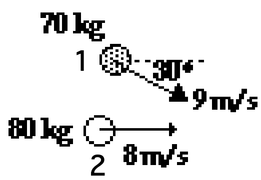
	Before Collision		After Collision	
	p_x	p_y	p_x	p_y
Ima's Car			**SKIP**	**SKIP**
Lisa's Car			**SKIP**	**SKIP**
Total				

Determine the final speed and direction of the two 900-kg entangled cars.

3. A top view of two inelastic collisions on a football field is shown below. Before- and after-collision snapsots are shown. Determine the x- and y-components of the momenta of the football players before and after the collision. Determine the total system momentum before and after collision; use these values to determine velocities and directions of the players after the collision.

Before Collision	**After Collision**
	
p1x = ____________ kg•m/s p2x = ____________ kg•m/s ∑ px = ____________ kg•m/s p1y = ____________ kg•m/s p2y = ____________ kg•m/s ∑ py = ____________ kg•m/s	∑ p'x = ____________ kg•m/s ∑ p'y = ____________ kg•m/s v' = ____________ m/s Θ = ____________ degrees

This space provided for work:

Before Collision	**After Collision**
	
p1x = ____________ kg•m/s p2x = ____________ kg•m/s ∑ px = ____________ kg•m/s p1y = ____________ kg•m/s p2y = ____________ kg•m/s ∑ py = ____________ kg•m/s	∑ p'x = ____________ kg•m/s ∑ p'y = ____________ kg•m/s v' = ____________ m/s Θ = ____________ degrees

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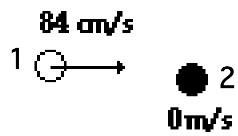
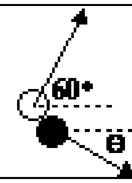
4. A top view of two elastic collisions on a billiards table is shown below. Before- and after-collision snapsots are shown. Assume identical mass billiard balls (0.25 kg). Determine the x- and y-components of the momenta of the billiard balls before and after the collision. Determine the total system momentum before and after collision; use these values to determine velocities and directions of the billiard balls after the collision.

Before Collision	After Collision
 	
p1x = ____________ kg•cm/s p2x = ____________ kg•cm/s ∑ px = ____________ kg•cm/s p1y = ____________ kg•cm/s p2y = ____________ kg•cm/s ∑ py = ____________ kg•cm/s	∑ p'x = ____________ kg•cm/s ∑ p'y = ____________ kg•cm/s v'1 = ____________ cm/s v'2 = ____________ cm/s Θ = ____________ degrees

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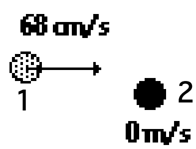
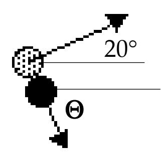
Before Collision	After Collision
 	
p1x = ____________ kg•cm/s p2x = ____________ kg•cm/s ∑ px = ____________ kg•cm/s p1y = ____________ kg•cm/s p2y = ____________ kg•cm/s ∑ py = ____________ kg•cm/s	∑ p'x = ____________ kg•cm/s ∑ p'y = ____________ kg•cm/s v'1 = ____________ cm/s v'2 = ____________ cm/s Θ = ____________ degrees

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